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INVESTMENT IN U.S. EDUCATION AND TRAINING

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ABSTRACT

The current high rates of return to human capital stimulate a supply response via increased investments in education and training. The so increased human capital stock exerts downward pressures on the rates of return that reduce the skill differential in wages.

This paper reports estimates of: the responses of investments in post-secondary education, measured by enrollments, to changes in the rate of return; responses of investment in job training, measured by incidence; and effects of accumulated human capital stocks, measured by educational attainment, on educational wage differentials. Enrollment responses and attainment effects are shown to be separated by a time lag of about a decade.

The parameter estimates are based on annual CPS and NCES data, covering a recent 25 year period. If demands for human capital cease their acceleration, the rate of return is expected to decline about 25% over the current decade, judging by the estimated parameters and lags.

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Investments in Education and Training in the U.S.[1]

(Levels and changes since the 1960's)

Introduction

A look at the contemporary American educational system is a study in contrasts and paradoxes:

1. In quantitative terms, levels of enrollment and attainment measured in years of schooling remain among the highest in the world. So are the expenditures on schooling which amount to about 7% of GNP without the inclusion of student opportunity costs, and over 10% when they are included. The total cost is high not merely as a result of the large numbers of students enrolled, but also in terms of cost per student year; In 1989 this was about $4300 per student enrolled in elementary and secondary schooling, and about $10,000 per student in post-secondary schooling[2], without the inclusion of opportunity costs. As is oft repeated, U.S. costs per student are the highest in the world.

   Qualitative assessments present two contrasts:

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[1] Funding by the National Science Foundation is gratefully acknowledged. The work benefitted from excellent research assistance provided by John Higgins.

[2] By 1990-91, these costs per student rose to $5,300 and over $12,000, respectively.

While by international standards, U.S. outlays for education are very high, by the same standard students at high school levels and below do regularly less well than their peers abroad on tests of knowledge and achievement. Despite the longest schooling (about 80% completed high school) a recent study of the Department of Education reports that nearly a half of U.S. adults cannot read English properly or handle arithmetic for the purpose of elementary tasks.[3] At the same time, the higher educational system in the U.S. is still considered to be a model of excellence. One wonders how long the supply of students to higher education can remain unaffected by prior educational experience, especially if school education continues to expand in response to growing demand for a skilled labor force and/or if selectivity standards in admissions begin to decline.

2. The past two decades were especially turbulent: first decelerating then accelerating demands for human capital were accompanied by apparently perverse changes in supplies: Thus the proportion of college graduates increased rapidly in the 1970's, while it stabilized in the 1980's just when demand for skills accelerated.

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[3] Source: Educational Testing Service, Princeton, N.J., as reported in the New York Times, September 9, 1993

Data on schooling levels, costs, and rates of return are available and are not controversial. The challenge in analyzing the developments of the past two decades lies in identifying changing demands for human capital and the supply responses, if any. In Part I of this paper I present a brief survey of the current levels, and an analysis of the recent trends in demand and supply resulting in and responding to changing profitabilities of education.

3. A comparable survey of job training investments encounters the biggest hurdle in the difficulties of estimating the quantitative levels or volumes of training, and in gauging profitabilities or rates of return on these investments. I have recently published a report on such estimates (Mincer, 1991). These are somewhat more reliable with current data, which were not available 30 years ago when I first (Mincer, 1962) ventured to estimate national levels of job training. In Part II I briefly describe the results and analyze the trends in profitability and volumes of investments in job training. Did the growth in demand for human capital in the 1980's apply to job training as well, and did job training investments increase as a result? The answers based on indirect as well as more direct evidence appear to be positive.

In both analyses of school education and of job training, the evidence shows that investments in human capital respond positively to profitability, that is to changing skill differentials. Yet the supply of the accumulated stock has not as yet (1991) begun to reduce current profitabilities which are high by historical standards. Lags in the educational pipeline, growing costs, and perverse demographics represent delays and impediments to timely supply effects. It is also very likely that the poor performance of elementary and high school students represents a major bottleneck for the supply adjustment.

I. School education

1. Levels, Enrollments, Costs, Attainment

In 1989 46 million students were enrolled in elementary and secondary schools. In the same year 13.1 million students were enrolled in post-secondary education, including 3.8 million in 2-year colleges, 6.8 million in 4- year colleges and universities, and 2.5 million in postgraduate schooling.

The educational attainment of young people, most of whom completed schooling, is described in Table 1. The Table shows increases in high school and college completions in the 1970's and a levelling off in the 1980s.

Table 2 shows educational attainments in international perspective.

Among six foremost developed countries, the U.S. working age population (25-64) has the highest educational levels measured in school years completed. However, in the younger population (25-34) Japan and Germany overtook the U.S. in the proportion of high school graduates, and Japan comes close to the U.S. in the proportion of college graduates. The more rapid expansion of education in Japan and Germany in the past 2-3 decades is consistent with their high rates of income growth.

To visualize the process by which the human capital stock, measured by attainment, arises in the figures of Table 1, it is necessary to look at investment behavior measured by enrollments in Table 3. Here, all three columns show moderate declines in enrollment rates in the 1970's and large increases in the 1980's. Note the difference between the investment behavior shown in Table 3 and the human capital stock behavior shown in Table 1. The filtering of enrollments to ultimate attainments during this period can be described simply: Of the 80-85% of the 25-29 year old population who were high-school graduates (col. 1, Table 1) 50-60% enrolled in college in October after graduation during the 1980's (col.1, Table 1) but only one-third of high-school graduates continued to be enrolled through ages 18-24 (col. 2). This represents about 25%-30% of the (18-24) population group (col. 3). Half a dozen years later a somewhat smaller proportion of the age group (25-29) attained at least 16 years of schooling (col. 2 in Table 1).

Table 4 shows the expenditures on elementary and high-school students and on post-secondary education (public and private) in current dollars and as a proportion of GNP. In 1989 the expenditures on elementary and high-school students were over $200 billion, or about $4,300 per student, and constituted 4.1% of GNP. Expenditure of $131 billion on post-secondary education constituted 2.7% of GNP, amounting to about $10,000 per student. These figures exclude opportunity costs of students. The latter are on average about as high as the direct costs at the post-secondary level. Adding those at that level only yields a total fi[illegible]ure (for all levels) of $462 billion which was close to 10% of GN[illegible] Although no comparative Table is shown, the average annual cost per student is higher in the U.S. than in other countries. In 1[illegible]5 U.S. costs per college student (excluding opportunity costs) were at least 50% higher than in countries next in rank.[4]

2. <u>Changes Over Time</u>

Table 1 shows that educational attainment of the population in the early working ages (25-29) grew strongly in the 1970's but stagnated in the 80's. Figure 1 portrays the annual time series. <u>Figure 2</u> shows the concurrent time series of the rates of return to school education, or the college "wage premium" measured by the percent wage differential between college and high school graduates, at 6-10 years of experience[5]. As Figure 1 shows, educational attainment rose steadily to a historic high in the late 70's when "rates of return" (Fig. 2) reached a historic low. But there has been no increase in attainment since then, while it

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[4] Those were West Germany and Sweden, according to Clotfelter et. al, 1991 (p. 23)

[5] The pattern is similar though more shallow when the whole labor force is included. The "rate of return" here is on opportunity costs alone, excluding tuition net of student subsidies and earnings. "Wage Premium" is another term for this. Measures of the college wage premium at the end of the first decade of working life is least contaminated by differential job training (see Mincer, 1974 on "overtaking"). Similar patterns are produced by coefficients of schooling in wage functions.

appears that the need for a more highly skilled labor force accelerated as suggested by the rising "rate of return". The apparently perverse behavior of the educational supply of human capital, in relation to profitability of school education, poses several questions: Economic theory predicts a positive response of the supply of human capital to its profitability. Is the response missing, or perverse? Or is the rate of return a consequence of exogenous shifts in educational supplies, such as changes in public subsidies or family income?

To answer these questions it is important to disentangle the demand and supply factors which produce changes in the rates of return. And it is important to keep in mind the distinction between stocks of human capital (attainment) and investment flows (enrollment). It is the flows that respond to profitability, while the stocks accumulated over a number of years affect the profitability later on.

3. Anatomy of changing profitabilities of education in the past Quarter Century

A lively literature has grown in the past few years concerned with the dramatic changes in the rates of return to education.[6] These have grown in the sixties, fell in the 70's to reach a low

[6] Murphy and Welch (1989), Blackburn, Bloom, and Freeman (1990), Katz and Murphy (1991), Bound and Johnson (1991), Mincer (1991).

level of about 4%, a decline which was labelled or diagnosed as "overeducation" at the time. They have since rebounded in the 80's to reach heights at 12% or more in the past half a dozen years. The much increased inequality in labor incomes over the past decade is widely viewed as a corollary of this development.[7]

By now a consensus has emerged that the decline of the rate of return in the 70's was mainly due to the rapid influx of the large baby boom generation of college graduates into the labor market, and the steep rise of the rate of return in the 80's was due primarily to increases in skill biased or labor saving demand, while supply remained stagnant, as the "baby bust" generation began to enter the work force. International competition in low-skill intensive products, the growth of unskilled immigration, and the decline in union density played some, though apparently minor parts in the changing wage structure. Most studies agreed that skill-biased labor demand was the major factor in the 1980's, but inferences on the technologically-based increases in demand were mainly of a residual sort, rather than directly estimated. Only two studies identified demand shifts empirically. Of these, Krueger (1991) estimated the contribution of computerization to the growth of educational wage differentials in the 1980's, and my own work (1991, 1993) utilized information on R & D intensity as the demand shifter, covering the period 1963-1987 annually. This variable grew in the 60's, stagnated in the 70's, and grew rapidly

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7 Juin, Pierce, and Murphy (1992), Levy and Murnane (1992).

in the 80's.

Tables 5a&b shows the results of my regression equations which best performed in explaining the variation over time in "rates of return" to college education. As shown in Figure 2, the year-to-year educational percent wage differentials between young college and high school graduates are very closely tracked (col. 3 in Table 5a) by relative supplies of college graduates (REST) with negative sign and positively by changes in relative demand for educated workers. The latter is indexed by research and development expenditures per worker (RDE) as well as by trends in relative service employment (RSG). Of all the factors, RDE accounts for most of the explanatory power.

With the decline of average productivity growth, the labor saving changes in demand took the form of increases in demand for workers with post-secondary education and decreases in demand for workers at lower educational levels. The reduction in wages of the latter in the 1980's may in part be attributed to the growth of the negative balance in international trade, but as col. 1 of Table 5a suggests, its explanatory power is weaker, and when the RDE variable is included the effects of the trade balance vanish.

When the time series is extended back to 1957 and up to 1990, in Table 5b the results are qualitatively similar[4], and the elasticities of the demand variables close to unity, and of relative supply in the young labor force (age 25-29) is about -0.7.

A number of micro-level studies (Allen, 1993; Griliches, 1993) show that the technologically based skill-biased demand hypothesis is consistent with a variety of observed changes at detailed industry levels. Equations 4 and 5 in Table 5a point also to capital-skill complementarity as a factor in growing demands for educated workers. Capital intensity was measured by expenditures on new equipment per worker (EQ) which grew in the 1980's. It is not clear, however, whether the skill bias of new equipment represents anything different than the effects of new technologies embodied in the equipment.

4. Supply Responses to Changing Demand

While supplies of educated workers played a part in the drama, they appeared to behave perversely, especially in the 80's when demand took off. As already indicated this does not signify a lack of response of supply to changes in demand. Since the stock of human capital (here educational attainment) that is the supply which affects wage differentials is built up over a number of years, the flow of investments (i.e. enrollments) must be

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[4] It should be noted that Table 5a covers the more homogenous groups of white males, while 5b covers all males. Differences will be explored in future research.

investigated to detect responses to profitability. I now report on the response of enrollments in post-secondary education as observed annually over the 1967-1990 period:

Economic theory tells us that investments in education respond positively to prospective rates of return, as well as to parental education and income. More precisely, those with sufficient access to investment funds compare rates of return on school education with profitabilities of alternative investments, such as financial rates. Most, however, are limited by family income. (Parental education is an index of it, as well as of preferences for educational investments). Since our measure of educational wage premia is not a rate of return, as it misses direct costs, (net) tuition costs must be taken into account as well. Avoiding a more laborious effort, I used gross tuition costs, as these apparently behaved similarly to the net costs: Subsidies to students and earnings of students did not grow in the 80's while tuition costs rose greatly (Clotfelter,1991). The proper measure of financial rates of return is the real expected long term rate. We tried several expectational hypotheses to construct such rates without much success in the regression analysis. When put alongside the educational premium, the variable was not significant. Conventional financial wisdom claims that the real rates (nominal minus inflation) are usually very low. Educational rates of return (here r_s) are substantially higher, so the differential would move very much as the r_s does. The prospective wage premia are visualized (presumably by families and the "teenage econometricians") as the ratio of wages of college to high school graduates about a decade after graduation (6-10 years of experience) which they currently observe. This is the "overtaking stage" of experience which is minimally affected by job training (Mincer, 1974) another dimension of human capital investment on which I report In Part II.

In Table 6 I report results of three regressions of successive educational flows: enrollment rates in October following high school graduation (col. 1), enrollment rates of high school graduates in the following years (ages 18-24) (col. 2), and the resulting proportion of population of young people (18-24) enrolled (col. 3). Roughly 6-10 years later this population reaches the "overtaking" age and constitutes the effective relative supply (shown in Figure 1 and RESY in col. 1 of Tables 5a & b) which in turn affects educational wage differentials at that point (almost a decade later). A more comprehensive, though not necessarily better measure of relative educational supply includes people of all ages, not merely the younger ones. This variable (REST) was used in the regressions of Table 5a, beyond col. 1.

At all stages shown in Table 6, the response to wage premia is positive and significant, tuition has a negative effect and the proxy for parental education (and/or permanent income) is positive. All are significant except for tuition for continuing students and together track the time series of enrollment quite well (with adjusted R^2 of 75, 69, and 79%, respectively) as shown in the three panels of Figure 3.[9] When the residual u-hat of the first column regression is added as a variable for continuing students (column 2 & 3) it is positive and significant. It raises the R-squares to 82 and 88 percent respectively. The variable u-hat represents unmeasured factors, such as learning ability and achievement prior to high school graduation that promotes persistence in further schooling once enrolled in college.

The educational pipeline from enrollment to attainment implies a lag which is shown in Figure 4. The optimal lag, determined by a regression of attainment in the young population (Figure 1) on enrollment of roughly the same cohort was 8 years. This regression yielded an $R^2 = 0.93$, when the proportion of college graduates in the 25-29 age group is regressed on enrollments of 18-24 year olds 8 years before. Similarly, if the dependent variable is the cohort at 6-10 years of working age (years since completion of schooling) the optimal lag is again 8 years, and $R^2 = 0.89$. A similar, slightly weaker result is obtained when the cohort with 1-10 years

[9] It is interesting to note that, with only one exception (Mattila, 1982), none of the voluminous research on the demand for education related it to the (prospective) rate of return to education; various studies single out components of costs and/or of returns for investigation (see Freeman, 1986). In the cross-section, some of the variables which we could not capture (or were silent) in time series are shown to be significant, as for example number of siblings, single parents, and local unemployment (Heckman and Cameron, 1993).

of experience is used as the relative supply (proportion with 16+ of schooling) variable.

It is this relative supply variable which affects the rate of return negatively, holding demand variables constant - as shown in Table 5a&b. Figure 4 shows how well the enrollment series (lagged 8 years) fits relative supply, by shifting the attainment series of the young population 8 years back. Enrollment growth in the 60's produces the growth of attainment prior to 1975, while the static enrollment rate in the 70's leads to the stagnation in the supply in the 80's. In turn, the growth of enrollment in the 80's predicts an increasing relative supply in the 90's among the young cohorts, as shown in the extrapolation of the lower graph in Figure 4. The predicted increase in attainment from 1991 to 2000 is, according to Figure 4, about 8 percent points.

Parameter estimates of RESY in Tables 5a&b imply an elasticity of -0.72 of the wage premium with respect to the relative supply. The predicted increase in attainment of 35% in the young population (8/23 in Figure 4) would reduce the college premium by 35% x 0.72 = 25.2%. If the current college premium is about 12%, the supply response would return the college premium nearly two-thirds of the way toward its long-run average (1957-1990) a decade from 19[illegible].

In this scenario over half of the skill shortages would be eliminated by the end of the decade following the year 1993. This prediction relies on supply effects alone, and assumes no further growth in demand, in direct costs of schooling (such as tuition), and no changes in the composition of the work force. These assumptions are considered in the concluding section.

II. Job Training Investments

1. Aggregate Costs

There are no official data on national investments in job training comparable to data on enrollments and costs of schooling, published by the U.S. Department of Education. Three decades ago, I attempted to estimate job training volumes based on the human capital hypothesis which attributes growth of life-cycle wages to investments in formal and informal job training and learning as well as to investments in job search and mobility (Mincer, 1962).

The availability of direct information on job training in recent data panels, though far from adequate, makes it feasible to attempt once again estimates of investment volumes and of rates of return to job training. Empirically grounded direct estimates are clearly preferable to the largely hypothetical procedure of thirty years ago. In addition, some information is now also available on employer investments in training of workers.

In my recent study (Mincer, 1991, 1993) I estimated costs of job training in the economy for 1976 and 1987 using three entirely different methods: (1) In the "direct" method time (hours) spent in training per year was valued at wage rates prior to training, or of comparable non-trainees. (2) A second method uses information on costs of formal training programs and on time spent on them, and inflates the cost to a total training level, using information on time spent in all training, including informal training which is the bulk. (3) The third method is the "indirect" one which uses wage profiles, as in the old (1962) paper, but with wage gains due to mobility netted out. The direct estimates (1) and (2) are rather close. The indirect estimate (3) exceeds the former two by about one-third. This suggests that human capital investments can account for three-fourths of the growth of the (cross-sectional) wage profile, leaving a minor role to other, not mutually exclusive, explanations.

The "indirect" approach dates back to my 1962 work which was based on Census data for 1959. Costs of job training were estimated from typical (cross-sectional) wage profiles of male workers, classified by education level: Increments of wages over each year of experience in the cross-section[10] were summed over experience and across education groups and capitalized by internal

[10] Actual (longitudinal) increments contain in part wage changes due to aggregate growth and cycles, which are not returns on individual investments.

rates of return.[11] The arithmetic is straightforward: The annual wage increment is:

$$\Delta w_t = r \cdot c_t$$

where r is the internal rate of return and c_t the investment cost over the year t. The conclusion was that total costs of human capital investments during the working ages were large, almost a half of total costs (including opportunity costs) of school education.

No "direct" estimates of training costs were available at that time. These became feasible for 1976 when a special time-use study of the PSID (Duncan and Stafford, 1980) reported job training information. Wage data were available for the same year in the regular PSID panel. Thus for 1976 both "direct" and "indirect" estimates can be constructed and compared.

The "indirect" approach based on wage profiles was implemented on the 1976 data in a much less laborious fashion (Mincer, 1991) than in the 1962 study. The simplification was made possible by the use of a parametric wage function. A semi-log wage function (Mincer, 1974)

[11] The rates were estimated from pairs of successive education wage profiles.

$$\ln w = \alpha Z + rk_o X - \frac{rk_o}{2T}X^2 + \ln(1 - k_o + \frac{k_o}{T}X)$$

contains on the right-hand side a vector of variables Z which includes years of school education, the experience variable X, and the parameters of the linear investment profile $k_x = k_0 - (k_0/T)*X$, where k_0 is the initial fraction of earning capacity devoted to investment, and T the investment period. All the parameters were estimated in a non-linear procedure by H. Rosen (1982).

Based on the Rosen estimates Table (7) shows my calculation of inferred investment costs.[12] With w the average wage in each age bracket, N the number of workers in it and k, the mean investment ratio in the age bracket,

$$\bar{k} = \frac{\sum Nwk}{\sum Nw}$$

summed over all brackets yields the average ratio of training investments per hour to wage per hour. The resulting 8.5% ratio was applied to the wage bill in 1976 National Income Accounts and yielded a figure of $88 billion of worker post-school investments. Netting out mobility investments estimated as 15% of the above figure (Jovanovic and Mincer, 1981) leaves the indirect estimate of

[12] For greater detail, see Mincer (1991). Rosen's parameters are estimated on wages of males. My estimates average male and female investment ratios, with the latter assumed to be a half of the former, and applied to the wage bill of females which was about 40% of the total in 1976.

job training investment costs that would produce the observed (within firms) wage growth at $75 billion in 1976.

All that is needed for the "direct" estimate of job training investment costs is the time spent in training per period and the period opportunity cost of that training. The 1976 PSID Time Use Survey is the only such survey of time allocation on the job during a week's period. The data are shown in Table (8). The calculation is simple: It is the product of columns 1 through 4 summed over all ages: Total costs per week

$$TC=\sum w{\cdot}h{\cdot}N_t \ ,$$

where w is the wage foregone, h hours of training per week,[13] and N_t the number of workers receiving training during the week. So estimated, total annual costs of job training amounted to about $56 billion in 1976.

One check on this order of magnitude which may be viewed as another method of estimating on-the-job training is available from a survey of companies published in Training Magazine. The survey reported expenditures on formal training of about $40 billion in 1987. The time spent in formal training was about a week per

[13] The Time Use Survey lists separately training time without production and time with production ongoing. Only a third of the latter was (conservatively) estimated as training time. The two components are summed in col. 2.

trainee. This does not include time spent in informal training or learning on the job which is the preponderant manner of training in the U.S. Indeed, the PSID Time Use Survey suggests an average of about five weeks (200 hours) of training per year, so if the time spent in all forms of training in 1987 was the same as in 1976, the report from firms would suggest a figure of about 200 billion of 1987 dollars in 1987. Projecting the 55.7 billion (in 1976 dollars) to 1987 (assuming the same ratio of training expenditures to the wage bill) yields about $150 billion in 1987 dollars. Apparently the training ratio increased by 1987,[14] so the estimates based on the two entirely different and independent surveys are not far apart.

The "indirect" estimates of job training expenditures based on wage profiles and the "direct" ones using the PSID Time Use Survey provide the best comparison as they were taken in the same year (1976). Since growth in the wage profile over the working age is likely to include factors other than job training it is reasonable to find the "indirect" estimate to be larger (75 billion) than the direct estimate (56 billion). This suggests that roughly 75% of the (cross-sectionally) observed intra-firm wage growth over the life-cycle is attributable to job training or learning, while 25% is likely to contain factors which produce an upward sloping wage

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[14] see section 3 below.

profile other than human capital investments.[15]

2. Profitability of Job Training Investments

Another objective of the study was to estimate profitabilities of job training. That wage growth is related to in-firm training is a finding in many studies. Viewing this growth as a return on the investment costs produces positive rates of return which vary depending on the data, demographic group, and period.

Table 9 presents components of rates of return on investments in job training. Estimates of effects of a year with training on wage (w) growth shown in column 1 are not comparable to effects of an additional year of schooling at the average level of schooling. The reason is that job training is not a full-time (full-year) activity. If it takes 25 per cent of worktime during an average week of a year with training, the rates of return on worker opportunity costs are four times higher than the estimated rates of wage growth.

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[15] A series of rough calculations suggests that a generous margin of error could lower this ratio to 65% or raise it to 85%. The other models which posit an upward slope of the wage profile, aside from job training, include employer schemes to economize on costs of monitoring (Lazear), on costs of turnover (Salop and Salop) and wage outcomes of job matching (Jovanovic). No empirical evidence exists on the quantitative empirical importance of these undoubtedly plausible models.

As I show below, growth of the cross-section wage profile is affected also by changes in the age distribution. These changes were pronounced in the 70's, and reversed in the 80's. Indirect (wage profile) estimates of job training investments are, therefore, overstated in the 70's and understated in the 80's.

Let $k = h/H$, the fraction of work time devoted to job training. Here h is hours of training during the period (week, month, or year) and H average hours of work during the period. Let w_0 be the pre-training and w_1 the post-training wage. Then the (uncorrected) rate of return on training is $r^1 = [(w_1 - w_0) * H] / [w_0 * h]$. Here the numerator is the annual dollar increase in earnings, the return on the investment, while the denominator is the opportunity cost of training. Let $\dot{w} = (w_1 - w_0)/w_0$ be the percent increase in wages due to training; then the (uncorrected) rate of return is $r^1 = \dot{w}/k$. The first three columns of Table 9 show estimates of $\dot{w}$, k and r^1 based on the PSID, the EOPP, and the two young cohorts of the NLS.

The r^1 rates appear to be implausibly high. However, they need to be corrected downward, if skills acquired in training depreciate, and if the payoff period is short. If training is portable, the latter factor may be ignored, as the median age of trainees is about 30, so that, without depreciation, the payoff period may exceed 30 years. Depreciation, however, can be substantial, as suggested by Lillard and Tan (1986). For the previous NLS young cohort, they estimate an initial wage gain of 10.8 per cent due to training and a subsequent decline of 1 per cent per year following training. This translates into a [illegible] per cent exponential rate of decline due to depreciation in returns per year. My attempts to estimate a depreciation rate in the PSID using the Lillard and Tan (1986) procedure yielded a depreciation rate close to 4 per cent. This smaller figure in the PSID may be due to the broader coverage of all males, compared to younger males in NLS: if training has substantial elements of specificity, mobility would create wage depreciation. Since mobility of young workers exceeds substantially the mobility of older workers, a smaller depreciation rate in the PSID may be reasonable.

The estimate of corrected rates of return (r) is obtained as follows: given annual depreciation rates (d), and the payoff period T, equate costs or foregone earnings while training (kw_0) to the present value of the stream of gains (Δw) the first year following training,

$$\Delta W\frac{1-d}{1+r} \text{ the next year,}$$

$$\Delta W\left(\frac{1-d}{1+r}\right)^2 \text{ the year after, and so on:}$$

$$kw_o = \Delta w\left[\frac{1-d}{1+r} + \left(\frac{1-d}{1+r}\right)^2 + \ldots \left(\frac{1-d}{1+r}\right)^T\right]$$

$$= \Delta w\frac{1-d}{r+d} \text{ when } T = \infty$$

More generally,

$$\frac{kw_o}{\Delta w} = \frac{k}{\dot{w}} = \frac{1-d}{r+d}\left[1 - \left(\frac{1-d}{1+r}\right)^T\right]$$

It follows that corrected $r =$

$$r^1(1-d)\left[1 - \left(\frac{1-d}{1+r}\right)^T\right] - d \qquad (1)$$

Column 4 shows estimates of r, with T assumed >= 30. Since the estimates of d were obtained by ignoring labor mobility, they could reflect negative effects of mobility on gains from (partly) firm specific (nontransferable) training. The polar alternative is complete specificity which makes the payoff period T equal to the length of tenure in the firm in which training was received, and d=0, if there is no obsolescence within the tenure period T. (The observed average values of T are shown in col. (7). In this case, $r = r^1[1 - (1+r)^{-T}]$ according to equation 1; r was solved by iteration, and the results are shown in col. (5). These numbers are rather surprisingly close to those in col. (4). Thus, the estimates do not depend much on whether the observed depreciation is true and training is largely transferable, or it is an artifact due to substantial specificity.

To calculate the profitability rate of employer's investments in training we need to know their returns and costs. In principle, the way to assess returns is to compare increases in productivity resulting from training with increases in wages. The excess is the return on costs borne by the firm. Two recent studies using very different data and approaches suggest that the productivity increase is over twice that of the wage increase caused by training. This is found by Barron et al. (1989) in the EOPP data, where a productivity scale is used to gauge the increase. Blakemore and Hoffman (1988) use production and turnover data by industry to estimate effects of tenure on wages and on output per unit of time. They find a doubling of productivity compared to wages, implying that returns to employers are similar to returns to workers. If employer costs are also about the same as those of workers, the uncorrected r^1 (in col. 3 of Table 9) would be the same for employers as for workers. And if depreciation is negligible, the employer rate of return would be again the same as that of workers as listed in col. (5) in which observed tenure is the assumed payoff period. Note that this is always true for the employer who gains only as long as trainees stay in the firm - whether or not training is transferable. However, if depreciation is positive during workers' stay in the training firm, employers' rates are lower than those indicated in cols (5) or (4) . Using a 4 per cent depreciation rate for the PSID and 12 per cent for the young NLS group results in a lower limit for employer profitability rates, shown in col. (6). Only in the case of complete specificity of training would worker rates also be the same.

The assumption that employer costs are just about equal to worker costs is more speculative than the proposition of roughly equal return (r^1). It can be defended, if we consider time costs of workers ($\Sigma\ kw_0$) to be absorbed by workers, while time costs of supervisors, trainers, and of coworkers are absorbed by employers. Except for the time when trainees learn by watching others at work, the time spent on training is the same for trainers and trainees. If so, the EOPP data (Table 1 in Barron et al., 1989) suggest that trainers spend two-thirds of the 150 hours of training reported to be spent by trainees during the three months of new hires. Since wages of trainers, supervisors and co-workers are higher than wages of trainees, employer costs are likely to be about as high as employee time costs in the groups covered by the EOPP. Whether this ratio of employer to employee time inputs can be generalized is unknown. Neither is there any evidence that employees absorb precisely the costs of time they spent and employers the rest. In the absence of information on the actual division of costs between employers and workers, we can still consider the profitability of training if we know total costs and total returns. The fragmentary evidence described above suggests that these totals are roughly double the costs ascribed to workers and returns observed for workers. Consequently, the profitability rates in cols. (4), (5), and (6) remain conceptually valid, as measures of profitability of training, regardless of who bears the cost.

What does the range of estimates in Table 5a tell us about adequacy of training? As soft as it may be, this evidence is all that could be marshalled. Are the rates too high, suggesting under-investment? Column (5) in which depreciation within the firm is negligible but training is not portable suggest quite ample profitability, even if trainees stay in the firm no longer than non-trainees! In other words, average worker mobility would deter neither them nor employers from investment in training. However, depreciation is probably not zero, so the correct figures are between col. (4), (5) and (6). We also need to keep in mind that: (a) the rates in Table 5a are average, not marginal. Bishop (1989) suggests that marginal rates in the EOPP are about half the size of average rate[16]; (b) rates of return to training are expected to exceed those on schooling because they do not include consumption returns. Finally, the trade-off between training and mobility investments, especially at younger ages[17], needs to be considered before underinvestment in training can be determined.

Consequently, there is no definite evidence of under-investment in these data sets, though it clearly cannot be ruled out, given the average magnitudes within the range of estimates in Table 3 (cols. 4, 5, and 6).

3. Job Training Response to Growing Demand for Human Capital

The growth of demand for human capital which accelerated in the past decade resulted in increased rates of return to schooling and induced positive supply responses in enrollments. Do we find corresponding increases in profitabilities and volumes of job training? Several pieces of evidence yield affirmative answers:

Indirect evidence on the growth of profitability and volumes is provided by analyses of changing wage profiles over the 1964-1990 period. Two basic factors affect the slope of the (cross-

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[16] The EOPP sample shows the lowest rates of return. It consists mainly of inexperienced, unskilled young workers.

[17] Gains from mobility amount to one-third of wage growth of male workers during the first decade of work experience (Jovanovic and Mincer, 1981).

sectional) wage profile, that is the magnitude of age (experience) differentials in wages: (1) Increased profitability and/or volumes of job training steepen the profile, according to the human capital wage function. Here the slope of the profile, (or it's early slope measured by the coefficient of the linear term of the experience variable (X)) is the product rk_0, where r is the rate of return on post-school investments (read: mainly job training and learning) and k the fraction of time spent in training. If demand for skill training increases, the coefficient of X should rise because of increased profitability and the induced increase in training. (2) The recent gyrations in the U.S. age distribution - the baby boom and subsequent baby bust - resulted in changes in relative wages by age. The change in relative demographic supplies, or age distribution, is therefore another factor apart from r and k to affect the slope of the cross-sectional wage profiles. As studies by Freeman (1979) and by Welch (1979) have shown the influx of large numbers of "baby boomers" into the markets of the 1970's increased the slope of the wage profiles, especially of college graduates, less so for high school graduates. However, as the "baby bust" cohorts entered the markets of the 1980's, the profiles did not flatten. They remained steep for college graduates, and steepened strongly for high school graduates.

Table (10) shows that these changes in slopes of wage profiles[18] are explainable by both demographic changes (D) and the changing profitability of human capital (r). Wage profiles were fit separately to CPS samples of high-school graduates and college graduates using quadratic wage functions each year. In turn the coefficient of experience at X=10, was used as the dependent variable. Three independent variables were: D - the ratio of young male workers (1 to 5 years of experience) to all (up to 40 years of experience) in the respective schooling group; r_s - the rate of return to schooling, measured as the percent wage differential between college and high school graduates with 6-10 years of work experience. The third variable (u) is the male unemployment rate, which is particularly large and sensitive to cyclical changes in demand for young and less skilled workers.

Clearly, the effect of declining profitability (r_s) of college education on the slope of the wage profile in the 1970's was more than offset by the effect of the baby boom cohort entering the market while the growing demand for skills in the 80's indicated by the increased rate of return to schooling resulted in the increased profitability (and volume) of training, hence steeper profiles especially among high school graduates, and partly among college graduates. The increased demand for job training steepened the high school wage profile, and prevented the college profile from

[18] Here and elsewhere the analyses use wage profiles of males. Additional factors affect wage profiles of women, especially discontinuity in labor force participation.

flattening. The weaker fit to the male college profile in Table (10) may be a consequence of the growth of numbers of female college graduates, and of post-graduates - a question that needs to be investigated.

Similar experiments with wage profiles were reported by S. Allen (1993) at a disaggregated level, within industries: Allen correlated educational wage differentials within two-digit industries with slopes of wage functions estimated in cross-section and over time (late 70's to late 80's). The correlation were positive and significant.

The analysis of wage profiles indicates that either profitability (r) or volumes (k) of training or both increased in the 80's. The findings do not distinguish between r and k, though in parallel to school education we would expect that both rates of return and volumes of training increased, the latter in response to the former, as demand for skills increased.

Direct evidence on increases in volumes of training over the 1980's is available from two BLS Surveys (1983 and 1991). This is the only pair of job training surveys in the 1980's that are comparable as their design is identical.

The first survey was a supplement to the January 1983 CPS

(BLS Bulletin 2226) and the second a similar supplement in 1991.[19] The surveys report on the incidence (frequency) of job training of the work force, and, to a lesser extent on its duration. (A complete accounting would require reports on the product of the two components, amounting to total manhours of training).

Table (11) reports some of the salient levels and changes in the incidence of job training between 1983 and 1991. Two purposes of training were distinguished in the surveys: (1) Training needed to qualify for the current job, and (2) Training to improve skills on the current job.

While training requirements for jobs changed little, the incidence of training for skill improvement on the current job increased from 35% to 41% of all workers. In both surveys, the dominant sources of qualifying training were schools and informal on-the-job training, but for skill improvement, the distribution of sources was almost uniform. A major change between 1983 and 1991 was the relative increase in incidence and duration of formal company programs. According to Bartel and Sicherman (1993) formal company training programs are more closely correlated with technological change than other forms of training.

About 72% of workers whose prior training qualified them for

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[19] "How Workers Get Their Training", and "How Workers Get Their Training - an Update".

the job underwent skill improvement training as well, suggesting that training activities tend to be continuous, though diminishing over the working age. Some of the skill improvement training is retraining, a component of training that is likely to grow in the face of changing technology.

In both surveys levels of qualifying and of skill improvement training were positively related to the level of schooling. Increases in training over time occurred in all schooling and age groups, though somewhat more in the more educated and more experienced groups.

The positive correlation between training and school education has been noted in many studies. Two explanations of this finding may be proposed: those with greater learning abilities and facing lower discount rates (subjective and objective) are likely to invest in more schooling and, for the same reasons, in more job training. Alternatively, when schooling and training are viewed as heterogeneous forms of human capital, the same conclusion follows, if as productive inputs, training and schooling are complementary: That is to say, better schooling results in more efficient training on the job. It is difficult to distinguish these hypotheses. One piece of evidence (Bartel and Sicherman, 1993) is that not only years of schooling but also the quality of learning at given numbers of years of schooling, measured in aptitude scores, is positively related to training. If complementarity is the proper hypothesis, it implies that the optimal way to improve skills is to improve school learning. Indeed, employer complaints about their being forced into providing remedial literacy and numeracy programs is a case in point.

At any rate, although the data on training are far from adequate, there is enough evidence to indicate that in recent decades, education and training responded positively to the changing profitability of human capital.

If training and schooling are complementary, a conclusion that we are under-investing in training would follow, at least in a potential sense: Improvement in school learning would reduce the costs (increase the efficiency) of training, so rates of return would rise inducing an increased demand for training.

Some Prognosis, Once Again.

Since investments in human capital respond positively to profitability, we should expect reductions in the rates of return over the 1990's stemming from the accumulated supply due to the growth of enrollment rates and of training in the 1980's. If so, skill differentials in wages and overall wage and income inequality should also tend to narrow in the 1990's. The question is: how much of a reduction can we expect?

On the assumption that demand remains at current levels, that is without further growth, we can look at the predicted growth of the relative supply in the 1990's and the parameter estimates of the supply effect on the rate of return: The relevant growth in the educational supply of young workers is already known: Figure (4) shows its prospective growth of educational attainment in the 90's resulting from increased enrollment rates in the 80's. If the relevant supply is restricted to young people, the chart predicts an increase of the proportion with at least college education from 23 currently to 31 percent by the year 2000, an increase of 35%. Multiplying this increase by the relevant supply elasticity (-0.7) yields a 25% reduction in the wage premium by the year 2002[20] If "normal" rates of return to schooling are 6-8%, this reduction would get us back at least half way toward the long-term average a

[20] Note in Table 5 that the supply effect on the wage premium lags 2 years.

decade from now. The reduction is likely to be smaller if the relevant supply is not restricted to young (X<=10) workers, but is a function of relative school attainment (% of college plus) in the overall work force.

Two issues must be faced before we can accept these predictions: (1) Parameter estimates in Table 5a may not be the most reliable - a task for econometricians to explore. We can, however, use available alternative estimates to do some checking. The supply effect on the college wage premium comparable to our REST parameter in Table 4 which covers the whole labor force is estimated by Katz and Murphy (1991) in elasticity terms to be -0.71 (their Table 9). This implies a somewhat larger elasticity for the younger population, as stated above.

(2) The assumption that demand for human capital will stop rising is probably unrealistic[21]. In the 1980's the rate of return to education zoomed up 8 percent points, and this was due almost entirely to accelerated growth of demand for human capital as supply remained static. Even if the growth of demand were to continue at half that pace, the upward pressure on the wage premium would just about neutralize the supply effect, leaving skill differentials as wide as they are now, implying a continuation of

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[21] Our R&D index of demand stopped growing since the mid-eighties. However, its growth may well resume, once military cutbacks are completed. Net tuition costs may also stop growing, as subsidies increase, but budget deficits may prevent such moves.

pronounced skill shortages.

These shortages might even increase if needed supply responses are impeded by demography, including adverse changes in the family, stagnating family income for a large part of the population, rising tuition, and the inadequacies of learning at home, school and on the job. As already noted, the learning bottleneck represents an impediment to the expansion of job training as well, given complementarity between learning at school and training. Some information and much advocacy is available. Yet a closer analysis of these causes and of policy options remains urgent before we embark on bureaucratic solutions.

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Table 1

Educational Attainment of Population, Age 25-29

YEAR	Percent completed High School	Percent of HS grads who completed College
1971	78%	22%
1977		28%
1979		
1981	85%	
1987		26%
1989	85%	
1991		27%

Source: The Condition of Education, DOE, National Center for Education Statistics, 1992.

Table 2

Educational Attainment in Six Industrial Countries

Percent who completed at least ..

	High School		College	
Cntry/Age	25 to 64	25 to 34	25 to 64	25 to 34
U.S.*	82	86.6	23.4	24.2
Canada	71	83.5	15.1	16.1
Japan	70	90.6	13.3	22.9
W. Germany	78	91.5	10.2	11.8
U.K.	65	76.7	9.2	11.2
France	48	63.0	7.0	7.6

* Includes Graduate Equivalency Diplomas

Source: The Condition of Education, 1992.

Table 3

Enrollment Rates

YEAR	In October Following High School Complet'n	High School Grads Enrolled Ages 18-24	Population Enrolled Ages 18-24
1968	55.4		
1969		35.3	27.3
1979	49.4	31.2	25.2
1988		37.3	30.3
1989	59.6		

Source: Clotfelter (1992), with USDE (1989, 1991), and US Bureau of the Census P-20, 443 & 469.

Table 4

Expenditures on Education

YEAR	Element'y and Secondary		Post-Secondary (A)		Post-Secondary (B)		Total (A)		Total (B)	
	$ bil	% GNP	$ bil	% GNP	$ bil	% GNP	$ bil	% GNP	$ bil	% GNP
1969	43	4.5	25	2.6	50	5.2	68	7.1	93	9.7
1979	103	4.1	62	2.5	124	5.0	165	6.6	225	9.1
1989	200	4.1	131	2.7	262	5.4	331	6.8	462	9.5

Source: Clotfelter, op. cit.

Column B includes foregone earnings

Table 5a

Educational wage differentials (college – high school) 1963 - 1987.

Variables	Coefficients (1)	(2)	(3)	(4)	(5)
Intercept	−0.09	−0.59	−0.41	0.06	−0.14
	(1.4)	(3.4)	(4.6)	(1.0)	(3.5)
$RESY_{-1}$	−0.065				
	(2.2)				
$REST_{-1}$		−0.086	−0.080	0.081	0.002
		(1.9)	(3.0)	(1.1)	(0.2)
DR_{-1}		−0.20		−0.14	
		(4.6)		(2.7)	
PG	1.12	0.45		0.88	
	(2.2)	(1.00)		(1.9)	
$R\&D_{-1}$			0.00024		0.00025
			(12.3)		(9.0)
RNE	−0.011				
	(4.5)				
RSG		0.088	0.044		
		(4.1)	(3.5)		
EQ				0.000064	0.000028
				(3.4)	(2.1)
R^2	0.69	0.80	0.91	0.75	0.89

Notes
t-values in parentheses. Excluded variables not significant. Subscripts $_{-1}$ and $_{-1}$ denote a 2-year and 3-year lag.
D.W. = Durbin–Watson statistics.

DR - Ratio of young (exp less than or equal to ten years) to total workforce

PG - Total Factor Productivity growth (Jorgenson measure)

RNE - Merchandise Trade Balance as a ratio to GDP

Other variables defined in text.

TABLE 5b

Time series regression of rates of return
(errors in parentheses; elasticities in asterisks)

	logs	levels
intercept	-7.52 (0.97)	-0.025 (0.010)
RDE_{-2}	0.88 (0.15)	7.9E-5 (1.1E-5) *0.96*
RSG	1.03 (0.22)	0.033 (0.005) *1.07*
RSY_{-2}	-0.70 (0.16)	-0.003 (0.0006) *-0.71*
Adj R^2	0.69	0.81
period	1957-90	1957-90

VARIABLES

dependent r_t == for workers with 6-10 years experience, the log of the ratio of the average real wage of those with schooling years equal to 16 over those with schooling years equal to 12; March CPS tapes for 1963-1990; patchwork backwards using Mattila to 1955.

RSG ratio of service employment to goods-producing employment; US; Economic Report of the President, 1993

RDE_{-2} per-worker expenditure on research and development; lagged two years; 1982 dollars.

RSY_{-2} percent of population 25-29 years old who have 16 or more years of schooling.

Table 6
Enrollment Rates (1967-1990)
(T-statistics in parentheses; elasticities in asterisks)

Exogenous Variables Are 3-yr moving avgs	% of HS Graduates Enrolled next Oct	% of HS Grads Enrolled, Age 18-24		% of Population Age 18-24 Enrolled	
College Wage Premium	2.9 (5.1) *0.45*	1.3 (3.2) *0.31*	1.3 (4.3) *0.31*	0.77 (2.8) *0.23*	0.77 (3.6) *0.23*
Parental Education[2]	3.7 (3.7) *0.84*	1.2 (1.7) *0.42*	1.2 (2.3) *0.43*	1.6 (3.4) *0.73*	1.6 (4.5) *0.74*
Tuition	-0.007 (2.9) *-0.81*	-0.002 (0.96) *-0.29*	-0.002 (1.1) *-0.26*	-0.0004 (-0.3) *-0.08*	-0.0003 (-0.3) *-0.06*
Intercept	27.7 (3.1)	18.8 (3.1)	18.8 (4.1)	3.2 (0.7)	3.2 (1.0)
residual from first regression	=1=		0.46 (3.9)		0.32 (3.9)
R^2	0.75	0.69	0.82	0.79	0.88

Endogenous-variable sources:
Column (1): Condition of Education, 1992, Table 7-1
Columns (2-5): School Enrollment - Social and Economic Characteristics of Students: October, 1992, P20-474

[2] Average schooling of males with 26-30 years of experience.

Table 7

Calculation of 1976 Worker OJT Investments

Derived from Wage Function

Age	Mean Age	k	Nw	Nwk		
<25	22	.23	74	17.0		
25-34	30	.15	126	18.9		
35-44	40	.05	102	5.1		
45+		0	182	0	Ratio	Dollars
Total			484	41.0	8.5%	$88.4 billion

Sources: k estimated from Rosen (1982); N and w from Table 2.

Table 8

Worker Opportunity Costs of Job Training, 1976

Age	Hourly Wage (w_a) (1)	Hours of Training per Week (h) (2)	Percent with Training (p) (3)	Number of Employees (N-millions) (4)	Costs ($mil) per Week $(w_a hpN)$ (5)
<25	$3.7	6.4	76	20.0	360
25-34	5.6	4.3	72	22.5	390
35-44	6.2	3.8	58	16.5	225
45-54	6.7	2.2	48	16.1	114
55-64	6.3	1.1	29	10.9	22
				Total Cost	$1,111

Sources: Col. (1), (2), and (3) from Duncan and Stafford, 1980

Training hours in col. (3) calculated as sum of separate hours in training and one-third of hours spent jointly in training and production.

Col. (4) from Employment and Earnings, BLS, 1976.

Col. (5) is the product of col. (1) through (4).

Table 9

Rates of return on investments in job training

Data set	$\dot{w}$	k	r^1	corrected r			Average tenure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
PSID[a], all males	4.4	0.15	29.3	23.5	25.0	6.5	8
EOPP[b], young new hires	4.7	0.20	23.5	8.7	8.5	0	3
NLS_1[c], new young cohort	7.0	0.22	31.8	16.0	16.2	5.2	3
NLS_2[d], previous young cohort	10.8	0.25	43.2	26.0	31.0	22.8	4

Notes

[a]Based on Mincer (1988a); k from Duncan and Stafford (1980).

[b]Based on Holzer (1988).

[c]Based on Lynch (1989).

[d]Based on Lillard and Tan (1986); k from Duncan and Stafford.

Col. (3): $r^1 = \dot{w}/k$.

Col. (4): $r = r^1(1 - d) - d$; here $d = 0.04$ in the PSID, 0.12 in the other data sets.

Col. (5): $r = r^1[1 - (1/1 + r)^T]$; T as shown in col. (7).

Col. (6): $r = r^1(1 - d)[1 - (1 - d/1 + r)^T] - d$; here d as in col. (4).

Table 10
Slope of Wage Profile*
(T-stats in parentheses; elasticities in asterisks)

	High School	College
intercept	-0.0165 (-2.9)	n.s.
r_s	0.31 (7.8) *0.68*	0.12 (3.6) *0.27*
DR	0.06 (5.1) *0.61*	0.06 (6.0) *0.76*
u	0.0011 (5.2) *0.17*	n.s.
R^2	0.91	0.60

All endogenous and exogenous variables are for males only.

Two sets (one each for the two different columns above, corresponding to high school and college) of each of the endogenous and exogenous variables are used.

r_s - rates of return to schooling.

DR - ratios of numbers of workers of 1-10 yrs experience to all workers 1-40 yrs experience.

u - unemployment rates for recent grads.

* rk at experience = 10 years, where r is the rate of return on post-school investments and k is the time-equivalent fraction spent acquiring those investments.

Table 11: Part I

Job Training: Incidence of Qualifying and of Skill Improvement
(BLS, 1983 and 1991)
Qualifying in 1983

Source Dist'n		Education		Age	
School	33%	High School	40%	20 - 24	46%
Informal OJT	27	Some College	60	25 - 44	63
Formal Company	12	College	80	45-64	53
Other	10				

Table 11: Part II

Skill Improvement: Sources

YEAR	All	School	OJT	Company	Other
1983	35%	12%	14%	11%	4%
1991	41	13	15	16	7

Skill Improvement: Education and Age

	Education			Age		
YEAR	HS	SC	Coll	20-24	35-54	55-64
1983	26%	41%	54%	28%	41%	31%
1991	29	46	61	31	48	37

Source: Paul E. Bartels, "Training to be Competitive", ETS Report, 1993.

Figure 1

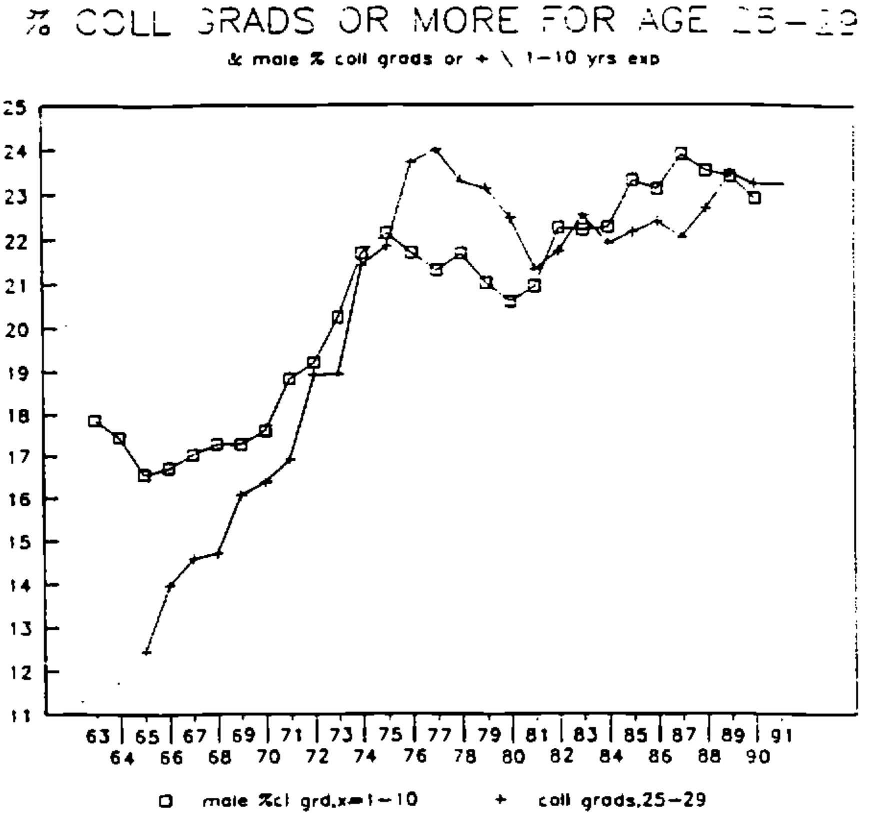
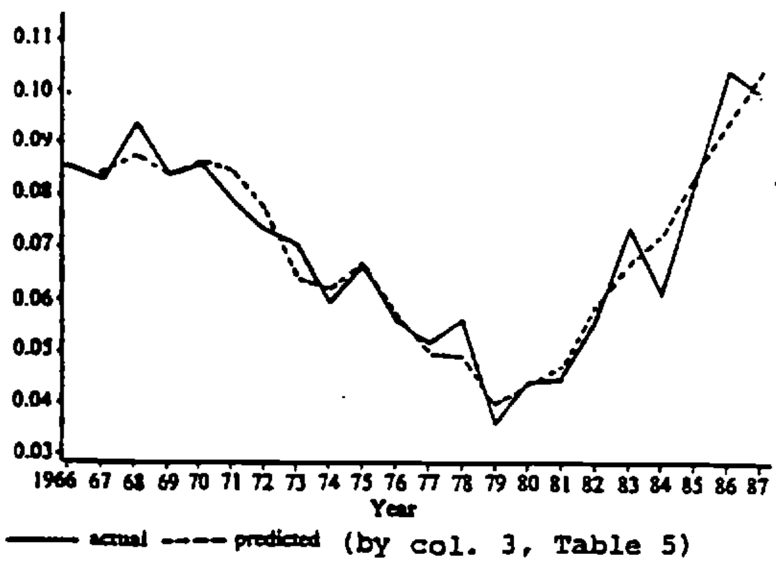


Figure 2

ACTUAL & PREDICTED RATES OF RETURN TO COLLEGE



(by col. 3, Table 5)

Figure 3

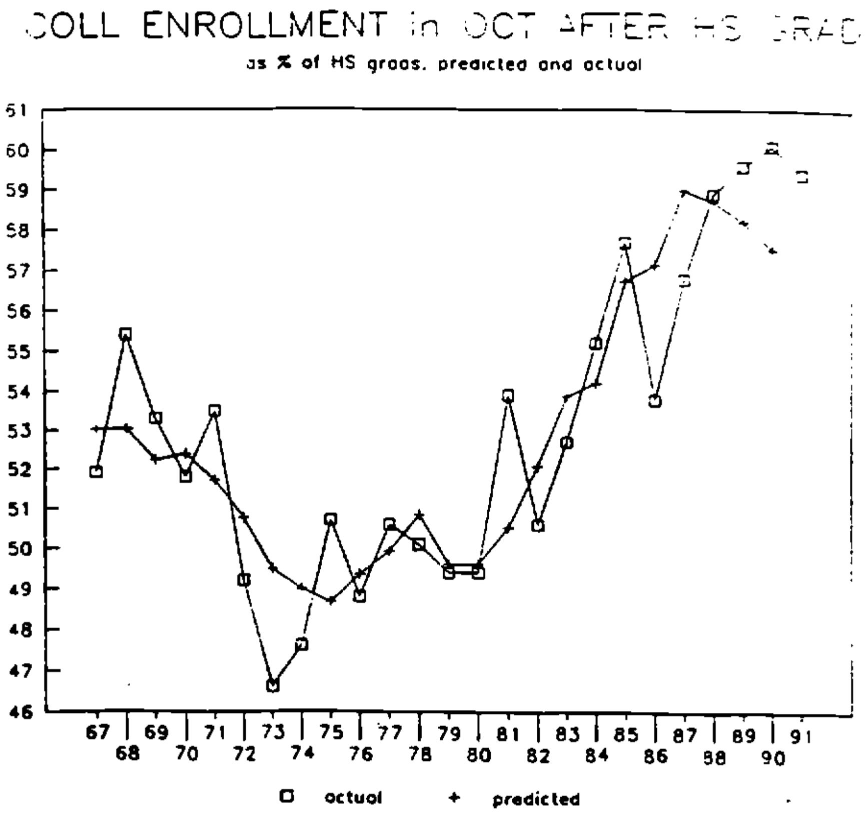
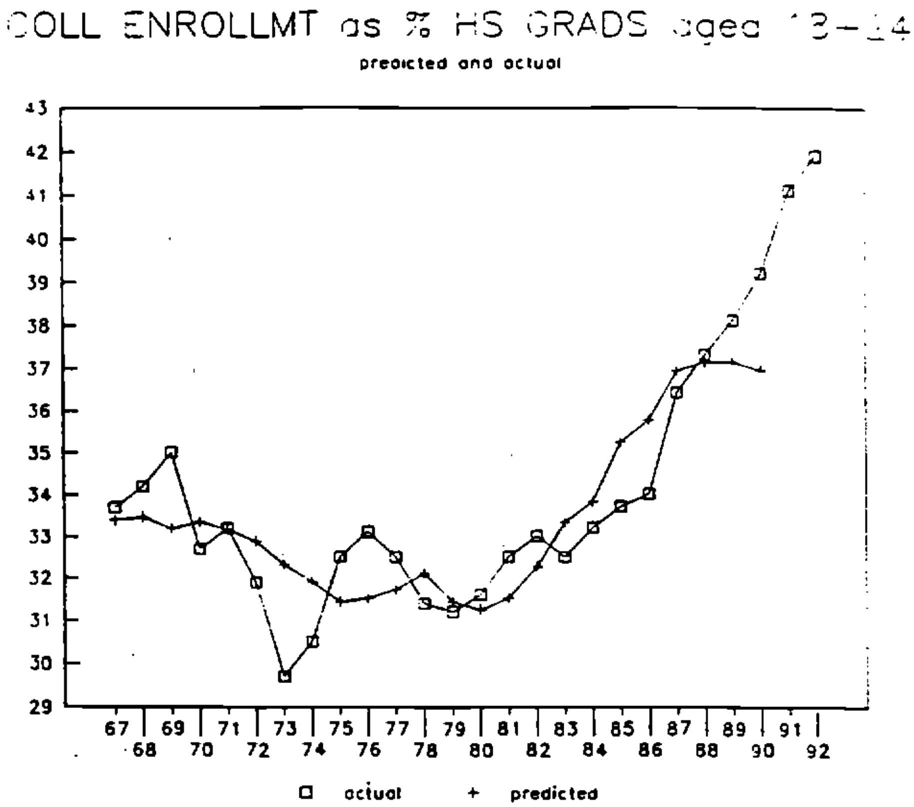

COLL ENROLLMENT in OCT AFTER HS GRAD
as % of HS grads. predicted and actual
51
60
59
58
57
56
55
54
53
52
51
50
49
48
47
46
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
actual
predicted

Figure 3 cont'd



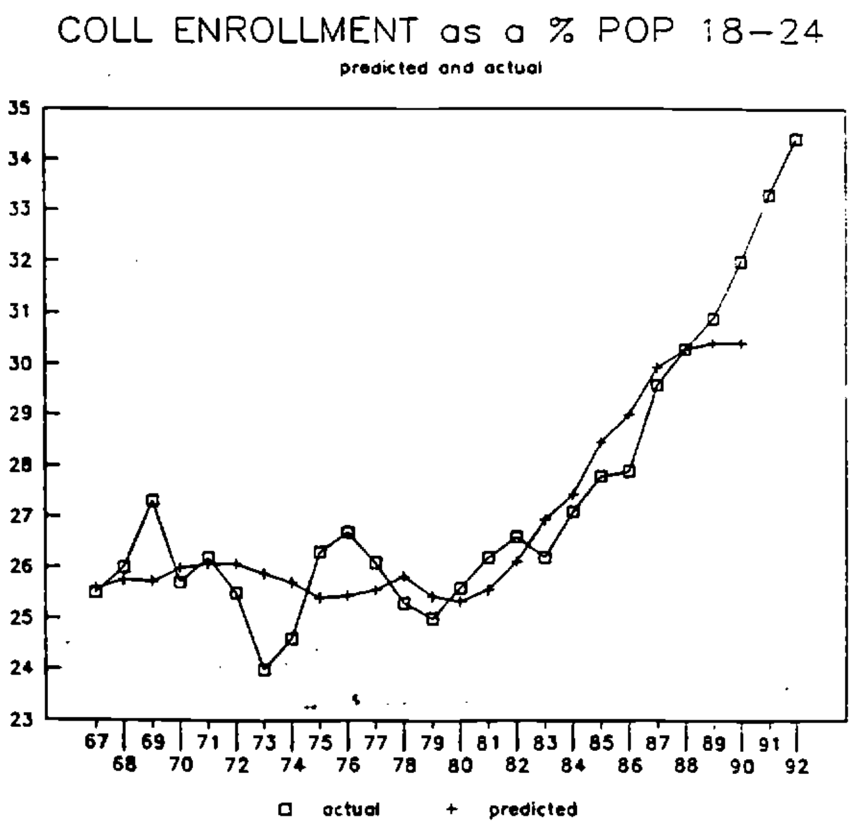


Figure 4

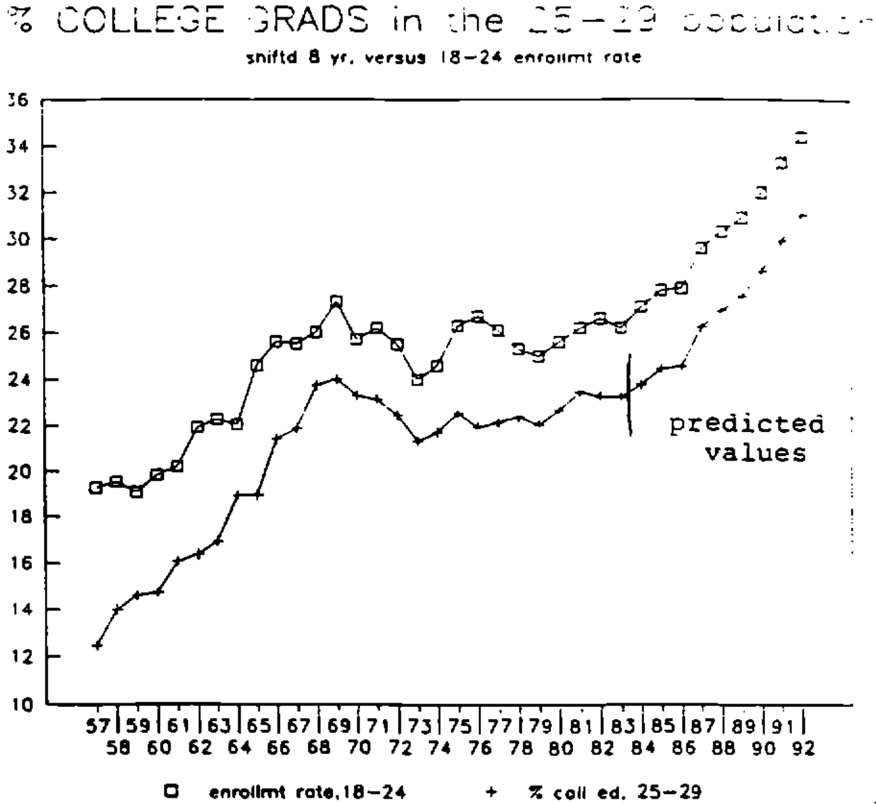
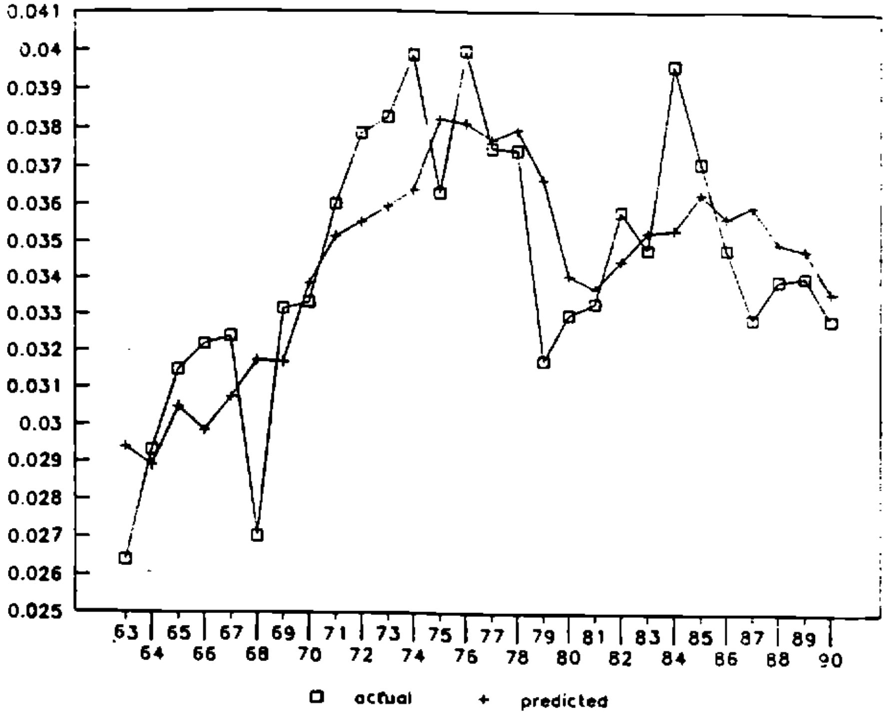

% COLLEGE GRADS in the 25-29 population
shiftd 8 yr. versus 18-24 enrollmt rate
36
34
32
30
28
26
24
22
20
18
16
14
12
10
predicted values
57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89 91
58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92
enrollmt rate, 18-24
+ % coll ed. 25-29

Figure 5

SLOPE OF THE WAGE PROFILE

college grad attainment



SLOPE OF THE WAGE PROFILE

high school attainment