The Economic Consequences of Schooling and Learning

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THE ECONOMIC CONSEQUENCES OF SCHOOLING AND LEARNING

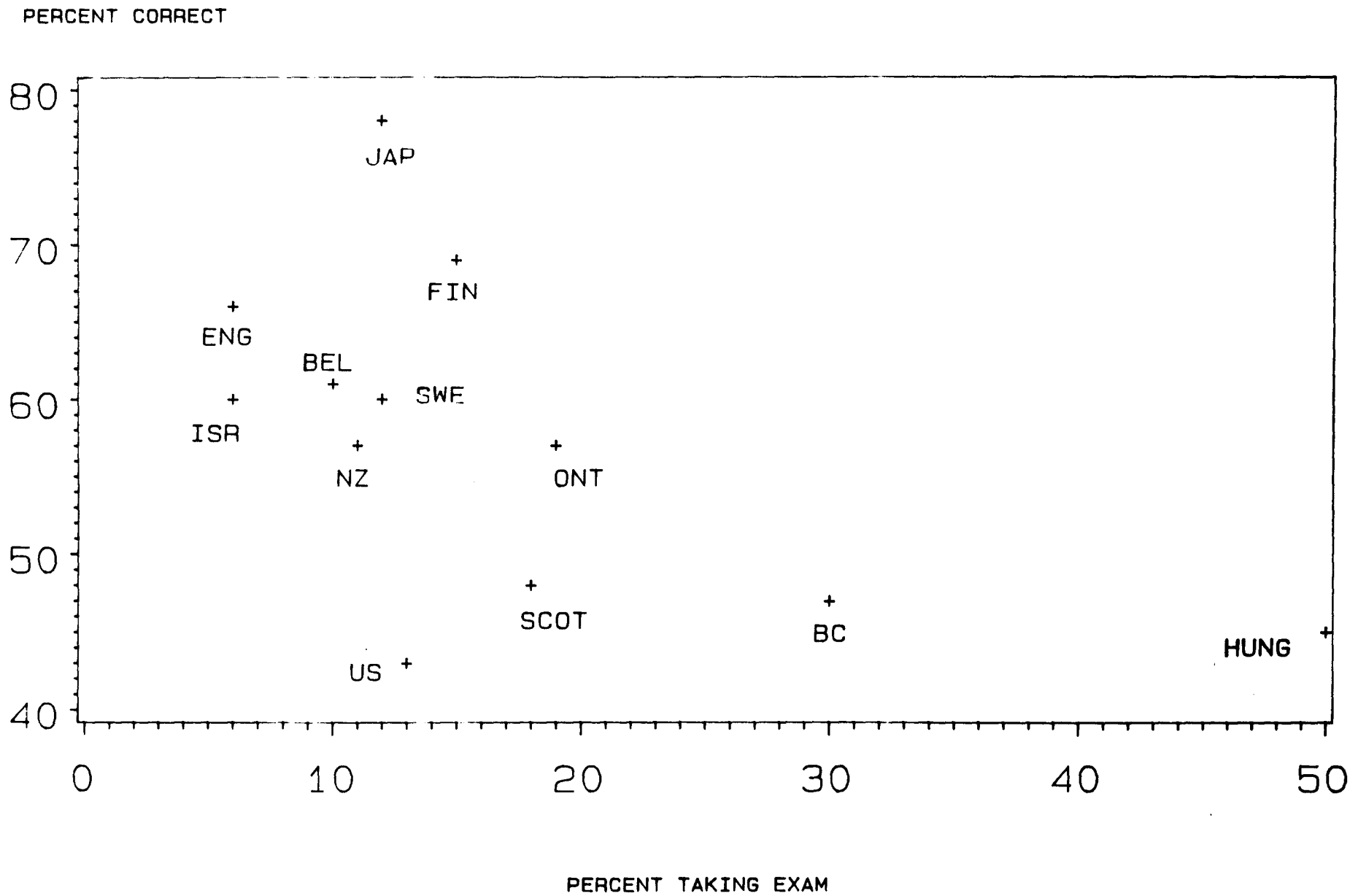
"The fate of empires depends on the education of youth"
--Aristotle

Concern about slackening productivity growth and deteriorating competitiveness has resulted in a new public focus on the quality and rigor of the elementary and secondary education received by the nation's front line workers. The National Assessment of Educational Progress, for example, reports that 93 percent of 17 year olds do not have "the capacity to apply mathematical operations in a variety of problem settings." (1988 p. 42)

Higher order thinking and problem solving skills are believed to be in particularly short supply so much attention has been given to mathematics and science education because it is thought that these subjects are particularly relevant to their development.

The debate has been enlivened by the availability of comparative data on mathematics and science achievement of representative samples of secondary school students for many industrialized nations. American high school students lag far behind their counterparts overseas. In the 1960s, the low ranking of American high school students in such comparisons was attributed to the fact that the test was administered to a larger proportion of American than European and Japanese youth. This excuse is no longer valid. Figures 1 to 4 plot the scores in Algebra, Biology, Chemistry and Physics against the proportion of the 18-year old population in the types of courses to which the international test was administered (Postlethwaite and Wiley, 1992). In the Second International Math Study, the universe from which the American sample was drawn consisted of high school seniors taking a college preparatory math course. This group which represents only 13 percent of American 17 year olds, is roughly comparable to the 12 percent of Japanese youth who were in the sample frame and is considerably smaller than the 19 percent of youth in the Canadian province of Ontario and the 50 percent of Hungarians who were taking college preparatory mathematics. In Algebra, the mean score for this very select

ALGEBRA RESULTS FOR 17-YEAR-OLDS



group of American students was about equal to the mean score of the much larger group of Hungarians and substantially below the Canadian achievement level (International Association for the Evaluation of Educational Achievement 1988).

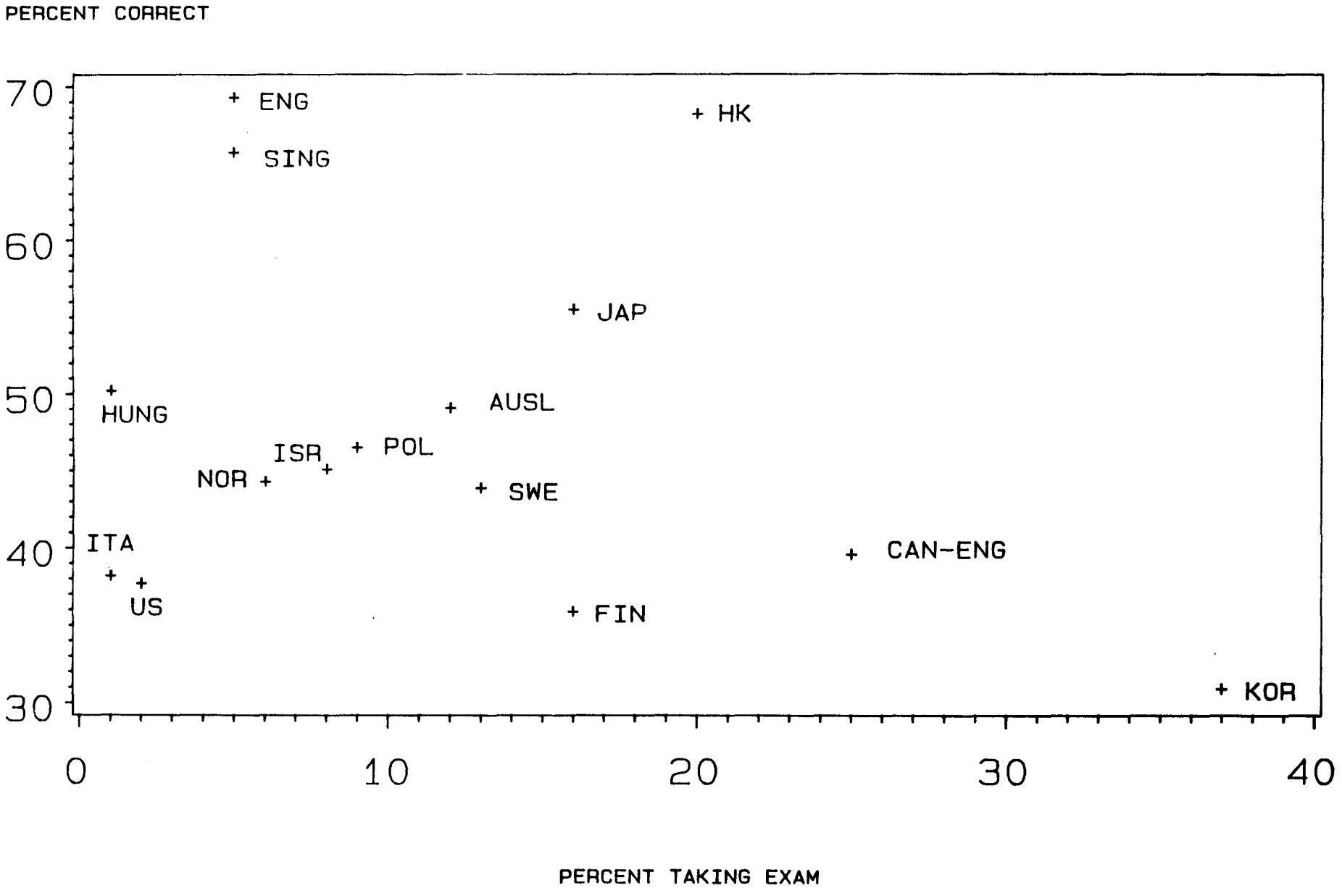
The findings of the Second International Science Study are even more dismal. Take the comparisons with English-speaking Canada, for example. The 18 % of English-speaking Canadian youth taking physics knew almost as much as the 1 % of American 17-18 year olds who were taking their second year of physics (most of whom were in "Advanced Placement"). The 25 % of Canadian 18-year olds taking chemistry knew just as much chemistry as the very select 2 % of Americans high school seniors taking their second chemistry course (Postlethwaite and Wiley, 1992).

(Figure 1-4 about here)

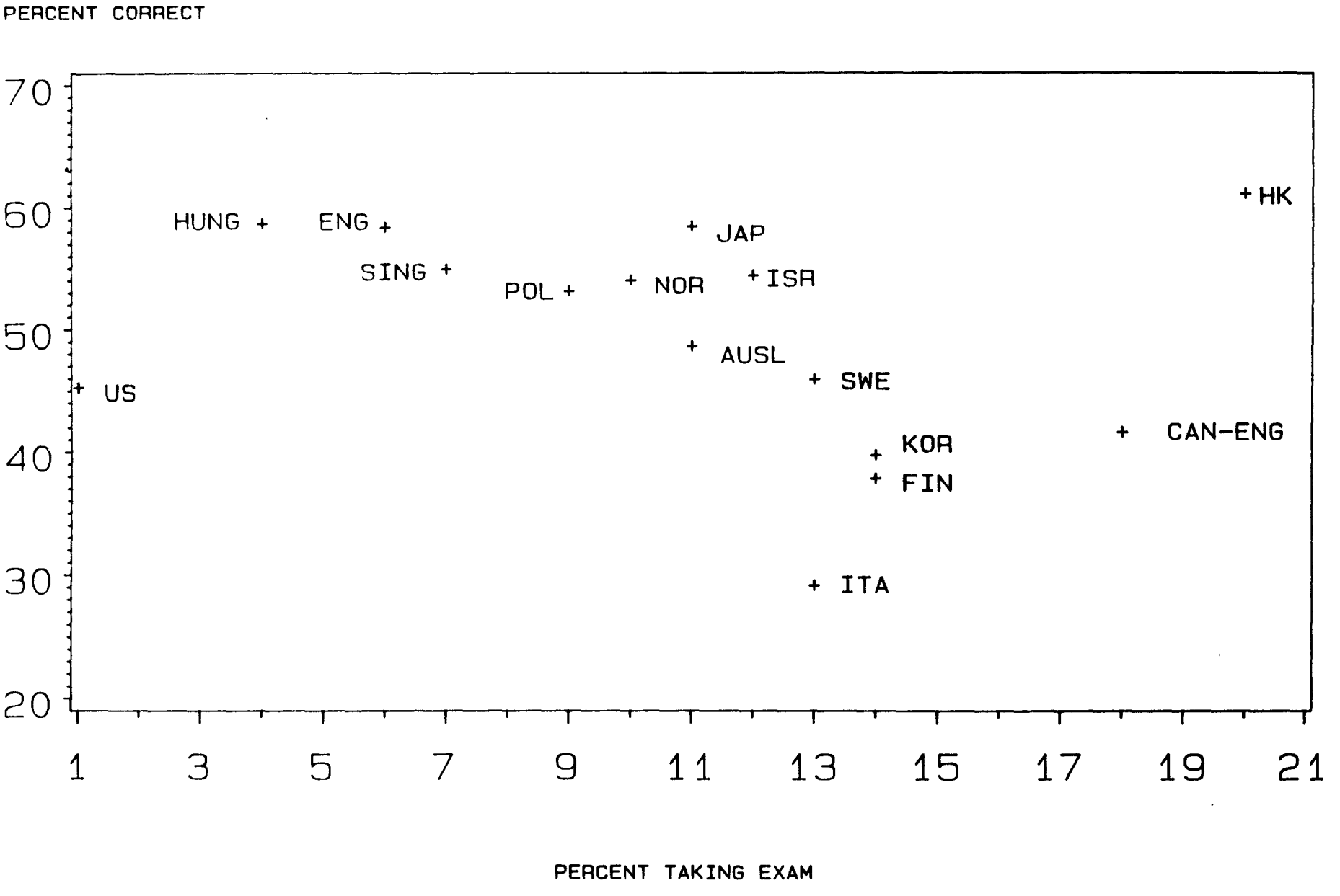
The poor performance of American students is sometimes blamed on the nation's "diversity". It is true that secondary schools do a particularly poor job educating African-Americans, Hispanics and children from low income backgrounds generally. But the affluent non-minority parents who believe that their children are doing acceptably by international standards are sadly misinformed. In Stevenson, Lee and Stigler's (1986) study of 5th grade math achievement, the best of the 20 classrooms sampled in Minneapolis was outstripped by every single classroom studied in Sendai, Japan and by 19 of the 20 classrooms studied in Taipeh, Taiwan. The nation's top high school students rank far behind much less elite samples of students in other countries. Substantially larger shares of 17-18 year old Belgians, Finns, Hungarians, Scots, Swedes and Canadians are studying advanced algebra, pre-calculus and calculus and their achievement levels are significantly higher than American high school seniors in such classes. The gap between American high school seniors in middle class suburbs and their counterparts in many European nations is larger than the two to three grade level equivalent gap between whites and blacks in the US (NAEP 1988; IAEEA, 1988). The learning deficit is pervasive.

Does the large gap between the mathematical and scientific competence of American youth and the youth of other nations have major consequences for a nation's standard of living? In the view of many, it does:

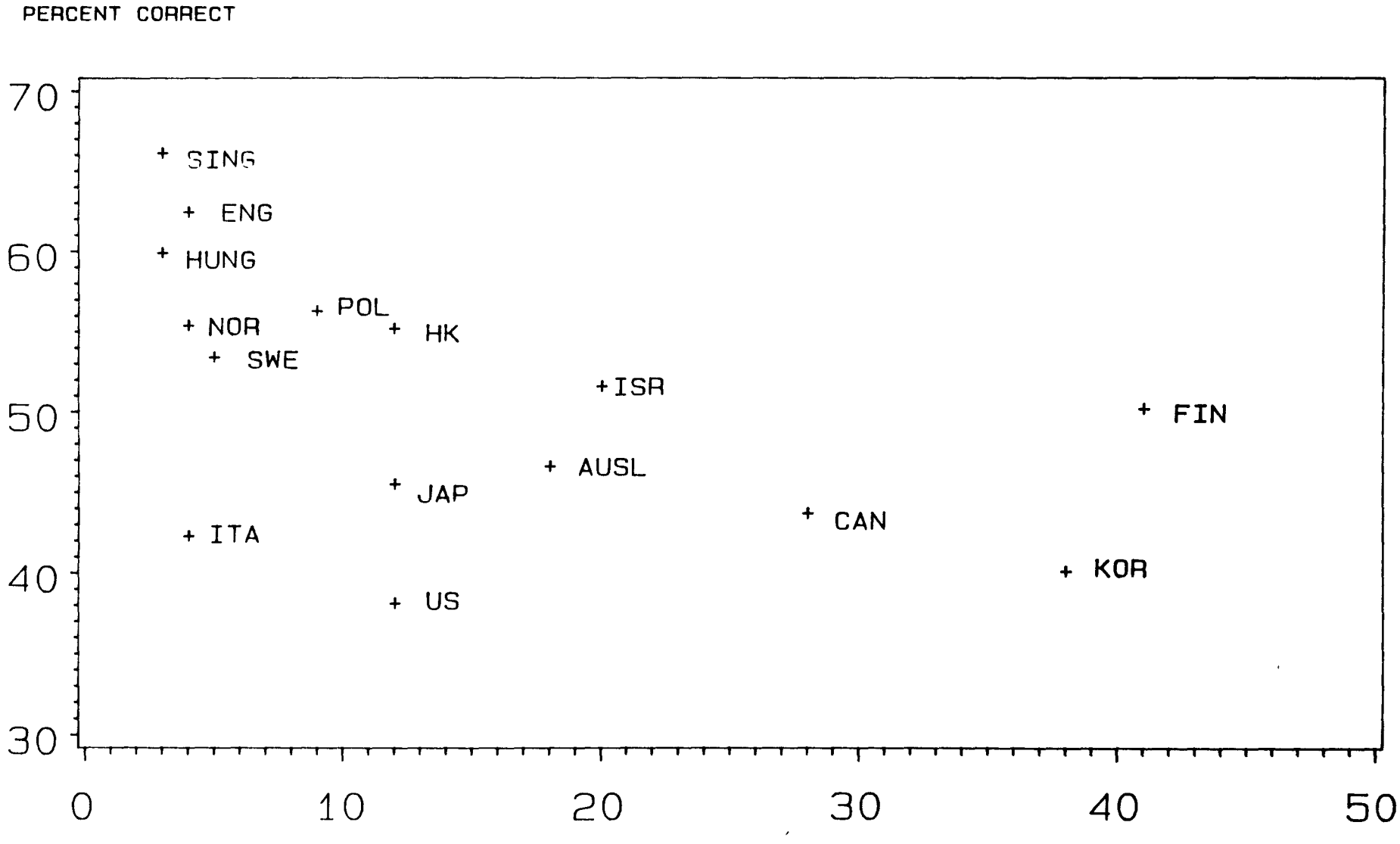
CHEMISTRY RESULTS FOR 18-YEAR-OLDS



PHYSICS RESULTS FOR 18-YEAR-OLDS



BIOLOGY RESULTS FOR 18-YEAR-OLDS



> If only to keep and improve on the slim competitive edge we still retain in world markets, we [Americans] must dedicate ourselves to the reform of our educational system....Learning is the indispensable investment required for success in the "information age" we are entering. (National Commission on Excellence in Education, p. 7).

Behind their call for higher standards and more class time devoted to core academic subjects--mathematics, science, social science and language arts--is an assumption that most jobs require significant competency in these fields. There is, however, some controversy about these claims. Morris Shamos, an emeritus professor of physics at New York University, argues, for example, that "widespread scientific literacy is not essential to... prepare people for an increasingly technological society"(Education Week, Nov. 23 1988. p. 28). Other commentators have questioned the relevance of algebra and geometry to the great majority of jobs that do not require technical training. It has been argued, for example, that since the great majority of employers do not currently use the new management techniques that are supposed to require a high skill work force, preparing young people for working in high performance work systems will make them unfitted for the boring and repetitive jobs that predominate in the labor market. This report examines whether evidence from labor markets supports the claims that schooling and academic achievement improve worker productivity and that the productivity benefits of quality schooling are increasing?

Americans are justly proud of the high participation in postsecondary education, but most college freshmen and sophomores are studying material that Europeans study in secondary school and drop out rates are extremely high due in part to the poor preparation received in high school. Participation in postsecondary education is expanding rapidly in other industrialized nations. For males, the ratio of higher education graduates to the population 24 years old is 33 percent for Japan, 25 percent for the United States, 20.6 percent for Canada, and 14-16 percent for England, France and Germany (NCES 1990, Indicator 2.8). What are the economic benefits of this high rate of participation in higher education?

The first two sections of the paper review the voluminous literature on the labor market impacts of well signalled educational achievements--obtaining a bachelors degree,

ones major in college, the quality of one's college or high school, pursuing a vocational program in high school, etc. Since information these gross characteristics of a youth's educational background is available to all prospective employers, competitive labor markets will insure that wage differentials between groups with different amounts and types of education will pretty closely correspond to the productivity differentials between these groups. Section 1 examines the wage effects of (a) years of schooling, (b) the quality of elementary and secondary education, (c) a college degree and (d) different college majors. Section 2 examines the literature on the impact of high school vocational education.

The remainder of the paper examines the effect of direct measures of skill and knowledge on wages and productivity. These dimensions of educational achievement, however, are not easily signalled to employers, so there is no assurance that competition will force employers to pay those who studied the hardest and learned the most a higher wage that reflects their higher productivity. Schools and programs which do a particularly good job of preparing students may be recognized by the labor market but then again they may not be. Consequently, a study of the effect of school quality and academic achievement on worker productivity is not a simple matter. A study of wage rate effects will not suffice; relationships between skill and knowledge and worker productivity must be examined as well.

The third section of the paper examines the effect of generalized academic competence on the wage rates of adults. In section four I examine which of the various competencies developed in secondary school has the largest impact on wage rates and earnings of young workers. The findings from this analysis appear on the surface to support Shamos and contradict the recommendations of many educational reformers. For young men in the United States, competence in mathematical reasoning, science and language arts does not increase wage rates or earnings in the first 8 years after graduating from high school. The competencies that pay off for young men are speed in doing simple computations (something that calculators do better than people) and technical competence (knowledge of mechanical principles, electronics, automobiles and shop tools), a skill which has been ignored by most educational reformers. For young women in the United States, the findings are that verbal and mathematical reasoning competence lower unemployment

and increase earnings but only mathematical reasoning competence and computational speed increase female wage rates. Competence in science has no effect on earnings or wage rates and verbal ability has no effects on wage rates. While these results provide little support for the Excellence Commission's recommendations, they suggest an immediate explanation for the poor performance of American students in science and higher level mathematics--the absence of significant rewards for the competencies.

The reports recommending educational reform, however, make claims about the **productivity** effects not the **wage rate** effects of science, mathematics and language arts competency. Are these effects necessarily the same? The fifth section of the paper addresses this question and concludes that, when the specific competencies of students are not signaled to the labor market by a credential (as is the case for math and science achievement in US high schools), there is very little reason to expect the wage rate effects of specific competencies which are highly correlated with each other to be the same as their productivity effects.

The sixth and seventh section of the paper, therefore, tackle the productivity effects question more directly by analyzing data sets in which worker competencies have been correlated with their relative job performance in specific jobs. These analyses provide support for recommendations for better preparation in math and science, but they also reinforce the findings from the analysis of wage rates, earnings and unemployment regarding the important role of technical competence in blue collar, craft and technician jobs.

The eighth section of the paper examines the association for the period following World War 2 between rates of gain on tests assessing the general intellectual achievement of the population and aggregate rates of productivity growth for the nation. The association is quite strong and survives the introduction into the model of controls for the setback to economic growth resulting from World War 2.

The ninth section of the paper briefly reviews growth accounting studies of the impact of schooling and learning on productivity growth and concludes that improvements in the academic achievement of the average worker can have substantial effects on a nation's productivity growth rate. The final section of the paper reviews the major findings and conclusions of the paper.

I. THE IMPACT OF SCHOOLING ON EARNINGS

There have been hundreds of studies of the private return to years of schooling. The growth accounting literature (Jorgenson 1984) and most of the rate of return literature (Becker 1975; Hansen 1963; Hines 1970; Hanoch 1967, Hause 1975) uses estimates of schooling's impact on wages and output that are not controlled for ability and social background. Corrected estimates of private returns to schooling can be obtained by including measures of ability in the model (Griliches and Mason 1972; Taubman and Wales 1975) or by using sibling data to match people on ability and socioeconomic factors (Behrman et al. 1977; Olneck 1977). Corrected estimates of rates of return must also take into account downward biases introduced by errors in measuring schooling (Bishop 1974; Griliches 1979) and the probability that those who choose to continue schooling face higher rates of return than those who do not (Willis and Rosen 1979). When models correcting for omitted variables and selection effects are estimated, impacts of years of schooling are typically smaller than in simpler models but the effects are still quite strong. One particularly ingenious study examined the payoff to the additional years of schooling that are caused by state compulsory attendance laws. Angrist and Krueger (1990) found that in 1960 that compulsory attendance laws kept in school about one third of the students who would have dropped out of school at age 16. They also found that the payoff to the additional years of schooling that resulted was 7 percent, roughly the same as the coefficient on schooling in a simple cross section regression.

The economic theory of occupational choice predicts that the selection of occupations and fields of study will be influenced by economic returns. Numerous empirical studies also have demonstrated that decisions to enter college (Bishop 1977a, 1977b, 1992; Tannen 1978; Blakemore and Low 1983) and selections of college major (Freeman 1971; Polachek 1978; Fiarito and Dauffenbach 1982; Blakemore and Low, 1984) are influenced by market signals.

Studies also typically find that vocational training at two-year colleges and technical institutes has positive effects on earnings and that the effects of training are generally more positive for blacks and women than for white males (Freeman 1974). None of the studies of college major or vocational training completely control for tastes, ability, and family

background, however. One of the most comprehensive studies of the impact of sub-baccalaureate education is a recent study of people who graduated from high school graduates in 1972 (Norton Grubb 1990). When credentials were obtained--particularly associate degrees in vocational specialties--, the payoff was substantial. When, however, credits were obtained but no program completed, wages and earnings seldom increased. Contrary to Freemans findings private vocational technical schools failed to increase wages and earnings.

College Quality: The returns to the quality of postsecondary education have been examined by a number of studies. These studies have found that college quality has significant effects on earnings (Alwin, Hauser and Sewell 1973, Wise 1975, Wachtel 1976, Symonette 1981). Analyzing 1967 CPS data, Reed and Miller (1970) found that when colleges are ranked by the average ability of entering students, the graduates of top ranked institutions earned 48 percent more than the graduates of the lowest ranked institutions holding college major and years of schooling constant but not student ability. Analyzing NBER-Thorndike data on World War II Air Force veterans and controlling on ability prior to entering college, Terence Wales (1973) found that those graduating from a college in the top quintile of the Gourman ratings earned 10 percent more than those in the other four quintiles. Solomon's (1975) study of the same data set examined compared the effects of different dimensions of quality (cost per student, faculty salaries, prestige, or selectivity) and found that the ability of entering students and faculty salaries were the two best predictors of future earnings. Impacts were quite large. The elasticities of earnings with respect to the quality indicators were .5 for faculty salaries and .7 with respect to SAT test scores of entering freshman. The most recent cohort of college graduates to be studied are students who graduated from high school in 1972. Fourteen years after graduating from high school, the elasticity of earnings with respect to SAT test score of entering freshman was roughly .29 (James, Alsalam, Conaty and To 1989). Clearly, improvements in the quality of ones college education have significant economic payoffs.

1.2 Does the Quality of Elementary and Secondary Schools Make A Difference?

Studies of the impact of schools and teachers on educational outcomes have used

standardized test scores indicating acquisition of basic skills (reading and mathematics) as their criterion. This research can be divided into two strands: the first addresses the question "Do schools make a difference?", while the second addresses the more difficult question: "What is it about schools that makes a difference?" The first question has been addressed by modelling student achievement as a function of the characteristics of the student and his/her parents and a set of dummy variables indicating the students' teacher or school. Hanushek concludes:

> The findings of these studies (Hanushek 1971, 1986b; Murnane 1975; Armor et al. 1976; Murnane and Phillips 1981) are unequivocal: Teachers and schools differ dramatically in their effectiveness. (Hanushek 1986a, p.1159)

Input-Output Studies

Finding out what makes some schools more effective than others has proved much more difficult. Input-output studies attempt to answer this question by regressing measures of output--academic test scores--on an array of "school resource" variables. Many of the "school-resource" variables, such as pupil-teacher ratios, physical equipment, and staff training, that have been hypothesized to influence learning turn out to have only weak associations with measured learning outcomes when individual characteristics of students are controlled (Coleman et al. 1966; Averch et al. 1972; Hanushek and Kain 1972; Mosteller and Moynihan 1972). Coleman's conclusion that school inputs of this type do not affect learning generated quite a controversy. Numerous commentaries and additional research have disputed these conclusions (Bowles and Levin 1968a, 1968b; Cain and Watts 1968; Smith 1972; Bowles 1968), but recent reviews of the input-output research conclude that these educational inputs do not have a consistent positive impact on student performance (Hanushek 1986, 1989). The teacher characteristics that most consistently have a positive effect on learning are tests measuring teacher knowledge and ability (Hanushek 1971; Strauss and Sawyer 1986, Ferguson 1991). The results are somewhat more equivocal for teacher experience--in Hanushek's 1989 survey 28 percent of the coefficients were significantly positive and 7 percent were significantly negative. For per pupil expenditure, 20 percent of the coefficients were significantly positive and 4.6 percent were significantly negative.

When, however, the dependent variable is an individual's wage rate (adjusted for local variations in the cost of living), measures of per pupil expenditures typically have significant positive effects (Akin and Garfinkel 1977; Ribich and Murphy 1975; Link and Ratledge 1975; Rizzuto and Wachtel 1980; Tremblay 1986). The best of these studies is a recent one by David Card and Alan Krueger 1992). They report:

> Using earnings data from the 1980 Census, we find that men who were educated in states with higher quality schools have a higher return to additional years of schooling. Rates of return are also higher for individuals from states with better educated teachers....A decrease in the pupil /teacher ratio by five students is associated with a 0.4 percentage point increase in the rate of return to schooling (p. 1,3).

These findings suggest the possibility that in the United States increased school expenditures do indeed increase a student's future labor market productivity but not by raising the scores on the tests of mathematical and verbal skills used in input-output studies. If, for example, poorly endowed school districts respond to their situation by focusing instruction on basic skills, adopting styles of teaching which inhibit the development of problem solving ability (but improve scores on basic skills tests), and scaling back offerings in the more costly scientific, vocational and technical subjects, one would expect school expenditures to have much larger effects on wages than on tests of basic skills.

In order for input-output studies to yield unbiased estimates of the effects of school resource variables on learning it is essential that school inputs are both exogenous and uncorrelated with unmeasured determinants of school quality. This is rather strong assumption. The philosophy behind compensatory education programs implies that one should react to failure by trying harder--ie. spending more. Examples of this are easy to find: special education, mastery learning, Title I and programs which offer additional state aid to districts with large numbers of students performing below grade level. If school failure indeed leads to increases in funding, the endogeneity biases the estimated effects of school resource variables toward zero.

Troubled schools often find that they cannot recruit and retain teachers without paying a salary premium and that class sizes become small because of truancy and pupil transfers. These phenomena tend to generate a negative correlation between unobserved

school quality, on the one hand, and teacher salaries and teacher-pupil ratios on the other. This biases the estimates of the effects of school inputs in the negative direction.

1.3 The Social Payoff to College Attendance

The Vietnam War, the baby boom and the founding of more than a thousand public colleges caused the college graduate labor force to explode during the 1970s. The share of 25-29 year old males with a bachelors degree rose from 13.5 percent in 1957 to 27.5 percent in 1976. The result was a surplus which substantially lowered the economic return to college. This caused enrollment rates to decline and by 1987 the share of 25-29 year old males with a BA had fallen to 22.3 percent. The surplus quickly disappeared and by the end of the decade a shortage had developed.

The wage premium for attaining a college degree rose dramatically during the 1980s and **is now at all time highs.** The evidence on this issue is overwhelming. In May/June CPS data, real hourly wage rates of workers with 16 years of schooling and 1 to 10 years of experience rose 14.7 (12.2) percent for males (females) between 1980 and 1988 while real wage rates of workers with 12 years of schooling and similar levels of experience fell 16 (5.4) percent for males (females) (Kosters 1989). Kosters concludes that "The college wage premium was more than twice as large for men and more than 50 percent higher for women in 1988 than in 1980 (p. 2)". In the National Center for Education Statistics' (1991) Recent College Graduate surveys, real average annual salaries (one year after graduation) rose 31 percent from $15,000 (in 1987 dollars) for the class of 1975 to $20,300 for the class of 1986. Blackburn, Bloom and Freeman (1989) report that between 1979 and 1987 the real full time earnings of 25 to 34 year old white male college graduates rose 9.2 percent while the earnings of their high school graduate counterparts fell 9.4 percent. The mean earnings of year-round full-time workers aged 25 to 34 with exactly 16 years of schooling rose 19.5 (8.9) percent for females (males) between 1980 and 1989, while the mean earnings of comparable high school graduates **fell** 0.8 percent for women and **fell** 8.9 percent for men (U. S. Bureau of the Census, 1982, 1991; price index was CPI-U-X1).

Katz and Murphy's (1990) study of March CPS data found that between 1980 and

1987 real weekly earnings of college graduates with 1 to 5 years of work experience rose 10.6 (12.9) percent for females (males) while the real earnings of high school graduates with similar levels of experience fell 3.2 and 15 percent respectively. They conclude that "changes in education differentials ...reflect changes in 'skill prices' rather than changes in group composition. We find that rapid secular growth in the relative demand for 'more skilled' workers is a key component of any consistent explanation..." of these changes in wage structure.

Further evidence on the issue comes from Freeman's (1991) study of trends in the incidence of unemployment by education group. While unemployment rates for college graduates were unchanged at very low levels (1.5 percent for 25-64 year olds) in both 1980 and 1988, they rose from 4.7 to 5.4 percent for high school graduates and from 7.4 to 9.2 percent for those who had not completed high school. He concludes that "Rising educational pay differentials thus understate the growing mismatch between demand and supply for labour skills in the United States. (p. 361)"

Not all analysts, however, take the view that the nation is currently experiencing a shortage of college graduates. Ronald Kutscher, Associate Commissioner of the Bureau of Labor Statistics, argues that there existed "an oversupply of college graduates during the 1980's (Kutscher 1991)." He sights as evidence for this view recent increases in the number of people with 16+ years of schooling who are coded by the Current Population Survey as having jobs which are not "traditional" for holders of a bachelors degree. He reports that between 1983 and 1988 workers claiming to have completed 16 years of schooling increased by 41,000 in secretarial and typist jobs, by 59,000 in factory operative jobs, and by 6,000 in bartender, waiter and waitress jobs. But what about the opposite kind of mismatch: workers who have substantially fewer years of schooling than are required by the job. This kind of mismatch also increased between 1983 and 1988. The number of workers claiming to have **fewer than 16 years of schooling** increased by 23,000 among physicians, by 18,800 among lawyers and judges, by 14,500 among college teachers, by 125,000 among other teachers and by 99,000 among mathematical and computer scientists (U. S. Bureau of Labor Statistics 1990). Don't these statistics imply a growing shortage of qualified college graduate workers?

But one should not give much credence to any of these estimates of mismatches between schooling and occupation. The reporting and coding of occupation is quite unreliable. Those coded as a professional, a technician or manager by a Census interviewer have a 15 to 21 percent chance of being coded in a lower level occupation by a second interviewer a few months later (U.S. Bureau of the Census 1972). Ten percent of those who report completing 16+ years of schooling also claim not to have received a bachelors degree. Errors in measuring education are also quite common and the incidence of such errors appears to have risen during the 1980s.[1] Many of the discrepancies between an individual's schooling and occupation found in CPS data are caused by reporting and coding errors. How else can one explain the 9.6 percent of college teachers and the 5.4 to 6.5 percent of lawyers, physicians and secondary school teachers who claim not to have completed 16 years of schooling (U.S. Bureau of Labor Statistics 1990, Table F-3). The unreliability of individual measures of occupation and education means that counts of mismatches between schooling and occupation derived from micro data have almost no validity at all. The fact that the BLS keeps track of only one kind of mismatch makes matters worse. True mismatches between education and occupation are a lot less common than these statistics suggest.

This is not to deny that mismatches occur. College graduates are incredibly diverse and seek work in very distinct labor markets. College graduates who major in subjects which have little value in the labor market, who get C's and D's in undemanding courses, who are not geographically mobile, who have a substance abuse problem or who make a poor impression in interviews, will sometimes have to accept jobs which do not appear to "require" a college degree. These graduates are included in the averages and despite the drag they represent on the mean, the average college graduate is doing very well and compared to those who did not go to college she is doing extremely well. Most of those graduating in engineering, computer science, natural science, and business during the 1980s had a variety of well paying alternatives and the job opportunities of humanities, education and social science majors had substantially improved by the end of the decade. Real starting salaries rose 36 percent for humanities majors, 14 percent for education majors, and 31 percent for social science majors between 1976 and 1987 (National Center for Education

Statistics 1990).

1.4 Is the Payoff to College Likely to Decline in the Future?

The 1991-92 recession caused many companies to cut back their hiring of college graduates. Is this setback the beginning of a crash in the market demand for college graduates or is it a temporary effect of the recession? In my view the recession is the cause of the problem. The recession has made things even more difficult for workers without a college degree. Real hourly compensation of production and non-supervisory workers fell 0.3 percent between the first quarter of 1990 and the last quarter of 1991 while the real hourly compensation rose 0.5 percent for managers and 0.8 percent for professional and technical workers (Bureau of Labor Statistics, March 1992).

The second way to examine whether the wage premium for college is likely to crash in the 1990s is to compare projections of the supply and demand for college graduates. Let us begin by examining projections of supply. Such an examination leads to the conclusion that the number of college graduates in the work force is fated to grow more slowly in the 1990s than in the 1980s. The latest Projections of Education Statistics (NCES, Nov. 1991) forecasts that 1,080,000 BAs will be awarded annually during the 1990s. This projection assumes that recent increases in college attendance rates will soon result in substantial increases in the proportion of 25-29 year olds with a college degree. Nevertheless, this forecast implies that during the 1990s there will be a slowdown of .71 percentage points per year in the growth rate of the ratio of workers with a college degree to those with a high school degree or less.[2] This slowdown has four causes: the baby bust, the rising number of college educated workers reaching retirement age during the 1990s, rising tuition levels, and falling achievement levels and high non-completion rates in American high schools (Bishop 1992).

If relative demand for college educated workers continues to grow at the rates that prevailed in the 1960s, 70s and 80s, the inevitable outcome is a further escalation of the already extremely high wage premiums for college education. Will the upskilling trends of the last three decades continue during the 1990s? The BLS predicts a slowdown. Bishop and Carter (1991, Bishop 1992a) argue, to the contrary, that past upskilling trends will

continue. They argue that the BLS's method of forecasting occupational demand is biased and tends to under project the growth of occupations in which college graduates predominate. An examination of the track record of recent BLS projections appears to support Bishop and Carter's claims.

BLS Projections for the 1980s: In August 1981, the BLS projected that professional, technical and managerial (PT&M) jobs, which were 24.9 percent of the nation's jobs in 1978, would account for 28 percent of employment growth between 1978 and 1990. Operatives, laborers, farm laborers and service workers (OL&S) which were 37 percent of employment in 1978, were projected to account for 35.4 percent of employment growth during the period. Columns 4 and 6 of Table 1 tell us what actually happened. Data from the Current Population Survey indicates that professional, technical and managerial jobs accounted for 53.6 percent of 1978-90 job growth and operative, laborer and service jobs accounted for only 8.7 percent of the growth.

For the 1982 to 1995 period, BLS projected that PT&M employment would account for 30.7 percent of employment growth and that OL&S would account for 30.8 percent of growth. Here again they appear to be far off the mark. For the 1982 to 1991 period PT&M accounted for 48.7 percent of job growth, and OL&S accounted for 17.7 percent. (see row 5 of Table 1).[3]

BLS Projections for 2000: The flawed methodology that failed to predict the strong growth of high skill occupations during the 1980s has not been changed. It is, therefore, reasonable to hypothesize that the BLS's latest projections understate upskilling trends of the 1990s. One can see this unfolding in Table 1. The actual growth shares calculated for 1986 through 1991 may be compared to BLS's forecasted growth shares for 1986 to 2000 (see row 7). BLS projects that managerial, professional and technical jobs will account for 37.9 percent of job growth between 1986 and 2000. So far, however, the three high skill occupations have accounted for 64.1 percent of job growth between 1986 and 1991. In 1987, BLS projected that operative, laborer, farm laborer and service jobs would account for 27.8 percent of job growth between 1986 and 2000. So far, these low skill jobs have accounted for only 19.7 percent of job growth between 1986 and 1991.

Still another way to evaluate BLS projections is to compare their predictions to

forecasts based on a regression analysis of changes in occupational employment shares during the 1972 to 1991 period.[4] Changes in occupational employment shares were assumed to follow a linear path. The variables that were found to have significant effects on occupational shares during the 1972 to 1991 period were: a simple trend, the unemployment rate, the merchandise trade surplus as a proportion of GNP, and the ratio of personal computers used in business to total employment. The personal computer variable captures the accelerated introduction of computer technology during the 1980s as well as the direct effects of microcomputers.

The results of these projections taken from Bishop (1992a) are summarized in rows 10 to 12 of Table 1 and columns 5 and 6 of Table 2. The preferred model which contains all four variables predicts that growth of managerial, professional and technical jobs will remain strong. These occupations are projected to account for 68 percent of growth of occupational demand between 1990 and 2005. Dropping the variable representing the share of the work force with a PC on their desk lowers the projected high skill share to 57 percent and dropping both the trade deficit and PC share lowers it to 52.5 percent. BLS, by contrast, projects that the growth of managerial and professional jobs will slow and that these three occupations will account for only 40.9 percent of job growth. The regression models project declines in the employment share of craft workers, operatives and laborers and farmers and a stable share for service workers. Low skill jobs--operatives, laborers (farm and factory) and service workers--are projected to account for no more than about 10 percent of job growth to the year 2005. BLS, by contrast, projects that 27 percent of job growth will be in these low skill occupations.

Forecasts of Future College Wage Premiums: Bishop and Carter's forecast that upskilling trends of the 1960s, 70s and 80s will continue in the 1990s imply that the wage premiums for college will continue their rapid growth in the 1990s. If the BLS's forecast of decelerating growth of professional and managerial jobs is correct, forecasts of the path of the college wage premium are little altered, however (Bishop 1992a). The balance between supply and demand would still look a great deal more like the 1980s than the 1970s and the result would probably be further growth of college wage premiums. Either way a precipitous