BLS WORKING PAPERS

U.S. DEPARTMENT OF LABOR
Bureau of Labor Statistics

OFFICE OF EMPLOYMENT RESEARCH
AND PROGRAM DEVELOPMENT

Tracking the Returns to Education in the Nineties:
Bridging the Gap Between the New and Old CPS Education Items

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Working Paper 288
September 1996

We acknowledge suggestions and comments from Marilyn Manser and David Jaeger, and the research assistance from Mariya Charney. The opinions expressed here are those of the authors and do not reflect the views of the U.S. Bureau of Labor Statistics or those of its staff. Any remaining errors are the responsibility of the authors.

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We acknowledge suggestions and comments from Marilyn Manser and David Jaeger, and research assistance from Mariya Charny. The opinions expressed here are those of the authors and do not reflect the views of the Bureau of Labor Statistics or those of its staff. Any remaining errors are the responsibility of the authors.

Abstract

The Current Population Survey (CPS) is used for many studies examining trends in the returns to education. The CPS changed its education item in 1992. This paper develops adjustment factors for earnings at different education levels to make pre- and post-1992 earnings comparable. To accomplish this, contradictory results from 1991 and 1992 data are analyzed and reconciled. Adjusted 1989-93 earnings show a much more moderate increase in the returns to college graduation over the period than unadjusted earnings.

JEL Classifications: J31, C81

I. Introduction

Much of what economists know about the returns to education has been learned through studies that use data from the Current Population Survey (CPS). Many of these studies take advantage of the fact that it is possible to construct series on earnings and education extending back to 1964 to look at long term trends in earnings by educational attainment (for example, Murphy and Welch [1992], Bound and Johnson [1992,1995]). Time series studies such as these will be sensitive to changes in questions that pertain to earnings or educational attainment.

In 1992, the CPS changed its educational attainment questions. The pre-1992 questions asked "What is the highest grade or year of regular school that ... has ever attended?" and "Did ... complete the grade?" In 1992, the CPS began asking a single question "What is the highest level of school ... has completed or the highest degree ... has received?"[1]

The new question represents an improvement over the pre-1992 item because it provides more detailed information about post-secondary educational attainment, which has become more prevalent in recent years. It has also been shown to be more accurate as a predictor of earnings than the pre-1992 item (Siegel 1991, Jaeger 1993, Park 1994, Ureta and Welch 1995). Unfortunately, its introduction caused a break in series.

As with any break in series, researchers need to know how it affects time series comparisons that span the break, and what adjustments must be made to compare pre-1992 data with post-1991 data. Already, researchers have begun to publish comparisons

based on unadjusted series (see Bound and Johnson 1995 and Gordon 1996). The purpose of this paper is to derive adjustment factors for earnings for the traditional four education groups: High School Dropout, High School Graduate, Some College, and College Graduate. We find that applying these adjustment factors to earnings for the 1989-1993 period substantially reduces the increase in the earnings advantage of college graduates over this period.

Another approach to bridging the break in series has been taken in papers by Jaeger (1996) and Park (1996). These papers propose ways of categorizing the data to improve comparability between the items. However, we show that re-categorization is limited in its ability to reconcile median and mean log earnings between the two measures.[2]

Although the main purpose of Jaeger (1996) is to suggest methods of re-categorization, the paper also contains a brief comparison of earnings under the two measures. He uses matched 1991-92 data from the March Income Supplement (which span the break in series). He finds that the ratio of college-graduate to high-school graduate earnings are the same under both measures when using earnings from March 1991 and are 2.4 percent higher under the new measure when using earnings from March 1992, and takes these estimates as upper and lower bounds for the effect of the new measure.

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[1] For more information on the current item and comparisons with the old item, see Kominski and Siegel (1993) and Frazis, Ports, and Stewart (1995).

[2] Since the results for the medians were very similar to those for log means, we report the median results in Appendix 2.

In this paper, we analyze and reconcile the contradictory results for earnings from the 1991 and 1992 samples. Our analysis reveals that the contradiction is due to the way the education question was updated in 1992. We estimate, and correct for, the effects of this updating procedure. Our analysis also differs from Jaeger's in that we use data from the CPS Outgoing Rotation Groups (ORG) rather than the March Income Supplement. We find that data from the first half of the year do not fully reflect the impact of the change in question due to a shakedown period, when interviewers became familiar with the question. Consequently, we restrict our sample to the last half of the year. We estimate that the college/high-school earnings ratio is 3.7 percentage points higher under the new measure, substantially higher than Jaeger's upper bound.[3]

The rest of the paper proceeds as follows. Section II describes the dataset we use in our primary analysis, and discusses some of the data problems we encountered. In Section III we show how estimates of earnings by education group have been affected by the introduction of the new question, and discuss and model the difference between estimates of the effect using 1991 earnings and estimates using 1992 earnings. In Section IV we give adjustment factors and examine how the measured trend in earnings by education level has been affected by the new item in the period 1989-93. Readers who are not interested in our derivation of the adjustment factors can skip Section III.

II. Data

[3] Jaeger (1996) also develops a numeric recoding scheme to allow comparison of linear returns to

To analyze the effect of the change in the education item, we need a CPS dataset that contains both the old and new questions. In the CPS, households are interviewed each month for 4 consecutive months, out of the survey for 8 months, and interviewed again for 4 months. This 4-8-4 rotation scheme makes it possible to match the responses for up to one-half of the sample to their responses in the same month of the previous year. In any one month, there are 8 rotation groups that are denoted by their Month In Sample (MIS). Respondents in MIS 5-8 can be matched to their responses in the previous year. Respondents in the outgoing rotation groups (MIS 4 and MIS 8) are asked about usual weekly earnings and usual weekly hours on their main job last week. Hence, we use matched[4] CPS Outgoing Rotation Group (ORG) data from 1991-1992. Not all members of the sample in MIS 4 can be matched, because they have moved between years or for other reasons. However, this does not appear to affect our results. To verify this, we matched December 1991 data to ORG data from January through March 1992. These data have a higher match rate than the year-to-year-match, but show no major differences with that match.

Before proceeding, we should note that there are two other CPS data sets with earnings information and education measures for both the 1991 and 1992 measure: the February 1990 test of the new item (used in Park 1996), and matched March Income Supplements in 1991 and 1992. (The March Income Supplements ask about annual earnings and labor market experience during the previous calendar year.) The February 1990 test asked both questions during the same interview, which has the advantage of

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schooling. This appears to be unaffected by the difference between the March and the ORG data.

eliminating any true changes in educational attainment. However, Frazis, Ports and Stewart [1995] have presented evidence that responses to the new question (which was asked at the end of the interview) were contaminated by the responses to the old questions (which were at the beginning of the interview). As a result, the correspondence between educational attainment in the old and new items differs from that in matched data from 1991-1992. The March Income Supplement data contain independent responses to the two questions. However, as mentioned in the introduction, the data early in the year appear to have been contaminated by a "shakedown" period that is not reflective of later experience with the item.

We present evidence for a shakedown period in Appendix 1. Because of this contamination, we use ORG data and restrict our sample to July-December 1991-92. To mitigate biases from actual changes in educational attainment, we also restrict our analysis to individuals who are ages 25-64.

In this paper, we use the traditional breakdown of: High School Dropouts, High School Graduates, Some College, and College Graduate. Using the old measure, the four categories are defined in the usual way by years of schooling completed: 0-11, 12, 13-15, and 16+. Under the new measure, High School Dropouts include only those who do not report having at least a high school diploma, High School Graduates includes only those who report High School Diploma, Some College includes people who have some college (no degree) and people with Associate's degrees, and College Graduate includes people who have a Bachelor's degree or higher.

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[4] We match by household ID number, line number, sex, and race. In addition, matches are disallowed if reported age increases by more than two years or decreases.

As in Jaeger (1996) and Park (1996), for our main analysis we assign respondents who reported attending but not completing the 13th year of school--hereafter referred to as "13As"--to the Some College category.[5] This makes the distribution of attainment more comparable between the two items. In most of the remainder of this paper, we compare the new question with the 13A-adjusted old question (hereafter "old (13A)"). Analysts with access to CPS microdata can perform the 13A adjustment on their own. For analysts seeking to compare published numbers without using microdata, we analyze the effect of making the 13A adjustment, and provide adjustment factors that can be used with published (non-13A-adjusted) data.

Our earnings sample is composed of all wage and salary workers ages 25-64 whose primary activity was working. We excluded those working in agriculture, forestry, and fisheries, and private household workers, those with major activity student in either year, as well as those making less than $1 or more than $100 in 1979 dollars as measured by the CPI-U. The CPS topcodes weekly earnings at $1923. We multiply this amount by 1.45 as in Katz and Murphy (1992). Finally, all data in this paper are weighted.

[5] Jaeger (1996) also reassigns respondents who report "12th grade--no diploma" to the new question to the High School Graduate category on the basis of 55 percent of such respondents reporting 12th grade completion to the old question. We do not make such a reassignment, since our purpose is to adjust the old question to the new categories rather than adjusting both to maximize comparability. See footnote 8 below.

III. Analysis of Earnings

Table 1 shows geometric mean hourly earnings[6] for all wage and salary workers and for workers by sex.[7] We draw three main conclusions from these tables. First, the High School Dropout, High School Graduate, and Some College categories show lower earnings under the new question than under the old (13A) question, while the College Graduate category shows higher earnings. Consequently, the college/high school wage premium is higher under the new measure. For both sexes, these differences are statistically significant in all categories in 1992 and in all categories except for High School Dropouts and High School Graduate in 1991.[8]

Second, there appears to be no consistent pattern of differences between men and women in the effects of the new measure. None of the differences between men and women in the effect of the new question relative to the old (13A) categories are statistically significant.

Third, the effects of the new question compared to the old (13A) are larger when using 1992 earnings than when using 1991 earnings. This difference is statistically significant for the college graduate category ($p<.003$), and also for the college/high school ratio. In what follows, we analyze possible reasons for this discrepancy. We then develop

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[6] Table A4 in Appendix 2 contains the analogous results for medians.

[7] The standard errors in Table 1 and in all other tables are computed using the method of random groups (see Wolter, 1985). Standard errors were computed by dividing the sample into 20 random groups, estimating the standard deviation of each estimate across the groups, and dividing by $\sqrt{20}$.

[8] Assigning "12th grade, no diploma" to the High School Graduate category as in footnote 4 increases the magnitude of the difference in mean earnings between the two measures. In the first panel of Table 1 below, the difference in geometric mean earnings between the new and old (13A) categories would fall between 1 and 1.4 percentage points for high-school drop-outs, to –1.8 - –2.8 percentage points. It would fall between 0.1 and 0.2 percentage points for high-school graduates, to –0.6 - –0.7 percentage points.

and apply a method for reconciling the discrepancy in order to get a single estimate of the effect of the new question.

One explanation for the difference between 1991 and 1992 results is that it reflects true differences in earnings growth among education categories. For a given education category, the difference in mean earnings between the old and new measures will predominantly reflect differences in "off-diagonal cells"--cells in which respondents do not report the same level of education for both questions. Differences in rates of growth of earnings among the off-diagonal cells would imply changes between years in the difference between the measures.

However, since the size of these off-diagonal cells is small relative to the main diagonal, only large year-to-year differences in mean earnings in these cells will generate non-trivial year-to-year differences in differences between the measures. Table 2a shows the percent change in the geometric mean of hourly earnings between 1991 and 1992 for each (j,k) cell for respondents who are in the earnings sample in both years,[9] as well as the percent of the sample that falls into each cell. We focus on cells that are one off the main diagonal, because cells further from the main diagonal are too small to analyze.

All else equal, one would expect year-to-year changes in earnings to be fairly similar across neighboring cells. However, the (High School Dropout, High School Graduate) and the (College Graduate, Some College) cells exhibit changes in earnings that are quite different from neighboring cells. In the former cell, earnings increased by 4.8 percent between 1991 and 1992, compared with 1.8 percent for the neighboring cells on

the main diagonal and 2.5 percent for the (High School Graduate, High School Dropout) cell. In the (College Graduate, Some College) cell, hourly earnings fell by nearly 5 percent compared to a less than 1 percent increase in the (Some College, Some College) cell, a 3.7 percent increase in the (College Graduate, College Graduate) cell, and a 2.8 percent increase for the (Some College, College Graduate) cell.

Do off-diagonal cells exhibit different earnings growth even in years when there was no change in the education measure? Table 2b shows the analogous numbers for 1990-91. Here there are three cells that stand out. The (Some College, High School Graduate) and the (College Graduate, Some College) cells both exhibit large decreases in earnings, while the (Some College, College Graduate) cell shows a large increase in earnings.

These results suggest that, conditional on the first year's response to the education questions, the response in the second year is correlated with earnings (or with measurement error in earnings), and that the correlation seems to be stronger at higher education levels. Corroborating this finding, the corresponding results for the March Income Supplement (not shown here) show an even stronger correlation between changes in income and changes in reported education, and larger differences in differences between measures between 1991 and 1992.

At first blush, it appears that this problem is less severe in the 1991-92 data than in the 1990-91 data because fewer cells are affected and the magnitudes of the changes are smaller. However, due to the change in the education item, a larger fraction of

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[9] Year-to-year comparisons will also be affected by changes in the composition of the earnings sample. Since our explanation of year-to-year differences is based on changes in responses, we ignore this factor

respondents change categories in the 1991-92 data than in the 1990-91 data. Because changes in reported education due to the change in question should not be closely related to changes in earnings, one would expect to see attenuation of the differences in earnings growth between off-diagonal cells and the main diagonal.

One cell that appears to be driving much of the year-to-year difference in differences between the measures is the (College Graduate, Some College) cell. Although the percent decrease in earnings is smaller in the 1991-92 data than in the 1990-91 data, this combination occurs over 6 times as often in the 1991-92 data. The continued differences in earnings growth between this cell and the neighboring main diagonal cells despite the increase in the probability of moving to this cell indicates a strengthening of the relationship between changes in earnings and changes in reported education category. To demonstrate this, for both 1990-91 and 1991-92, we ran a linear probability model regression of the probability of remaining in the College Graduate category in year 2 conditional on being in the category in year 1 on change in log earnings (for respondents in the earnings sample in both years). The coefficient of change in log earnings is 0.006 in 1990-91, but increases to 0.025 in 1991-92.

We believe that this contrast between 1991-92 and other year-to-year matches is due to a difference in the method of updating the education question. Normally, when the education question is updated, interviewers have the previous response in front of them and can confront the respondent about any decreases in education (increases in education are not questioned). But when the new education question was introduced, interviewers were not given the previous responses. As a result, there were more changes in education

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here.

category than would have been the case if the questions could have been updated normally. More importantly, there was a stronger relationship between changes in education and changes in earnings, which generated the discrepancy between the results using 1991 and 1992 earnings.

Correcting for Independent Updating

Here, we develop a method for correcting for the independent updating. We begin by assuming that earnings in each period are described by:

$$\begin{aligned} Y_{ij1} &= \mu_i + e_{ij1} \\ Y_{ij2} &= \mu_i + f_j + e_{ij2}, \end{aligned} \tag{1}$$

where Y_{ijt} is earnings of individual *i* in first-year education category *j* in year *t*, μ_i is a person-specific fixed effect, e_{ijt} is a mean-zero transitory component of year *t*'s earnings, and f_j is a year-specific effect for year 2 common to all persons with year 1 education category *j*. The variables μ_i and e_{ijt} are assumed mutually independent, though e_{ij1} and e_{ij2} are not assumed identically distributed (nor are e_{ijt} and $e_{ij't}$ for $j \neq j'$).

Let $Z_{ijk} = 1$ if person *i* in schooling category *j* in year 1 is in schooling category *k* in year 2, and 0 otherwise. The probability of being in *k* in year 2 given schooling category *j* in year 1 is modeled as:

(2)

$$P_{ijk} = \Pr(S_2 = k | S_1 = j, \mu_i, e_{ij1}, e_{ij2}) = E(Z_{ijk} | \mu_i, e_{ij1}, e_{ij2}) = \alpha_{jk}^T + \beta_{jk}^T \mu_i + \gamma_{jk}^T D_i + \delta_{jk}^T D_i^2,$$

where $D_i = e_{ij2} - e_{ij1}$ and T = 01,12, with the superscripts referring to the calendar years

1990-91 and 1991-92.[10] In words, we use a linear probability model to estimate the probability of reporting a given education level in the second year of a year-to-year match, with coefficients varying both by initial education level and by calendar year. The explanatory variables are permanent earnings, the change in transitory earnings and its square. This model is the simplest model that allows changes in the effect of transitory earnings to affect transition probabilities. It is straightforward to show that all values of γ_{jk}^{T} yield the same aggregate transition probabilities, so a quadratic term is necessary.

Our goal is to estimate what the probability of reporting education level *k* would have been in 1992 for the 1991-92 matched sample if the normal dependent updating of the education item had occurred. Given that Table 1 indicates significant differences only for College Graduates, it is natural to estimate (2) for *k*=College Graduate. Since we are particularly interested in the college/high school earnings ratio, we also estimate (2) for *k*=High School Graduate. We estimate these "counter-factual" probabilities from the 1991-92 matched data using coefficients on permanent earnings from 1991-92, and the intercept and coefficients on changes in earnings from 1990-91. That is, we aim to construct an estimated probability approximating:

$$(3) \qquad P_{ijk}^{C} = \alpha_{jk}^{12} + \beta_{jk}^{12}\mu_i + \gamma_{jk}^{01}D_i + \delta_{jk}^{01}D_i^{\,2},$$

where P_{ijk}^{C} is the counter-factual probability that respondent *i* in education category *j* in 1991 would have responded education category *k* in 1992 had there been the normal relationship between change in earnings and change in reported education. We then use

[10] We experimented with using 1992-93 matched data instead of the 1990-91 data and got similar results. We report the 1990-91 results because we can use a larger sample, as data from January-June 1992-93 have the problems mentioned above.

P^C_{ijk} to estimate $E(Y^C_{kt}) = \dfrac{\sum_j \sum_{i|h=j} P^C_{ihk} Y_{it}}{\sum_j \sum_{i|h=j} P^C_{ihk}}$, the average period *t* earnings of those who would have reported education level *k* in period 2 had the normal updating procedures been used in 1992.

Since neither μ nor D are directly observable, we must use estimated values. But since D and D^2 are independent of μ, regressing Z on D and D^2 yields consistent estimates of γ and δ. For individual *i* who has initial education level *j*, D is estimated as:

$$\hat{D}_{ij} = (Y_{ij2} - \overline{Y}_{j2}) - (Y_{ij1} - \overline{Y}_{j1}) = (Y_{ij2} - Y_{ij1}) - (\overline{Y}_{j2} - \overline{Y}_{j1}) = D_{ij} + f_j - \hat{f}_j \cong D_{ij},$$

where $\overline{Y}_{j1}$ and $\overline{Y}_{j2}$ denote the mean earnings in year 1 and year 2 for year 1 education category *j*. The equality is inexact because of error in estimating f_j (we ignore this hereafter). Omitting the subscript *i* for clarity, we use the regression equation

(4) $$Z_{jk} = a_{jk} + c_{jk}\hat{D}_j + d_{jk}\hat{D}_j^2 + u_j,$$

where the regression is estimated over the population who report schooling level *j* in year 1. Estimating c_{jk} and d_{jk} from (4) by least squares will consistently estimate γ_{jk} and δ_{jk}.

In determining the effect of the new question, it is not clear whether we should compare the counter-factual mean to the predicted mean from the regression model, $\overline{\hat{Y}}_{kt}$, or the actual mean, $\overline{Y}_{kt}$. Naturally, it would simplify our analysis if $\overline{\hat{Y}}_{kt} = \overline{Y}_{kt}$. Direct use of equation (4) does not guarantee this equality, but the following device does.

Adding first period earnings to the equation results in $X = [\mathbf{1} \quad Y_1 \quad \hat{D} \quad \hat{D}^2]$, where **1** is a vector of ones. The best linear prediction of Z given X is the least squares predictor $\hat{Z} = X(X'X)^{-1}X'Z$. Similarly, for the counter-factual, $\hat{Z}^C = X(X'X)^{-1}X'Z^C$,

where Z^C is the value of Z generated by (3). Note that for 1991-92 data,

(5) $X'Z = X'(\alpha^{12} + \beta^{12}\mu + \gamma^{12}D + \delta^{12}D^2 + u)$ and

(6) $X'Z^C = X'(\alpha^{12} + \beta^{12}\mu + \gamma^{01}D + \delta^{01}D^2 + u^C)$.

Noting that $X'u=X'u^C=0$, subtraction of (6) from (5), and premultiplication by $X(X'X)^{-1}$ yields:

(7) $\hat{Z}^C = \hat{Z} + X(X'X)^{-1}X'((\gamma^{01} - \gamma^{12})D + (\delta^{01} - \delta^{12})D^2)$

after arranging terms. Since we do not observe the γ's and the δ's, we estimate $\hat{Z}^C$ using our values of γ and δ estimated from equation (4) using 1991-92 and 1990-1991 data.

Counter-factual predicted mean of earnings for those with education level *k* in the second year is $\hat{\overline{Y}}^C_{kt} = \frac{\sum_j \sum_{i|h=j} Y_{it}\hat{Z}^C_{ihk}}{\sum_j \sum_{i|h=j} \hat{Z}^C_{ihk}}$, whereas the predicted mean from the actual process is $\hat{\overline{Y}}_{kt} = \frac{\sum_j \sum_{i|h=j} Y_{it}\hat{Z}_{ihk}}{\sum_j \sum_{i|h=j} \hat{Z}_{ihk}}$. Note that the linear probability model assures us that:

(8) $\hat{\overline{Y}}_{kt} = \overline{Y}_{kt}$,

the predicted mean earnings equals actual mean earnings, as desired.[11]

To summarize, our strategy is as follows: (a) estimate the probability that an individual with education level *j* in the first year reports education level *k* in the second year [equation (4)] for both the 1990-91 and 1991-92 matched samples. (b) Compute counter-factual probabilities for the 1991-92 sample using the coefficients on the earnings

variables from the 1990-91 matched sample [using equation (7)].[12] (c) Reweight each observation by multiplying its sample weight by its counter-factual probability, and recompute mean earnings.

We used the formulation above to generate counter-factual estimates for both geometric means and medians. The median results are presented in Appendix 2.

Another problem of interpretation arises because the preceding method assumes a constant population. It does not allow for changes in the composition of the sample as people gain and lose employment, enter or leave the relevant age range, etc. We assess the effect of this problem on our results below.

Results from the Counter-factuals

Table 3a shows actual and counter-factual mean hourly earnings for High School Graduates and College Graduates. Note that the means for the old (13A) and new measures are slightly different from those presented earlier in the paper as the sample includes only respondents who meet our sample inclusion criteria in both years. This change in the sample eliminates the already small difference between using 1991 and 1992 earnings when comparing the measures for high school earnings, and consequently narrows the between-year gap in the difference for the college/high-school ratio. Applying the counter-factual correction completely eliminates the difference between using 1991

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[11] Note that, from the normal equations for least squares, for any linear combination L of the elements of X, $L'(Z - \hat{Z}) = 0$. Earnings Y_1 and Y_2 are both linear combinations of the elements of X, so $\sum Y_t Z = \sum Y_t \hat{Z}$. Also, $\sum Z = \sum \hat{Z}$, so $\overline{Y}_t = \sum Y_t Z \Big/ \sum Z = \sum Y_t \hat{Z} \Big/ \sum \hat{Z} = \hat{\overline{Y}}_t$.

[12] These counter-factual probabilities show slightly lower probabilities of changing education category between years, as desired.

and 1992 earnings for the between measure comparison of college earnings, as well as for the college/high school ratio. The difference is eliminated because the adjustment increases 1991 College Graduate earnings to the 1992 level; the adjustment leaves 1992 earnings essentially unchanged.

This suggests the following simple method for generating a preferred adjustment to the pre-1992 geometric mean earnings: average the 1991 and 1992 percentage differences between the measures for the high school drop-out, high school graduates, and some college categories, and use the 1992 percentage change for college graduates. Results are shown in the first column of Table 4. Adjustment factors for medians are also presented in Table 4, although the discussion is in Appendix 2. The largest (in absolute value) adjustment factor is for College Graduates. This reflects the new question's superiority in measuring attainment of Bachelors Degrees.[13]

IV. Adjustment Factors and Adjusted Trends in Earnings

The above analysis yields adjustment factors for broad education categories for pre-1992 data that have been adjusted for the 13As. These are shown in the first and third columns of Table 4. Since analysts working from published tables may not have access to the CPS microdata necessary to make the 13A adjustment, we derive adjustment factors for non-13A-adjusted data. To do this, we derive 13A adjustment factors and add them to our preferred adjustments described above. The 13A adjustment factors were constructed

[13] As further evidence along this line, Jaeger and Page (1996) find that using the degree measure from the new question generates larger diploma effects in the returns to education than attribution of a Bachelor's degree to 16-year completers using the old question.

by averaging the observed effect of the adjustment for unmatched ORG data across the years 1989-91. While the effect of the 13A adjustment for the High School category does not differ between the sexes, the adjustment to the Some College category is substantially higher for women. The adjustment factors for non-13A-adjusted data are shown in the second and fourth columns of Table 4.

What effect do these adjustments have on estimated trends in earnings by education level and returns to a college degree? Table 5 shows the trend in (geometric) mean hourly earnings[14] by educational attainment for ORG data for 1989-1993, by sex.[15] The first rows of the table show the series without adjusting for the break in series. The second group of rows shows the effect of making the 13A adjustment to the data.[16] The third group of rows shows the effect of our suggested adjustments to the old (13A) item.

The unadjusted series in general show small declines or increases for college graduates, and substantial declines in real earnings for everyone else. The contrast between college graduates and other education levels is fairly dramatic for both sexes. Between 1989 and 1993, the increase in the college/high school premium is 6.0 percent for women and 8.6 percent for men . The 13A adjustment decreases the estimated increase in the ratio by between a half and a full percentage point. Our adjustments substantially reduce the estimated increase in the college/high-school premium by around half to two-thirds. After these adjustments, changes in the college/high school premium

[14] Analogous tables for medians are in Appendix 2.

[15] The CPS processing system changed between 1988 and 1989, which would complicate comparisons to 1988 and earlier years. In 1994 the survey was revised substantially. Between 1989 and 1993 there was no change in the processing system, which allows a clear examination of the effect of the new education question.

now is 1.8 percent for women and 4.7 percent for men. Moreover, for both sexes, the college/high-school ratio is no higher in 1993 than it was in 1990.

We also computed adjustments for weekly earnings for full-time workers. Suggested adjustment factors and 1989-93 trends are shown in tables in Appendix 2.[17]

Adjusting March CPS Data

Given that the adjustments described above were derived using CPS ORG data, it is natural to ask whether they can be used to adjust data from the March CPS Income Supplements. Differences in the surveys make it preferable to derive adjustment factors from the March data directly.[18] However, as our discussion of the shakedown effect points out, data from the first part of 1992 are not representative of post-1991 data.

To determine which adjustment factors should be used with March data, we replicated Tables A2a-A2d in Appendix 1 (which are analogous to Table 1) using 1991-92 matched March CPS data. The pattern of differences between the new and old measures were similar to those using the first 6 months of ORG data, and quite different from those using the second six months. This is consistent with the hypothesis that the shakedown effect affected the March data to a large degree. Hence, we recommend using the factors in Table 5 for the March data as well.

V. Summary and Conclusion

The adjustments derived in this paper provide a general guide for researchers who seek to describe trends in wages by education level in the CPS across the 1992 break in

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[16] That is, recategorizing the micro-data, not using the average adjustments suggested in Table 5.
[17] Tables for weekly earnings duplicating the analysis of hourly earnings are available from the authors on request.

series. Adjustment is clearly necessary, since unadjusted series substantially exaggerate the increase in the earnings advantage of college graduates in the early 1990s. We did not find substantial variation in the effect of the break in series by sex or (in results not shown here) by age. We believe that in most cases the adjustments suggested here provide a reasonable method for bridging the gap.

The CPS processing system was revised in 1989. The CPS survey itself was substantially revised in 1994, including significant changes to the earnings questions. The effect of these changes on measurement of trends in earnings by education level is a topic for further research.

[18] The main differences are that the ORG questions ask about earnings and hours on the main job last week, whereas the March questions ask about earnings, hours, and weeks worked at all jobs in the previous year.

Tables

Table 1: Geometric Mean of Hourly Earnings by Education Category for July-December, 1991-1992
Matched Outgoing Rotation Groups (1991 dollars) Both sexes
(Standard Errors in Parentheses)
{p-values in Brackets}

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	7.89	7.89	7.83	-0.8	-0.8	
				(0.6)	(0.6)	
				{0.170}	{0.170}	
High School Graduate	9.47	9.42	9.38	-0.9	-0.4	-0.5
				(0.3)	(0.3)	(0.2)
				{0.002}	{0.172}	{0.001}
Some College	11.63	11.46	11.34	-2.5	-1.2	-1.4
				(0.4)	(0.4)	(0.2)
				{0.000}	{0.014}	{0.000}
College Graduate	15.46	15.46	15.60	0.9	0.9	
				(0.3)	(0.3)	
				{0.001}	{0.001}	
College Grad/HS Grad	1.632	1.641	1.663	0.031	0.022	0.009
	(0.011)	(0.011)	(0.011)	(0.007)	(0.007)	(0.003)
				{0.000}	{0.001}	{0.001}

n=25,667

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	7.91	7.91	7.80	-1.4	-1.4	
				(0.4)	(0.4)	
				{0.001}	{0.001}	
High School Graduate	9.57	9.49	9.43	-1.4	-0.6	-0.8
				(0.2)	(0.2)	(0.2)
				{0.000}	{0.013}	{0.000}
Some College	11.44	11.35	11.17	-2.3	-1.6	-0.8
				(0.5)	(0.4)	(0.3)
				{0.000}	{0.000}	{0.006}
College Graduate	15.52	15.52	15.80	1.8	1.8	
				(0.3)	(0.3)	
				{0.000}	{0.000}	
College Grad/HS Grad	1.623	1.636	1.675	0.052	0.040	0.013
	(0.009)	(0.010)	(0.012)	(0.007)	(0.007)	(0.003)
				{0.000}	{0.000}	{0.000}

n=25,673

Table 1 (continued) Men

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	8.96	8.96	8.88	-0.7	-0.7	
				(0.7)	(0.7)	
				{0.308}	{0.308}	
High School Graduate	11.10	11.02	10.97	-1.5	-0.7	-0.7
				(0.3)	(0.3)	(0.2)
				{0.000}	{0.025}	{0.000}
Some College	13.16	13.07	12.75	-1.3	-0.7	-0.7
				(0.7)	(0.6)	(0.3)
				{0.040}	{0.255}	{0.038}
College Graduate	17.39	17.39	17.64	0.8	0.8	
				(0.4)	(0.4)	
				{0.049}	{0.049}	
College Grad/HS Grad	1.567	1.579	1.607	0.036	0.025	0.011
	(0.018)	(0.018)	(0.015)	(0.010)	(0.009)	(0.003)
				{0.000}	{0.005}	{0.000}

n=13,305

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	9.03	9.03	8.88	-1.6	-1.6	
				(0.7)	(0.7)	
				{0.021}	{0.021}	
High School Graduate	11.14	11.03	10.97	-1.5	-0.5	-1.0
				(0.3)	(0.3)	(0.2)
				{0.000}	{0.143}	{0.000}
Some College	12.95	12.95	12.75	-1.6	-1.5	-0.1
				(0.6)	(0.5)	(0.3)
				{0.007}	{0.001}	{0.853}
College Graduate	17.36	17.36	17.64	1.6	1.6	
				(0.4)	(0.4)	
				{0.000}	{0.000}	
College Grad/HS Grad	1.559	1.574	1.607	0.049	0.033	0.015
	(0.015)	(0.016)	(0.015)	(0.008)	(0.009)	(0.003)
				{0.000}	{0.000}	{0.000}

n=13,232

Table 1 (continued) Women

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	6.49	6.49	6.49	0.0	0.0	
				(1.1)	(1.1)	
				{0.996}	{0.996}	
High School Graduate	8.11	8.07	8.04	-0.9	-0.4	-0.4
				(0.4)	(0.4)	(0.2)
				{0.029}	{0.260}	{0.0052}
Some College	10.18	9.98	9.85	-3.2	-1.3	-2.0
				(0.5)	(0.6)	(0.2)
				{0.000}	{0.029}	{0.000}
College Graduate	13.32	13.32	13.46	1.0	1.0	
				(0.4)	(0.4)	
				{0.011}	{0.011}	
College Grad/HS Grad	1.643	1.650	1.674	0.031	0.024	0.007
	(0.018)	(0.018)	(0.017)	(0.009)	(0.008)	(0.003)
				{0.000}	{0.004}	{0.006}

n=12,362

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	6.44	6.44	6.41	-0.5	-0.5	
				(1.0)	(1.0)	
				{0.595}	{0.595}	
High School Graduate	8.23	8.18	8.08	-1.8	-1.1	-0.7
				(0.3)	(0.3)	(0.2)
				{0.000}	{0.000}	{0.001}
Some College	10.05	9.93	9.79	-2.6	-1.4	-1.2
				(0.6)	(0.6)	(0.4)
				{0.000}	{0.015}	{0.001}
College Graduate	13.51	13.51	13.79	2.0	2.0	
				(0.5)	(0.5)	
				{0.000}	{0.000}	
College Grad/HS Grad	1.641	1.653	1.706	0.065	0.053	0.012
	(0.022)	(0.022)	(0.023)	(0.011)	(0.010)	(0.003)
				{0.000}	{0.000}	{0.001}

n=12,441

Table 2a: Cell by Cell Percentage Change in the Geometric Mean of Hourly Earnings. 1991-92.
Workers in earnings sample in both years

New Measure Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Total
High School Dropout	1.8	4.8	6.2	37.0	2.5
Cell %	8.4	1.4	0.2	0.1	10.1
High School Graduate	2.5	1.8	-0.1	9.2	1.7
Cell %	1.1	32.3	3.3	0.3	37.0
Some College	-14.7	0.3	0.7	2.8	0.7
Cell %	0.1	2.0	21.4	1.5	25.1
College Graduate	15.4	-4.3	-5.0	3.7	3.0
Cell %	0.0	0.3	1.8	25.8	27.9
Total	1.7	1.7	0.2	3.8	1.9
Cell %	9.6	36.0	26.8	27.7	100.0

n=22,577

Table 2b: Cell by Cell Percentage Change in the Geometric Mean of Hourly Earnings, 1990-91
Workers in earnings sample in both years

Old (13A) Measure Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Total
High School Dropout	0.2	1.8	2.6	23.9	0.3
Cell %	10.4	0.4	0.1	0.0	10.9
High School Graduate	-0.6	1.1	1.0	5.2	1.1
Cell %	0.3	36.2	0.9	0.2	37.6
Some College	-17.7	-7.6	1.1	6.1	1.0
Cell %	0.1	0.3	23.1	0.4	23.9
College Graduate	-27.4	-7.8	-8.5	2.1	2.0
Cell %	0.0	0.1	0.3	27.3	27.7
Total	0.0	1.0	1.0	2.2	1.2
Cell %	10.8	37.0	24.3	27.9	100.0

n=45,825

Table 3a: Counter-factual (geometric) means of earnings
(Standard Errors in Parentheses)
{p-values in Brackets}

	Old (13A)		New		Counter-factual	
	1991	1992	1991	1992	1991	1992
High School Graduate	9.58	9.74	9.53	9.70	9.53	9.70
College Graduate	15.50	15.97	15.66	16.25	15.75	16.24
College/High School ratio	1.618	1.639	1.643	1.6760	1.652	1.674
	(0.012)	(0.010)	(0.012)	(0.013)	(0.012)	(0.014)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}

n=22,577

Note: Mean earnings will differ from those in reported in earlier tables, because these means are computed using only individuals in earnings sample in both 1991 and 1992.

Table 3b: Percent Difference Between Counter-factual, Actual, and Estimated (geometric) means of earnings
(Standard Errors in Parentheses)
{p-values in Brackets}

	Counter-factual and Old (13A)			Counter-factual and New			New and Old (13A)		
	1991	1992	Difference	1991	1992	Difference	1991	1992	Difference
High School Graduate	-0.5	-0.5	0.1	0.0	0.0	0.0	-0.5	-0.5	0.1
	(0.3)	(0.4)	(0.3)	(0.2)	(0.2)	(0.3)	(0.3)	(0.3)	(0.2)
	{0.053}	{0.214}	{0.812}	{0.982}	{0.906}	{0.961}	{0.118}	{0.072}	{0.753}
College Graduate	1.6	1.7	0.1	0.6	-0.1	-0.6	1.0	1.8	0.7
	(0.4)	(0.3)	(0.2)	(0.2)	(0.1)	(0.3)	(0.3)	(0.3)	(0.2)
	{0.000}	{0.000}	{0.784}	{0.013}	{0.550}	{0.041}	{0.000}	{0.000}	{0.003}
College/High School ratio	0.035	0.035	0.000	0.009	-0.002	-0.011	0.026	0.037	0.011
	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.006)	(0.007)	(0.007)	(0.007)
	{0.000}	{0.000}	{0.989}	{0.021}	{0.650}	{0.065}	{0.000}	{0.000}	{0.089}

n=22,577

Table 4: Suggested Adjustment Factors for Hourly Earnings at New Education Categories (%)

	Geometric Means		Medians	
Education Category	Old (13A)	Old	Old (13A)	Old
Drop-outs	-1.1	-1.1	-1.1	-1.1
High School Grad.	-0.5	-1.1	-0.5	-1.1
Some College	-1.3	Men:-2.2 Women:-2.7	-1.2	Men:-1.6 Women:-1.9
College Grad.	1.8	1.8	1.8	1.8
College/High School ratio (computed as the average adjustment factor for 1989-1991)[1]	3.7	4.7	3.9	4.9

1 Applying adjustment factors for each education level will cause adjustment to College/High School ratio to vary with the ratio.

Table 5. Geometric mean of hourly earnings by educational attainment for workers age 25-64 (in $1991), by sex. Both sexes

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Hourly Earnings						
High School Dropout	7.97	7.75	7.63	7.56	7.44	-6.6%
High School Graduate	9.54	9.38	9.31	9.19	9.13	-4.3%
Some College	11.39	11.29	11.24	10.82	10.73	-5.8%
College Graduate	15.17	15.18	15.02	15.11	15.06	-0.7%
College/High School ratio	1.590	1.619	1.613	1.644	1.649	5.9%
Making 13A adjustment to old item						
High School Graduate	9.50	9.31	9.25			-3.9%
Some College	11.25	11.17	11.10			-4.6%
College/High School ratio	1.598	1.632	1.623			5.2%
Making Suggested Adjustment to old (13A) item						
High School Dropout	7.88	7.66	7.55			-5.6%
High School Graduate	9.45	9.26	9.20			-3.4%
Some College	11.10	11.02	10.96			-3.3%
College Graduate	15.44	15.45	15.29			-2.5%
College/High School ratio	1.634	1.668	1.662			1.5%

Table 5 (continued) Men

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Hourly Earnings						
High School Dropout	9.18	8.87	8.61	8.51	8.33	-9.2%
High School Graduate	11.25	10.96	10.77	10.57	10.45	-7.1%
Some College	12.95	12.90	12.70	12.12	11.99	-7.4%
College Graduate	17.04	17.07	16.88	16.86	16.72	-1.9%
College/High School ratio	1.515	1.557	1.568	1.595	1.601	8.6%
Making 13A adjustment to old item						
High School Graduate	11.20	10.89	10.70			-6.7%
Some College	12.84	12.79	12.57			-6.6%
College/High School ratio	1.522	1.567	1.577			7.9%
Making Suggested Adjustment to old (13A) item						
High School Dropout	9.08	8.77	8.51			-8.2%
High School Graduate	11.14	10.84	10.65			-6.2%
Some College	12.67	12.63	12.41			-5.4%
College Graduate	17.31	17.35	17.16			-3.4%
College/High School ratio	1.554	1.601	1.611			4.7%

Table 5 (continued) Women

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Hourly Earnings						
High School Dropout	6.34	6.25	6.31	6.30	6.22	-1.9%
High School Graduate	8.03	7.96	8.01	7.94	7.91	-1.4%
Some College	9.90	9.81	9.85	9.62	9.59	-3.2%
College Graduate	12.98	13.01	12.95	13.20	13.27	2.2%
College/High School ratio	1.617	1.634	1.616	1.664	1.677	6.0%
Making 13A adjustment to old item						
High School Graduate	7.99	7.90	7.96			-1.0%
Some College	9.74	9.69	9.71			-1.6%
College/High School ratio	1.624	1.647	1.627			5.3%
Making Suggested Adjustment to old (13A) item						
High School Dropout	6.27	6.18	6.24			-0.8%
High School Graduate	7.95	7.86	7.92			-0.5%
Some College	9.62	9.56	9.59			-0.3%
College Graduate	13.19	13.22	13.16			0.6%
College/High School ratio	1.659	1.682	1.662			1.8%

Appendix 1: Evidence on the Shakedown Effect

This appendix presents evidence that responses to the 1992 question changed over the course of the year, implying that the first few months' responses cannot be taken as a guide to the final effect of the change in the education item.

Let p_{jk} be the probability of being in education category *k* under the 1992 measure conditional on being in education category *j* in 1991. Tables A1a and A1b show the 4×4 transition matrix of the p_{jk} as well as the unconditional probabilities of being in each category under each measure for all matched individuals 25-64 (not just wage earners) in the first half of the year (January-June) and the last half of the year (July-December). Cell-by-cell differences in probabilities are shown in Table A1c. If the administration of the question had remained constant through the year, these differences in probabilities should be indistinguishable from zero.

While differences in the p_{jk} appear small, in some cells they are a large portion--over ten percent--of the original p_{jk} and are statistically significant at the five percent level in several cases. In the (j=High School Graduate, k=Some College) cell, the difference of .9 represents nearly a 13 percent increase in transition probability. The probability of making the transition from High School Dropout to High School Graduate is about 12 percent higher in the last half of the year, while the probability of the reverse transition is about 12 percent lower.

We also compared the distribution of educational attainment between Jan. 1992 and Dec. 1992. During that time, the percentage of the population that reported Some College increased by 1.1 percentage points, while the percentage of the population that

reported High School Dropout decreased by the same amount. In other years, changes in the distribution are usually on the order of a half a percentage point. We now examine whether this change in the distribution affects earnings comparisons.

Tables A2a and A2b compare the geometric mean of hourly earnings by education measure for ORGs in January-June 1991-92 to those from July-December 1991-92. Comparing the 13A-adjusted measure to the new measure, the July-December period shows substantially greater differences between the two measures for the High School Dropout, Some College, and College Graduate categories for both 1991 and 1992 earnings (we discuss the differences between 1991 and 1992 in the text). Earnings data from Jan.-June show only small differences between the two measures. However, for July-Dec. using the new measure results in earnings estimates that are 0.8-1.6 percent lower for high school dropouts and people with some college, and estimates for college graduates that are 0.9-1.8 percent higher. The college/high school earnings ratio is not much affected by the change in questions in Jan.-June. The new measure indicates that the ratio is 0.3 percentage points higher when using 1991 earnings, and 1.7 percentage points higher when using 1992 earnings. For the last half of the year, this ratio is 2.2 and 4.0 percentage points higher than under the old measure using 1991 and 1992 earnings.

Tables A3a and A3b show mean log hourly earnings for each (j,k) combination for January-June and July-December. Cell by cell differences of mean log wage between the first half and last half of the year are shown in Table A3c. In 10 of the cells, the differences are greater than one percentage point, but most of these differences do not exceed their standard errors. In only one cell (j=College Graduate, k=Some College), where it equals 16.0, is the difference statistically significant. The difference in means for this cell

accounts for most of the difference in the between-measure difference in the Some College and College Graduate categories between the two halves of the year.

While the magnitude of the difference between the two half-years for this cell could conceivably be due to seasonal or labor market factors, we do not think this is the case. First, we would expect other cells to exhibit comparable differences between half-years, but none do. Second, the pattern of decreasing wages for this cell with time is striking. The correlation of the monthly mean log hourly wage for this cell with month last asked the education item is -0.81 (p=.002). Using a non-parametric test, Kendall's tau (a measure of rank correlation) equals -0.64 (p=.004).

Tables for Appendix 1

Table A1a: Percentage Probabilities of Reporting 1992 Education Categories Conditional On 13A Adjusted 1991 Categories, Matched Outgoing Rotation Groups, January-June.

New Measure Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Unconditional Probability
High School Dropout	88.1	10.5	1.2	0.3	15.1
High School Graduate	4.2	88.0	7.0	0.8	37.5
Some College	0.6	9.0	85.1	5.3	23.1
College Graduate	0.2	1.4	6.7	91.8	24.4
Unconditional Probability	15.1	37.0	24.0	23.9	100.0

n=32,889

Table A1b: Percentage Probabilities of Reporting 1992 Education Categories Conditional On 13A Adjusted 1991 Categories, Matched Outgoing Rotation Groups, July-December.

New Measure Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Unconditional Probability
High School Dropout	86.2	11.7	1.6	0.4	15.3
High School Graduate	3.7	87.6	7.9	0.8	37.2
Some College	0.6	8.3	85.3	5.8	23.2
College Graduate	0.2	0.9	7.3	91.6	24.3
Unconditional Probability	14.8	36.5	24.8	24.0	

n=33,655

Table A1c: Second-Half First-Half Year Differences in Probabilities of Reporting 1992 Educational Categories Conditional on 13A Adjusted 1991 Categories, Matched Outgoing Rotation Groups.
(Standard Errors in Parentheses)
{p-values in Brackets}

New Measure Old (13A) Measure	(1) < HS Grad	(2) HS Grad	(3) Some Col.	(4) Coll. Grad	(5) Unconditional Probability
(1) High School Dropout	-1.8	1.3	0.5	0.1	0.2
	(0.6)	(0.6)	(0.2)	(0.1)	(0.2)
.	{0.003}	{0.030}	{0.036}	{0.281}	{0.234}
(2) High School Graduate	-0.5	-0.3	0.9	-0.1	-0.3
	(0.3)	(0.5)	(0.4)	(0.1)	(0.2)
	{0.071}	{0.548}	{0.036}	{0.415}	{0.130}
(3) Some College	0.0	-0.7	0.2	0.5	0.1
	(0.2)	(0.4)	(0.6)	(0.5)	(0.3)
	{0.986}	{0.074}	{0.704}	{0.264}	{0.593}
(4) College Graduate	0.1	-0.5	0.6	-0.2	0.0
	(0.1)	(0.2)	(0.4)	(0.5)	(0.3)
	{0.437}	{0.001}	{0.149}	{0.726}	{0.889}
(5) Unconditional Probability	-0.3	-0.5	0.7	0.0	
	(0.3)	(0.2)	(0.3)	(0.3)	
	{0.272}	{0.035}	{0.008}	{0.897}	
(6) Difference Between Old (13A) and New Measures Unconditional Probabilities Between Half Years (Column 5 – Row 5)	0.5 (0.1) {0.000}	0.1 (0.2) {0.466}	-0.6 (0.2) {0.001}	-0.1 (0.1) {0.549}	

Table A2a: Geometric Mean of Hourly Earnings by Education Category for January-June, 1991-1992 Matched Outgoing Rotation Groups (1991 dollars) Both sexes
(Standard Errors in Parentheses)
{p-values in Brackets}

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	7.85	7.85	7.87	0.3	0.3
				(0.4)	(0.4)
				{0.512}	{0.512}
High School Graduate	9.52	9.45	9.45	-0.7	-0.1
				(0.4)	(0.3)
				{0.044}	{0.817}
Some College	11.48	11.37	11.35	-1.2	-0.1
				(0.6)	(0.5)
				{0.043}	{0.763}
College Graduate	15.22	15.22	15.24	0.1	0.1
				(0.3)	(0.3)
				{0.617}	{0.617}
College Grad/HS Grad	1.600	1.610	1.613	0.014	0.003
	(0.018)	(0.018)	(0.018)	(0.006)	(0.006)
				{0.027}	{0.577}

n=25,673

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	7.84	7.84	7.83	-0.1	-0.1
				(0.5)	(0.5)
				{0.816}	{0.816}
High School Graduate	9.55	9.46	9.41	-1.4	-0.5
				(0.3)	(0.3)
				{0.000}	{0.072}
Some College	11.31	11.26	11.27	-0.4	0.1
				(0.5)	(0.4)
				{0.454}	{0.822}
College Graduate	15.49	15.49	15.58	0.6	0.6
				(0.2)	(0.2)
				{0.010}	{0.010}
College Grad/HS Grad	1.622	1.637	1.654	0.032	0.017
	(0.017)	(0.017)	(0.017)	(0.006)	(0.005)
				{0.000}	{0.000}

n=25,558

Table A2b: Geometric Mean of Hourly Earnings by Education Category for July-December, 1991-1992
Matched Outgoing Rotation Groups (1991 dollars) Both sexes
(Standard Errors in Parentheses)
{p-values in Brackets}

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	7.89	7.89	7.83	-0.8	-0.8	
				(0.6)	(0.6)	
				{0.170}	{0.170}	
High School Graduate	9.47	9.42	9.38	-0.9	-0.4	-0.5
				(0.3)	(0.3)	(0.2)
				{0.002}	{0.172}	{0.001}
Some College	11.63	11.46	11.34	-2.5	-1.2	-1.4
				(0.4)	(0.4)	(0.2)
				{0.000}	{0.014}	{0.000}
College Graduate	15.46	15.46	15.60	0.9	0.9	
				(0.3)	(0.3)	
				{0.001}	{0.001}	
College Grad/HS Grad	1.632	1.641	1.663	0.031	0.022	0.009
	(0.011)	(0.011)	(0.011)	(0.007)	(0.007)	(0.003)
				{0.000}	{0.001}	{0.001}

n=25,667

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)	% Difference Between Old (13A) and Old
High School Dropout	7.91	7.91	7.80	-1.4	-1.4	
				(0.4)	(0.4)	
				{0.001}	{0.001}	
High School Graduate	9.57	9.49	9.43	-1.4	-0.6	-0.8
				(0.2)	(0.2)	(0.2)
				{0.000}	{0.013}	{0.000}
Some College	11.44	11.35	11.17	-2.3	-1.6	-0.8
				(0.5)	(0.4)	(0.3)
				{0.000}	{0.000}	{0.006}
College Graduate	15.52	15.52	15.80	1.8	1.8	
				(0.3)	(0.3)	
				{0.000}	{0.000}	
College Grad/HS Grad	1.623	1.636	1.675	0.052	0.040	0.013
	(0.009)	(0.010)	(0.012)	(0.007)	(0.007)	(0.003)
				{0.000}	{0.000}	{0.000}

n=25,673

Table A3a: Geometric Mean of 1992 Hourly Wages by Old (13A) and New Education Measures
January-June, 1991-1992 Matched Outgoing Rotation Groups (in 1979 dollars)

New Measure / Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Overall Geo. Mean
High School Dropout	7.66	8.86	9.53	12.42	7.84
High School Graduate	8.93	9.37	10.56	12.39	9.46
Some College	9.92	10.38	11.24	13.54	11.26
College Graduate	10.38	10.57	13.24	15.73	15.49
Overall Geo. Mean	7.83	9.41	11.27	15.58	

n (1991)=25,673
n (1992)=25,558

Table A3b: Geometric Mean of 1992 Hourly Wages by Old (13A) and New Education Measures
July-December, 1991-1992 Matched Outgoing Rotation Groups (in 1979 dollars)

New Measure / Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Overall Geo. Mean
High School Dropout	7.69	8.73	9.83	14.21	7.91
High School Graduate	8.60	9.41	10.39	12.95	9.49
Some College	8.65	10.35	11.31	13.92	11.35
College Graduate	9.09	10.25	11.28	15.96	15.52
Overall Geo. Mean	7.80	9.43	11.17	15.80	

n (1991)=25,667
n (1992)=25,673

Table A3c: Second-Half First-Half Year Differences In Mean Log Wages (x 100) by Old (13A) and New Education Categories, 1991-1992 Matched Outgoing Rotation Groups
(Standard Errors in Parentheses)
{p-values in Brackets}

New Measure / Old (13A) Measure	High School Dropout	High School Graduate	Some College	College Graduate	Overall Difference
High School Dropout	0.5	-1.5	3.1	13.5	0.9
	(1.4)	(3.2)	--	--	(0.9)
	{0.748}	{0.646}			{0.337}
High School Graduate	-3.8	0.4	-1.6	4.4	0.3
	(4.3)	(0.8)	(4.1)	(10.0)	(0.6)
	{0.372}	{0.604}	{0.693}	{0.657}	{0.573}
Some College	-13.6	-0.3	0.6	2.7	0.8
	--	(3.1)	(1.0)	(4.7)	(0.7)
		{0.912}	{0.559}	{0.559}	{0.2891}
College Graduate	-13.4	-3.1	-16.0	1.5	0.2
	--	(9.9)	(4.5)	(1.2)	(0.8)
		{0.755}	{0.000}	{0.218}	{0.778}
Overall Difference	-0.4	0.2	-0.9	1.4	
	(1.2)	(0.6)	(0.7)	(0.8)	
	{0.743}	{0.740}	{0.244}	{0.069}	
Difference Between Old (13A) and New Measures Changes in Mean Log Wages Between Half of Years (Column 5 – Row 5)	1.3	0.1	1.7	-1.2	
	(0.5)	(0.3)	(0.4)	(0.2)	
	{0.014}	{0.594}	{0.000}	{0.000}	

Dashes indicate insufficient sample to calculate standard error.

Appendix 2: Adjustment Factors and Earnings Trends, Median Hourly Earnings of All Workers and Geometric Mean and Median Weekly Earnings of Full-Time Workers

This Appendix discusses the adjustment of median earnings. We also present adjustment factors and earnings trends for geometric mean and median weekly earnings for full-time workers, derived using the methods presented in this paper.

Throughout the section, median earnings were calculated using the same interval procedure used by the Bureau of Labor Statistics for official statistics.[19] The counter-factual medians were computed as described in footnote 21, but sample weights were multiplied by the counter-factual probabilities as was done with geometric means. To prevent negative weights, in calculating medians we assign values of zero to observations where $\hat{z}^C<0$ and one where $\hat{z}^C>1$.[20]

Estimation of the counter-factual medians poses a problem because the condition in equation (8) no longer holds. Hence, it is not clear whether one should compare the

[19] We calculate medians using the same procedure that the Bureau of Labor Statistics uses for official statistics. The first step is to divide the range of possible earnings values into intervals (the interval width is $.50 for hourly earnings and $50 for weekly earnings). Next, determine which interval contains the median observation. Let N be the total number of observations, W_i denote the weight attached to each observation, and D^L and D^U denote the lower and upper earnings levels of the interval that contains the median. The median equals

$$\text{Median} = \frac{\left(\frac{\sum_{i=1}^{N} W_i}{2} - \sum_{I_i<D^L} W_i\right)}{\left(\sum_{I_i<D^U} W_i - \sum_{I_i<D^L} W_i\right)} \times D^L + \frac{\left(\sum_{I_i<D^U} W_i - \frac{N\sum_{i=1}^{N} W_i}{2}\right)}{\left(\sum_{I_i<D^U} W_i - \sum_{I_i<D^L} W_i\right)} \times D^U.$$

[20] There were few values that were outside the unit interval.

counter-factual medians to the predicted medians or to the actual medians. Accordingly, we report both actual and predicted (non-counter-factual) medians.

Results are shown in Tables A4 and A5. A comparison of Table A4 with Table A5 shows that the change in the sample eliminates the difference between using 1991 earnings and 1992 earnings when comparing the two measures for college graduates (the difference in differences falls from .0045 to .0002) and reduces it by more than half for high school graduates (from .0026 to .0013)and more than half for the college/high school ratio (from .0119 to .0037), leaving very little for the counter-factual adjustment to do. Using the difference between the counter-factual with the estimated medians as the counter-factual adjustment, we find that this adjustment exhibits roughly the same pattern as it does for the geometric means; the difference between the measures for 1991 median college graduate earnings is 0.0076 greater under the counter-factual than the estimated. However, if we add this adjustment to the difference in measures between the new and the old (13A) it over-corrects in the sense that the correction is larger that the initial difference between 1991 and 1992 earnings. As a result, the college graduate earnings and the college/high-school ratio between the years are greater in 1991 than in 1992 after the adjustment.

Since our analysis gives us no clear guidance on how to adjust the medians and the counter-factual estimates show the same basic pattern as the geometric means, we use the method described above to generate our preferred adjustment factors for the medians: average the 1991 and 1992 differences between measures for all categories except college graduate, where we use the 1992 difference. Results are shown in the third column of Table 4.

Table A6, which is analogous to Table 5, shows the effect of applying the adjustment factors to earnings data from 1989-1993. Note that the growth of the college/high school earnings ratio falls in half once the adjustment has been made.

Results for weekly earnings for full-time workers are shown in Tables A7-A9.

Table A4: Median Hourly Earnings by Education Category for July-December, 1991-1992
Matched Outgoing Rotation Groups (1991 dollars) Both sexes
(Standard Errors in Parentheses)
{p-values in Brackets}

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	7.73	7.73	7.69	-0.5	-0.5
				(0.6)	(0.6)
				{0.409}	{0.409}
High School Graduate	9.43	9.35	9.32	-1.2	-0.4
				(0.4)	(0.4)
				{0.001}	{0.386}
Some College	11.89	11.73	11.59	-2.5	-1.2
				(0.6)	(0.5)
				{0.000}	{0.030}
College Graduate	15.46	15.46	15.71	1.6	1.6
				(0.4)	(0.4)
				{0.000}	{0.000}
College Grad/HS Grad	1.639	1.653	1.686	0.047	0.032
	(.0165)	(.0174)	(.0187)	(.010)	(.010)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.001}

n=25,667

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	7.65	7.65	7.52	-1.6	-1.6
				(0.7)	(0.7)
				{0.018}	{0.018}
High School Graduate	9.55	9.51	9.45	-1.1	-0.6
				(0.3)	(0.4)
				{0.000}	{0.080}
Some College	11.59	11.49	11.36	-2.1	-1.2
				(0.7)	(0.6)
				{0.002}	{0.056}
College Graduate	15.72	15.72	16.05	2.1	2.1
				(0.5)	(0.5)
				{0.000}	{0.000}
College Grad/HS Grad	1.646	1.654	1.698	0.052	0.044
	(.011)	(.012)	(.016)	(.009)	(.009)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}

n=25,673

Table A4 (continued) Men

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	9.23	9.23	8.95	-3.0	-3.0
				(0.6)	(0.6)
				{0.000}	{0.000}
High School Graduate	11.47	11.37	11.32	-1.3	-0.5
				(0.4)	(0.3)
				{0.000}	{0.140}
Some College	13.49	13.46	13.23	-1.9	-1.7
				(0.6)	(0.6)
				{0.001}	{0.003}
College Graduate	17.94	17.94	18.34	2.2	2.2
				(0.5)	(0.5)
				{0.000}	{0.000}
College Grad/HS Grad	1.565	1.578	1.620	0.055	0.042
	(0.016)	(0.016)	(0.020)	(0.012)	(0.011)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}

n=13,305

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	8.94	8.94	8.86	-0.8	-0.8
				(1.2)	(1.2)
				{0.438}	{0.438}
High School Graduate	11.35	11.25	11.17	-1.6	-0.7
				(0.4)	(0.4)
				{0.000}	{0.089}
Some College	13.67	13.54	13.49	-1.3	-0.4
				(0.7)	(0.5)
				{0.061}	{0.407}
College Graduate	17.72	17.72	17.87	0.8	0.8
				(0.5)	(0.5)
				{0.076}	{0.076}
College Grad/HS Grad	1.561	1.576	1.510	0.039	0.024
	(0.018)	(0.020)	(0.021)	(0.010)	(0.011)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.027}

n=13,232

Table A4 (continued) Women

Panel 1 -- 1991 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	6.20	6.20	6.20	0.0	0.0
				(1.1)	(1.1)
				{0.996}	{0.996}
High School Graduate	7.97	7.93	7.91	-0.6	-0.2
				(0.4)	(0.3)
				{0.091}	{0.476}
Some College	10.07	9.94	9.84	-2.3	-1.0
				(0.9)	(1.0)
				{0.017}	{0.317}
College Graduate	13.80	13.80	13.95	1.1	1.1
				(0.6)	(0.6)
				{0.058}	{0.058}
College Grad/HS Grad	1.732	1.739	1.762	0.030	0.023
	(0.023)	(0.023)	(0.021)	(0.012)	(0.011)
	{0.000}	{0.000}	{0.000}	{0.014}	{0.042}

n=12,362

Panel 2 -- 1992 Earnings	Old	Old (13A)	New	% Difference Between New and Old	% Difference Between New and Old (13A)
High School Dropout	6.12	6.12	6.12	-0.0	-0.0
				(1.1)	(1.1)
				{0.969}	{0.969}
High School Graduate	8.10	8.02	7.91	-2.3	-1.4
				(0.5)	(0.4)
				{0.000}	{0.000}
Some College	9.81	9.71	9.66	-1.5	-0.5
				(0.7)	(0.6)
				{0.029}	{0.401}
College Graduate	14.04	14.04	14.31	1.9	1.9
				(0.7)	(0.7)
				{0.006}	{0.006}
College Grad/HS Grad	1.733	1.750	1.809	0.075	0.059
	(0.028)	(0.028)	(0.027)	(0.016)	(0.015)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}

n=12,441

Table A5a: Counter-factual medians of earnings
(Standard Errors in Parentheses)
{p-values in Brackets}

	Old (13A)		New		Counter-factual		Estimated	
	1991	1992	1991	1992	1991	1992	1991	1992
High School Graduate	9.58	9.98	9.54	9.92	9.52	9.95	9.52	9.94
College Graduate	15.56	16.67	15.85	16.99	15.78	16.88	15.66	16.83
College/High School ratio	1.625	1.671	1.662	1.713	1.658	1.696	1.646	1.693
	(0.018)	(0.014)	(0.019)	(0.017)	(0.016)	(0.015)	(0.017)	(0.015)
	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}

n=22,577
Note: Median earnings will differ from those in reported in earlier tables, because these means are computed using only individuals in earnings sample in both 1991 and 1992.

Table A5b: Percent Difference Between Counter-factual, Actual, and Estimated medians of earnings
(Standard Errors in Parentheses)
{p-values in Brackets}

	New and Old (13A)			Counter-factual and Old (13A)			Counter-factual and Estimated		
	1991	1992	Difference	1991	1992	Difference	1991	1992	Difference
High School Graduate	-0.4	-0.5	-0.1	-0.6	-0.2	0.4	0.0	0.1	0.1
	(0.4)	(0.2)	(0.4)	(0.4)	(0.2)	(0.3)	(0.3)	(0.1)	(0.2)
	{0.356}	{0.009}	{0.714}	{0.128}	{0.233}	{0.239}	{0.950}	{0.327}	{0.653}
College Graduate	1.9	1.9	0.0	1.4	1.2	-0.2	0.8	0.3	-0.5
	(0.4)	(0.4)	(0.3)	(0.3)	(0.3)	(0.2)	(0.1)	(0.2)	(0.2)
	{0.000}	{0.000}	{0.944}	{0.000}	{0.000}	{0.175}	{0.000}	{0.228}	{0.042}
College/High School ratio	0.038	0.041	0.004	0.033	0.025	-0.0087	0.012	0.003	-0.010
	(0.011)	(0.007)	(0.009)	(0.008)	(0.005)	(0.006)	(0.005)	(0.003)	(0.006)
	{0.001}	{0.000}	{0.668}	{0.000}	{0.000}	{0.158}	{0.008}	{0.415}	{0.095}

n=22,577

Table A6. Median earnings by educational attainment for workers age 25-64 (in $1991), by sex
Both sexes

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Hourly Earnings						
High School Dropout	7.78	7.57	7.37	7.27	7.17	-7.8%
High School Graduate	9.60	9.37	9.24	9.18	9.20	-4.2%
Some College	11.29	11.38	11.37	10.86	10.82	-4.2%
College Graduate	15.47	15.47	15.14	15.29	15.34	-0.8%
College/High School ratio	1.612	1.651	1.639	1.666	1.668	5.6%
Making 13A adjustment to old item						
High School Graduate	9.54	9.31	9.18			-3.6%
Some College	11.17	11.23	11.20			-3.1%
College/High School ratio	1.623	1.662	1.648			4.5%
Making Suggested Adjustment to old (13A) item						
High School Dropout	7.69	7.49	7.30			-6.8%
High School Graduate	9.49	9.26	9.13			-3.1%
Some College	11.04	11.10	11.07			-2.0%
College Graduate	15.75	15.75	15.41			-2.6%
College/High School ratio	1.660	1.701	1.688			0.8%

Table A6 (continued) Men

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Hourly Earnings						
High School Dropout	9.15	8.82	8.59	8.43	8.28	-9.6%
High School Graduate	11.37	11.10	10.88	10.75	10.59	-6.9%
Some College	13.25	13.11	13.00	12.33	12.14	-8.3%
College Graduate	17.43	17.44	17.36	17.31	17.23	-1.2%
College/High School ratio	1.533	1.572	1.596	1.611	1.627	9.4%
Making 13A adjustment to old item						
High School Graduate	11.29	10.98	10.80			-6.2%
Some College	13.15	13.04	12.85			-7.6%
College/High School ratio	1.544	1.589	1.608			8.3%
Making Suggested Adjustment to old (13A) item						
High School Dropout	9.05	8.72	8.50			-8.6%
High School Graduate	11.23	10.92	10.74			-5.7%
Some College	12.99	12.88	12.70			-6.5%
College Graduate	17.74	17.75	17.67			-2.9%
College/High School ratio	1.580	1.625	1.645			4.7%

Table A6 (continued) Women

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Hourly Earnings						
High School Dropout	6.16	6.07	6.09	6.00	5.96	-3.1%
High School Graduate	7.98	7.86	7.86	7.78	7.71	-3.3%
Some College	9.93	9.90	9.86	9.58	9.49	-4.5%
College Graduate	13.33	13.14	13.06	13.52	13.60	2.1%
College/High School ratio	1.670	1.673	1.662	1.738	1.763	9.3%
Making 13A adjustment to old item						
High School Graduate	7.94	7.80	7.80			-2.8%
Some College	9.77	9.69	9.76			-2.9%
College/High School ratio	1.679	1.686	1.674			8.5%
Making Suggested Adjustment to old (13A) item						
High School Dropout	6.09	6.00	6.02			-2.1%
High School Graduate	7.90	7.76	7.76			-2.3%
Some College	9.66	9.57	9.65			-1.7%
College Graduate	13.57	13.38	13.30			0.2%
College/High School ratio	1.718	1.724	1.714			4.5%

Table A7. Suggested Adjustment Factors for Weekly Earnings at New Education Categories (%)

	Geometric Means		Medians	
Education Category	Old (13A)	Old	Old (13A)	Old
Drop-outs	-1.5	-1.5	Men: -1.7 Women: -0.5	-1.7 -0.5
High School Grad.	-0.4	-1.1	-0.4	-1.0
Some College	-1.2	Men:-2.1 Women:-2.5	-1.0	Men: -1.4 Women: -2.0
College Grad.	1.6	1.6	1.5	1.5

Table A8 Geometric mean of weekly earnings by educational attainment for workers age 25-64 (in $1991), by sex.

Men

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Weekly Earnings						
High School Dropout	392	380	367	362	355	-9.5%
High School Graduate	485	472	463	456	453	-6.6%
Some College	567	563	556	530	529	-6.8%
College Graduate	769	768	760	763	756	-1.6%
College/High School ratio	1.585	1.628	1.642	1.674	1.669	8.4%
Making 13A adjustment to old item						
High School Graduate	482	468	460			-6.0%
Some College	562	559	550			-6.0%
College/High School ratio	1.594	1.641	1.652			7.5%
Making Suggested Adjustment to old (13A) item						
High School Dropout	387	374	362			-8.1%
High School Graduate	480	466	458			-5.6%
Some College	556	552	544			-4.9%
College Graduate	781	781	772			-3.2%
College/High School ratio	1.627	1.674	1.686			4.2%

Women

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Weekly Earnings						
High School Dropout	265	261	263	262	261	-1.8%
High School Graduate	337	335	338	334	335	-0.6%
Some College	415	412	412	403	403	-3.0%
College Graduate	556	559	557	571	575	3.4%
College/High School ratio	1.647	1.668	1.648	1.708	1.714	6.7%
Making 13A adjustment to old item						
High School Graduate	336	332	336			-0.1%
Some College	409	407	407			-1.5%
College/High School ratio	1.655	1.682	1.659			5.9%
Making Suggested Adjustment to old (13A) item						
High School Dropout	261	257	259			-0.3%
High School Graduate	334	331	335			0.3%
Some College	404	402	402			-0.3%
College Graduate	565	568	566			1.8%
College/High School ratio	1.689	1.716	1.693			2.5%

Table A9 Median of weekly earnings by educational attainment for workers age 25-64 (in $1991), by sex.

Men

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Weekly Earnings						
High School Dropout	397	380	363	358	353	-11.1%
High School Graduate	500	485	476	469	463	-7.4%
Some College	569	569	569	543	545	-4.3%
College Graduate	779	777	768	771	762	-2.1%
College/High School ratio	1.558	1.602	1.615	1.645	1.647	8.9%
Making 13A adjustment to old item						
High School Graduate	496	480	472			-6.7%
Some College	566	565	562			-3.8%
College/High School ratio	1.569	1.619	1.628			7.8%
Making Suggested Adjustment to old (13A) item						
High School Dropout	390	374	357			-9.5%
High School Graduate	494	478	470			-6.3%
Some College	560	559	556			-2.7%
College Graduate	791	789	780			-3.7%
College/High School ratio	1.601	1.651	1.660			4.6%

Women

Educational Attainment	1989	1990	1991	1992	1993	%Change, 1989-93
Weekly Earnings						
High School Dropout	261	256	256	254	253	-3.2%
High School Graduate	337	330	332	330	330	-1.9%
Some College	419	414	411	399	401	-4.4%
College Graduate	560	561	566	579	577	3.1%
College/High School ratio	1.661	1.700	1.706	1.755	1.746	8.6%
Making 13A adjustment to old item						
High School Graduate	335	328	329			-1.5%
Some College	412	409	406			-2.8%
College/High School ratio	1.669	1.712	1.720			7.8%
Making Suggested Adjustment to old (13A) item						
High School Dropout	260	255	255			-2.7%
High School Graduate	334	327	328			-1.2%
Some College	408	405	402			-1.7%
College Graduate	568	569	574			1.6%
College/High School ratio	1.701	1.740	1.750			4.5%

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