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ABSTRACT

This paper addresses conflicting views on whether there is now or will soon be a surplus of college graduates and other skilled workers by analyzing data from the Bureau of Labor Statistics (BLS). Ten questions (and the answers reached) are addressed: (1) "Do the latest BLS projections of college graduate supply actually predict a bust--a substantial deterioration in the ability of college graduates to get good jobs?" (No); (2) "Do BLS estimates of the share of jobs that "require" a college degree and the share of college graduates who are "underemployed" have a credible scientific basis?" (No); (3) "Have past BLS projections successfully predicted changes in the market for college graduates?" (No); (4) "Are BLS's occupational projections biased?" (Yes); (5) "Is there an alternate methodology for projecting occupational employment that does a better job than the BLS projections?" (Yes); (6) "Are the regression models of occupational shares stable?" (Yes); (7) "Have skill differentials between college level jobs and other jobs stopped growing?" (No); (8) "Have rates of college completion risen enough to flood the college graduate market?" (No); (9) "Is the U.S. overeducated relative to other nations?" (No); and (10) "What are the policy implications of the above?" (They suggest the need to raise high school standards, increase financial aid, make tuition tax deductible, and stop increasing public college tuition). (Contains 61 references.) (DB)

NCPI
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Is an Oversupply of College Graduates Coming?

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Demand for college graduates workers was strong during the 1980s (Blackburn, Bloom, and Freeman 1989; Katz and Murphy 1990; Kosters 1989; Freeman 1991). The relative wage of college graduate workers rose and college attendance rose in response. Have the demand and technology shocks that produced this result run their course? Is the supply response large enough to stop and/or reverse the 1980s escalation of the relative wages of college graduates? Read superficially, Bureau of Labor Statistics (BLS) projections appear to suggest that the answers to these questions are "Yes." In the latest BLS report, the growing supply of college graduates was projected to outstrip growth of demand by 300,000 annually (Shelley 1996). Even larger gaps between supply and demand were projected in 1992 and 1994 (Shelley 1992, 1994). Looking at these projections, some in the press have reported that the college graduate labor market is about to go bust. *New York Times* reporter Louis Uchitelle, for example, led off an article titled "Surplus of College Graduates Dims Job Outlook for Others" with the following:

> Hundreds of thousands of jobs, once performed creditably without a college degree, are today going to college graduates as employers take advantage of an oversupply . . . . At roughly 25 percent of the work force—higher than in any other industrial nation—college graduates outstrip the demand for their skills, the Labor Department reports (18 June 1990, p. 1).

On the other hand, most economists do not believe there is now or likely soon to be a surplus of college graduates and other skilled workers. The Secretary of Labor and the Chief Economist's office within the Department of Labor apparently give little credence to the BLS projections of a college graduate surplus. Skill shortages are a common theme of Secretary Reich's speeches and policy initiatives of the department.

Who is right? Is a bust of the college graduate labor market on the horizon? This paper tackles this issue by asking and answering ten questions:

1. Do the latest BLS projections of college graduate supply and demand actually predict a bust—a substantial deterioration in the ability of college graduates to get good jobs?

   Answer: While the projections are often interpreted this way, a closer reading of the latest projections suggests that they do not. The future is predicted to be much like the past. Since the recent past has been characterized by low unemployment and rising relative wages for college graduates, the BLS can be interpreted as predicting more of the same.

2. Do BLS estimates of the share of jobs that "require" a college degree and of the share of college graduates who are "underemployed" have a credible scientific basis?

   Answer: They do not. Reports of occupation and education are not reliable enough to sustain these estimates. The attempt to measure jobs "requiring a college degree" and "underemployment" reflects misconceptions about how the U.S. labor market works.

3. Have past BLS projections successfully predicted changes in the market for college

graduates?

Answer: They have not. BLS projected a strong market for college graduates in 1970, just prior to the bust of the 1970s. BLS projected a weak market in 1980, just prior to the 1980s boom. The task of projecting the number of jobs "requiring a college degree" into the future is essentially impossible. The methods used to make the projections are not well adapted to the task.

4. Are BLS's occupational projections biased?

   Answer: They are. BLS projections published in 1981, 1983 and 1985 underestimated the growth of managerial and professional jobs and overestimated the growth of lower skill jobs. The methods used to project occupational employment tend to miss an important portion of the upskilling that is underway in our economy.

5. Is there an alternate methodology for projecting occupational employment that does a better job than the BLS projections?

   Answer: There is. Regressions predicting occupational employment shares with a trend, unemployment, the trade deficit, and the share of workers using PCs did a better job projecting the early 1990s than the BLS. Both methods however, missed predicting slowdowns in the growth of clerical, technical, and craft jobs.

6. Are the regression models of occupational shares stable?

   Answer: They appear so. However, small changes in coefficients sometimes have large effects on occupational shares projected for 10 to 15 years in the future. The updated model projects that professional, technical, and managerial jobs will account for 60 percent of job growth between 1990 and 2005.

7. Have skill differentials between college level jobs and other jobs stopped growing?

   Answer: They have not. They continue to expand, though at a slower rate than in the 1980s.

8. Have rates of college completion risen enough to flood the college graduate market?

   Answer: They have not. Because the cohort is small, the increase in the share of the age cohort attending school has not produced a substantial increase in the ratio of new BAs to total employment.

9. Is the U.S. overeducated relative to other nations?

   Answer: It is not. Young Europeans and East Asians spend more years in school than young Americans.

10. What are the policy implications of the above?

Answer: They suggest a need to raise high school standards, increase financial aid, make tuition tax deductible, and stop increasing public college tuitions.

What Do the 1996 BLS Projections of Supply and Demand for Graduates Really Imply?

Let us begin by examining the projections of supply and demand made in 1992, 1994, and 1996. The 1992 report states that "estimates of available entrants to the college graduate labor force (supply) will average. . . 406,000 more than demand" (Shelley 1992, p. 16). The 1996 report predicts that "the proportion of college graduate entrants expected to end up in noncollege jobs or unemployed will grow from 18 percent to 22 percent" (Shelley 1996, p. 9). Both sound quite negative about the future demand for college graduates. Table 1 presents the numbers:

Table 1: College graduates entering the labor force and college level job openings past and projected to 2005 (annual averages in thousands)

	1992 Projections		1994 Projections		1996 Projections	
	1984-90	1990-2005	1984-92	1992-2005	1983-94	1994-2005
Supply coming from:						
New Graduates (NCES Proj)	974	1106	1000	1180	1020	1180
Other Entrants	214	214	200	200	160	160
Annual incr. of BAs in LF	1188	1320	1200	1380	1180	1340
Demand coming from:						
Growth Occupations 'requiring' BA	459	311	593	562		510
Growth due to upgrading	308	291	157	168	780	170
Replacement Dem-retirements	197	312	190	320	190	360
Yearly increase in college-level jobs held by BAs	964	914	940	1050	970	1040
Yearly increase in graduates not in college-level jobs	224	406	260	330	210	300
Ratio of Supply/Demand Gap to growth of BAs in LF	18.9%	30.8%	21.7%	23.9%	17.8%	22.4%
Annual change in the share of BAs underemployed	.16%	.61%	.35%	.50%		

The bottom lines of the BLS supply/demand projections are found in rows 8, 9 and 10. In 1992 BLS projected a significant deterioration of the S/D balance during the 1990s. The annual increase in the number of "underemployed" graduates was projected to be equal to 31 percent of the flow of BAs into the labor force (both immigrants and new graduates) during the period. The share of college graduates underemployed was projected to increase from 19.9 percent in 1990 to 25.9 percent in 2000.

When, however, projections were made two years later, predictions of employment growth in professional jobs were revised upward from the 340,500 per year of the 1991 projections to 477,000 per year in the 1993 projections and 461,000 in the 1995 projections (Silvestri & Lukasiewicz 1991; Silvestri 1993, 1995). This has improved the BLS projected outlook for college graduates. Consequently, in the most recent report, the gap between supply and demand is expected to grow only slightly from 18 percent of the gross increase in supply of BAs to 22 percent after 1994. The BLS also projects that the growth of the "underemployment" share will accelerate somewhat after 1992. The 1984-92 growth rate of 0.35 percentage points per year is projected to increase to 0.5 percentage points per year between 1992 and 2005.

There are two very different ways to interpret these projections. Many reporters have interpreted them as implying that the market for college graduates is about to deteriorate. This interpretation comes from focussing on projected gaps between demand and supply in the future. How projections of the future compare with the recent past are ignored.

If the focus is instead placed on how the future is expected to differ from the recent past, one arrives at a different conclusion. The 1994 and 1996 reports project that the supply/demand balance for college graduate workers through 2005 will be rather similar to the conditions that prevailed during the previous decade. Since unemployment rates of college graduates remained low and relative wage rates grew substantially from 1984 to 1996, the BLS projections are really predicting a continuation of the strong labor market for college graduates that characterized the 1980s. They are also pointing out, quite correctly, that a strong market for college graduates does not imply that all college graduates will have professional, technical, managerial, or high level sales jobs.

Are the BLS Estimates of Jobs "Requiring" a College Degree and of "Underemployed" College Graduates Credible and Reliable?

The BLS assesses the current supply/demand balance for college graduates by defining a set of jobs that "require" a college degree and then counting up the number of college graduates who do not have one of these jobs. The workers being categorized are not asked whether they believe a college degree is required or useful in their job. The classification is based on the match between reported education and reported occupation. Workers with fewer than 16 years of schooling are automatically counted as having jobs that do not require a college degree. Workers with 16+ years of schooling are classified as "underemployed" when the reported occupation appears to not "require" a college degree.

The problem with this approach is that the classification of occupations into a "requires a college degree" category is inherently arbitrary and idiosyncratic to the analyst. When Jon Sargent and Janet Phleeger (1990) did the analysis, the BLS concluded there were 18,137,000 college level jobs in 1988. When Daniel Hecker (1992) reestimated the number two years later, he concluded that there were 21,848,000 college level jobs (a 20 percent increase). Yet the validity of the whole effort to measure "underemployment" depends on this classification being done correctly in every detail not only for the present but also for up to 15 years in the future. This is essentially impossible for four reasons.

First, the occupational coding system used by the CPS and the Census is not reliable and comprehensive enough to allow accurate measurement of a concept like "underemployment." Census Bureau studies have found that between 18.3 and 27.3 percent of the individuals recorded as professionals, technicians, or managers in one interview are recorded as being in a less skilled occupation in a subsequent interview four to seven months later (U.S. Bureau of the Census 1972).

There are also substantial errors in measuring educational attainment. Between 5.5 and 9 percent of respondents who are recorded as having more than 16 years of schooling in one interview are recorded as having fewer than 16 years of schooling in a later interview. If errors in reporting occupation and schooling are uncorrelated with each other, measurement error alone causes 12 to 18 percent of college graduates to be incorrectly classified as "underemployed."[1]

Consequently, reporting and coding errors are responsible for many of the apparent mismatches between an individual's occupation and their education. 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 microlevel CPS data have little validity. True mismatches between education and occupation are a lot less common than these statistics suggest.

The second problem is the lack of symmetry in the handling of possible mismatches between educational qualifications and occupation. Large numbers of workers without college degrees say they occupy jobs that most people would agree "require" at least a four year degree. In 1988 there were 44,000 lawyers, 42,000 social scientists, 46,000 natural scientists, 33,000 physicians, 61,000 college teachers, 143,000 elementary/secondary teachers, and 363,000 engineers who said they had not completed four or more years of college (U.S. Bureau of Labor Statistics 1990, Table F-3). The BLS does not classify these individuals as "undereducated." By ruling out the possibility of undereducation, the conceptual framework makes a conclusion that there are too many college graduates inevitable.

The third problem is the great heterogeneity of the college graduate category. Ten percent of college graduates cannot write a brief letter explaining an error made on a credit card bill or determine the discount from an oil bill for early payment (NCES 1994, pp. 38, 40, 66). As one can see in Table 2, these graduates are less likely to have professional, technical or managerial jobs and much more likely to have service or laborer jobs (NCES 1994, p. 95).

Table 2: Occupations of College Graduates by Prose Literacy

	Prose Literacy Group					
	1	2	3	4	5	Total
Percent in Service or Laborer Job	11.2	7.3	7.5	4.6	2.3	5.5
Percent in Prof., Tech. or Managerial Job	46	56	64	75	83	71
Percent of College Grads in Literacy Group	1.6	7.8	30	42	16.8	100

Robst's (1995) analysis of PSID data indicates that the prestige ranking of the college one attends also has large effects on the probability of being "underemployed." Those who attended colleges in the bottom fifth of the prestige ranking had twice the likelihood of being counted as "underemployed" than those who attended colleges in the top quartile.

More than 40 percent of young adults with associates and/or bachelors degrees cannot calculate change from a menu. Seventeen percent of young college graduates read at a level below the typical eleventh grader (Kirsch and Jungeblut 1986). How can someone with an eleventh grade reading level be considered "underemployed" or "overeducated" in a secretarial, carpentry, or retail sales job? For such individuals, the problem is "undereducation" not "underemployment."

The fourth problem is that for most occupations, the question "Does it require a college degree?" does not have a simple yes or no answer. It is a matter of degree. Some employers structure their management jobs in ways that make the skills normally developed in college absolutely essential, for other employers the skills are very helpful, and for still others the skills are of little advantage. The magnitude of the college graduate productivity advantage also depends on the quality of the alternative labor supply. If the competence of those who ended their schooling with high school deteriorates [as it did during the 1970s (Bishop 1989)], the demand for college graduates will increase. The correct answer to the question of whether a college degree is required is, "It depends." It depends on circumstances that analysts and researchers have little knowledge of and no ability to forecast a decade ahead.

The BLS projection exercise apparently assumes that occupations have specific educational and/or basic skill "requirements". This job requirements view of the world is illustrated in Figure 1. The "low skill" job requires a basic skill level of at least E1 while the "high skill" job requires basic skills at or above E*. Exceeding these skill thresholds, however, very quickly yields no further increases in productivity. Once the threshold is reached, diminishing returns sets in with a vengeance. People working in the "low skill" who have a skill level are classified as "underemployed". Is this how basic skills influence job performance? Let us test the job requirements hypothesis.

The job requirements view predicts that everyone in the low skill job 'A' will have at least the E1 skill level, and that due to diminishing returns, the steep productivity increase near the E1 skill level quickly becomes a flat slope as the individual's skill increases. In other words, the relationship between test scores and job performance should have a convex shape (a large negative second derivative). The job requirements view also implies that the impact of basic skills tests on job performance should diminish as schooling increases.

Data collected by the U.S. Department of Labor's Employment Service to validate the General Aptitude Test Battery (GATB) was used to test these hypotheses. This data set contains data on job performance, the nine GATB "aptitudes" and background data on 36,614 individuals in 159 different occupations. Professional, managerial, and high level sales occupations were not studied but the sample is quite representative of the 71,132,000 workers in the rest of the occupational distribution. It ranges from drafters and laboratory testers to hotel clerks and knitting-machine operators. Firms that used aptitude tests similar to the GATB for selecting new hires for the job being studied were excluded. The employment service officials who conducted these studies report that this last requirement did not result in the exclusion of many firms. A total of 3,052 employers participated.

The workers in the study were given the GATB test battery and asked to supply information on their age, education, plant experience, and total experience. Plant experience was defined as years working in that occupation for the current employer. Total experience was defined as years working in the occupation for all employers. The dependent variable was an average of two ratings (generally two weeks apart) supplied by the worker's immediate supervisor. The Standard Descriptive Rating Scale obtains supervisory ratings of five aspects of job performance (quantity, quality, accuracy, job knowledge and job versatility) as well as an "all-around" performance rating. Firms with only one employee in the job classification were excluded, as were individuals whose reported work experience was inconsistent with their age.

Because wage rates, average productivity levels, and the standards used to rate employees vary from plant to plant, mean differences in ratings across establishments have no real meaning. Therefore, normalized ratings deviations were predicted by deviations from the job/establishment's mean for gender, race, Hispanic, age, age squared, plant experience, plant experience squared, total occupational experience, total occupational experience squared, schooling, and test composites.

Deviations of rated performance (R^m_{ij}-R^m_j) from the mean for the establishment (R^m_j) were analyzed. The variance of the job performance distribution was also standardized across establishments by dividing (R^m_{ij}-R^m_j) by the standard deviation of rated performance, ($SD_j(R^m_{ij})$), calculated for that firm.[2] Separate models were estimated for each major occupation. They were specified as follows:

$$(1) \qquad \frac{R^m_{ij}-R^m_j}{SD_j(R^m_{ij})} = ß_o + ß_1(\underline{T}_{ij}-\underline{T}_j) + ß_2(\underline{T}_{ij}-\underline{T}_j)^2 + ß_3(S_{ij}-S_j) + ß_4(\underline{X}_{ij}-\underline{X}_j) + ß_5(\underline{D}_{ij}-\underline{D}_j) + v_2$$

where R_{ij} = ratings standardized to have a zero mean and SD of 1.

$\underline{T}_{ij}$ = a vector of test score composites—general academic ability and psychomotor ability

S_{ij} is the schooling of the i^{th} individual.

$\underline{X}_{ij}$ = a vector of age and experience variables—age, age^2, total occupational experience, total occupational experience^2, plant experience and plant experience^2.

$\underline{D}_{ij}$ = a vector of dummy variables for black, Hispanic and female.

$\underline{T}_j$, S_j, $\underline{X}_j$ and $\underline{D}_j$ are the means of test composites, schooling, experience variables and race and gender dummies for the j^{th} job/establishment combination.

General Academic Ability was constructed by averaging the GATB's G and N composites. Consequently, it is a weighted average of four subtests: a timed arithmetic computation test with weight of .25, a arithmetic reasoning test with a weight of .41, a vocabulary test with a weight of .17, and a spatial relations test with a weight of .17. Square terms and an interaction with schooling greater than 12 were included in the model to test for ceiling effects and other non-linearities.

The results are presented in Table 3 and Figure 2.[3] For general academic ability (referred to as Basic Skills in Figure 2), the hypothesis of diminishing returns was rejected in seven of the eight occupation groups. The exception was sales clerks, where the square term on general academic ability was significantly negative and general academic ability had a positive effect on performance only when the test scores were less than one-half a standard deviation above the mean (see Figure 2).

For psychomotor skills, however, the hypothesis of diminishing returns was accepted at the 10 percent level for operatives, service workers, sales workers, and in the aggregate relationship. The second derivatives are not so large, however, that the sign of the relationship reverses within the range of actual data. In the aggregate relationship and for operatives, the derivative of performance with respect to the psychomotor test scores at one SD above the mean of the test is 52-57 percent of the derivative when test scores are one SD below the mean. For service workers the derivative one SD above the mean is 37 percent of the derivative at one SD below the mean.

These results suggest that the job requirements model has some validity for psychomotor skills but not for the basic academic skills that are the primary objective of schooling. Both this analysis and studies conducted by others have found that the underlying relationship between basic academic skills and performance in a specific job is smooth, continuous and close to linear (Hunter 1983).

The Record of BLS Projections of the Demand and Supply for College Graduates

Despite the difficulties, BLS has been publishing biannual projections of the supply/demand balance since 1970. The starting point of its projections are its forecasts of occupational employment growth. It then projects changes in the proportion of particular occupations that "require a college degree," the number of bachelors degrees to be awarded per year and the annual rates of flow into and out of jobs by workers with a college degree. Comparisons are then made between the projected number of job openings "requiring a college degree" and the projected flow of college graduates seeking work, producing estimates of the number of "underemployed" college graduates. Column 3 of Table 4 presents BLS's projection of the annual increase in the number of "underemployed" college graduates during the projection period. Column 4 presents the projected 10 year change in the share of college graduates who are "underemployed."

Quite clearly the BLS effort to project the supply/demand balance for college graduates has been a failure. Compare the predicted changes in the share of college graduates underemployed in column 4 to the actual changes in column 5. At the beginning of the 1970s, BLS projected a decline in the share of college graduates who were underemployed during the subsequent decade. Instead, the share underemployed grew substantially. Changes in the relative wage of young college graduates provides an additional ex post criterion for evaluating the accuracy of the BLS projections of supply / demand balance (see columns 7 and 8). If the projection had been correct, the relative wage of college graduates should have also risen during the period. Instead, the college premium fell 6.7-7.6 percentage points by 1980 (see column 8).

At the end of the 1970s, BLS was projecting large surpluses of college graduates during the 1980s. According to the projection made in 1978, the surplus of college graduates was going to grow at a rate equal to 30 percent of the annual flow of bachelors degrees awarded and the "underemployment" share was going to rise 5.5 percentage points by the end of the decade. The rise in the "underemployment" share was instead only 1.7 percent. If the projections had been correct, relative wages of college graduates should have fallen; instead they rose by 23 to 26 percentage points. Thus, the projections were much worse than uncorrelated with the truth, they were negatively correlated with the truth.

The methodology is entirely a priori. Relationships are not empirically estimated on historical data. The number and quality of college educated workers are assumed to have no effect on the number of college level jobs. Every new college graduate who finds a college level job is assumed to force someone else into the ranks of the "underemployed." In reality, demand responds to supply and supply responds, with a lag, to demand. An increase in the supply of college graduates with computer science degrees, for example, lowers wages for the group and this allows some companies to undertake projects not feasible before and it induces other companies to keep development work in the United States rather than moving it abroad. Wage rates and job-finding difficulties influence enrollment decisions and choice of major, so supply responds to demand. Getting "college level" jobs also depends on the personal qualities—initiative, work habits, etc.—of the graduates. The absence of feedback loops and empirically estimated relationships causes the BLS projection model to oscillate wildly between predicting large decreases and large increases in the share of college graduates that are "underemployed."[4]

The evidence suggests that the BLS methods of translating occupational projections into college graduate demand / supply projections are flawed. But the problems are not limited to the way in which occupational employment distributions are translated into numbers of college level jobs. The BLS occupational projections also have serious flaws. The BLS systematically underprojects the growth of skilled jobs and overprojects the growth of unskilled jobs.

Biases in BLS Projections of the Growth of Managerial and Professional Jobs

There is a myth abroad in the land that job growth is coming (or will come) primarily from low skill jobs ("Mac jobs"). In 1987, Henry Levin and Russell Rumberger, for example, stated that:

> In summary, the evidence suggests that new technologies are unlikely to have a profound effect in upgrading the education and skill requirements of jobs, and that most new jobs or job openings will be in occupations that require relatively low skills and education (1987, p.344).

In 1990, Lawrence Mishel and Ruy Teixeira predicted:

> Growth in skill levels from occupational upgrading will actually slow down in the 1990s. In fact, future growth rates in skill levels are likely to be only one-fourth to one-third as fast as those in the recent past. (1990, p. 1)

In 1995, Basil Whiting, a former deputy assistant secretary in the Department of Labor, said:

> Labor Department projections show that most new jobs in the economy at the turn of the century will not be those of technicians but rather in the more prosaic and lower paid fields of hospitality, retail sales, clerical work, janitoring and other service occupations (Whiting and Sayer 1995, p. 11).

All of these writers based their forecasts on BLS occupational projections. Levin and Rumberger justified their reliance on BLS projections as follows:

> On the basis of their past record they are still likely to provide a better indication of how the overall job market will look in the future than generalizations from a few casual observations, guesswork, or simple extrapolations of past trends. The point is that none of the latter devices has come close to the accuracy of the BLS forecasts in a world where—by their nature—no forecasts will be perfect (1987, p. 338).

How good is the past record of BLS projections? Is there, as claimed, no way of improving them? The record is laid out in Table 5 (Bishop and Carter 1990, 1991a, 1991b). BLS projected in 1981 that professional, technical, and managerial (PT&M) jobs, which were 24.9 percent of the nation's jobs in 1978, would account for 31.3 percent of employment growth between 1978 and 1990, adjusted to a CPS basis (see Table 5).[5] Operatives, laborers, farm laborers, and service workers (OL&S), which were 37 percent of employment in 1978, had been projected to account for 34.3 percent of employment growth during the period. Columns 4 and 6 of Table 5 tell us what actually happened. 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.

Figure 3 presents a detailed comparison of BLS projections of occupational employment growth between 1978 and 1990 with actual growth rates. Because the comparison employs the 1980 Census occupational categories, adjustments were made to the BLS projections to account for the occupations that were switched from one major occupational group to another.[6] The grey bars represent the percentage growth projected by the BLS. The dark bars represent the actual percentage growth. BLS projected managerial jobs to grow by 20 percent and professionals to grow by 25 percent. In fact, managerial and professional jobs both grew by 57 percent. The error in projecting managerial employment was roughly equal to the total number of bachelors and masters degrees awarded in business, marketing, and accounting between 1978 and 1990.

The passage of time has produced two new opportunities to compare projected growth to actual growth: BLS 1983 and 1985 projections of occupational employment growth through 1995. BLS projected in 1983 that professional, technical, and managerial jobs would account for 34 percent of job growth from 1982 to 1995. In fact, PT&M jobs accounted for 53 percent of employment growth. Operative, laborer, and service jobs were projected to account for 29.7 percent of job growth, but in reality accounted for only 15.7 percent of job growth.

For the 1984 to 1995 period, BLS projected that PT&M employment would account for 42.1 percent of employment growth and that OL&S would account for 27.6 percent of growth. While somewhat more optimistic about upskilling, they are still far off the mark. For the 1984 to 1996 period, PT&M accounted for 58.3 percent of job growth, and OL&S accounted for 15.9 percent. (see row 6 of Table 5). Figure 4 presents a comparison of projected and actual growth for the 1984-1995 period. As before modest growth (22 percent over 11 years) was projected for professional and managerial jobs. Actual growth rates were much greater: 35 percent for professional jobs and 51 percent for managerial jobs.[7]

While better than the 1981 and 1983 projections, the 1987 and 1989 projections also appear to be off target. With 71 percent of the projection period already completed, the actual PT&M share of job growth is running 20 percentage points above the share projected in 1987. With 67 percent of the projection period already completed, the actual PT&M share is running 22 percentage points above the share projected in 1989. With employment projected to grow by 25 million over the period, a 20 point discrepancy means that high skill jobs in the year 2000 were probably under projected by five million.

Why are BLS Projections Biased?

There are many sources of error in the BLS occupational projections. Projections of final demand shares may be wrong. The input-output matrix is often quite old and this contributes to errors in projecting value added shares. For example, unanticipated changes in the federal deficit and exchange rates made export and import shares of industry output particularly difficult to predict in the 1980s. Industry specific productivity growth may also be in error resulting in incorrect predictions of industry employment.

Substantial changes have occurred in the occupational composition of specific industries and this has often been a major source of error in occupational projections. BLS derives occupational employment demand by multiplying projected industry employment totals by an assumed industry specific occupational share vector. Adjustments are made to these vectors when BLS studies of the introduction of new technology indicate that changes can be anticipated by the end of the forecast period.[8] Since studies cannot be funded for every industry and for every technological innovation and the effects of these changes are difficult to foresee ten years in advance, many of the changes that will occur in the composition of occupational demand within industry were missed by BLS projections.

The BLS obtains its estimates of the occupational composition of employment in specific industries from a survey of establishments, the Occupational Employment Statistics (OES). When the BLS made the projections of 1990 occupational employment in 1981, they had only one wave of OES survey data available to them for most states and industries. The projections for the 1984-1995 period were made more difficult by a change in the occupational classification system in 1982-83. Comparability over time is also threatened by the periodic changes in the industry-specific list of occupations that respondents receive on their questionnaire. BLS staff feel that these changes in questionnaire format have often resulted in data that were not comparable over time. The *Handbook of Methods* describes what was done when data was thought to be of doubtful comparability: "When an occupation is added, deleted or changed in definition from one OES survey to the next, extrapolated trends are not developed: the current-year ratios for these occupations are held constant in the preliminary projected matrix" (BLS 1982, p. 143). Given these data problems and the BLS focus on projecting over 500 different occupations in 250 industries, it is easy to see why BLS chose not to systematically extrapolate past trends in occupational staffing ratios derived from OES or Census data into the future, but rather to rely on the judgement of analysts who can take data quality problems into account. Systems which rely on the judgement of analysts are inherently conservative, however. Sometimes analysts feel that they are knowledgeable enough about the situation in a particular industry to project substantial changes in staffing patterns. But forecasting big changes is definitely perceived as "going out on a limb." The staff is small and cannot be expert about all industries and occupations. As one analyst described the situation, "In a lot of cases, if we did not know a lot about the occupation, we just left it alone." Unfortunately, occupational staffing ratios are seldom stable over periods of ten years or more and it is better to start with an assumption that trends are stable rather than that the ratios themselves are stable.

Can Other Projection Methods Succeed Where BLS Has Failed?

Ron Kutscher, the Associate Commissioner responsible for projections, has said "One could never hope that a projection of the future is entirely accurate" (1991, p. 253). A natural response to the criticisms of BLS methods is to ask "Can you do better?" Shani Carter and I attempted to do better in our 1991 paper. We showed that both a simple linear extrapolation of occupational share trends for 1972-80 and a regression-based projection did a better job of predicting 1990 shares of large occupational categories than the BLS.

Hindsight is always better than foresight, however. A projection constructed by someone with knowledge of the actual outcome will generally be better than projections developed without such knowledge. Probably the only really fair test of the validity of alternative forecasting methodologies is to look back at projections published in the past and compare results.

This section of the paper offers such a test. The regression-based projections Shani Carter and I published in 1991 are compared to the BLS projections published in the same year. The regression equations used for this exercise are found in Table B2 of Bishop and Carter (1991a).[9] The two sets of projections are presented in bar graph form in Figure 5. Projections of growth were quite similar for sales, technical, and professional jobs. Bishop and Carter projected slightly higher growth for clerical jobs and dramatically higher growth for managerial jobs. BLS projections of growth were higher for blue collar, farm, and service occupations.

Summary results on the high and low skill share of projected and actual job growth are presented in rows 9 and 11 of Table 5. Projected shares of job growth through 2000 will be compared to shares of actual job growth through 1996. Professional, technical, and managerial jobs actually accounted for 67.8 percent of job growth between 1990 and 1996. OL&S accounted for 18.7 percent. Bishop and Carter's projections clearly come closer to the 1990-96 reality than the BLS projections. Bishop and Carter projected a 70 percent PT&M share of job growth and a OL&S share of 2 percent. By contrast, BLS projected a PT&M share of 41 percent (46 percent when translated into CPS data) and an OL&S share of 27 percent.

In a paper published in early 1992, Bishop presented projections based on a variety of linear (rather than a logit specification). Summary results for these projections are in rows 12 through 14 of Table 5. These projections also outperform the BLS projections. The best of the projections have the same four variables on the right hand side as the preferred model of Bishop and Carter (1991a). In this preferred model occupational shares are a function of a time trend, the unemployment rate, the merchandise trade balance as a share of GDP, and the share of workers with computers on their desk.

Let us take a more disaggregated look at how the projections are doing one-third of the way through the fifteen-year projection period. Which occupations were accurately projected by both methodologies? Which occupations surprised both Bishop and Carter and BLS? Figure 6 compares actual growth during the 1990 to 1995 period to projected growth. The fifteen-year projections were sized to a five-year period by the simple expedient of dividing percentage growth projections by 3. Both projections missed three important developments: sharp slowdowns in the growth of craft jobs, clerical jobs, and technical jobs. Where there were disagreements about growth—e.g. for managers, professionals, operatives and laborers and service workers—the Bishop and Carter methodology produced more accurate predictions.[10]

How Stable is Bishop and Carter's Model of Occupational Employment Growth?

Like Bishop and Carter, I assume that the growth of occupational employment shares follows a logistic growth path. Bishop and Carter assumed that the logistic function had a ceiling of 20 percent.[11] In the preferred model, the log of the ratio of the "j"th occupation's share of employment in year t to .2 minus that same occupational share, $[S_{jt}/(.2-S_{jt})]$, is assumed to depend on the year (T_t), the unemployment rate (U_t), and one or more structural variables, (X_t), intended to capture the influence of the economic changes that have occurred in the 1980s. The independent variables have been defined relative to their projected value in the year 2005.

(2) $$\log[S_{jt}/(.20-S_{jt})] = a_0 + a_1(T_t-2005) + a_2(U_t-.055) + a_3(X_t-X_{2005}) \qquad t = 1972...1989$$

For the three smallest occupations, farm workers, protective service workers, and private household workers, X_t is a trend shift variable for the years after 1980. For the other ten occupations the X variables were the ratio of the merchandise trade deficit to GNP, ($TRADEF_t$), and the ratio of personal computers used in business to civilian employment, ($PCUSE_t$).[12] The advantage of deviating all independent variables from their projected level in the year 2005 is that the intercept term, a_0, then provides an estimate of the forecasted logit of 5 times the "j"th occupation's share of employment in the year 2005.[13]

Bishop and Carter's regression model of employment growth was estimated on data on employment shares from 1972 to 1989. What happens to parameter estimates when an additional six years of data are included in the estimation? Table 6 presents a comparison of the two estimated equations. The first two rows of each panel present the coefficients, T statistics, RMSE (root mean square error), R^2, and Durbin-Watson statistic of the Bishop and Carter specification estimated on the 1972-1995 data. The R^2s are quite high and in most cases Durbin-Watson statistics are satisfactory. For comparison, the bottom row of each panel presents the coefficients, RMSE, and Durbin-Watson statistics for models estimated on data from 1972 to 1989.[14] The models estimated on the 1972-89 time period typically have lower RMSEs and higher Durbin-Watson statistics than the model estimated on data through 1995. This suggests that the model's ability to track shifts in occupational shares has deteriorated.

Nevertheless, most of the estimated parameters were remarkably stable when six additional years were added to the analysis. Coefficients on the time trend hardly changed at all. All of the changes in coefficients on unemployment and trade deficit were within the estimated one standard error confidence interval. It was the intercept coefficients that changed the most. The right hand side variables have been defined in such a way that the intercept term provides an estimate of the projected occupational share in the year 2005 under an assumption of 5.5 percent unemployment, a zero trade deficit and an 80 percent higher share of workers using PCs than in 1990. By comparing these intercept coefficients, we can get a rough idea about how the new data has changed the forecast for 2005. For some occupations—professionals, craft, transportation operatives, protective service workers—the updated forecast for 2005 is the same as the old forecast. Compared to Bishop and Carter's 1991 forecast, the revised forecast predicts more rapid growth for farm workers (6.7 percent), factory operatives (9.6 percent) and other service workers (2.7 percent) and laborers (5.5 percent). The revised forecast predicts 3.8 percent less growth for managers, 4.9 percent less growth for sales workers and 3.3 percent less growth for clerical workers.[15]

Overall Upskilling

The updated regressions predict slower growth for managerial and technical employment than the 1991 Bishop and Carter regressions and faster growth of operatives, laborers and service workers. This means that instead of predicting that PT&M will account for 70 percent of employment growth to 2005, the updated projections now forecast that PT&M will account for 60 percent of job growth. The updated model projects that the operative, laborer, and service worker share of 1990-2005 job growth will be 12 percent, up from the 2 percent of the 1991 projection. The new estimates imply slower upskilling than before, but they still imply faster upskilling than BLS projections. Predictions of the growth of professional jobs are now quite close to BLS's 1993 and 1995 projections. For managerial jobs, however, there is a big difference. The updated projections of managerial job growth are about 4.5 million greater than BLS's 1993 projection.

Are the Wage Premiums Paid for Skill Continuing to Rise?

The wage differential between college graduates and high school graduates grew more slowly after 1987 than it did in the period from 1979 to 1987. It still appears to be growing, however. In Katz and Murphy's data, the weekly wage differential for workers with one to five years of work experience stabilized at a high level beginning around 1985, but the differential for workers of all experience levels continued to grow through 1990 the latest year of their data series (Murphy and Welch 1993). In Mischel and Bernstein's (1992) data the differential for workers of all experience levels rose 7.8 percent between 1987 and 1990 and then fell 2.9 percent in 1991. Figure 7 presents more recent data on the wage premium received by those with 4 or more years of college. For males the wage premium rose from 57 percent in 1989, to 64 percent in 1992, and to 71 percent in 1993. For females the premium rose from 63 percent in 1989 to 68 percent in both 1992 and 1993.

The 1991-92 recession caused the unemployment rate of managers and professionals to rise from 2.0 percent in the first quarter of 1989 to 3.5 percent in September 1992. Some thought this was the beginning of a bust. But, the recession hurt blue collar workers even more. Their unemployment rose from 7.7 to 11.4 percent. Now (November 1996) after a long expansion, unemployment rates have returned to their previous level: 2.1 percent for managers and professionals and 7.1 percent for operatives and laborers.

BLS data on median weekly earnings can also be brought to bear on the issue of recent trends in wage premiums for skill. Between the third quarter of 1991 and the third quarter of 1996, the annual rate of increase of nominal wages for males (females) was 2.1 (2.2) percent for operatives and laborers, 1.0 (1.9) percent for service workers, 3.1 (2.2) percent for craft workers, 2.5 (2.4) percent for clerical workers, 2.0 (2.7) percent for managers and 2.6 (5.3) percent for professionals. In summary the very latest data on trends in occupational wage differentials suggests that skill differentials continue to widen.

The latest data on employment growth has similar implications. Between November 1995 and November 1996, professional jobs grew 1,069,000, managerial jobs grew 454,000, and technical jobs grew 94,000. Together they accounted for 63 percent of total job growth during the year.

Is the Supply Response Large Enough to Flood the Market with New BAs?

The one event that could invalidate my prediction of continued high wage premiums for college graduates is a massive increase in the number of college graduates trained in well paid fields like science, engineering, and business. How likely is such a flood?

The high economic payoffs to college during the late 1980s and 1990s have increased enrollment in college and the proportion of high school graduates who complete at least one year of college (middle panel of Figure 8). Noncompletion rates have remained high, however, so enrollment increases during the 1980s have had only a modest effect on the share of 25-29 year old high school graduates who have completed a four year degree or more (bottom panel of Figure 8). Many adults have gone back to school and completed their degree, however, and this has resulted in a substantial increase in the ratio of BAs awarded to the number of 22-year-olds—from 21.6 percent in 1980 to 30.7 percent in 1994 (see Figure 9). In the National Center for Education Statistics' "High alternative" scenario this ratio is projected to increase further to 36.8 percent in the year 2000, a 70 percent increase over 1980 (NCES March 1996).[16]

The proportionate increase in the total number of BAs awarded, however, is much smaller because the low birth rates of the 1960s and 1970s means that there are fewer individuals in the 20- to 30-year-old age cohort that typically receives most of the BAs. As a result, the ratio of the number of BAs awarded to total employment fell from 1.09 percent in 1974 to 0.95 percent in 1980 and 0.96 percent in 1994. Despite large increases in college graduation rates, the "high alternative" projection implies almost no increase in the ratio of the flow of new graduates to total employment. That ratio is projected to be 0.94 percent in 2000 and 1.0 percent in 2005. Relative to the stock of college graduates, the number of new BAs has declined substantially.

To make matters worse, the number of college graduates retiring from the labor force is increasing every year (as the veterans who went to college under the GI bill retire from the work force). As a result, the ratio of workers with a college degree to those with a high school degree or less is projected to grow no more rapidly in the 1990s than it did during the 1980s (Bishop 1992, Table 4).

Is the Rapid Growth of College Level Jobs Since 1970 an Aberration?

Still another way to test the reasonableness of our projections of continued strong growth of demand for college graduates is to look abroad at trends in managerial and professional jobs and in the supply of well educated workers in other industrialized nations. Let us define an index of upskilling (the upskill rate) as the difference between the growth rate of professional, technical, and managerial (PT&M) jobs and growth rate of manual (service, craft, operative, laborer, and farm occupations) jobs. For the U.S. the upskill rate was 1.6 percent per year during the first half of the twentieth century, 1.9 percent per year between 1950 and 1970, 2.8 percent per year between 1970 and 1981 and 2.46 percent per year during the 1980s.

Upskilling is proceeding even more rapidly in Europe and East Asia (see Table 7). The Japanese upskill rate was 4.27 percent per year in the 1970s and 3.26 percent per year in the 1980s. The German upskill rate was 3.67 percent in the 1970s and 2.53 percent per year in the 1980s (Bishop 1992). The Finnish upskill rate was 6.4 percent per year in the 1970s and 5.1 percent per year in the 1980s. Korea's upskill rate was 4.2 percent per year in the 1970s and 5.05 percent per year in the 1980s. As a result, three countries—Canada, Norway, and the United Kingdom—now have proportionately more professional, technical, and managerial workers than the U.S. and other countries are close behind.

The supply of college educated workers has been increasing rapidly all over the world. During the 1970s and 1980s the university graduate share of the population of working age grew at an annual rate of 3.34 percent in the United States, 3.55 percent in Japan, 2.75 percent in Germany, 5.6-5.8 percent in Sweden and Norway, 3.07 percent in Belgium, and 3.97 percent in Canada (OECD 1989).

The share of the adult population that has graduated from university is higher in the U.S. than in any other country (see columns 4 and 5 of Table 7). But many Europeans would argue that the bachelors degrees awarded at the second and third rank American colleges and universities that educate the vast bulk of students reflect a lower standard than the French licence or the Dutch Doctoraal examen. High school graduation standards are also higher in Europe and Asia. Some countries require 13 or 14 years of attendance before graduation from upper secondary school. In other countries, high standards have resulted in many students having to repeat grades. In many cases the material American students study in freshman year of college is taught to Asians and Europeans in secondary school.

Any U.S. lead in the share of the workforce with college eduction is a legacy of policy initiatives that are 30 to 50 years old. The share of 25-29 year olds who have graduated from college is no higher now than it was in 1977 (NCES 1996, p. 72). In terms of flows—the numbers currently in school—the nations of Northern Europe and East Asia have either caught up or are surging ahead. Using age specific school enrollment headcounts, the OECD has calculated the expected number of years of schooling (K-12 or postsecondary) received between age 5 and 29. These estimates are presented in column 6 of Table 7. For the U.S. the figure is 15.6 years. The comparable figure is 16.4 for West Germany and Norway, 16.8 for the Netherlands, 16.9 for Belgium, 16.2 for Canada, Denmark and France, 16.1 for Spain, and 14.0 for Korea (OECD 1996, p. 112).

In summary, growing numbers of college graduate workers is not uniquely American. American youth are neither more nor better educated than their counterparts in Japan and Northern Europe. Thus, the "America is so well educated, much of it must be unnecessary" argument made by Louis Uchitelle and others is based on a premise that is no longer valid.

Policy Implications

Professional, technical, managerial, and high level sales workers currently (October 1996) account for 39 percent of employment, 43 percent of hours worked, and about 59 percent of the earnings received by all workers.[17] By comparison, craft workers, operatives, and laborers outside of construction receive only about 19 percent of the compensation paid in the economy. Thus, the competitiveness of the American workforce is in reality more a function of the cost and quality of managerial, professional, and technical workers than of the blue collar factory workers that are normally the focus of competitiveness discussions.

The short run consequence of a shortage of highly qualified workers is higher wage premiums for the skilled. The long-run consequences may included the loss of comparative advantage in industries that make heavy use of managerial, professional and technical workers. The high cost of hiring managerial and professional workers in the U.S. is already be inducing firms to look elsewhere for these skills. Many software companies now economize on expensive American programmers and systems analysts by contracting with subsidiaries in Bulgaria, Russia, and India to develop code for new programs.

In 1991, Hewlett-Packard picked a Frenchman to head its troubled PC division and moved the division's headquarters to his home town, Grenoble, France. Since then HP has staged a dramatic comeback in the PC market. Manufacturing time was cut from 25 minutes to 4 minutes, pricing became more aggressive, and, as a result, HP moved from the 14th- to the 6th-largest PC producer in the world. Production which had been spread across twelve plants, was concentrated into just two, one of which is in Grenoble (*Economist*, 19 June 1993). Hewlett-Packard is not alone. In 1991-92 Dupont moved the headquarters of its electronics division to Tokyo and its agricultural products division and part of its fiber and polymer business to Switzerland. IBM moved its networking systems division headquarters to the U.K. (Lublin 1992) Is this the start of a trend?

During the 1980s, 18- to 64-year-old college graduates with a business major earned nearly three times what high school graduates of the same gender earned (Kominski and Sutterlin 1992). Since social rates of return to college are now at postwar highs, substantial increases in supply are desirable. This simultaneously reduces the supply of unskilled workers; skill premiums should fall and unskilled wages should rise. It would not be a tragedy if a major increase in college completion rates lowered the wage premium paid to business BAs over high school graduates to only 100 percent rather than 200 percent. Indeed, competitiveness would improve and income inequality would decline.

The proportion of young people getting college degrees has greatly increased, but this has not halted further escalation of the college wage premium. Bigger increases in college enrollment have been prevented by a rapid escalation of tuition charges at public colleges and the limited availability of need based financial aid (Bishop 1992a). During the 1980s, tuition charges rose 48 percent more than student ability to pay out of current earnings.

Legislators and college presidents often justify the escalation of tuition as only fair, given the high wages college graduates receive as adults. Setting tuition high is claimed to be a way of helping those who do not go to college at the expense of rich college graduates. This is a myth. The promised increases in financial aid are never sufficient to keep college students from low-income families unharmed. The primary outcomes are fewer students, fewer graduates, and higher wages for those who complete college. College enrollment and graduation rates are highly responsive to tuition levels (Leslie and Brinkman 1985). Regression models estimated by Bishop (1992a) imply that raising public college tuition by 50 percent ($893 per year) would lower enrollment of 18- to 19-year-old women by 16 percent, lower enrollment of 20- to 24-year-old women by 21 percent, and lower BAs awarded to women by 11.75 percent.[18] Elasticities of demand for and supply of college graduates are such that a 12 percent reduction in the supply of college graduates increases their wage relative to that of high school graduates by about 5.78 percent or $1886 per year in 1992 dollars.[19] In the new long run equilibrium that results, the present discounted value of aftertax earnings over the course of the graduate's career goes up $23,100; much more than the $3574 of additional tuition payments.[20] Those who graduate from college gain from a high tuition policy. Two groups lose: those who are prevented from attending and graduating from college and those who never planned to go to college in the first place. They suffer a decline in their real wage because the number of high school graduates competing for the limited number of low and medium skilled jobs has gone up.

The implication of this discussion is that low tuition levels in public colleges (and tax credits for college tuition) are effective and fair ways of increasing the supply of college graduates. Other ways of increasing the supply of college graduates are (1) expanded financial aid, (2) higher academic standards in high school (to reduce college drop out rates), (3) expansion of Advanced Placement programs (so as to shorten the time to degree), and (4) giving immigrants with high level scientific and technical training preference over immigrants with little education and few skills.

Endnotes

[1] Let us make the standard assumption that measurement error is random (in other words, uncorrelated over time and uncorrelated across questions). Then, 18.3 to 27.3 percent of respondents reporting a PT&M occupation in one interview reporting a non-PT&M occupation in another interview implies that .8526 to .9039 of the individuals who are truly in a PT&M occupation report themselves in a PT&M occupation [(1-.273).5 =.8526]. The estimated proportion of true college graduates who report having less than a college degree is .9539 to .9721 [(1-.09).5=.9539]. Thus, the estimated proportion of true college graduates with PT&M jobs who underreport either their occupation or schooling ranges between .1213 and .1867 [.1867 =(1-.8526*.9539)]. If measurement error of schooling and occupation are positively correlated, "overeducation" will be overestimated by 10 to 15 percentage points. If measurement error is correlated over time, the overstatement of "overeducation" will be greater than the 12 to 18 percent range given.

[2] The estimates of within firm standard deviations were sometimes unreliable because of small sample sizes. In order to insure that normalized differentials were not exaggerated by an underestimated standard deviation, a lower bound was placed on the estimate of the firm's standard deviation. The minimum value was set at .377 of the mean for the within firm standard deviation and 15 percent of the individual worker standard deviation.

[3] Selection effects generate a negative bias in coefficients on years of schooling. In a selected sample like accepted job applicants or job incumbents, one cannot argue that these omitted unobservable variables are uncorrelated with the included variables that were used to make initial hiring decisions and, therefore, that coefficients on included variables are unbiased. When someone with 10 years of formal schooling is hired for a job that normally requires 12 years of schooling, there is probably a reason for that decision. The employer saw something positive in that job applicant (maybe the applicant received a particularly strong recommendation from previous employers) that led to the decision to make an exception to the rule that new hires should have 12 years of schooling. The analyst is unaware of the positive recommendations, does not include them in the job performance model and, as a result, the coefficient on schooling is biased toward zero. This phenomenon also causes the estimated effects of other worker traits used to select workers for the job such as previous relevant work experience to be biased toward zero. Consequently, the results presented below should not be viewed as estimates of the structural effect of schooling on worker productivity. The test score results are not similarly biased, however, because cognitive tests were not used to select workers. Mueser and Maloney (1987) experimented with some plausible assumptions regarding this selection process and concluded that coefficients on education were severely biased but that coefficients on test scores were not substantially changed when these incidental selection effects were taken into account.

[4] If one wants to project shares of college graduates in "non-college" jobs, a better approach is to estimate a model (or system of equations) predicting this ratio in historical data using variables that can be forecasted into the future.

[5] High-skill occupations account for a larger proportion of total employment in Current Population Survey (CPS) household data than in the Occupational Employment Survey (OES) of employers used by the BLS. Consequently, the BLS growth shares reported in Table 5 for the period after 1980 have 3.3 percentage points (the difference in 1994) added to the BLS projected growth shares for high skill jobs, to render them comparable to CPS estimates of occupational growth. BLS estimates of operative, laborer, and service share of jobs likewise have had 1.1 points subtracted from them to put them on a CPS basis. The CPS is the best source of data on trends in employment for broad occupation groups during the late 1970s and 1980s. The CPS counts workers who describe themselves as being in a given occupation, while the OES counts jobs that employers describe as being in a particular occupation. The advantage of CPS data is that there is no double counting of workers with more than one job. For supply/demand comparisons CPS data has the further advantage of also being the source of data on educational attainment. This means that underenumeration of undocumented workers and homeless individuals has little effect on estimates of the balance between supply and demand because these individuals are excluded from both sides of the equation. The potential disadvantage of CPS data is the possibility that self-reports of occupation are less accurate than employer descriptions of jobs. To the extent this is a problem, it effects estimates of the level of employment in an occupation, not trends.

[6] For managers, this involved adding accountants, personnel and labor relations workers and inspectors, n.e.c. to and subtracting ships' officers and conductors from both the 1978 base and the 1990 projection. For professional workers it involved adding decorators and window dressers and health trainees and subtracting accountants, personnel and labor relations workers, computer programmers, and sales engineers (Gren, Dinh, Priebe, and Tucker 1983). When separate data were not available for some of the smaller occupations that were reclassified, they were left in the major group they had been prior to 1983. The BLS has published CPS-based yearly estimates of employment by major occupation all the way back to 1972 using the 1980 Census classification system in Deborah Pisetzner Klein (1984). This data series was used to calculate actual percentage rates of growth and actual shares of employment growth. Thus percentage growth calculations are based on definitions of major occupation that are consistent over time but there are slight differences in the detailed occupations included in a major occupation for the two calculations. The data on 1990 employment are from *Employment and Earnings*, (January, 1991).

[7] Changes in CPS questionnaire format in January 1994 resulted in small changes in occupational shares. The most striking result was a 23.7 percent increase in the number of farm owners and managers. The parallel survey during 1994 generated unreliable results, so an alternative methodology was needed to construct a consistent data series. The difference between December 1993 and January 1994 was compared to the average seasonal shift to estimate the adjustments required. The mean seasonal shift between December and January was calculated by averaging the December to January changes in occupational shares for 1990, 1991, 1992, 1993, and 1995. The adjustments raise the number of managers after 1994 and reduce the number of professionals. The two changes have offsetting effects on the high skill share.

[8] This characterization of how occupational staffing patterns were projected is based on Bureau of Labor Statistics, *Handbook of Methods*, Bulletin 2134-1, 1982, p.143, and conversations with Ron Kutscher.

[9] Bishop and Carter's projections did not take account of the expected downsizing of the defense sector during the 1990s. Explicit consideration of projected changes in defense employment would not have changed their projections, however. Saunders (1993) estimates that professional, technical and managerial workers (PT&M) accounted for 30.1 percent of the employment decline in these industries between 1987 and 1992 and will account for 25.5 percent of the decline expected between 1992 and 1997. For the economy as a whole PT&M occupations accounted for 30.5 percent of all jobs in October 1993.

[10] Bishop and Carter's optimism about the growth of managerial jobs was justified. Their projection of continued rapid growth seemed to be wrong in the early 1990s during the recession, but when the recession ended managerial employment grew by over a million annually between 1993 and 1995. Bishop and Carter's projection turned out to underestimate their growth by 3 percent. Professional jobs grew 2 percent more than Bishop and Carter predicted and 5 percent more than BLS predicted. Operative and laborer jobs grew 3 percent less rapidly than predicted by the BLS and 1 percent less rapidly than predicted by Bishop and Carter. Service employment grew by 7 percent as predicted by Bishop and Carter; 2 percent less rapidly than projected by the BLS.

[11] The logit was assumed to have a ceiling in order to build in a slowdown in the rate of growth for three large fast growing occupations—managers, professionals and sales workers. The ceiling was set at 20 percent because that fit the data slightly better than higher ceilings.

[12] The estimates of the number of PCs in use in business during the 1980s were made by Future Computing/ Datapro Inc. and can be found in Table 1340 of *The Statistical Abstract*, p. 179. They are derived by cumulating numbers of machines sold. A very low scrap rate of 3.4 to 6 percent depending on the year was assumed. Where possible, vendor reports were used to allocate sales of computers between categories of end user—business, education, and home. Quite often, however, rules of thumb were used to make these allocations. Future Computing is no longer in business so more detailed information on how the series was constructed and data for 1989 are not available. CPS surveys in 1989 and 1993 provide data on the proportion of workers who use computers at work (NCES 1993, p. 434 and 1994, p. 439). The proportionate growth rate produced by comparing the two surveys was applied to the 1989 value of the PC-use variable from Future Computing. Projections of PC-use for succeeding years were made by extrapolation. Projections were based on an assumption that the unemployment rate in 2005 would be 5.5 percent and the merchandise trade deficit would be 1.4 percent of GDP.

[13] Bishop and Carter estimated a number of alternative models in order to test the sensitivity of results to changes

in functional form, specification and in the scenario projected for the year 2000. Such tests were needed because there were only 18 years of data on which to estimate the forecasting model and theory did not yield only one plausible specification. The results of some of these tests are detailed in Bishop and Carter (1990). While specification and scenario did affect projected occupational shares, all of the specifications yielded substantially larger increases in skilled jobs than the BLS projections. Other findings were robust with respect to specification and scenario as well.

[14] There are slight differences between the data and specification used to estimate models in Bishop and Carter (1991) and those presented here. The trade deficit data for 1989 had to be revised as was PC-use. The primary difference however comes from making 2005 the end year rather than 2000. This causes a major change in the intercept term. The intercept terms in Bishop and Carter (1991) are estimates of the logit of 5 times the specified occupation's projected share of employment in the year 2000. The intercept terms in Table 6 are estimates of the logit of 5 times the specified occupation's projected share of employment in the year 2005.

[15] The addition of 1990-1995 data significantly changed the projections of employment in 2005 for three key occupations. Why?

Managerial Workers: In the 1991 paper, the growing use of PCs appeared to be the primary explanation of the accelerating growth of managerial jobs during the 1980s. Despite the continued rise in PC-use, the recession of the early 1990s caused a larger than expected slowdown in the growth of managerial jobs. Bishop and Carter forecasts overpredicted managerial jobs by 2 to 4 percent between 1990 and 1993 but then got back on track when unemployment fell to 5.5 percent in 1994-95. The updated estimate of the model gives unemployment a more important role and PC-use a less important role in the determination of managerial jobs.

Clerical Workers: The 1991 Bishop and Carter model overpredicted the growth of clerical jobs in the early 1990s, underestimating the negative effect of the PC revolution. The updated regression reflects this by giving PC-use a bigger role in the determination of clerical employment.

Factory Operatives: In the 1991 Bishop and Carter model, PC-use had a large statistically significant negative effect on operative employment. Operative jobs did not decline nearly as much as the model predicted, so the updated regression model assigns less weight to PC-use and the result is an increase in projected employment of factory operatives.

[16] For the last decade or so, NCES "middle alternative" projections of BAs awarded have consistently underpredicted future levels. That is why the high alternative is used in this paper. I plan in future papers to estimate models of college attendance and graduation that can be used to project future supply of college graduates.

[17] *Employment and Earnings*, (November 1995, pp. 27, 34). High skill sales workers include sales representatives outside of retail and services and proprietors and supervisors in the retail and service industry. The median weekly wage for full-time managerial and professional workers is 46 percent above the overall median. High skill sales workers wages are 30 percent and technician wages are 14 percent above the overall average. These ratios are multiplied by the occupation's share of hours worked to calculate the share of earnings going to these high skill occupations.

[18] Average public college tuition charges were $1787 in 1992-93 (National Center for Education Statistics 1993, p. 309). A regression predicting the ratio of BAs awarded to women divided by the mean number of high school diplomas received by women 4 to 10 years previously was used to predict the impact of a 50 percent increase public college tuition from its 1988 level (Bishop 1991). The ratio of tuition to the foregone earnings of female college students (the wage of female high school graduates with 1-5 years of work experience times .75) was assumed to be .1355, its actual level in 1988. The higher tuition policy is assumed to increase this permanently to .20325. The proportionate change in BA awards was calculated by multiplying (.20325 -.1355)*(the coefficient on the tuition variable)*(1 minus the ratio of BAs to high school diplomas in 1989) = (.06775)*(-2.72)*(1-.362) = 11.75 percent.

[19] The relative supply of college graduates is defined as $ln[(BAs/HSG)(1-BAs/HSG)] = ln(BAs/(HSG-BAs) = \mathbf{E}_s$. The effect of the 50 percent increase in tuition on $\mathbf{E}_s$, TP, is -.1843 =.06775*(-2.72). Using a logarithmic approximation of the model predicting $\mathbf{E}_s$ in Bishop (1991), we have a formula for the relative supply curve: $\mathbf{E}_s = .89*ln(W_{CG}/W_{HSG})/.75 + TP + S$, where S captures the effect on supply of other exogenous variables. Following Blackburn, Bloom and Freeman (1989), I assume an elasticity of relative demand of -2, so the relative demand curve is $\mathbf{E}_d$ = -

$2.0^{*}ln(W_{CG}/W_{HSG}) + D$, where D is a variable reflecting other influences on relative demand for college graduates. Setting $E_d = E_s$, and reorganizing terms to get an expression for the relative wage, we have $ln(W_{CG}/W_{HSG}) = (TP + S - D)/(-2.0-.89/.75) = (TP + S - D)/3.19$. The long run impact of the tuition increase on relative wages is (-.18428)/(3.19) = .0578 or 6 percent. If the elasticity of relative demand had been assumed to be -4., the equilibrium increase in relative wages would have been 3.55 percent. Even with this very high elasticity of substitution, the long-run effect of a high tuition policy is to help college graduates and hurt those who do not go to college. Since a twelve percent change in the flow of new BAs takes many years to have comparable effects on the stock of BAs, short run effects on relative wages would be small, so when the policy is introduced the first few cohorts of college graduates lose out initially because the wage increase starts out being small. After 8 years or so, however, college graduates benefit from the policy change.

[20] I seek to calculate the long run impact of the policy of raising public college tuition charges by 50 percent and keeping them high. Mean earnings of college graduates were $32,629 in 1992, so a 5.78 percent increase is $1886 per year. The marginal tax rate (netting out deductions) on these earnings is assumed to be 35 percent, so at a 5 percent real rate of discount the PDV at age 21 is $1886.*.65*17.89 = $21,931 where $17.89 = (1/.05)(1-e^{45r})$ because the individual is assumed to work continuously until age 66.

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TABLES 3 THROUGH 7

Table 3: A Test of the Job Requirements Model

	General Academic Ability	General Academic Abil. Sq	GAA when Sch over 12	Psycho-motor Ability	Psycho-motor Abil. Sq	Years of Schooling	R Sq/ Number of Obs	Mean of Genl. Acad.	Mean of Psycho-Motor
All Workers	.227***	-.0096	.057***	.122***	-.017***	-.017***	.1329	.00	.00
	(.009)	(.007)	(.014)	(.007)	(.005)	(.004)	31,399		
Occupational Groups									
Technicians	.265***	-.033	.030	.116***	-.018	.030*	.1188	.49	.19
	(.043)	(.026)	(.026)	(.026)	(.017)	(.016)	2,384		
High Skill	.223***	.012	.033	.112***	.003	.022	.1611	.53	.42
Clerical	(.037)	(.028)	(.046)	(.030)	(.017)	(.017)	2,570		
Low Skill	.323***	.013	.024	.115***	-.019	-.010	.1354	.21	.18
Clerical	(.028)	(.021)	(.039)	(.020)	(.015)	(.012)	4,122		
Plant	.181***	-.030	.062	.135***	-.032	.003	.2063	.30	-.16
Operator	(.066)	(.043)	(.098)	(.048)	(.027)	(.031)	651		
Craft Wrkrs	.236***	-.007	.018	.098***	-.010	-.011	.1481	.12	-.11
	(.016)	(.012)	(.026)	(.013)	(.008)	(.007)	10,061		
Operatives	.177***	-.002	.050	.168***	-.019*	-.032***	.1433	-.38	-.03
	(.017)	(.013)	(.036)	(.014)	(.010)	(.008)	8,167		
Service Wrkrs	.340***	.005	.070	.148***	-.032*	-.021	.1559	-.31	-.24
	(.037)	(.026)	(.063)	(.028)	(.019)	(.017)	1,927		
Sales Clerks	.175*	-.173***	.109	.197***	-.070*	-.015	.1172	.19	.08
	(.090)	(.063)	(.129)	(.066)	(.042)	(.037)	416		

Analysis of GATB Revalidation Data in the U.S. Employment Service's Individual Data file. Deviations of job performance ratings from the mean for the job-establishment are modeled as function of deviations of worker characteristics from the mean for the job-establishment. The General Academic Ability construct is the sum of the GATB G and N composites. This implies that GAA is a weighted average of four subtests: a timed arithmetic computation test with weight of .25, a arithmetic reasoning test with a weight of .41, a vocabulary test with a weight of .17, and a spatial relations test with a weight of .17. The test composites are in population SD metric. The metric for job performance is the within job-establishment standard deviation. The other variables included in the models but not shown were age, age squared, occupational experience, occupational experience squared, plant experience, plant experience squared, and dummies for female, Black and Hispanic. Standard errors are in parenthesis under the coefficient.

* Prob. LT .10 on a two tail test   ** Prob. LT .05 on a two tail test   *** Prob. LT .01 on a two tail test

Table 4: BLS Projections of the Supply/Demand for College Graduates and Subsequent Changes in the College Wage Premium

Date Published	Projection Period	Proj Grth Underemployed CG Annual Avg (1,000's)	Proj Grth Underemployed CG 10yr Chg Share Underemployed	Actual 10yr Growth of Share Underemployed	Underemployed College GradChg. Share—BLS	Implied Pred. in CG/HSG Wage Ratio	Actual Chg. in CG/HSG Wage Ratio
1970	1968-80	8	-4.2%	6.7%	10.6%	Rise	- 6.7%
1972	1970-80	20	-4.3%	7.3%	11.3%	Rise	- 7.6%
1974	1972-85	62	-3.5%	5.3%	14.4%	Rise	+14.2%
1976	1974-85	86	-2.9%	3.7%	15.4%	Rise	+18.9%
1978	1976-85	300	5.5%	1.7%	17.7%	Decline	+23.2%
1980	1978-90	275	3.5%	2.2%	17.3%	Decline	+26.5%
1982	1980-90	300	4.1%	1.3%	18.6%	Decline	+23.6%
1984	1982-95	300	4.2%	0.3%	19.7%	Decline	
1986	1984-95	200	1.2%	0.9%	19.1%	Small Decline	
1988	1986-2000	100	-2.3%		19.4%	Small Rise	
1990	1988-2000	150	-0.5%		19.5%	Stable	
1992	1990-2005	406	6.1%		19.9%	Big Decline	
1994	1992-2005	330	5.0%		20.0%	Decline	

Source: The record of past BLS forecasts of the supply demand balance is from an unpublished BLS memorandum and from Shelley (1992, 1994). Columns 4 and 5 are the projected and actual growth over the succeeding 10 year period of the share of college graduates who are "underemployed." The BLS estimates of the share of college graduates underemployed given in column 6 are taken from Hecker (1992). They are for the year that begins the projection period. For occupations outside the professional, technical, managerial and sales representative category, worker reports of qualifying training requirements from the 1983 survey of training received were used to estimate the proportion of jobs in the occupation that required a college degree. The data on subsequent changes in the ratio of college and high school wages for workers with 1 to 5 years of experience is from Lawrence Katz and Kevin Murphy, "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," 1990.

Table 5: Growth Shares of High and Low Skill Jobs:BLS Projections Compared to Subsequent Changes

When Published	Projection Period	% Prof-Tech-Manager Projected	% Prof-Tech-Manager Actual	% Oper-Lab-Service Projected	% Oper-Lab-Service Actual
	1950-60	—	31.2%	—	27.7%
1969	1960-75	34.7%	37.3%	28.9%	23.1%
1971	1970-80	33.8%	38.1%	28.4%	20.1%
BLS Changes Projection Method (*Data Adjusted to CPS Basis*)					
1981	1978-90	31.3%	53.6%	34.3%	8.7%
1983	1982-95	34.0%	53.0%	29.7%	15.7%
1985	1984-95	42.1%	58.3%	27.6%	15.9%
1987	1986-2000	41.2%	61.5%*	26.7%	19.6%*
1989	1988-2000	44.1%	66.0%*	23.5%	17.4%*
1991	1990-2005	44.2%	67.8%*	26.0%	18.7%*
1993	1992-2005	43.9%	55.3%*	30.5%	23.7%*
1995	1994-2005	49.2%	72.9%*	29.1%	16.5%*
Bishop / Carter Logit Regressions-1990-2000					
Model: Time-Unemp-Trade-PCShare		69.8%	67.8%*	1.9%	18.7%*
Bishop Linear Regressions-1990-2005					
M1—Time-Unemp-Trade-PCShare		68.1%	67.8%*	0.3%	18.7%*
M2—Time, Unemp, & Trade		57.2%	67.8%*	10.6%	18.7%*
M3—Time & Unemp.		52.5%	67.8%*	6.1%	18.7%*
Bishop—Table 6 Model-1995-2005		61.4%	—	12.1%	——

Source: The record of the 1960-75 and 1970-80 BLS projections of occupational shares of job growth is taken from Carey (1980) and Carey and Kasunic (1982). Estimates of actual occupational employment growth are based on the CPS household survey [*Employment and Earnings*, various January issues and Klein (1984)]. Estimates of the share of workers in managerial, professional and technical occupations are 3.3 percentage points higher in CPS data than in the Occcupational Employment Survey that is the basis of BLS occupational projections. In order to put the BLS projections of jobs on a CPS employment basis 3.3 points were added to the BLS's projected MPT shares and 1.1 percentage points was subtracted from BLS's projected OLS shares. BLS's projections for the period after 1980 come from Carey (1981); Silvestri, Lucasiewicz and Eckstein (1983); Silvestri and Lucasiewicz (1985, 1987, 1989, 1991); Silvestri (1993, 1995). For projection periods ending after 1995, an "actual" growth share (indicated by a *) is reported for the shorter period from the baseline year up to August 1995. The logit regression model assumed a ceiling of 20 percent for all occupational categories (Bishop and Carter 1991, Table 2). The linear regression predictions of employment growth are from Bishop (1992). The projections in the bottom row uses the regressions in Table 6 and assumes that in 2005 there is a 5.5% unemployment rate, a trade deficit equal to 1.4% of GDP and PCUse that is 80 percent above its 1990 value.

Table 6: Determinants of Occupational Employment Shares for 1972-1995 Logit Model with Ceiling of 20%

	Trend	Unemp	Trade Deficit	PC Use	Trend GT80	Intercept	MSE	R2/ DW	Proportion Multiplier
Managers	.0419***	-2.30**	-1.19	.160		1.233***	.0384	.985	.246
	(6.66)	(2.45)	(.89)	(.46)		(18.73)		1.27	
	[.0406]	[-1.30]	[-2.87]	[.615]		[1.387]	.0169	2.90	
Professionals	.0224***	3.64***	-.41	.76***		1.207***	.0208	.992	.277
	(6.59)	(7.17)	(.57)	(4.09)		(28.23)		2.16	
	[.0223]	[3.72]	[-.37]	[.72]		[1.185]	.0157	2.17	
Technicians	.0289***	1.43*	-1.81	-.53*		-1.305***	.0338	.941	.817
	(5.21)	(1.73)	(1.54)	(1.76)		(22.51)		1.58	
	[.0301]	[.99]	[-1.71]	[-.58]		-1.288	.0187	1.25	
Sales	.0075	1.54*	5.30***	.32		.442***	.0343	.936	.341
	(1.34)	(1.84)	(4.45)	(1.05)		(7.53)		1.04	
	[.0063]	[2.27]	[4.18]	[.76]		[.586]	.0289	1.42	
Clerical	.0335***	-.42	-3.54	-2.60***		1.356***	.0664	.731	.216
	(3.08)	(.26)	(1.53)	(4.37)		(11.91)		1.12	
	[.0350]	[-.67]	[-4.45]	[-2.33]		[1.511]	.0588	1.65	
Craft	-.0053	-2.28***	3.24***	-.91***		-.0131	.0291	.944	.412
	(1.10)	(3.28)	(3.20)	(3.51)		(.26)		1.33	
	[-.0048]	[-2.48]	[3.19]	[-.87]		[.0188]	.0285	1.75	
Factory Operatives	-.0260***	-5.26***	-5.02***	-.86***		-1.0869***	.0288	.992	.649
	(5.51)	(7.48)	(5.01)	(3.35)		(22.04)		1.43	
	[-.0253]	[-5.86]	[-3.79]	[-1.27]		[-1.235]	.0240	1.96	
Transportation Operatives	-.0180***	-.95	-1.50	.13		-1.64***	.0257	.923	.792
	(4.26)	(1.51)	(1.26)	(.43)		(27.87)		.59	
	[-.0174]	[-1.44]	[-.04]	[.11]		[-1.60]	.0198	1.01	
Laborers	-.0235***	-2.72***	-1.50	.13		-1.64***	.0342	.959	.791
	(4.19)	(3.25)	(1.26)	(.43)		(27.87)		1.01	
	[-.0234]	[-2.83]	[-1.05]	[-.07]		-1.71	.0357	1.19	
Private Household	-.0650***	1.48			.0332***	-3.709***	.0604	.960	.963
	(9.40)	(1.26)			(3.50)	(65.3)		.74	
	[-.0567]	[.61]			[.0138]	[-3.933]	.0444	1.08	
Protective Service	.0004	1.77***			.0145***	-2.152***	.0180	.948	.916
	(.20)	(5.08)			(5.12)	(127.2)		1.52	
	[-.0003]	[1.88]			[.0160]	[-2.136]	.0196	1.39	
Other Service	.0091**	2.44***	.57	.01		.313***	.0243	.900	.458
	(2.28)	(4.11)	(.67)	(.04)		(7.56)		1.23	
	[.0084]	[2.40]	[1.27]	[-.07]		[.254]	.0220	.81	
Farm	-.0453***	2.673***			.0236***	-2.089***	.0214	.991	.854
	(18.51)	(6.43)			(7.04)	(103.8)		1.06	
	[-.0427]	[2.46]			[.0172]	[-2.168]	.0178	1.30	

* Prob. LT .05   ** Prob. LT .025   *** Prob. LT .01   Durbin Watson Statistic is below the R2

Table 7: Occupational Upskilling In OECD Countries

	Annual Rate by which Prof-Tech-Manag Grew more Rapidly than Manual Workers 1970-1981[2]	1981-1990[3]	Prof-Tech-Manag Share in 1990	% 25-64 Yr Olds[1] in 1992 with: BA/ MA+	NonUniv/ AA Deg	Yrs of School Expected at age 5[1] in 1994
Australia	2.34%	2.02%	24.0%	13%	10%	15.9
Belgium	3.86%	3.14%	25.8%	10%	12%	16.9
Canada	3.48%	3.87%	30.2%	17%	29%	16.2
Denmark	6.60%	2.50%	28.0%	14%	6%	16.2
Finland	6.41%	5.13%	28.6%	11%	9%	15.9
France	—	—	—	9%	8%	16.2
West Germany	3.67%	2.53%	19.9%	13%	10%	16.4
Greece	6.11%	3.76%	14.3%	12%	6%	13.9
Ireland	5.97%	2.10%	20.3%	9%	10%	15.2
Japan	4.27%	3.26%	14.9%	19%	—	—
Korea	4.24%	5.95%	8.7%	—	—	14.0
Malaysia	—	3.03%	9.5%	—	—	—
Netherlands	4.46%	4.30%	28.1%	21%	0%	16.8
Norway	5.48%	3.85%	30.0%	16%	11%	16.4
Singapore	3.77%	4.79%	20.3%	—	—	—
Spain	3.34%	5.88%	12.8%	11%	4%	16.1
Sweden	2.95%	—	—	12%	14%	15.7
United Kingdom[4]	3.28%	3.88%	31.5%	12%	9%	15.1
United States[5]	2.78%	2.46%	29.3%	24%	8%	15.6

[1] OECD, *Education at a Glance*, 1996, p. 35 & 112. The OECD calculates expected years in school for 5-year-olds by summing, from school reports of enrollment, age specific school or college attendance (full or part time) rates. Since the calculation starts with age 5, kindergarten or nursery school attendance by 5- and 6-year-olds counts as school attendance.

[2] Manual occupations include farming, fisheries, craft, operatives, laborers and service workers. Source: *Yearbook of Labour Statistics* for 1971, 1976, 1981 & 1991, International Labour Organization, Table 2B & Table 3C. Data availability problems resulted in somewhat different time periods being used for Belgium—1970-83, Canada—1971-81, Denmark 1965-81, Greece—1961-81, Ireland—1966-83, Japan—1970-80, Germany—1970-82, Netherlands—1971-81.

[3] Source: *1991 Handbook of Labour Statistics*, Table 3. Absent data meant that shorter time periods were used for some countries: Austria 1984-89, Belgium 1983-89, Federal Republic of Germany 1982-89, Greece 1981-88, Ireland 1983-88, Malaysia 1981-87.

[4] Growth rates were calculated for 1971-1978 and 1978 to 1989. Source: *MSC Manpower Report 1980*, pg. 8 and *Labour Force Survey 1988 and 1989*, Office of Population Censuses and Surveys, Table 5.11.

[5] Source: Deborah Klein, "Occupational Employment Statistics for 1972-82," *Employment and Earnings*. Jan. 1984. 13-16; and later January issues of *Employment and Earnings*. Because of a change in occupational coding in 1972, the trend was calculated for the 1972-1981 period.

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