Cornell University ILR School

Cornell University ILR School
DigitalCommons@ILR

CAHRS Working Paper Series

Center for Advanced Human Resource Studies (CAHRS)

10-1-2004

Drinking from the Fountain of Knowledge: Student Incentive to Study and Learn-Externalities, Information Problems and Peer Pressure

John H. Bishop
Cornell University, jhb5@cornell.edu

Follow this and additional works at: https://digitalcommons.ilr.cornell.edu/cahrswp

Part of the Education Commons

Thank you for downloading an article from DigitalCommons@ILR.
Support this valuable resource today!

This Article is brought to you for free and open access by the Center for Advanced Human Resource Studies (CAHRS) at DigitalCommons@ILR. It has been accepted for inclusion in CAHRS Working Paper Series by an authorized administrator of DigitalCommons@ILR. For more information, please contact catherwood-dig@cornell.edu.

Drinking from the Fountain of Knowledge: Student Incentive to Study and Learn-Externalities, Information Problems and Peer Pressure

Abstract

Students face four decision margins: (a) How many years to spend in school, (b) What to study. (c) How much effort to devote to learning per year and (d) Whether to disrupt or assist the learning of classmates. This paper reviews an emerging economic literature on the effects of and determinants of student effort and cooperativeness (c and d above) and how putting student motivation and behavior at center of one's theoretical framework changes one's view of how schools operate and how they might be made more effective. In this new framework students have a dual role. They are both (1) investors/consumers who choose which goals to focus on and how much effort to put into each goal and (b) workers getting instruction and guidance from their first-line supervisors, the teachers. I present a simple model where the behavior of students, teachers and administrators depends on the incentives facing them and the actions of the other actors in the system. The incentives, in turn, depend upon the cost and reliability of the information (signals) that is generated about the various inputs and outputs of the system. Our review of empirical research support many of the predictions of the model. Student effort, engagement and discipline vary a lot within schools, across schools and across nations and have significant effects on learning. Higher extrinsic rewards for learning are associated the taking of more rigorous courses, teachers setting higher standards and more time devoted to homework. Taking more rigorous courses and studying harder increase student achievement. Post World War II trends in study effort and course rigor are positively correlated with achievement trends. Even though, greater rigor improves learning, parents and students prefer easy teachers.They pressure tough teachers to lower standards and sign up for courses taught by easy graders. Curriculum-based external exit examinations improve the signaling of academic achievement to colleges and the labor market and this increases extrinsic rewards for learning. Cross section studies suggest that CBEEES result in greater focus on academics, more tutoring of lagging students, more homework and higher levels of achievement. Minimum competency examinations do not have significant effects on learning or dropout rates but they do appear to have positive effects on the reputation of high school graduates. As a result, students from MCE states earn significantly more than students from non-MCE states and the effect lasts at least eight years. Students who attend schools with studious well-behaved classmates learn more.Disruptive students generate negative production externalities and cooperative hard-working students create positive production externalities. Norms of student peer cultures often encourage student disruptions and harass nerds. In addition, learning is poorly signaled to employers and colleges. Thus, market signals and the norms of student peer culture do not internalize the externalities that are pervasive in school settings and as a result, students typically devote less effort to studying than the parents and the public would wish.

Keywords

student, knowledge, study, incentive, school, learn, externalities, employer, earnings, employ, educational, goals, academic, vocational

Disciplines

Education

This article is available at DigitalCommons@ILR: https://digitalcommons.ilr.cornell.edu/cahrswp/19

Comments

Suggested Citation

Bishop, J. H. (2004). *Drinking from the fountain of knowledge: Student incentive to study and learn-externalities, information problems and peer pressure* (CAHRS Working Paper #04-15). Ithaca, NY: Cornell University, School of Industrial and Labor Relations, Center for Advanced Human Resource Studies.
http://digitalcommons.ilr.cornell.edu/cahrswp/19

This article is available at DigitalCommons@ILR: https://digitalcommons.ilr.cornell.edu/cahrswp/19

Cornell University
School of Industrial and Labor Relations
Center for Advanced Human Resource Studies

CAHRS Cornell University
187 Ives Hall
Ithaca, NY 14853-3901 USA
Tel. 607 255-9358
www.ilr.cornell.edu/CAHRS

WORKING PAPER SERIES

Drinking from the Fountain of Knowledge: Student Incentive to Study and Learn-- Externalities, Information Problems and Peer Pressure

John H. Bishop

Working Paper 04 – 15

Drinking from the Fountain of Knowledge: Student Incentive to Study and Learn- Externalities, Information Problems and Peer Pressure

John H. Bishop
Cornell University

http://www.ilr.cornell.edu/cahrs

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 available to others interested in preliminary form to encourage discussion and suggestions.

Most (if not all) of the CAHRS Working Papers are available for reading at the Catherwood Library. For information on what's available link to the Cornell Library Catalog: http://catalog.library.cornell.edu if you wish.

Abstract

Students face four decision margins: (a) How many years to spend in school, (b) What to study. (c) How much effort to devote to learning per year and (d) Whether to disrupt or assist the learning of classmates. This paper reviews an emerging economic literature on the effects of and determinants of student effort and cooperativeness (c and d above) and how putting student motivation and behavior at center of one's theoretical framework changes one's view of how schools operate and how they might be made more effective. In this new framework students have a dual role. They are both (1) investors/ consumers who choose which goals to focus on and how much effort to put into each goal and (b) workers getting instruction and guidance from their first-line supervisors, the teachers. I present a simple model where the behavior of students, teachers and administrators depends on the incentives facing them and the actions of the other actors in the system. The incentives, in turn, depend upon the cost and reliability of the information (signals) that is generated about the various inputs and outputs of the system.

Our review of empirical research support many of the predictions of the model. Student effort, engagement and discipline vary a lot within schools, across schools and across nations and have significant effects on learning. Higher extrinsic rewards for learning are associated the taking of more rigorous courses, teachers setting higher standards and more time devoted to homework. Taking more rigorous courses and studying harder increase student achievement. Post World War II trends in study effort and course rigor are positively correlated with achievement trends.

Even though, greater rigor improves learning, parents and students prefer easy teachers. They pressure tough teachers to lower standards and sign up for courses taught by easy graders. Curriculum-based external exit examinations improve the signaling of academic achievement to colleges and the labor market and this increases extrinsic rewards for learning. Cross section studies suggest that CBEEES result in greater focus on academics, more tutoring of lagging students, more homework and higher levels of achievement. Minimum competency examinations do not have significant effects on learning or dropout rates but they do appear to have positive effects on the reputation of high school graduates. As a result, students from MCE states earn significantly more than students from non-MCE states and the effect lasts at least eight years.

Students who attend schools with studious well-behaved classmates learn more. Disruptive students generate negative production externalities and cooperative hard-working students create positive production externalities. Norms of student peer cultures often encourage student disruptions and harass nerds. In addition, learning is poorly signaled to employers and colleges. Thus, market signals and the norms of student peer culture do not internalize the externalities that are pervasive in school settings and as a result, students typically devote less effort to studying than the parents and the public would wish.

Drinking from the Fountain of Knowledge: Student Incentive to Study and Learn-- Externalities, Information Problems and Peer Pressure

The theory of human capital provides a unified explanation of why students invest in education, how much and what type of education and training they choose and how these investments determine an individual's future productivity and earnings. This very fruitful theory has been the stimulus for thousands of studies assessing student incentives to stay in school, the returns to years of schooling, to field of study, to type of school attended, school quality and to employer training, the sources of variation in these returns and who chooses to get different amounts and types of schooling and training (Freeman 1986, Card 1999, Heckman 2003, other papers written for this handbook volume.)

Human capital theory, however, has seldom been applied to studying the educational process itself or the internal workings of schools. Economists have instead employed a production function paradigm. Conventionally, test scores measuring academic achievement are the outputs, school administrators are the managers, teachers the labor input and students are goods in process. But a research program that treats students as the object of the actions of teachers and administrators has inherent limitations. Learning requires active participation of the learner. Students or parents choose the difficulty level—honors, regular college prep or remedial—of courses. If typical classes have twenty-five students, the students are spending at least 25 times as many hours trying to learn (or possibly choosing not to try) as teachers are spending teaching. They decide whether to skip school, how much effort to devote to each course and whether to help or obstruct the learning of others in the class. On any given day in 1900 twenty-eight percent of enrolled students were absent from school. By 1997-98 absenteeism had dropped to 7 percent, but in some states it reached 15 percent (NCES 2000a, Table 38, 41, 43). Studies of time use in classrooms have found that American students actively engage in a learning activity for only about half the time they are scheduled to be in school. A study of schools in Chicago found that public schools with high-achieving students averaged about 75 percent of class time for actual instruction. For schools with low achieving students, the average was 51 percent of class time (Frederick, 1977). Overall, Frederick, Walberg and Rasher (1979) estimated 46 percent of the potential learning time is lost due to absence, lateness, inattention, classroom disruptions or teachers being off task.

Time devoted to homework also varies a great deal. In 1998, 21 percent of high school seniors reported doing 10 or more hours of homework per week, while another 23 percent reported not being assigned homework or not doing the homework assigned (NCES, Condition… 2001b, p. 41). Studies have found that learning has a strong relationship with time on task (Wiley 1986; Walberg 1992), time devoted to homework (Cooper 1989; Betts 1996) and the share of homework that is completed. Differentials in time committed to learning are likely to be an important reason for variations in achievement across students, across schools and across nations.

Just as important as the time devoted to learning is the student's engagement in the process. John Goodlad (1983) study of American high schools described: *"a general picture of considerable passivity among students..* (p. 113)". Asked "How often does your mind wander" during class, 23 percent of a large sample of American middle school and high school students said "usually" or "always," while 33 percent said "seldom" or "never". (Educational Excellence Alliance 2002)."[1] Sixty-two percent of 10th graders agreed with the statement, "I don't like to do any more school work than I have to" (Longitudinal Survey of American Youth or LSAY, Q. AA37N).

A second problem with the education production function literature is its failure to deal with the fact that academic achievement (as assessed by math, science and reading tests) is just one of the many goals that schools are expected to serve. Many studies use math test scores as the sole measure of output even though elementary students spend less than a quarter of their time doing math and high school students spend only 14 percent of their time in math classes. Non-academic courses account for 35 percent of credits earned in American high schools. For 2000 graduates, personal use courses accounted for 11.1 percent of total credits, art and music for 7.8 percent and vocational education for 16.2 percent of total credits earned (NCES, *Digest of Education Statistics* 2002, Table 139). In multivariate models predicting earnings, credits taken in occupational specialties have significantly more positive effects on wages and earnings (both immediately and eight years after graduation) than academic credits (conditional on school attendance and years of schooling, Bishop and Mane 2003). Non-academic goals—vocational training, developing artistic talent, discouraging drug use, learning teamwork, providing opportunities for physical exercise, developing respect and tolerance for others and community entertainment (eg. band, cheer leading and interscholastic sports), etc.-- are very important in the eyes of students and the community.

These two observations suggest that students play a dual role in schools. They are (1) investors/ consumers who choose which goals (outputs) to focus on and how much effort to put into each goal and (2) workers getting instruction and guidance from their first-line supervisors, the teachers. Teachers also have a great deal of discretion over how much emphasis they place on various aspects of their subject and how they handle discipline and character development. Students must cooperate with the teacher and each other if educational goals are to be achieved. In practice this means that classroom goals are often negotiated between teacher and students (Sizer 1984; Powell, Cohen and Farrar 1985). The behavior of each of the system's actors (teachers, administrators, school board, parents, students and the leaders of student crowds) depends on the incentives facing them. The incentives, in turn, depend upon the cost and reliability of the information (signals) that are generated about the various outputs and inputs of the system.

This paper focuses on the incentives faced by students, the effects of incentives on student behavior and the character and quality of the information about performance that generates these incentives. Similar issues arise in modeling the behavior of teachers and school administrators. I point out the similarities as the analysis develops, but the focus is on student incentives, student norms and student behavior. This review has five parts.

The first part of the paper presents evidence that student effort accounts for an important share of the variance across individuals and nations in student achievement. The second part of the paper outlines a simple model of how students decide how much effort to put into their studies and how their decisions interact with public support for greater spending on education. It also reviews evidence on the effects of extrinsic rewards for learning on student effort, school quality and achievement. The third part of the paper reviews the empirical literature on the effects of improved signaling of student achievement at the end of high school on the rewards for learning, on student effort, teacher's standards and student achievement. The fourth part of the paper reviews studies of the effects of raising the standards for getting good grades, promotion to the next grade or a diploma. The final section of the paper examines how externalities generated by peer effects and grading on a curve influence student peer culture and norms about study effort. I then discuss two economic models of student peer groups and pressures--Akerlof and Kranton's 'identity' model and a model in which norms are signaled by the behavior of a crowd's leaders and enforced by threats of harassment and social exclusion.

I. Student Effort Influences Learning

Not surprisingly students who do not pay attention in class and/or frequently skip school are poorer readers and less competent mathematicians than students who attend regularly and pay attention. In the Program for International Student Assessment (PISA) study (OECD, 2003a), the 3.1 percent of American 15 year olds who had skipped five or more classes in the past two weeks scored slightly more than a standard deviation lower [approximately four U.S. grade-level equivalents (GLE)] on the PISA reading literacy assessment than the 55 percent of students who said they were attending regularly. Data for 25 other countries on class skipping and the reading deficit of those who skip 5 or more classes is presented in columns 4 and 5 of Table 1.[2] The reading deficit of students who skip a lot of classes is 79 points on average (about three-quarters of a standard deviation) in the other nations that participated in PISA-2000.

Table 1
Effort, Discipline and Achievement of Secondary School Students

	Share 15-19 in School In 2001	I often feel Bored	Percent Schools With Absent eeism	% who skipped 1 or more class	Reading Deficit Students who Skipped	Discipli-nary Climate	Reading Diff betw. Top & Bottom Quartile	TIMSS End of HS	TIMSS End of HS	PISA age 15 (Native-Born Students)	
	percent	% Agree	above 5 %	In last 2 weeks	5 or more classes	Student Rept.	On Disc. Climate	Math	Science	Read ing	Math
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Australia	81.1	60	76	43	46	-.09	47	522	527	532	536
Austria	76.9	49	46	37	61	.19	41	518	520	515	523
Belgium	91.0	46	35	28	108	-.12	10	---	---	522	536
Brazil	74.6	30	---	53	52	-.34	-18	---	---	398	337
Canada	75.0	58	59	47	60	-.14	25	519	532	538	536
Chile	67.8	--	--	47	79	-.32	35	---	---	411	384
Czech Rep.	87.8	47	81	53	76	.14	55	466	487	501	504
Denmark	82.9	41	41	49	37	-.20	27	547	509	504	520
Finland	85.3	60	--	43	42	-.16	9	---	---	548	537
France	86.6	32	28	34	100	-.05	16	523	487	512	523
Germany	89.4	49	37	26	67	.10	48	495	497	507	510
Hungary	79.0	29	45	33	64	.23	93	483	471	482	489
Iceland	79.2	30	12	37	46	-.08	23	534	549	509	516
Italy	72.2	54	---	56	99	-.24	79	476	475	489	459
Japan	---	32	5	10	na	.49	92	---	---	525	559
Korea	79.3	46	5	20	35	.20	47	---	---	525	547
Mexico	41.0	28	---	32	70	.17	4	---	---	427	391
N. Z.	73.0	60	80	44	92	-.15	24	522	529	538	543
Norway	85.3	58	31	35	78	-.36	18	528	544	510	503
Portugal	73.3	24	44	16	72	-.05	39	---	---	472	456
Russia	70.8	27	---	34	34	.45	40	471	481	463	480
Spain	80.1	66	26	33	71	-.17	30	---	---	494	478
Sweden	86.4	58	45	38	33	-.19	35	552	559	523	517
Switzerland	83.3	38	13	32	56	.30	28	540	523	514	548
U. K.	74.7	54	78	35	71	.02	45	---	---	528	534
United States	**77.6**	**61**	**60**	**38**	**112**	**.03**	**31**	**461**	**480**	**511**	**500**
OECD Avg.	**77.7**	**48**	**44**	**33**	**79**	**.00**	**39**	**---**	**---**	**503**	**500**

Enrollment Rate (column. 1)--OECD, *Education at a Glance*, 2003, p. 258.
Bored in Class (column 2)-- OECD, *Education at a Glance*, 2002, p.330;
School means of absenteeism (column 3)—OECD, *Education at a Glance*, 2000 p.241
Class Skipping and Reading deficit (column 4 & 5) *Literacy Skills for the World of Tomorrow: Further Results from PISA 2000*, 2003, p.290
Student reported Disciplinary Climate and it's association with reading achievement (column 6 & 7) *Literacy Skills for the World of Tomorrow: Further Results from PISA 2000*, 2003, p.372.
TIMSS Scores at end of secondary school for all students (column 8 & 9)--Gonzales, *Pursuing Excellence*, p 92;
PISA reading & math for 15 year old students from students who were born in the country to at least one parent from the country, (col. 10 & 11) *Literacy Skills for the World of Tomorrow: Further Results from PISA 2000,* p 351.

PISA also found that student achievement was correlated with the disciplinary climate of the student's classroom. Column 6 of the table presents the mean value of PISA's standardized index of a positive disciplinary climate.[3] Column 7 presents the difference between the reading scores of students who reported few disruptions in their classes (top quartile of the index) and the scores of students who reported many disruptions [bottom quartile of the index]. The reading differential between students in classrooms with low and high levels of disruption varies a good deal across countries. It is over 90 points for Hungary and Japan and under 10 points in Brazil, Finland and Mexico. For the United States the differential is 31 points (about 1.2 grade level equivalents).

While these positive associations are consistent with the hypothesis that student effort and discipline improve achievement, the bi-variate relationships presented in table 1 exaggerate the magnitude of any causal relationship. PISA has looked at the effect of disciplinary climate on achievement while controlling for many potentially confounding variables: student background, school SES, student-teacher ratios, teacher qualifications and student use of school resources (library, computers, internet and science labs). They found that the "students are disciplined" index was a highly significant [t statistics above 5.7] predictor of reading, mathematics and science achievement. Numerous other studies also find that indicators of student effort such as absenteeism, paying attention, completing homework assignments and hours doing homework have significant effects on learning in multivariate models controlling for prior achievement and family background (e.g. Cooper 1989; Ehrenberg et al, 1991; Betts 1996, Williams and Somers 2001, Bishop et al 2003). Their importance in any given study will depend on how well effort and discipline are measured, whether complementary inputs such as quality instruction are being provided and the sensitivity of the achievement indicator to student effort levels.

Do variations in student effort and discipline across countries account for some of the large differences in average achievement levels? Let's look at the data in Table 1 columns 1-4 and 6 on how student effort and engagement varies across nations. Column 1 reports the proportion of 15 to 19 year olds enrolled in school. On this indicator the United States lags behind most of Western Europe, the Czech Republic, Korea and Hungary. Column 2 presents a proxy for student engagement--the percent of students who say they "often feel bored" in school. Sixty–one percent of American students say they are often bored. The OECD average is 48 percent. Lack of engagement seems to be a pretty universal problem. Column 3 reports the percentage of schools in a nation that have absenteeism rates exceeding 5 percent. Here there are big differences across nations. Absenteeism is above five percent for 60 percent of American schools, 76 percent of Australian schools and 80 percent of New Zealand schools but only 5 percent of Japanese and Korean schools. Class skipping was also much lower in Japan and Korea and student discipline was better as well (see columns 4 and 6). Possibly this is the explanation for the remarkably high achievement levels of students in East Asia: students are more disciplined in class and study harder.

To test this hypothesis, an effort/discipline scale combining the PISA student discipline index (column 6) and the school skipping data in column 4 was created and then included in models predicting PISA literacy scales for native-born students. The achievement of native-born students is analyzed in order to eliminate variation in rates of immigration as a confounding variable. The base line model has two variables: GDP per capita (to capture national wealth, the socio-economic background of parents and the efficiency of the nation's institutions) and a dummy variable for East Asia intended to capture cultural differences between East and West that produce the remarkable work ethic of Asian students. This dummy variable has always been a significant predictor of mathematics and science achievement in my previous work. Table 2 presents the results. The effort/discipline index is a significant predictor of national mean achievement levels in mathematics and science. A one-standard deviation (measured in the sample of 42 nations) improvement in both components of the index predicts a 14 point (about .50 U.S. GLE) higher level of science achievement and a 20 point (a .80 U.S. GLE) higher level in mathematics. When the effort/discipline index is added to the model, the Asian dummy becomes insignificant. Apparently differentials in student effort and discipline do account for some of the differences between nations in academic achievement and contribute to the outstanding achievement levels of East Asian nations.

Table 2
Student Effort and Academic Achievement
Program for International Student Assessment 2000 Data

Native of the Country	*Effort Index*	*Log GDP/ Pop 1995*	*East Asia*	*Adj R^2 RMSE*	*#of Obs*
Mathematics —15 Yr Olds	20.8*** (7.5)	87.6*** (8.2)	26.8 (19.0)	.746 33.9	41
		86.3*** (8.9)	52.8*** (17.9)	.702 36.7	41
Science —15 Yr Olds	14.0** (6.4)	70.6*** (7.0)	26.9 (16.2)	.720 29.0	41
		69.8*** (7.3)	44.3*** (14.8)	.721 29.7	41
Combined Reading Literacy —15 Yr Olds	4.5 (5.6)	76.8*** (6.1)	20.8 (14.2)	.794 25.3	41
		76.5*** (6.1)	26.5** (12.1)	.796 25.2	41

Source: OECD, Literacy Skills for the World of Tomorrow: Further Results From PISA 2000, 2003.

We now turn to a discussion of policy options for inducing students to try harder. We begin with a simple model that elucidates some of the key issues.

II. A Model of Student Learning

2.1 The Model of Student Effort

The student's decision about effort in school can be simply represented by three equations: a learning function, a rewards for learning function and a costs of student effort function.

The Learning Function

Learning is a change that takes place in a person. It occurs when an individual who is ready and able to learn, is offered an opportunity to learn and makes the effort to learn. All three elements are essential. Learning readiness and ability—indexed by $\mathbf{A_i}$—depends on prior learning, intelligence and family background. $\mathbf{A_i}$ is exogenous (i.e. determined outside the model). The part of the learning equation controlled by individual students is effort ($\mathbf{E_i}$).

While, in principle, every literate individual with access to a library or the internet has the opportunity to learn, schools and teachers have, in practice, a great deal of influence on what youngsters learn and at what pace. Educators determine what courses are required, the topics covered, teaching methods, homework and paper assignments and classroom expectations. In the model opportunity to learn is operationalized as $I\mathbf{X}^{m}$ or school quality. $\mathbf{X}^{m}$ is per pupil expenditure on school inputs and policies that foster academic achievement for the school 'm'. I is an exogenous efficiency parameter for these school inputs/policies. While facilitating academic learning is the primary purpose of American schools, other goals (sports, art, music, occupational skills, developing character and teamwork, equality of opportunity, etc) compete for school resources and administrative attention. Consequently, $\mathbf{X}^{m}$ is not the same thing as per pupil expenditure.

The fourth input in the individual's learning function is the effort and cooperativeness of the other students at the school. Empirical studies of peer effects and social interactions have generated persuasive evidence that individuals are influenced by the norms and behavior of coworkers and close associates. Education value-added production function studies consistently find that the socio-economic status of the other students in a school influences an individual's learning. Until recently it was not clear, however, whether this finding reflected a causal relationship or was instead a selection effect caused by parents with strong preferences for education choosing to move to high SES communities. Recent studies based on data free from such bias show that causal peer effects do exist. Randomly assigned college roommates have been shown to influence each other's academic performance (Zimmerman 1999; Sacerdote 2000). An elegant study by Carolyn Hoxby (2000) has shown that boys and girls learn more when girls account for a larger share of the students in a grade. Angrist and Lang's (2002) study of Brookline schools found that increasing the number of Boston Metco students in a classroom did not affect the learning of white students but had significant negative effects on learning of Black 3rd graders who were Brookline residents. Hanushek, Kain and Rivkin's (2002) analysis of Texas data found that high ability Black students learned more in years in which their grade had a higher proportion of non-black students. Using experimental data from Project Star, Boozer and Cacciola (2001) have demonstrated that the students who were taught in small classes during their first years in school had positive spillover effects on their classmates in regular third and fourth grade classrooms once the experiment was completed. Using panel evidence from administrative data, Julian Betts and Andrew Zau (2002) found that “changes in the average achievement at the school have independent large effects on student learning.” These effects were substantially larger than the effects of class size and teacher credentials, education and experience. Uribe, Murnane and Willett’s (2003) analysis of data from Bogota Columbia obtains similar results.

These studies are strong evidence that peer effects are real. But before peer spillover effects can be manipulated to further learning, we must understand exactly how they are generated. The SES, skin color and gender of classmates probably do not directly influence learning. Rather the observed spillover effects are probably generated by the norms and behavior of classmates. Some students help their classmates learn, others disrupt their learning. Some honor academic engagement, others make fun of kids who are friendly with teachers. The norms and behavior patterns of young women are more supportive of academic learning than the norms and behavior patterns of young men. This is probably the reason for Hoxby’s gender composition findings.

There are two distinct ways that peers influence a student’s learning. First, their behavior influences how much classroom time is devoted to maintaining discipline and to other distractions, how much is learned from classroom discussions and projects that students work on together, how rapidly teachers move through the curriculum and how many students require one-on-one assistance. These influences are production externalities and are represented in our model by including average effort levels of other students as one of the inputs in the individual’s learning production function. Lazear has demonstrated that when students are heterogeneous with respect to disruptive behavior, it is optimal for more disruptive students to be placed in smaller classes (2001).

The second mechanism by which peers influence learning outcomes is the effect of their norms and teasing and harassment behavior on the individual's own effort level. A discussion of these influences is postponed to section 5.

To keep the model simple, years attending K-12 schools are assumed to be predetermined. The learning that occurs during that period is described by the simple equation:

(1) Human Capital at the end of secondary school =

$$\mathbf{L} = \mathbf{A}\ \mathbf{E}^{\alpha}\ \mathbf{E}^{\mathbf{m}\rho}(\mathbf{IX^m})^{\beta} \qquad\qquad \alpha + \rho + \beta < 1$$

where **E** = Effort of the individual student—an index of the time and psychic energy that the "i th" pupil devotes to learning [years spent in K–12 school are taken as predetermined]

$\mathbf{E^m}$ **=** Mean effort of all other students at school 'm'—an index of the time and psychic energy that the other pupils at school 'm' annually devote to learning

$\mathbf{X^m}$ = Expenditure on school inputs and policies that foster academic achievement at school 'm'. This is not equivalent to spending per pupil because school budgets contain items serving other purposes—e.g. sports, art, music, occupational skills, character, teamwork, etc.

I = An exogenous efficiency parameter for school inputs that foster academic achievement

α = elasticity of the "i' th student's human capital (**L**) with respect to her effort.

ρ = elasticity of the "i' th student's human capital (**L**) with respect to the effort of all other students in the school. ρ is also referred to as the effort externality multiplier.

ß = elasticity of the 'i'th student's human capital (**L**) with respect to ($\mathbf{IX^m}$).

Note that the 'i' superscript has been suppressed throughout. While the choice of a Cobb-Douglas function is more specific than is necessary to reach the conclusions of the model, the main intuition and results of the model can readily be followed in this specific functional form.[4] It implies that:

(a) School quality and student effort interact positively. An improvement in teacher quality enhances the effect of greater student effort and vice versa.

(b) Effort by one student interacts positively with the effort of classmates. (e.g. One student can disrupt the learning of an entire class).

(c) A 20 percent increase in effort by all students (**E** and $\mathbf{E^m}$) and school quality ($\mathbf{X^m}$) increases human capital (**L**) by less than 20 percent.

The Private Rewards for Achievement Function

The model assumes that young people have high rates of time preference, so the present discounted value of future payoffs is heavily influenced by the signals of L that are available to colleges and employers immediately after high school.[5] An individual's productivity depends on L, a latent variable that is not visible to college admissions officers and employers. When a student leaves high school, colleges and employers potentially have four indicators they can use to predict L: (1) aptitude and family background (**A**), (2) achievement relative to others at the school such as class rank or GPA **($L - L^m$)**, (3) a pass/fail dummy variable for a minimum competency exam (MCE) and/or (4) a vector of scores on curriculum-based external exit exams (CBEEES). Students are pooled across schools.[6] **L** is positively correlated with both **A** and **($L - L^m$)** and even more strongly correlated with scores on CBEEEs when they have been taken.

2) Present Discounted Value of Intrinsic and Extrinsic (both Pecuniary and Non-Pecuniary) Rewards for Achievement = $\Pi = (\boldsymbol{j} + \boldsymbol{w})\mathbf{L} + \theta(\mathbf{L} - \mathbf{L}^{m}) + \sigma\mathbf{A}$ where

j = the present discounted value of the intrinsic non-pecuniary benefits, **joy**, of learning received by the 'i' th student and her parents. Note that these benefits are assumed to occur regardless of whether the learning is signaled to others or honored publicly.

w = the impact of absolute levels of achievement (human capital) at the end of secondary school on the present discounted value of lifetime after–tax earnings and other extrinsic rewards for learning for person 'i'. It includes the effects of secondary school learning on wage rates conditional on years of schooling and on the years and quality of postsecondary schooling obtained. It also includes the benefits that parents derive from the economic success of their children and the honor and prestige given to those who are signaled to be high achievers. The magnitude of these benefits increase when L is more reliably signaled to colleges and employers (Becker and Rosen 1992). Curriculum-based external examinations increase **w**, the payoff to absolute achievement, and tend to reduce θ, the payoff to one's relative position (rank) in the secondary school's graduating class, and σ the payoff to IQ and family background. The introduction of an MCE has a similar but smaller effect on ***w***, θ and σ.

$L - L^m$ = Achievement of the 'i'th student relative to the representative student's achievement (**L^m**). Rank in class and grades awarded on a curve are examples of signals of achievement that describe the student's achievement relative to others in the school.

θ = the impacts of achievement relative to the school mean (e.g. effects of class rank and grades assigned on a curve) on social status in the community, admission to preferred colleges and lifetime income.

σ = the impact of $\mathbf{A_i}$ (i.e. Early IQ, early achievement and family background) on the present discounted value of lifetime earnings. σ will be large and **w** and θ small if access to college depends solely on family background and IQ test scores obtained prior to entering secondary school. The SAT is not a pure IQ test, but relative to curriculum based exams it is at the aptitude end of the spectrum. Consequently, substituting curriculum-based exams for the SAT in university admissions decisions would lower σ and raise **w**. Since **A** is assumed exogenous, changes in σ have only second order effects on student incentives to study or community incentives to invest in schools.

Choosing Learning Effort

Students compare expected benefits to expected costs.

3) Benefits of Effort for student 'i' =

$$\mathbf{B} = (\boldsymbol{j} + \boldsymbol{w} + \theta)[\mathbf{A}\mathbf{E}^{\alpha}\,\mathbf{E^{m}}^{\rho}(\mathbf{IX^m})^{\mathbf{ß}}] - \theta[\mathbf{A^m}\,\mathbf{E^m}^{\alpha+\rho}(\mathbf{IX^m})^{\mathbf{ß}}]$$

$$\text{where } \mathbf{L^m} = \mathbf{A^m}\,\mathbf{E^m}^{\alpha+\rho}(\mathbf{IX^m})^{\mathbf{ß}}$$

≈ human capital at graduation of the representative student at school 'm'.
A^m is the ability of this representative student.

Studying generates costs—psychic energy, loss of free time and boredom—that are assumed to be an increasing function of the time and energy devoted to schoolwork:

4) Costs of Student Effort =

$$\mathbf{C} = \mathbf{C_0E}^{\mu} \text{ where } \mu > \mathbf{1}$$

because the marginal costs of effort rise as effort increases.

Determining Student Effort

To study the determinants of student effort, we define a net benefits of study effort equation, **B – C**, and obtain it's maximum by differentiating with respect to **E**, assuming $\mathbf{X^m}$ and $\mathbf{E^m}$ fixed.

5) max $\mathbf{B\text{-}C} = (\boldsymbol{j} + \boldsymbol{w} + \theta)[\mathbf{AE}^{\alpha}\,\mathbf{E^m}^{\rho}(\mathbf{IX^m})^{\mathbf{ß}}] - \theta[\mathbf{A^m}\,\mathbf{E^m}^{\alpha+\rho}(\mathbf{IX^m})^{\mathbf{ß}}] - \mathbf{C_0E}^{\mu}$

The derivative of (5) with respect to **E** for each student is:

6) $$\frac{\partial(B-C)}{\partial E} = \alpha(\boldsymbol{j} + \boldsymbol{w} + \theta)[\mathbf{AE}^{\alpha-1}\mathbf{E^m}^{\rho}(\mathbf{IX^m})^{\mathbf{ß}}] - \mu\mathbf{C_0E}^{\mu-1} = \mathbf{0}$$

7) $$\mathbf{E} = \{[\alpha/\mu\mathbf{C_0}][\boldsymbol{j} + \boldsymbol{w} + \theta][\mathbf{A^m}\,\mathbf{E^m}^{\rho}(\mathbf{IX^m})^{\mathbf{ß}}]\}^{\mathbf{1}/(\mu-\alpha)}$$

8) $$ln\mathrm{E} = \left(\frac{1}{\mu - \alpha}\right)\left[ln\alpha - ln\mu\mathrm{C}_0 + ln\left(j + w + \theta\right) + ln\mathrm{A} + \rho\ln\mathrm{E}^{\mathrm{m}} + \beta ln(I\mathrm{X}^{\mathrm{m}})\right]$$

The policy implications of equations 7 and 8 are straight forward. To induce students to study longer and harder, educators, employers and parents must either:

- Lower the opportunity costs of studying ($\downarrow \mu C_0$), e.g. by requiring that homework be completed before television or a video game is turned on or establishing homework clubs after school.
- Increase the effectiveness of study time ($\uparrow \alpha$), e.g. by providing a quiet place to study, learning aids (such as encyclopedias, computers and the internet) and tutoring/assistance if needed.
- Improve the quality of one's peers ($\uparrow E^m$), e.g. by moving to a higher income community or getting your child into honors courses or a school or program for the 'gifted.'
- Improve the quality of instruction ($\uparrow IX^m$), e.g. by developing excellent courses and curricula, hiring gifted teachers, providing excellent professional development and holding them accountable.
- Increase intrinsic rewards for learning $(\uparrow j)$ e.g. by hiring more interesting teachers, making content more engaging, allowing students to select the course they take and instilling a love of learning in children.
- Increase extrinsic rewards for learning $\uparrow (w+\theta)$ e.g. by awarding merit scholarships and greater social prestige to high achievers, persuading employers to offer bigger wage increments immediately after high school for skills and for college completion and persuading colleges to become more selective and admit students into competitive programs on the basis of learning during high school (L), not ability (A), family background or ability to pay tuition.

2.2 Model of Government Effort

To determine the government's choice of the level of spending X^m, we have to look at the benefits and costs of the government G. The government's benefits B_G are given by:

$$9)\qquad B_G = P(j^m + w^m)L^m = P(j^m + w^m)A^m E^{m\,a+\rho}\left(IX^m\right)^{\beta} \quad .$$

Assuming for simplicity no external benefits of education, the average intrinsic rewards for learning for students at school 'm' (***j^m***) and the average extrinsic rewards (***w^m***) for L are equivalent for the individual student and for the general public. Note, however, that the rewards for learning generated by a student's high rank relative to other students at the school, θ, that motivate some students to excel are not found in the community's payoff function. Note further that the mean community benefits, $(j^m+w^m)L$, of learning are weighted by the parameter P which reflects the priority government gives to the quality of a school's academic program. P characterizes the political power of supporters of high academic standards in the governance of schools relative to the political power of those whose objectives lie elsewhere.

The government's cost C_G is defined as expenditure per pupil on the academic goals of school:

10) $$C_G = X^m.$$

Note that X^m is the choice variable under the control of the government. To keep things simple, I assume the other goals of schooling are sought independently. It chooses X^m in order to maximize its net benefits ($B_G - C_G$), given students' effort and the institutional setting. After reorganizing the first order condition for a maximum, we have the following equation for government effort.

11) $$X^m = \{ ß P [j^m + w^m][A^m E^{m\,a+\rho} I^{ß}] \}^{1/(I - ß)}$$

An examination of equation (11) characterizing government effort reveals that public investments in the quality and quantity of academic instruction (X^m) are driven by many of the same forces—intrinsic and extrinsic rewards for learning, school efficiency (I), the elasticity of learning with respect to inputs--as student decisions to study hard (Bishop and Wößmann 2003). E^m is on the right hand side of (11) implying that diligence and engagement on the part of students tends to induce taxpayers to fund schools more generously. Note also that X^m is on the right hand side of the student effort equation implying that politically powerful parents who obtain generous funding of the school's academic program find that the students attending their local school will become more engaged and diligent. These positive feedbacks mean that policy multipliers for the equilibrium of this system are quite large (Bishop and Wößmann 2003). As a result, decentralized governance and funding is likely to result in Matthew effects. Schools with politically powerful parents and able students who believe rewards for learning are large will significantly outperform schools with politically weak parents and disadvantaged students who dislike academics. If a society with a decentralized education system wants to equalize achievement outcomes across schools, it must establish compensatory systems of financing, teacher assignment and/or student assignment.

One important exception to the generalization that X^m and E are driven by the same forces is the absence of θ, **the payoff to class rank,** in the equation for school quality investments. If selective colleges admit students solely on the basis of class rank (ie. θ is large and ($\boldsymbol{j+w}$)= 0), some students will be motivated to try to do better than their classmates, but parents will see no benefit to introducing more rigorous courses and hiring more qualified teachers.

2.3 Evidence that Extrinsic Rewards Matter

What evidence is there for the claim that student effort responds to extrinsic rewards? When students are asked why they study, 79 percent say "I need the grades to get into college." and 58 percent say "Help me get a good job (EEA Survey, 2002)." A randomized experiment in Kenya found that girls who were told that they would receive a large cash grant and free tuition if they scored well on an exam at the end of the year scored about .25 standard deviations higher on the exam (Kremer, Miguel and Thornton 2003). Generous merit scholarship programs provide a natural experiment for evaluating the effects of pecuniary incentives. Studies have found that the $3000+ Hope Scholarship for Georgia high school graduates with averages of B or better increased SAT scores, GPAs and college attendance rates relative to other states in the South (Henry and Rubenstein 2002; Dynarski, 2000; Cromwell, Mustard and Sridhar 2003). When the payoff to college rises, college attendance rates rise. When payoffs fall, attendance falls (Freeman 1975, 1976, 1986; Bishop 1977). Preparations for college during high school appear to be similarly responsive? College-high school pay differentials in the regional labor market surrounding a high school had significant effects on the academic orientation of students' courses and their likelihood of going to college (Bishop 1991).

For students planning on college, the key determinants of the extrinsic rewards for study $(w+\theta)$ are how important high school learning is for getting into and completing college and the payoff to getting a college degree. For those not planning to go to college, better jobs are the relevant pecuniary inducement for study. During the last fifty years, these indicators of the payoff to effort and learning in high school have tended to rise and fall together. Lets review their history and then compare that history to trends in the academic focus of schools, student effort and achievement.

Wage Premium for College: The college wage premium for 25 to 34 year old men and women rose during the 1950s, stabilized during the 1960s, then fell precipitously during the early 1970s, stabilized again for 5 years at a low level and then climbed rapidly during the 1980s and more slowly during the 1990s (Census Bureau 1974; NCES, 2002b, Table 16.1).

College Selectivity: During the 1930s social class was the primary determinant of who went to college. College entrants in 1929 were on average at the 55th percentile of ability among high school graduates. Those who did not enter college were at the 44th percentile on average; a gap of only 11 points. The percentile gap between college entrants and high school graduates not going to college rose to 15 points in 1934, 20 points in 1946, 19 points in 1950, 22 points in 1957, 28 points in 1960 Project Talent data (Taubman and Wales 1972). The trend toward growing academic selectivity of college enrollment reversed during the 1960s and early 1970s. Many 2-year colleges with open admissions policies were founded and males attended college in record numbers to postpone being drafted. The class rank gap between those who attend college and those who do not fell to 21 points in 1972. During the late 1970s the relationship grew stronger (reaching 24.7 points in 1980) (Bishop 1991).

Wage Payoff for Academic Achievement: In the United States, reading and math skills have historically not had large effects on the wage rates of young workers who have not gone to college (Bishop 1985). Even so, the payoffs to these skills appeared to decline during late 1960s and early 1970s. The threat of litigation brought under the 1971 Griggs interpretation of Title 7 of the Civil Rights Act of 1965 induced many employers to stop using tests assessing reading and mathematics to help in the selection of new employees (Friedman and Williams 1982). As a result, during the 1970s young high school graduates who had learned English, science and mathematics thoroughly typically did not earn appreciably more than the high school graduates who had done poorly in these subjects (Bishop 1985, 1989, 1993). Individuals who have strong mathematics skills and good grades in high school are better employees (Dept. of Labor 1970, Ghiselli 1973; Hunter, Crossen and Friedman 1985, Hartigan and Wigdor 1989, Bishop 1992). Over time employers learn which employees are the most competent by observing job performance and greater productivity is eventually recognized and rewarded though it often takes a decade or so (Hauser and Daymont 1977; Taubman and Wales 1975; Bishop 1992; Farber and Gibbons 1996, Grubb 1994, Bishop 1990, Altonji and Pierett, 1998).

The environment changed during the 1980s and 90s due to the spread of personal computers and the rapid growth of professional-technical and managerial jobs. The Supreme Court's Wards Cove decision made it easier to defend using reading and mathematics tests as part of a selection process and some employers reintroduced basic skills tests into their selection procedures for clerical and factory jobs. As a result, the labor market rewards for mathematical ability of young workers rose. Murnane, Willett and Levy (1994) found that the effect of a one standard deviation increase in mathematics skill on the wage rates of 24 year old men rose from $0.46 per hour in 1978 to $1.15 per hour in 1986. The wage payoff for young women rose from $1.15 per hour to 1.42 per hour in 1986.

The Bishop/ Wößmann model predicts that the rise during the 1980s and 90s in the payoff to college and to mathematics achievement should have stimulated schools to set higher standards and induced students to study harder. Many states increased the number of mathematics and science courses required for graduation and established minimum competency tests for graduation. Students are taking more rigorous courses. Between 1982 and 2000 the share of students taking Geometry rose by 31 percentage points, Algebra II by 28 percentage points, Chemistry by 30 points and Physics by 16 points (NCES 2002a p. 164). The number of students taking AP calculus quintupled. Homework assigned and completed increased. Hofferth and Sandberg (2000) report that 9 to 12 year old students in the U.S. averaged 3 hours and 41 minutes of homework per week in 1997, a 9 percent increase since 1981. The percentage of 13 year olds reporting they either had no homework or did not do it fell from 33 percent in 1982 to 9 percent in 1990. The percentage of 17 year olds reporting they did at least one hour of homework each day rose from 32.5 percent in 1978 to 66 percent in 1990 (NCES 1993 p. 122, 351).

As predicted, achievement improved. NAEP reading scores in 1999 were two grade level equivalents (GLEs) higher than in 1980 for African-American and Hispanic 17 year olds. For whites the gain on the reading tests was only 0.2 GLEs. NAEP math scores were up one grade level equivalent (GLE) since 1982 for whites, two GLEs for African-Americans and 1.6 GLEs for Hispanics. SAT scores were flat in verbal and up by 24 points in math. NAEP science scores rose 1.3 GLE's for whites, 1.9 GLE's for African-Americans and 2.7 GLE's for Hispanics (NCES 2001b).

These positive trends contrast with the trends of the previous decade--the late 1960s and the 1970s when college selectivity and payoffs to learning and college attendance were declining. During the 1970s the summed math and verbal SAT-1 declined 50 points. Scores of Iowa 12th graders on the Iowa Test of Educational Development which had risen steadily during the 1940s, 1950s and the first half of the 1960s, declined by more than a grade level equivalent after 1966 (Bishop 1989).

There may, however, be other explanations for the post 1966 test score decline and the rebound during the 1980s and 1990s. Graduation requirements and teacher expectations appear to have followed the same cycle. While the Bishop/Woesmann theory explains these changes in teacher expectations and school policies as responses to shifts in economic payoffs, others might argue the causes lie elsewhere. As a result, the examination of aggregate time series data for just one country can never be conclusive evidence for the changing economic payoffs hypothesis. Other data need to be examined. The quality and reliability of signals of academic achievement can have big effects on extrinsic rewards for learning, w and θ. We turn now to a review of evidence on how mechanisms for signaling student achievement influence academic achievement (**L**), public investment in student learning, X^m and student effort (E, E^m).

III. The Effects of Better Signaling of Academic Achievement

In most European and Asian nations externally set high school exit exams assessing the secondary school curriculum determine university admission and access to preferred fields of study. Grades on these exams are requested on job applications and typically included on resumes. Consequently, curriculum-based external exit exam systems (CBEEES) like the Baccalaureate in France and the GCSE and A levels in England and Wales have profound effects on student incentives to study. What are the critical features of a CBEEES? How are they different from the minimum competency exams (MCE) that so many American states have established? We begin by noting the features that MCEs and CBEEES have in common. They:

1. **Produce signals of accomplishment that have real consequences for the student.** MCEs are tests that must be passed to get a regular high school diploma. For CBEEES the nature and the magnitude of the rewards vary. In Canada CBEEE grades are averaged with teacher assessments to generate final grades for specific courses. In Europe and East Asia exam results influence hiring decisions of employers and access to popular lines of study in university that are oversubscribed. CBEEES sometimes make one eligible for a more prestigious diploma or confer rights to enroll in higher level post-secondary institutions.
2. **Define achievement relative to an <u>external</u> standard, not relative to other students in the classroom or the school.** Fair comparisons of achievement across schools and across students taught by different teachers are now possible.[7] Costrell's (1994, 1997) analysis of the optimal setting of educational standards when students from schools with different grading standards are pooled concluded that centralized standard setting (state or national achievement exams) with a local option to set even higher standards results in higher standards, higher achievement and higher social welfare than decentralized standard setting (ie. teacher grading or school defined graduation requirements).
3. **Are controlled by the education authority that establishes the curriculum for and funds K-12 education.** When a national or provincial ministry of education sponsors an external exam, it is more likely to be aligned with the national or provincial curriculum. It is, consequently, more likely to be used for school accountability; not just as an instrument of student accountability. Curriculum reform is facilitated because coordinated changes in

instruction and exams are feasible. Tests established and mandated by other organizations serve the interests of other masters. America's most influential high stakes exams--the SAT-I and the ACT—serve the needs of colleges to sort students by aptitude **not** the needs of high schools to reward students who have learned what schools are trying to teach.

4. **Cover the vast majority of students.** Exams for a set of elite schools or advanced courses influence standards at the top but may have limited effects on the rest of the students.

Curriculum-based external exit exam systems are distinguished from MCEs by the following additional features. CBEEES:

5. **Assess a major portion of what students are expected to know or be able to do.** Studying to prepare for an exam (whether set by one's own teacher or by a ministry of education) should result in the student learning important material and developing valued skills. Some exit exams do a better job of achieving this goal than others. Dimensions of achievement that cannot be reliably assessed by external means should be evaluated by teachers.

6. **Are collections of End-of-Course Exams (EOCE).** This requires that the Ministry of Education forge an agreement on minimum content standards for each subject that has an external exam. Since they assess the content of specific sequences of courses, alignment between instruction and assessment is maximized and teacher accountability is enhanced. This feature also aligns the interests of teachers, students and parents. Teachers become coaches helping their team do battle with the national or provincial exam. Students should be less likely to pressure teachers to lower standards.

7. **Signal multiple levels of achievement in the subject.** If only a pass-fail signal is generated by an exam, the standard will, for political reasons, have to be set low enough to allow almost everyone to pass. The achievement of most students will be so far above this level, the threat of failing the exam will not stimulate them to greater effort (Kang 1985; Becker and Rosen 1992; Costrell 1994; Betts and Costrell 2001). CBEEEs signal the student's achievement level in the subject, not just whether the student exceeds or falls below a specific cut point that all high school graduates are required to surpass. Consequently all students, not just those at the bottom of the class, are given an incentive to study hard to do well on the exam (Becker and Rosen 1992). Consequently, EOCE are hypothesized to improve classroom culture more than a pass/fail minimum competency exam.

8. Assess more difficult material. Since CBEEES are supposed to measure and signal the full range of achievement in the subject, they contain more difficult questions and problems. This induces teachers to spend more time on cognitively demanding skills and topics. MCEs, by contrast, are designed to identify which students have failed to surpass a rather low minimum standard, so they do not to ask questions or set problems that students near that borderline are unlikely to be able to answer or solve.[8] This tends to result in too much class time being devoted to practicing low level skills.

The SAT-I and the ACT are not CBEEES because they are not curriculum-based, cover only a narrow slice of the high school curriculum and are not controlled by a Ministry of Education that funds education and sets the curriculum. As Harvard's admissions director put it shortly after the switch to the SAT-1, "***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)." If students are admitted to selective colleges on the basis of aptitude and IQ (i.e. σ is large in equation 2) not achievement [($\boldsymbol{w} + \theta$) is small], student incentives to learn and community incentives to invest in school quality (IX^m) are weakened and all students arrive in college less well prepared (Bishop 1999b). Rick Harbaugh has shown that, if admissions decisions are centralized for all public institutions in a state or a nation, the central authority will choose to admit on the basis of knowledge and achievement (not aptitude) because this policy induces students to work harder in high school. Leaving the selection of admissions criteria to colleges that are competing for students leads to "more emphasis on aptitude tests…and less emphasis on achievement tests and grades (2003 p. 1)."

Curriculum-based external exit exams (CBEEEs) increase **w**, the pecuniary rewards for absolute levels of academic achievement by improving the signals of the latent variable academic achievement made available to colleges and employers (Becker and Rosen 1992). This causes these institutions to give greater weight to achievement when they make admissions and hiring decisions. They also shift attention and rewards away from aptitude tests, measures of relative achievement such as rank in class and teacher grades, family connections, recommendations and interviews toward measures of absolute achievement (eg. grades on the external exam). The student's rewards for achievement rise and the community benefits of increasing school quality rise even more, $\frac{\partial\left[P\left(j^{m}+w^{m}\right)\right]}{\partial(\mathrm{CBEEE})}>\frac{\partial\left(j^{m}+w^{m}\right)}{\partial(\mathrm{CBEEE})}>\frac{\partial(j+w+\theta)}{\partial(\mathrm{CBEEE})}>0$. First, community benefits of school quality increase more than the student's private benefits because $\frac{\partial(\theta)}{\partial(\mathrm{CBEEE})}<0$. Making better measures of L available reduces the weight attached to class rank and GPA in college and employer selection decisions. Secondly, the education system's sponsorship makes the CBEEE a highly visible signal of the school's academic success and strengthens the hands of the local advocates for increased emphasis on the academic (as distinct from the artistic, athletic and vocational) goals of the school $\frac{\partial P}{\partial(\mathrm{CBEEE})}>0$. Since organizations tend to get what they measure, it is very important that the Ministry use high quality exams that challenge students and induce good teaching.

3.1 Does Better Signaling of Achievement Result in Students Learning More?

The hypothesis that curriculum-based external exit examination systems improve achievement has been tested by comparing nations and provinces that do and do not have such systems. Five different international data sets have been examined. In most studies of the effect of CBEEES national mean test scores (for an age group or a grade) were regressed on per capita gross domestic product deflated by a purchasing power parity price index, a dummy for East Asian nation and a dummy for CBEEES. Analyzing 1994-95 Third International Math and Science Study (TIMSS) data, Bishop (1996, 1997) found that 13 year old students from countries with medium and high stakes CBEEE systems outperformed students from other countries at a comparable level of economic development by 1.3 U.S. grade level equivalents (GLE) in science and by 1.0 GLE in mathematics. Analysis of data from the 1990-01 International Association for the Evaluation of Educational Achievement's study of the reading literacy study of 14 year olds in 24 countries found that students in countries with CBEEES were about 1.0 GLE ahead of students in nations that lacked a CBEEES (Bishop 1999). Analysis of data from both waves of TIMSS data collection also implies that CBEEES have highly significant effects (of about 1.5 GLEs) on the math and science achievement in 8th grade (Bishop 2003). Analysis of PISA data presented in rows 1, 4 and 7 of Table 3 also yields large statistically significant estimated effects of CBEEES on reading, mathematics and science literacy of native-born students.

Two other studies (Ludger Wößmann (2000, 2002) and Hyea Sook Ryoo (2002) have conducted hierarchical analyses of the entire TIMSS and TIMSS-R micro data set and included a comprehensive set of controls for family background, teacher characteristics, school resources and policies at the individual and school level. In Wößmann's study the 8th graders in CBEEES nations were about 1.1 international grade level equivalents ahead in mathematics and about 0.8 international grade level equivalents ahead in science. He also found that learning gains between 7th and 8th grade were significantly larger in CBEEES nations.

Another five studies compare students living in different provinces/states in Germany, Canada and the United States. Wößmann found that the German Lander with centralized secondary school exit examinations had significantly higher scores on the PISA literacy assessments. Students attending school in Canadian provinces with CBEEES were a statistically significant one-half of a U.S grade level equivalent ahead in math and science of comparable students living in provinces without CBEEES (Bishop 1997, 1999a). In 1990 New York State's Regents exam system was the only example of a curriculum-based external exit exam system in the United States. Graham and Husted's (1993) analysis of 1991 SAT test scores in the 37 states with reasonably large test taking populations found that New York State students did much better than students of the same race and social background in other states. Bishop, Moriarty and Mane (2000) confirmed Graham and Husted's SAT findings and also found that 1992 NAEP math scores of New York 8th graders were significantly higher than in other demographically similar states. Analyzing NELS-88 data Bishop, Mane, Moriarty and Bishop (2001) found that New York students learned about a half a GLE more between 8th grade and 12th grade than comparable students in other states. By the middle of the 1990s another state, North Carolina, had established a CBEEES. Controlling for ethnicity, social background and other standard's based reform policies, 8th graders in New York and North Carolina in 1996-98 were about one-half of a GLE ahead of comparable students in other states in reading, math and science. State minimum competency exams had smaller non-significant effects on achievement (Bishop, Mane, Moriarty and Bishop 2001).

Table 3
Academic Achievement in Nations with and without Curriculum-Based External Exit Examination Systems:
Program for International Student Assessment 2000 Data

Native Born Students	***Effort Index***	***Curriculum-Based*** *External Exit Exam*	***Log GDP/ Pop 1995***	***East Asia***	***Share Upper Secondary Students in CTE***	***Adj R^2 RMSE***	***# of Obs***
Mathematics—15 Yr Olds		39.9*** (12.1)	84.9*** (7.9)	36.6** (16.7)		.764 32.7	41
	19.6*** (6.6)	38.2*** (11.0)	86.2*** (7.2)	12.8 (17.1)		.805 29.7	41
	21.9*** (5.8)	40.2*** (10.6)	95.4*** (7.1)			.807 29.6	41
Science—15 Yr Olds		32.4*** (9.9)	71.3*** (6.5)	29.7** (13.9)		.756 27.1	41
	12.9** (5.7)	31.2*** (9.4)	72.1*** (6.2)	14.2 (14.9)		.780 25.7	41
	15.4** (5.1)	33.5*** (9.8)	71.4*** (6.2)			.780 25.7	41
Combined Reading Literacy — 15 Yr Olds		25.2*** (8.8)	76.6*** (5.6)	15.7 (11.9)		.828 23.1	41
	3.7 (5.2)	24.8** (8.9)	76.9*** (5.6)	11.2 (14.6)		.826 23.3	41
	5.7 (4.6)	26.7*** (8.6)	76.3*** (5.6)			.827 23.2	41
School/College Enroll. of 15-19 yr olds (percent)		-5.7 (4.8)	13.1*** (4.3)	-1.1 (7.7)	.18* (.10)	.552 10.3	30
Expected FTE Yrs of Schooling: 5-65		-.11 (.47)	2.51*** (.40)	.27 (.73)	.020* (.010)	.700 1.10	32
Upper-Secondary Graduation Rate		4.9 (6.9)	27.2*** (4.5)	14.3* (8.2)	.23* (.12)	.725 11.7	26

Holding schools accountable also appears to increase student achievement. States that introduced standards based reform programs during the 1990s-- annually reporting school data on achievement and rewarding successful schools and shaming schools that are not improving-

-achieved larger gains in student achievement on the NAEP exams than states that did not pursue these policies (Hanushek and Raymond 2003, Carnoy and Loeb 2003). Standard-based reform had larger effects on Blacks and Hispanics than Whites. Student stakes and school stakes appear to be complementary policies particularly at the secondary school level.

3.2 Does Better Signaling of Achievement Strengthen the Academic Focus of Schools?

What is the primary mechanism by which CBEEES increase student achievement? Do they induce school districts to hire more qualified teachers, to devote more time to teaching core subjects, to assign more homework etc? The impacts of CBEEES on school policies and instructional practices have been studied in the TIMSS data, in PISA data and in the Canadian International Assessment of Educational Progress data. CBEEES are not associated with higher teacher-pupil ratios nor greater spending on K-12 education. They are, however, associated with higher minimum standards for entry into the teaching profession, higher teacher salaries, a greater likelihood of having teachers specialize in teaching one subject in middle school and a greater likelihood of hiring teachers who have majored in the subject they will teach. Teacher satisfaction with their job appeared to be lower, possibly because of the increased pressure for accountability that results from the existence of good signals of individual student achievement. Schools in CBEEES jurisdictions devote more hours to math and science instruction and build and equip better science labs (Bishop 1997, 1999b).

Fears that CBEEES have caused the quality of instruction to deteriorate appear to be unfounded. Students in CBEEES jurisdictions were less likely to say that memorization is the way to learn the subject and more likely to do experiments in science class. Apparently, teachers subject to the subtle pressure of an external exam four years in the future adopted strategies that are conventionally viewed as "best practice," not strategies designed to maximize scores on multiple-choice tests. Quizzes and tests were more common, but in other respects CBEEES jurisdictions were no different on a variety of indicators of pedagogy. Students were more likely to get tutoring assistance from teachers after school. They were just as likely to enjoy the subject and they were more likely to believe that science is useful in every day life. Canadian students did more homework and talked with their parents more about schoolwork (Bishop 1999b).

Advocates of external measurement of student achievement with important stakes attached argue that it will improve the functioning of decentralized education systems. Parents will be better able to judge which schools are doing a good job. The information will influence choice of school and strengthen competitive pressures for excellence. Ministries of Education no longer need to try to improve education quality by rigidly specifying inputs—teacher qualifications, salaries, budget allocations and textbooks. Instead, teachers and school administrators can be given authority to use their local knowledge about teacher talents and budget circumstances to maximize school quality. Publishing data on achievement, it is theorized, creates accountability pressures that induce teachers and administrators to place greater emphasis on improving academic achievement. Tests of these hypotheses have been supportive. Bishop's (1999a, 2000) analysis of IAEP data found that controlling on student background, math achievement of students in private schools was higher only in jurisdictions that required externally set diploma exams at the end of secondary school. Analyzing TIMSS and PISA data, Ludger Wößmann (2002, 2003, 2004) found that school autonomy over salaries and teacher influence over course content, textbooks and budget allocations had positive effects on student achievement in nations with external exams. In nations without external exams, by contrast, high levels of school and teacher autonomy were associated with lower student achievement. This is a promising and very important line of research. Since changes in school governance and autonomy are commonly proposed as a way to make schools more efficient, it is critical that we understand how the effects of school choice and autonomy are influenced by the measurement and signaling of student achievement.

3.3 Does Better Signaling of Achievement Improve Student Behavior and Discipline?

Was attending more regularly and better discipline a mechanism by which CBEEES increased student achievement? Apparently not, the student effort and discipline index was not significantly higher in nations with CBEEES. When the effort/discipline index was added to the model, the coefficient on CBEEES hardly changed (contrast rows 1 and 2 in each panel of Table 3). On the other hand, students in CBEEES jurisdictions did more homework, got more tutoring and were tested more frequently. Possibly teachers responded to the external exam by assigning more homework and scheduling more students for tutoring. Many researchers have described classrooms as regulated by implicit treaties between students and the teacher (Sizer 1984, Powell, Farrar and Cohen 1985). External exams may allow teachers to require a higher standard of work from students but claim they are being forced to become tougher by the necessity to prepare them to pass the graduation exam. More research on the mechanisms by which examination systems influence classroom interactions and student achievement is clearly needed.

3.4 Does Better Signaling of Achievement Influence School Attendance and Labor Market Success?

What effects do high stakes curriculum-based external exit exam systems have on high school enrollment rates and college attendance? This question was addressed by analyzing OECD data on school enrollment rates of 15 to 19 year olds, upper-secondary graduation rates and years spent in school [summed net-enrollment rates of people from age 5 to 65] (OECD 2000, Table C1.1). Regressions predicting these variables are presented in rows 10, 11 and 12 of Table 3. CBEEES had no significant effect on any of these indicators. The statistically significant predictors were per capita GDP and the share of upper-secondary students in pre-vocational and career-technical educational programs (Bishop and Mane 2004). Analyses of U.S. state cross section data have also found that CBEEES (i.e. a dummy for New York State) and MCEs had no significant effect on aggregate enrollment rates or graduation rates in the early 1990s. The total number Carnegie units required to graduate, however, was negatively related to enrollment rates and graduation rates (Bishop and Mane 2000; Lillard and DeCicca 2001).

The longitudinal NELS-88 data set allows a more refined look at the distributional effects of CBEEES and MCEs on high school completion. Students with low or average GPAs in 8^{th} grade were significantly more likely to get their diploma late or to get a GED when they were from New York or a state with an MCE. The proportion of 8^{th} graders who eventually got either a regular diploma or a GED was no different in New York but significantly lower for low GPA students from other MCE states (Bishop, Mane, Moriarty and Bishop 2001). As in Europe, fast paced instruction and high standards for getting an academic diploma results in some students taking longer to get the diploma and other students switching over to less demanding programs of study.

There is only one study of the effects of MCEs and CBEEES on college attendance in the United States. When eighth graders in 1988 were followed up in the fall of 1993, those who lived in New York or a state with an MCE were (controlling for a host of student, school and labor market characteristics including the cost and payoff to college attendance) significantly more likely to be in college than students who attended school in other states (Bishop, Mane, Moriarty and Bishop 2001).

Economic theory predicts that raising graduation standards will improve the average quality of high school graduates and raise their mean wage and earnings (Betts and Costrell 2001). Analysis of HSB and NELS-88 data support this prediction. Controlling on high school completion, college attendance and local labor market characteristics, students from states with MCEs earned significantly more--**9 percent more** in the calendar year following graduation--than students from states without MCEs. The MCE also helped recent graduates get jobs that offered better opportunities for training and advancement (Bishop, Mane, Moriarty and Bishop 2001). As a result, eight years after graduating from high school, those growing up in a MCE state earned between $1100 and $2000 per year more than those who had attended high school in a non-MCE state (Bishop and Mane 2005).

IV. Setting Higher Standards for Course Grades and Promotion to the Next Grade

Do higher expectations and tougher grading standards induce students to work harder and learn more? Sociologists and psychologists have been studying this issue for decades. Those taking more rigorous courses get lower grades but learn a good deal more (Gamoran and Barends 1987). Kulik and Kulik's meta analysis (1984) of the educational literature found that students chosen to skip a grade or to take an accelerated curriculum score 75 percent of a standard deviation higher on tests a few years later than matched students who were not accelerated. Repeating a grade effectively lowers learning goals and reduces the retained child's achievement a few years later by about 30 percent of a standard deviation (Holmes 1989).

The goal setting literature is also relevant. Wood, Mento and Locke's (1987) meta analysis of experimental studies of the effect of goal difficulty on various kinds of achievement concluded that on highly complex tasks like school and college course work, specific hard goals raised achievement by 47 percent of a standard deviation relative to students instructed simply to "do your best." Achievement goes up, but so does the probability of failing to reach the goal. In most studies more than two-thirds of those in the "hard goal" condition failed to achieve their goal (Locke 1968 p. 163-165). Will effort be sustained in the face of repeated failure?

In the laboratory and field settings used by psychologists, subjects have generally accepted the goal set for them by the researcher. Stedry (1960) found, however, that when subjects who had already set their own goals were assigned even higher goals by the study director, they rejected the assigned goal and achievement did not rise. Will students accept the goals that teachers set for the class? Can, for example, teachers induce students to set higher learning goals by raising the learning target that students must achieve to get an A or a B grade? Betts (2001), Betts and Grogger (2003) and Figlio and Lucas (2001) have addressed this question. Grading standards were measured by comparing student test scores to the grades teachers awarded. Schools and teachers that gave better grades than predicted were classified as having low grading standards. Worse grades than predicted classified the teacher as a tough grader. In multivariate models controlling for characteristics of students and teachers, students in the tough grading standards schools/classrooms had significantly larger test score gains. Aware that these results could be generated by unmeasured variations in teacher quality and grading on a curve, a series of robustness tests were conducted that tend to support the causal interpretation of the finding.

Figlio and Lucas have particularly rich data so their tests are the most convincing. They have four years of longitudinal data and are able to match pupils to individual teachers for whom they have good measures of grading standards. Controlling for classroom composition and school and student fixed effects, they find that one year gains are about 20 percent greater in math and one-third greater in reading for students assigned to teachers who are tough graders. They also found that parents spent 60 percent more time helping their child with homework when the child's teacher was a tough grader. This was probably one of the mechanisms by which students in the high standards classes learned more.

These parents did "not perceive tougher teachers to be better teachers (Figlio and Lucas 2001 p. 20)." Difficult homework assignments intrude on parents' time and often put the family under stress, so parents complain. This is one of the reasons why 30 percent of American teachers feel pressured "to reduce the difficulty and amount of work you assign and "to give higher grades than students' work deserves" (Hart 1995)." When the only signal of student achievement is teacher grades, parents typically prefer high grades not high standards. Teachers who work in systems with external exams are aware of this. When a proposal was put forward in Ireland to drop the nation's system of external assessments and have teachers assess students for certification purposes, the union representing Ireland's secondary school teachers reacted as follows:

> *Major strengths of the Irish educational system have been:*
> *(i) The pastoral contribution of teachers in relation to their pupils*
> *(ii) the perception of the teacher by the pupil as an advocate in terms of nationally certified examinations rather than as a judge.*
> *The introduction of school-based assessment by the pupil's own teacher for certification purposes would undermine those two roles, to the detriment of all concerned....*
> *The role of the teacher as judge rather than advocate may lead to legal accountability in terms of marks awarded for certification purposes. This would automatically result in a distancing between the teacher, the pupil and the parent. It also opens the door to possible distortion of the results in response to either parental pressure or to pressure emanating from competition among local schools for pupils*. (Association of Secondary Teachers of Ireland, Flyer, 1990, p.1).

Note how the Irish teachers union feared that switching entirely to internal assessment would result in teachers being pressured to lower standards. If they are right, school choice does not inevitably lead to higher standards and better teaching. Higher standards will result only if student achievement is externally assessed, the results of these assessments are published and students benefit from attending schools that set high standards.

Gresham's Law of Course Selection: American high schools offer courses in core subjects at vastly different levels of rigor and allow students to choose their level. A good grade requires less work in the lower level classes so a Gresham's law of course selection tends to prevail in which easy courses displace rigorous courses. Admissions officers at elite colleges have reacted by telling prospective students to take rigorous courses and are factoring course rigor into their deliberations. But most students do not aspire to attend elite colleges. Community colleges admit just about everyone and send students into noncredit remedial classes if they do poorly on placement exams given to arriving students. State universities seldom formally consider course rigor in their formula driven admissions process.

Asian and European schools also allow students to choose lower standards options. But the option chosen is well signaled to others by the name or type of secondary school or program. There is considerable prestige and honor attached to being in rigorous programs, so competition for admission to the most demanding programs is often fierce, particularly in Asia. Once the school or program is selected, European students are typically formed into classes that take almost all subjects together. The class often remains intact for a couple of years and friendships tend to develop within this class. Students who are not able to keep up with the fast paced curriculum are asked to repeat the grade or to transfer to an easier school or an easier line of study. When I asked a Dutch student who, despite long hours of study had been required to repeat a grade, why she had studied so hard, she responded, ***"I wanted to stay with my class!"*** Apparently, trying to keep up academically (i.e. accepting the academic goals of the school) is viewed positively by peers because it is an expression of commitment to the group. Indeed Dutch teachers and students tell me it is common for some of the better students to help struggling students pass the courses they are having difficulty with.

While the threat of retention appears to have the intended incentive effects in Belgium, France, Netherlands and Germany, the institutional features that make it such a powerful incentive—the intimate class that takes all its courses together and stays intact multiple years—are absent in large American comprehensive high schools. Failing a course only means it must be repeated during the summer or next year. It does not push you out of your clique, so the incentive effects of the threat of retention are likely to be weaker in the U.S. than in Europe. Furthermore, retention is very costly because keeping a student in school for an extra year costs taxpayers over $7000. Compulsory summer school and after school programs appear to be a better, and less costly, alternative (Jacob 2002; Roderick, Bryk, Jacob, Easton and Allensworth 1999; Roderick, Engel and Nagaoka. 2003; Betts 1998.) This is a policy issue that needs a great deal more research.

V. Peer Norms about Studying and Academic Engagement.

At most schools, students have developed strong independent sub-cultures that make highly prescriptive demands on group members—no squealing on classmates, for example. In Philadelphia's inner city secondary schools, the "code of the street" dominates:

> With each passing year the school loses ground as more students adopt a street orientation, if only for self defense in the neighborhood. But often what is out on the streets is brought into the classrooms. The most troublesome students are then encouraged by peers to act out, to "get over on" the teacher, to test authority by probing for weaknesses (Anderson 1999 p. 94).

While middle class schools have fewer disruptive students, peer support for their behavior is quite common. The EEA survey found that 60 percent of students disagreed with the proposition that "it was annoying when other students talk or joke around in class." Based on a multiyear study of nine high schools Laurence Steinberg, Bradford Brown and Sanford Dornbusch concluded that:

> The adolescent peer culture in [middle class] America demeans academic success and scorns students who try to do well in school....Less than 5 percent of all students are members of a high-achieving crowd that defines itself mainly on the basis of academic excellence... Of all the crowds the 'brains' were the least happy with who they are--nearly half wished they were in a different crowd (1995, 145).

Where do such norms come from? Kenneth Arrow has said that "norms of social behavior, including ethical and moral codes ….are reactions of society to compensate for market failure (Arrow 1971, 4)." This "internalize externalities" explanation of norms would appear to predict a norm <u>against</u> class disruptions because such disruptions prevent classmates from learning. Clearly this prediction fails. Are there other externalities at work that can explain the peer culture's toleration of disruptive students and it's dislike of nerds. The beginnings of an answer can be found by looking very closely at (3), the expression for the benefits of learning. Let's ask: 'How large a benefit do I derive from others studying harder?' This can be calculated by taking the derivative of (3) with respect to E^m holding E and X^m constant:

12) My benefit from effort by classmates **=**

$$\frac{\partial B^i}{\partial E^m} = \{(\boldsymbol{j}+\boldsymbol{w})\rho \mathbf{L^i} - \theta\alpha \mathbf{L^m} + \theta\rho(\mathbf{L^i} - \mathbf{L^m})\}/\mathbf{E^m}$$

When we ask "what is the effect of my study effort on aggregated learning payoffs of other students at the school', we get an even simpler expression:

13) Others payoff *wrt* my effort

$$= \Psi = \frac{E^m}{L^m}\frac{\partial B^m}{\partial E^i} = \frac{E^m}{L^m}\frac{\partial B^m}{\partial E^m}\frac{\partial E^m}{\partial E^i} = (\mathbf{j^m} + \mathbf{w^m})\boldsymbol{\rho} - \boldsymbol{\theta\alpha}$$

Note that both of these expressions are negative when $\boldsymbol{\theta\alpha}$ is large and $\boldsymbol{\rho}$ is sufficiently small.

Why are Nerds unpopular and targeted for harassment? Equation 12 and 13 tells us that students are made worse off by the studying of others when (a) most of the rewards for learning arise from how one is ranked relative to other students in the class [θ is large relative to ($\boldsymbol{j+w}$)], (b) the elasticity of learning with respect to others effort (ρ) is much smaller than $\boldsymbol{\alpha}$, the elasticity of learning with respect to own effort and (c) the student is a slow learner ($L^i < L^m$). When many of the extrinsic rewards for learning depend on rank in class or grades calculated on a curve, students may come to believe they have a common interest in persuading each other "not to study too much." Evidence for this comes from the EEA survey, where those who strongly agreed that 'It is harder for me to get good grades, …if others study hard' were three times more likely to have friends who 'make fun of those who try to do well in school' than those who disagree. Thus the purpose of nerd harassment is not punishing high aptitude students for being smart, but discouraging study effort. Indeed, pressure against doing all your homework or volunteering comments during class will probably be stronger in low track classes than high track classes because the students in low track classes are more likely to have chosen an identity that rejects school (Akerlof and Kranton 2002).

In Akerlof and Kranton's very interesting theory a student's primary motivation derives from his or her identity—jock, brain, burnout, party animal, etc. Associated with each identity is an ideal type—stereotypical physical attributes and behaviors that characterize the members of the crowd. "Individuals then gain or lose utility insofar as they belong to social categories with high or low social status and their attributes and behavior match the ideal of their category (2002 p.1168)." Students with physical and social attributes that bring them close to the 'ideal' of a particular crowd tend to join that crowd. Once you join a crowd you try to live the ideal. Crowds tend toward homogeneity and discourage socializing with members of lower status crowds. "The quality of a school depends on how students fit in a school's social setting (p.1167)." While they argue that the distribution of student identities (crowds) at a school and how they interact are more important determinants of learning than measurable school inputs, they do not put forward a set of policy prescriptions.

Akerlof and Kranton do not try to explain what determines the ideals and norms that characterize an identity, how new students learn the norms and are induced to conform to them and how norms evolve over time in response to changes in the environment and school policy. In three recent papers (Bishop et al 2003, 2004 and Bishop 2003b) my colleagues and I have constructed a rational choice theory (Olson 1965, Hechter 1987) of student peer group solidarity to address these questions. Strong independent sub-cultures are mechanisms by which students produce and consume excludable jointly produced goods and services such as friendship, socializing, parties, interscholastic competition, respect, prestige and norms regarding academic effort. The norms promoted by peer sub-cultures are sometimes in opposition to the rules and norms that principals, teachers and parents are trying to promulgate. For example, “sucking up” to teachers and rate busting are typically strongly discouraged just as they are in many work settings. Students entering middle school learn its norms by trying to copy the traits and behaviors of students who are respected and avoiding contact with those who are frequently harassed.

Norms are directed at focal actions that are visible to other group members (or where a significant risk of discovery exists) and are enforced by sanctions (Coleman 1990, 246). Since norm enforcement is a public good, peer groups must devise a means of inducing classmates to sanction those who violate peer norms. Norms that survive the test of time typically impose two obligations: avoid focal action A and sanction group members who do A. Aspirants for admission to high status crowds, ‘wannabes,’ are particularly sensitive to pressures to demonstrate their loyalty to group norms, so they are often the ones who harass norm violators. Social norms that impose obligations on group members to enforce the norm powerfully replicate in later generations of the population and do so under quite general conditions. Employing evolutionary game theory, Bendor and Swistak (2001) have shown that social norms enforcing cooperation in prisoner’s dilemma games have a very robust ability to repel invasions by non cooperating intruders only when third parties (not just the victim of non-cooperation) are obligated to impose sanctions on deviant actors. Fehr and Gachter's (2000) four-person public goods experiments found that allowing players to punish those who contribute little to the public investment results in heavy punishments of free riders and a big reduction in free rider behavior. Many players devoted some of their money to punishing norm violators even though punishing free riders was costly. Harassing a student who has violated peer norms is close to costless in American secondary schools and is indeed often rewarded (Bishop et al 2003).

Since not conforming to the school's norms generates harassment and social exclusion, one can infer the norms by noting who gets harassed and who doesn't. Traits that in EEA data led to higher risks of being bullied and harassed were: being in a special education, being in gifted programs, taking accelerated courses in middle school, tutoring other students, enjoying school assignments, taking a theatre course, saying that rap-hip hop is not your favorite music and preferring musicals, heavy metal, country, or classical music. The relationship between harassment and academic effort was curvilinear; both nerds and slackers were harassed. To some degree these norms are, as Kenneth Arrow and James Coleman have suggested, trying to internalize externalities. But why does music preference predict harassment? Why are student tutors victimized?

We propose that school wide norms also have a "We're cool, Honor us" function of legitimizing the high status that the leading crowds claim for themselves. While norms tend to be passed from one generation to the next, the mass of students learn the norms by noting the example set by current members of the leading crowds. If leaders of popular crowds spend more time on and are particularly talented at sports, extracurricular activities, hanging out and partying, the theory predicts that peer culture will give high priority to extracurricular and social achievements. Academic norms will also reflect the interests of the leading crowds. If state government introduces a tough graduation exam and leaders of the popular crowd fear they may not be able to graduate if they do not study harder, study norms will rise. If a new generation of leaders of the popular crowd aspires to go to the highly competitive flagship state university rather than a local college with open door admissions, study effort norms will rise. The theory suggests, therefore, that peer norms are not immutable. They adjust to changes in graduation requirements, school policies and the labor market and they are influenced by the values and abilities of the students who become leaders of a crowd.

Summary

Students face four decision margins: (a) How many years to spend in school, (b) What to study. (c) How much effort to devote to learning per year and (d) Whether to disrupt or assist the learning of classmates. The thousands of studies that have applied human capital theory to the first two questions are reviewed elsewhere in this volume and the handbook series. This paper reviews an emerging economic literature on the effects of and determinants of student effort and cooperativeness and how putting student motivation and behavior at center of one's theoretical framework changes one's view of how schools operate and how they might be made more effective. In this new framework students have a dual role. They are both (a) investors/consumers who choose which goals (outputs) to focus on and how much effort to put into each goal and (b) workers getting instruction and guidance from their first-line supervisors, the teachers. A simple model is presented in which the behavior of students, teachers and administrators depends on the incentives facing them and the actions of the other actors in the system. The incentives, in turn, depend upon the cost and reliability of the information (signals) that is generated about the various inputs and outputs of the system. Our review of empirical research, support many of the predictions of the model.

Student effort, engagement and discipline vary a lot within schools, across schools and across nations and have significant effects on learning. Higher extrinsic rewards for learning are associated the taking of more rigorous courses, teachers setting higher standards and more time devoted to homework. Taking more rigorous courses and studying harder increase student achievement. Post World War II trends in study effort and course rigor, for example, are positively correlated with achievement trends.

Even though, greater rigor and higher standards improve learning, parents and students prefer easy teachers. They pressure tough teachers to lower standards and sign up for courses taught by easy graders. Curriculum-based external exit examinations improve the signaling of academic achievement to colleges and the labor market and this increases extrinsic rewards for

learning. Cross section studies suggest that CBEEES result in greater focus on academics, more tutoring of lagging students, more homework and higher levels of achievement. Minimum competency examinations do not have significant effects on learning or dropout rates but they do appear to have positive effects on the reputation of high school graduates. As a result, students from MCE states earn significantly more than students from states without MCEs and the effect lasts at least eight years.

Students who attend schools with studious well-behaved classmates learn more. Disruptive students generate negative production externalities and cooperative hard-working students create positive production externalities. Peer effects are also generated by the norms of student peer cultures that encourage disruptive students and harass nerds. In addition learning is poorly signaled to employers and colleges. Thus, market signals and the norms of student peer culture do not internalize the externalities that are pervasive in school settings and as a result students typically devote less effort to studying than the taxpayers who fund schools would wish.

References

Akerlof, George and Rachel Kranton .(2002) "Identity and Schooling: Some Lessons for the Economics of Schooling." Journal of Economic Literature, Vol. 41, # 4, December, .

Altonji, Joseph and Charles Pierret, "Employer learning and the signaling value of education" (with Charles Pierret), in Ohashi and T. Tachibanaki (eds.) *Internal Labour Markets: Incentives and Employment.* McMillan Press (1998): 159-195.

Anderson, Bernard. (1999) The Code of the Street. New York, New York: W.W. Norton, 1-352.

Angrist, Joshua D. and Keven Lang, (2002) "How important are Classroom Peer Effects? Evidence from Boston's Metco Program," Cambridge Mass, National Bureau of Economic Research, Working Paper 9263, 1-38.

Arrow, Kenneth. "Political and Economic Evaluation of Social Effects and Externalities," in Michael Intriligator, ed., *Frontiers of quantitative economics.* Amsterdam: North-Holland, 1971, 3–25.

Association of Secondary Teachers of Ireland, Flyer, 1990,

Becker, William and Sherwin Rosen. (1992) "The Learning Effect of Assessment and Evaluation in High School." Economics of Education Review, Vol 11, # 2, pp.107-118.

Bendor, Jonathan and Piotr Swistak. "The Evolution of Norms." *The American Journal of Sociology*, Vol. 106, no. 6, May 2001 , p. 1493.

Betts, Julian, (1996), "The Role of Homework in Improving School Quality", Discussion Paper 96-16, Department of Economics, UCSD.

Betts, Julian, (1998) "The Impact of Educational Standards on the Level and Distribution of Earnings." American Economic Review, vol. 88, no. 1, 266-275.

Betts, Julian, (1998) "The Two-Legged Stool: the Neglected Role of Educational Standards in Improving America's Public Schools", Economic Policy Review, Vol 4, # 1, 97-116.

Betts, Julian, "Do Grading Standards Affect the Incentive to Learn?" Dept of Economics, UC San Diego, 2001, 1-36..

Betts, Julian & Andrew Zau. (2002) "Peer Groups and Academic Achievement: Panel Evidence from Administrative Data," Public Policy Institute of California.

Betts, Julian and Robert Costrell. "Incentives and Equity under Standards-Based Reform " Brookings Papers on Education Policy 2001, edited by Diane Ravitch, (Washington, DC: The Brookings Institution), 9-74.

Betts, Julian R. and Jeff Grogger, (2003) "The Impact of Grading Standards on Student Achievement, Educational Attainment, and Entry-Level Earnings", *Economics of Education Review*.

Bishop, John H "The Effect of Public Policies on the Demand for Higher Education." Journal of Human Resources, Vol. XII, No. 3, Summer 1977.

Bishop, John H "Is the Test Score Decline Responsible for the Productivity Growth Decline?" American Economic Review, Mar 1989, 178-197.

Bishop, John H "Incentives to Study: Why American High School Students Compare so Poorly to their Counterparts Overseas" Research in Labor Economics, Vol. 11, edited by David Crawford and Lauri Bassi, Greenwich, Ct.: JAI Press, 1990, 17-51.

Bishop, John H. "Achievement, Test Scores and Relative Wages" Workers and Their Wages, edited by Marvin Kosters, Washington, DC: The AEI Press, 1991, 146-181.

Bishop, John H. "Impact of Academic Competencies on Wages, Unemployment and Job Performance," *Carnegie-Rochester Conference Series on Public Policy*, Volume 37, (December 1992), pp. 127-194.

Bishop, John H. "Schooling, Learning and Worker Productivity" Human Capital Creation in an Economic Perspective, edited by Rita Asplund, Elinkeinoelaman Tutkimuslaitos Naringslivets Forskningsinstitut (ETLA), (Helsinki, Finland: Physica-Verlag 1995) 13-67,.

Bishop, John H.. "Signaling Incentives and School Organization in France, the Netherlands, Britain and the United States: Lessons for Education Economics." Incentives and Education Reform ed. Eric Hanushek, Washington D.C.: National Academy Press, 1996b.

Bishop, John.H. (1996) "The Impact of Curriculum-Based External Examinations on School Priorities and Student Learning." International Journal of Education Research. Vol 23, No. 8, 1996a.

Bishop, John H. "The Effect of National Standards and Curriculum-Based External Exams on Student Achievement." American Economic Review, May 1997.

Bishop, John H. "Nerd Harrassment, Incentives, School Priorities and Learning," *Earning and Learning*, ed. by Susan Mayer and Paul Peterson, (Washington, DC: Brookings Institution Press, 1999a).

Bishop John H., "Are National Exit Examinations Important For Educational Efficiency?" (1999b) Swedish Economic Policy Review, Vol. 6, #2, Fall 1999, 349-401.

Bishop John H. (1999c) "Nerd Harassment and Grade Inflation: Are College Admissions Policies Partly Responsible?" Center for Advanced Human Resources Discussion Paper 99-14, Cornell University.

Bishop, John H. "Privatizing Education: Lessons from Canada, Asia and Europe" Vouchers and the Provision of Public Services, ed. by Eugene Steurele, Van Doorn Ooms, George Peterson, and Robert D. Reischauer, (Washington, DC: The Urban Institute and Brookings Institution, 2000), 292-335.

Bishop John H., (2003a) "What is the Appropriate Role of Student Achievement Standards," Education in the 21st Century: Meeting the Challenge of a Changing World, ed. Yolanda Kodrzycki, Boston, MA: Federal Reserve Bank of Boston.

Bishop, John H. (2003b) "An Economic Theory of Nerd and Slacker Harassment and it's Role in Enforcing Social Norms in Schools?" Center for Advanced Human Resources Discussion Paper 03-06, Cornell University.

Bishop, John, Michael Bishop and Matthew Bishop. (2004) "Nerds and Slackers: The Struggle for Popularity in American Secondary Schools." Journal of School Health

Bishop, John and Ferran Mane. (2005) "Raising academic standards and vocational concentrators: are they better off or worse off?" Education Economics.

Bishop, John and Ferran Mane. (2004) "The Impacts of Career-Technical Education on High School Completion and Labor Market Success." Economics of Education Review.

Bishop, John H.., Joan Moriarty and Ferran Mane, "Diplomas for Learning: not Seat Time," *Economics of Education Review.* Vol 19, No. 3, 2000.

Bishop, John and Ferran Mane. (2001) "Incentive Effects of New York State's Reform Strategy" to appear in Parental Choice vs. Best Systems: What Improves Education eds. Margaret Wong and Herbert Walberg, Lawrence Earlbaum Associates, 1-35 .

Bishop, John and Ferran Mane. "The Impacts of Minimum Competency Exam Graduation Requirements on High School Graduation, College Attendance and Early Labor Market Success" Labour Economics Vol. 8, nº2, Spring 2001, 203-222.

Bishop, John, Ferran Mane, Michael Bishop and Joan Moriarty. (2001) "The Role of End-of-Course Exams and Minimum Competency Exams in Standards-Based Reforms." Brookings Papers on Education Policy 2001, edited by Diane Ravitch, (Washington, DC: The Brookings Institution), 267-346.

Bishop, John, Matthew Bishop, Lara Gelbwasser, Shanna Green and Andrew Zuckerman. "Nerds and Freaks: a Theory of Student Culture and Norms" Brookings Papers on Education Policy: 2003. edited by Diane Ravitch, (Washington, DC: The Brookings Institution, 2003),

Bishop, John and Ludger Wößmann. "Institutional Effects in a Simple Model of Educational Production," Education Economics. Vol. 12 No. 1 (2004)

Boozer, Michael and Stephen E. Cacciola, (2001) "Inside the 'Black Box' of Project Star: Estimation of Peer Effects Using Experimental Data," Yale University, Economic Growth Center Discussion Paper # 832, 1-__.

Card, David. "The Causal Effects of Education on Earnings" Handbook of Labor Economics. Eds. Orly Ashenfelter and D. Card, Vol. 3, Elsevier Science Publishers BV, 1999, 1801-1863.

Carnoy, Martin and Susanna Loeb "Does External Accountability Affect Student Outcomes?" Educational Evaluation and Policy Analysis Vol. 24, # 4, 2003.

Census Bureau, "Annual Mean Income, Lifetime Income and Educational Attainment of Men, 1956-1972." Current Population Reports, Series P60, No. 92. US Government Printing Office, Washington DC, 1974.

Coleman, James S. *Foundations of Social Theory*. (Cambridge, Mass: Harvard University Press, 1990).

Cooper, Harris M. *Homework.* White Plains, New York: Longman, 1989.

Costrell, Robert. (1994) "A Simple Model of Educational Standards," *American Economic Review*, vol. 84, no. 4, (1994) pp. 956-971.

Costrell, Robert M. (1997) "Can Centralized Educational Standards Raise Welfare?" *Journal of Public Economics*, Vol. 65, 271-293.

Cromwell, Christopher, David Mustard and Deepa Sridhar, "The Enrollment Effects of Merit-Based Financial Aid: Evidence from Georgia's HOPE Scholarship," Athens GA: University of Georgia, Jan., 2003, 1-49.

Department of Labor, "General Aptitude Test Battery Manual" (Superintendent of Documents, 1970).

Dynarski, Susan, "Hope for Whom? Financial Aid for the Middle Class and it's Impact on College Attendance," *National Tax Journal*, Sept. 2000, 5 3(3), pp.629-661.

Ehrenberg, Ronald; R.A. Ehrenberg, D. Rees and E. Ehrenberg "School District Leave Policies, Teacher Absenteeism and Student Achievement," *Journal of Human Resources*, Winter 1991.

Farber, Henry and Robert Gibbons, "Learning and Wage Dynamics," *Quarterly Journal of Economics* (1996), pp. 1007-47.

Fehr, Ernest and Simon Gachter, "Cooperation and Punishment in Public Goods Experiments," American Economic Review, Vol. 90(4), Sept. 2000, 980-994.

Figlio, David and Maurice Lucas. (2001) "Do High Grading Standards Affect Student Performance." Univ. of Florida, 1-38.

Frederick, W. C. "The Use of Classroom Time in High Schools Above or Below the Median Reading Score." Urban Education 11, no. 4 (January 1977): 459-464.

Frederick, W.; Walberg, H.; and Rasher, S. "Time, Teacher Comments, and Achievement in Urban High Schools." Journal of Educational Research 73, no. 2 (November-December 1979): 63-65.

Friedman, Toby and Williams, Belvin, "Current Use of Tests for Employment." Ability Testing: Uses, Consequences, and Controversies, Part II: Documentation Section, edited by Alexandria K. Wigdor and Wendell R. Gardner. Washington, DC: National Academy Press, 1982, pg. 999-169.

Freeman, Richard. "Over Investment in College Training?" Journal of Human Resources 10 (Summer 1975): 287-311.

Freeman, Richard. The Overeducated American. New York: Academic Press, 1976b.

Freeman, Richard. "Demand for Education." "Handbook of Labor Economics. Eds. O. Ashenfelter and r. Layard, Vol. 1, Elsevier Science Publishers BV, 1986, 357-386.

Gamoran, A and Barends, M. (1987) "The Effects of Stratification in Secondary Schools: Synthesis of Survey and Ethnographic Research." Review of Education Research. Vol. 57, 415-435.

Ghiselli, Edwin E. "The Validity of Aptitude Tests in Personnel Selection." Personnel Psychology. 1973: 26, 461-477.

Goodlad, J. A Place Called School. New York: McGraw-Hill, 1983.

Gonzales, Patrick. Pursuing Excellence: Comparisons of International Eighth-Grade Mathematics and Science Achievement from a U.S. Perspective, 1995 and 1999. (Washington, DC: National Center for Educational Statistics, 2000), 1-.

Graham, Amy and Husted, Thomas. "Understanding State Variation in SAT Scores." Economics of Education, Vol 12, No. 3, 197-202.

Grubb, Norton. "The Varied Economic Returns to Postsecondary Education: New Evidence from the National Longitudinal Study of the Class of 1972." Journal of Human Resources, Vol. 28, No. 2, Spring 1993, 365-382.

Gummere, Richard, (1943) "The Independent School and the Post War World." Independent School Bulletin. Vol 4, April, (quoted in Arthur Powell, Standards, 1995 Chap 6).

Hanushek, Eric A., John Kain and Steven G. Rivkin, (2002) "New Evidence about Brown V. Board of Education: the Complex Effects of School Racial Composition on Achievement," Cambridge Mass, National Bureau of Economic Research, Working Paper 8741, 1-38.

Hanushek, Eric A. and Margaret Raymond. "Improving Educational Quality: How Best to Evaluate Our Schools?" Education in the 21st Century: Meeting the Challenge of a Changing World, ed. Yolanda Kodrzycki, 2003, Boston, MA: Federal Reserve Bank of Boston.

Harbaugh, Rick. (2003) "Achievement vs. Aptitude: The Incentive - Screening Tradeoff in College Admissions" Claremont Working Papers in Economics 2003-11

Hart, (Peter D.) Research Associates, "Valuable Views: A public opinion research report on the views of AFT teachers on professional issues" (Washington D.C.: American Federation of Teachers, 1995), pp. 1-24.

Hartigan, John and Alexandra Wigdor, eds. *Fairness in Employment Testing* (Washington, D.C.: National Academy Press, 1989).

J. C. Hauser and Thomas M. Daymont, "Schooling, ability and earnings: Cross-sectional evidence 8-14 years after high school," *Sociology of Education*, Vol. 50 (July 1977), 182-206.

Hechter, Michael. *Principles of Group Solidarity.* Berkeley, Calif., University of California Press, 1987), 1-219.

Henry, Gary T. and Rubenstein, Ross (2002) "Paying for Grades: Impact of Merit-Based Financial Aid on Educational Quality" Journal of Policy Analysis and Management 21:1, 93-109.

High School and Beyond. Data File Users Manual. National Opinion Research Corporation, Chicago, Illinois, 1982..

Hofferth, Sandra and John F. Sandberg. (2000) "Changes in American Children's Time 1981-1997." Center for the Ethnography of Everyday Life Working Paper 013-00, University of Michigan, Institute for Social Research, 1-47.

Hollenbeck, K., and Smith B. The Influence of Applicants' Education and Skills on Employability Assessments by Employers. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

Holmes, C.T. (1989) "Grade Level Retention Effects: A Meta-Analysis of Research Studies." in Flunking Grades, ed. Lorrie Shepard and Mary Lee Smith, New York: The Falmer Press, 16-33.

Caroline Hoxby, (2000) "Peer Effects in the Classroom: Learning from Gender and Race Variation," Cambridge Mass: National Bureau of Economic Research, Working Paper 7867, 1-62.

Hunter, John E., James J. Crosson and David H. Friedman, "The Validity of the Armed Services Vocational Aptitude Battery (ASVAB) For Civilian and Military Job Performance" (Department of Defense, August 1985).

Jacob, Brian. (2002) "Accountability, Incentives and Behavior." NBER Working Paper

Kang, Suk. "A Formal Model of School Reward Systems." in Incentives, Learning and Employability, edited by John Bishop, Columbus Ohio: National Center for Research in Vocational Education, 1985

Kremer, Michael, Edward Miguel and Rebecca Thornton. "Incentives to Learn" presented at the NBER Program on Education, November 14, 2003.

Kulik, James and Kulik, Chen-Li. (1984) "Effects of Accelerated Instruction on Students." Review of Educational Research, Fall, Vol. 54, No. 3, 409-425.

Lazear, Edward P. "Educational Production." *Quarterly Journal of Economics* 116:3 (August 2001): 777-803.

Lillard, Dean and Phillip DeCicca. (2001) "Higher Standards, More Dropouts? Evidence within and across Time," *Economics of Education Review*, Vol 20 # 5, 459-73

Locke, Edwin "Toward a theory of Task Motivation and Incentives." Organizational Behavior and Human Performance, Vol. 3, 1968, p. 157-189.

Longitudinal Survey of American Youth. "Data File User's Manual" Dekalb, Ill: Public Opinion Laboratory, 1988.

Murnane, Richard, John Willett and Frank Levy. "The growing importance of cognitive skills in wage determination," Review of Economics and Statistics, Vol 77, no 2, May 1995, 251-266.

National Center for Education Statistics. The Digest of Education Statistics ****. (2001a, 2002a, 2003a) Wash. D.C.: US Department of Education.

National Center for Educational Statistics. (2001b, 2002b, 2003b) The Condition of Education ****., Wash. D.C.: US Department of Education..

Olson, Mancur. (1965) The Logic of Collective Action. (Cambridge, Mass: Harvard University Press).

Organization of Economic Co-operation and Development. Living Conditions in OECD Countries: A Compendium of Social Indicators. Social Policy Studies No. 3. Paris, France: Organization for Economic Co-operation and Development, 1986.

Organization of Economic Co-operation and Development. Education at a Glance. Paris, France: Organization for Economic Co-operation and Development, 2000, 2002, 2003.

Organization of Economic Co-operation and Development. Literacy Skills for the World of Tomorrow: Further Results from PISA 2000. Paris, France: Organization for Economic Co-operation and Development, 2003.

Powell, Arthur; Farrar, Eleanor and Cohen, David. The Shopping Mall High School. New York, New York: Houghton Mifflin, 1985.

Roderick, Melissa, Anthony S. Bryk, Brian A. Jacob, John Q. Easton, and Elaine Allensworth. (1999) Ending Social Promotion: Results from the First Two Years. http://www.consortium-chicago.org/publications/p0g04.html, Consortium on Chicago School Research, December 1999

Roderick, Melissa, Mimi Engel and Jenny Nagaoka. (2003) Ending Social Promotion: Results from Summer Bridge, http://www.consortium-chicago.org/publications/p59.html Consortium on Chicago School Research,

Rosenbaum, James. Beyond College for All: Career Paths for the Forgotten Half. New York, Russell Sage Foundation, 2001.

Bruce Sacerdote, (2000) "Peer Effects with Random Assignment: Results for Dartmouth Roommates," Dartmouth College .

Sizer, Theodore R. Horace's Compromise: The Dilemma of the American High School. Boston: Houghton Mifflin, 1984.

Stedry, A. C. Budget Control and Cost Behavior, Englewood Cliffs, New Jersey: Prentice Hall. 1960.

Steinberg, Laurence, Brown, Bradford and Dornbusch, Sanford. Beyond the Classroom. New York: Simon and Schuster, 1996, 1-223.

Taubman, Paul and Wales, Terence. "Mental Ability and Higher Educational Attainment in the 20th Century." National Bureau of Economic Research Occasional Paper 118, 1972.

Taubman, Paul and Terence Wales, "Education as an investment and a screening device," *Education, Income and Human Behavior,* ed. F. T. Juster, (New York: McGraw Hill, 1975), pp. 95-122.

Uribe, Claudia, Richard Murnane and John Willett. "Why do Students Learn more in Some Classrooms than in Others? Evidence from Bogota" February 2003, Harvard Graduate School of Education.

Ward. "A Day in the Life." N.Y. Teacher. Jan. 1994, Albany, N.Y.

Wiley, David E. "Another Hour, Another Day: Quantity of Schooling, a Potent Path for Policy." In Schooling Achievement in American Society, edited by William H. Sewell, Robert M. Hauser, and David L. Featherman. New York: Academic Press, 1976.

Willms, J. Douglas and Somers Marie-Andree. (2001) "Family, classroom, and school effects on children's educational outcomes in Latin America." International Journal of School Effectiveness and Improvement, 12(4), 409-445.

Wood, Robert E., Mento, Anthony & Locke, Edwin. "Task Complexity as a Moderator of Goal Effects: A Meta Analysis." Journal of Applied Psychology, Vol 72, No. 3, 1987, 416-425.

Wößmann, Ludger "Schooling Resources, Educational Institutions, and Student Performance: The International Evidence**,"** Kiel Working Paper No. 983, (May 2000) Kiel Institute of World Economics, Germany, <http://www.uni-kiel.de/ifw/pub/kap/2000/kap983.htm> 1-88.

Wößmann, Ludger. "How Central Exams Affect Educational Achievement: International Evidence from TIMSS and TIMSS-Repeat." Paper presented at conference on: Taking Account of Accountability: Assessing Politics and Policy. Kennedy School, June 2002, 1-62.

Wößmann, Ludger. "Central Exams as the "Currency" of School Systems: International Evidence on the Complementarity of School Autonomy and Central Exams." DICE Report - Journal for Institutional Comparisons 1 (4): 46-56, 2003.

Wößmann, Ludger. "The Complementarity of Central Exams and School Autonomy: Theory and International Evidence." Conference on "Institutional Models in Education." in Frascati Italy, May 2004.

David Zimmerman, (1999) "Peer Effects on Academic Outcomes: Evidence from a Natural Experiment' NBER

Endnotes

[1] The Educational Excellence Alliance is a consortium of schools and school districts that have administered the ED-Excel survey of student peer culture and received reports comparing their students' responses to the responses at other comparable schools. A total of about 325 schools and 110,000 students have participated in the study (Bishop et al 2003).

[2] PISA assesses the cumulative educational experiences of all students at age 15 regardless of the grade levels or type of institution they are attending. The students complete a 20 to 30 minute background questionnaire and a 90-minute assessment consisting of a mix of multiple choice, short answer, and extended response questions. It's most recent report (OECD 2003a) presents data on 222,948 students from 43 nations accounting for one-third of the world's population.. Great care is taken to insure that the schools and students who are assessed are representative of the all 15-year old students in the nation.

[3] Students were asked the frequency in their language arts class of: "the teacher has to wait a long time for the students to <quiet down>; students cannot work well; students don't listen to what the teacher says; students don't start working for a long time after the lesson begins; there is noise and disorder; and, at the start of class, more than five minutes are spent doing nothing." The response alternatives were 'never', 'some lessons,' 'most lessons,' and 'every lesson.'

[4] The main necessary features of a more general model are that there is complementarity between individual student effort, school disciplinary climate and resource input in educational production and that certain institutional features enhance the productivity of resource usage.

[5] Observing how a worker performs on the job should allow employers to develop more accurate opinions about L over time. There are, however, job and firm specific match components to job performance that may cloud an employer's ability to evaluate general human capital. Nevertheless, the difficulties of signaling L at the end of high school become less important to job placement and wages as the worker gains labor market experience. But they nevertheless have very large effects on the choice of college, field of study and early entry into desirable occupations that have lasting effects on earnings even when better information on L later becomes available. These early outcomes are particularly salient to students and parents and influence their expectations about the long run consequences of learning in high school (Rosenbaum 2001). Their lack of knowledge about the true long term consequences may lead them to focus on manipulating the signals—SAT-1, class rank and GPA—that they know influence immediate outcomes and to neglect developing a really good education (Bishop 1990).

[6] Pooling occurs when employers do not know which school a student has graduated from or when schools have not developed reliable reputations that employers and colleges can use to improve their prediction of **L** (Betts and Costrell 2001). If grading standards of schools and of courses within schools were known, it might be feasible to handicap class rank and course grades so as to construct a good measure of L. Constructing such estimates for 100s of schools and tens of thousands of courses would be extremely costly. Some employers and colleges use subjective judgments to handicap GPAs and class rank, but these judgments are unreliable and infrequently updated (Bishop 1999b).

[7] When grading standards vary across high schools, across classrooms within the school and over time, employers and universities are not able to place applicants for jobs or admission on a common scale, Students must be pooled together so schools and teachers have an incentive to help their students compete for jobs and colleges by inflating grades.

[8] In 1996 only 4 of the 17 states with MCEs targeted their graduation exams at a 10^{th} grade proficiency level or higher. Since the tests can be taken multiple times, eventual pass rates for the Class of 1995 were often quite high: 98% in Louisiana, Maryland, New York, North Carolina and Ohio; 96 % in Nevada and New Jersey, 91% in Texas and 83% in Georgia. American Federation of Teachers, *Making Standards Matter: 1996* (Washington, DC: American Federation of Teachers, 1996) p. 30.