Life-time earnings patterns of individuals are an important consideration in forecasting future earnings of individuals who have losses due to personal injury or death as well as valuing the enhanced earnings due to licenses and education obtained during a marriage. This paper provides fresh evidence of how earnings change over an individual’s life based on their educational level and whether these earnings have kept pace with inflation. In addition it provides some limited evidence on the issue of the stability of the age-earnings patterns over time and the possible effects of different data samples on the conclusions of previous studies.

**Keywords:** lifetime earnings, income potential, income and education

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Introduction

Earnings patterns of individuals, returns to education and accumulation of human capital from educational investments have long interested economists and a great deal has been written on the subject. In spite of all this interest, comparatively little attention has been devoted to studying the pattern of earnings over an individual’s life-time and whether this pattern varies with the level of education. Yet this pattern of earnings can be an important variable in forecasting an individual’s earnings to estimate losses from personal injury or death or estimating the value of education acquired during a marriage for the division of property in a divorce. Similarly, the effect of inflation on earnings is an important variable and many valuations simply factor a rate of inflation into their forecasts with little attention to whether it is reasonable to expect that an individual would have received inflationary increases over his or her remaining work life.

Economists have long recognized the concept of the formation of human capital. To quote Alfred Marshall (1890), “the most valuable of all capital is that invested in human beings.” The theory underlying the formation of human capital is straightforward. An individual creates capital by acquiring skills and knowledge through education, training, or experience associated with work. The acquisition of these skills and knowledge (human capital) then increases the individual’s future earnings over what he would have earned without the acquisition of the human capital. While generally the formation of human capital is an investment process, it can also be the result of the improvements in productivity that naturally occur on the job.

Since the formation of human capital is expected to result in an enhanced earnings stream, the valuation of that capital is done in the same way that any other economic asset is valued. That is, the expected future enhanced earnings over the individual’s working life are discounted to the present value.
This paper presents the results of a study of earnings patterns of individuals over the period from 1995 to 2010 by level of education. The cross-sectional data employed in this paper is based on annual releases by the U.S. Census Bureau’s Current Population Survey (CPS). Specifically the study shows:

The average pattern in which an individual’s income increases over time and how this pattern varies with the individual’s level of education.

How the earnings of individuals have changed over time in relation to inflation and whether this pattern varies with the individual’s level of education and age.

**Literature Review**

In an early study of life cycle earnings, Rosen and Taubman (1982) use a sample of data from Social Security and the Current Population Survey to study the life-cycle earnings patterns of white males over the period from 1951 to 1976. They use regression and tobit analysis with a single dependent variable on the logarithm of earnings in 1967 and 1972. As a result of their methodology Rosen and Taubman can speak to the effects of education and age, but their findings do not directly provide an earnings pattern by age and they cannot separate the results by educational level. In summary Rosen and Taubman find that estimated direct effects of schooling and experience compare well with other studies, but interaction effects with cohort do not. Specifically they note that “... younger cohorts exhibit smaller marginal returns to schooling and larger marginal returns to experience” (p. 321).

Rosen and Taubman also provide an interesting discussion of the data limitations in their sample. They report that the CPS only has data on individuals since 1967 and that a large proportion of the individual observations do not have valid earnings records. As a result they only
have useable information on 2,453 individuals. Fortunately, the CPS now provides a much more complete set of data.

Gohmann, McCrickard and Selsnick (1998) studied life cycle earnings patterns using a different source of data and compared changes in patterns from 1979 and 1989. Their data came from the U.S. Census Public Use Micro data which, at the time, had more depth of data than the P-60 source used by Rosen and Taubman. Gorman et al. raise the issue that using cross-sectional data for future earnings projections will bias the results if age-earnings profiles are not stable over time. Their analysis showed that the profiles did change over the time interval studied. They also found that earnings peak at about age 60. However, there is the question of whether the change in the age-earnings profiles they found still persists, whether the results are affected by combining all education beyond 16 years in one category and whether sampling error affects the results since they only looked at two points in time. Moreover, the current version of the P-60 has become much richer since their study.

A year later Christensen (1999) used the P-60 data in a study which includes age-earnings profiles. He used data for 1980 and 1997 and found that earnings peaked for individuals in their late 50’s and exhibited an inverted U shape. Again these data are dated and are limited to two points in time.

A good summary of age-earnings profile research and issues is found in Selsnick, Payne and Thornton (2005). They pay particular attention to the issue of the stability of the profiles and talk about earnings peaking at around age 60.

Using the National Longitudinal Survey of Young Women, Betts (200) reported “no link between education and school resources.” The education measures employed were pupil-teacher ratio, spending per pupil, teachers’ starting salaries, or books per student. They did however find differential impacts of education by race. Additionally, they found that in some instances the impact of education on earnings weakens as workers
grow older. While this work focuses on education inputs, rather than educational attainments, its conclusions about the differential impact of education by race and age are important and related to this work.

Authored by Cheeseman Day and Newburger (2002), this Census Bureau report that employs CPS data to identify lifetime earnings would seem to be the most relevant previous analysis to our current work. The report employs CPS data to identify lifetime earnings estimates as well as the economic value of an education, that is, the added value of a high school diploma or college degree. It is our contention that these data provide the best insight into these issues.

Since Cheeseman Day and Newburger analyze data up to the year 2000 for full-time year round workers, our contribution extends the analysis to 2010 and looks at all workers rather than only full time workers employed year round. This last point may reduce the downward bias in the returns to education, introduced if, as economists have contended since Ashenfelter and Ham (1979), individuals with lower levels of educational attainment have more frequent incidences of unemployment of longer duration than individuals with higher levels of education. Limiting the analysis to full-time workers who were employed year round eliminates those that are unemployed at any time during the year from the sample. One would expect lower mean annual earnings from the excluded group.

**DATA DESCRIPTION**

The data used in this study come from the Current Population Survey (CPS), a joint effort between the Bureau of Labor Statistics and the Bureau of the Census. The information about earnings, age, gender and educational attainment were formerly released in print as the P-60 series. This information is now only available on Census web servers in the PINC-04 tables. The web site for the PINC-04 series is referenced at the end of this paper. The relationship between the paper releases of the
P-60 series and the current web based PINC-04 tables and the transition from the Annual Demographic Supplement to the March Annual Social and Economics Supplement of the Current Population Survey is described by Hachman and Fjeldsted (2006). The micro data generated by the supplements to the CPS source has been used in the earlier studies. The current survey is now a much richer source of data and contains information on the mean earnings of individuals by age category, level of education, gender and race. It also differentiates between all workers and workers who worked full-time year round. We had data available for the years 1995 and the years 2000 through 2010, which gives us the ability to address the issue of sampling error introduced by only looking at a few points in time. This paper’s analysis is limited to the sample of all workers and combines gender and races. Further work will disaggregate the sample to see if the findings differ by gender and race.

Unlike the sample size problems encountered by Rosen and Taubman, the CPS currently has over 151,000 observations. We did not use all the age categories and Table 1 provides the sample sizes by educational level for 2010 for the data we used. In order to maximize sample size by age we limited the categories to 10 year intervals and did not include anyone under the age of 25. This will exclude the experience of individuals with lower levels of education that enter the work force at an earlier age. A clear limitation of the data is that it does not necessarily track the earnings of the same individuals over time. It is reasonable to expect that the individuals in each sample year will change. As stated by Gohmann, et al., the use of age-education-earnings profiles based on aggregated cross-sectional data to establish future earnings patterns are appropriate if the profile is stable over time. The availability on a yearly basis of the earnings by education and age by the Census Bureau provides annual data that is consistent over time. It is our contention that this cross-sectional data source shows that the underlying profile is stable, at least in terms of relative change when compared to inflation; and thus a reliable source of information about future earnings patterns.
Life-Time Earnings by Age and Level of Education

Findings

At this stage we limited our analysis to a comparison of means over time. Table 2a provides the mean earnings by year and by age category for all levels of education combined. The data are broken down by educational level in Tables 2b through 2i in the Appendix. Mean earnings have the advantage over median earnings if the bias introduced from the use of interval data in median calculations for the PINC-04 data found by Hachman and Fjeldsted (2006) holds. In Table 2a it can be seen that the mean earnings of all individuals, regardless of education have increased from $26,792 in 1995 to $42,922 or by 60% over the 15 year period. This clearly exceeds the rate of inflation as measured by the Consumer Price Index over the same period, which is 43%. In addition the mean earnings increased every year from 2006 to 2010 with the exception of 2009 where the decrease was minor. This suggests that the impact of the Great Recession on mean earnings in this sample was not that large.

Figure 1, which is for 2010, clearly shows the returns to increasing levels of education. It also provides a preview of the findings about the behavior of earnings over workers’ life-times. However since this is only for one year it does not reflect the average earnings pattern over the entire sample of years which will now be presented and discussed.

In Table 3 we provide summary statistics for all educational levels combined showing the average increases in earnings by age category over the 12 sample years. A breakdown of the age patterns by level of education is in the Appendix. Looking at the all persons category, we see that on average earnings of 35 to 44 year old individuals are 31.8% higher than the earnings of 25 to 34 year olds. In the next 10 year category the earnings are 6.8% higher than the previous age category. Earnings for 55 to 64 year olds are 95% of the earnings of 45 to 54 year olds and those 65 years of age and older are 71% of the earnings of the 55 to 64 year olds. Thus, holding the effects of inflation constant, it is apparent that individual earnings in general peak at age 45 to 54 category. Due to the 10 year spans in our age categories we cannot confirm or refute
the conclusions of previous studies that earnings peak in the late 50’s. However it seems reasonable to conclude that our data confirms the earlier studies. Interesting, the earnings peak in the 45 to 54 year old category for each level of education except for those who are not high school graduates. This pattern is not what we would have expected. If individuals with lower levels of educational attainment are more likely to work in more physically demanding jobs then it would be reasonable to expect that their earnings would peak earlier than those who are more highly educated, have less physically demanding jobs and are more likely to work longer. Perhaps individuals who are more highly educated and have higher incomes are able to retire or cut back their work effort earlier.

A visual inspection of Tables 2b through 2i shows the effect of what we call sampling error in the data, i.e. different results because each year’s data is a sample from the underlying population. There are 12 years of data and 8 different educational levels giving a total of 96 observations. The most frequent age group for earnings peaking is 45 to 54 with 74 observations or 77.1%. However in four cases (4.1%) the earnings peaked in the 35 to 44 age group and in 18 cases (18.8%) the earnings peaked in the 55 to 64 age group. This variability is sufficient to suggest that some of the lack of stability in age-earnings patterns found in prior studies is due to sampling error.

Table 4 provides evidence about the changes in earnings relative to inflation as measured by the CPI. In this table we hold the age categories constant. Again looking at the all persons category, the average earnings for individuals 25 to 34 years of age increased 52.1% from 1995 to 2010. Over that same period the CPI increased 43.1% showing earnings clearly out-pacing inflation. All the age categories out-pace inflation, but the greatest increase is in the 65 and older category. This may well reflect individuals who are working longer. Table 4 in the appendix breaks the data down by level of education. Interestingly, this breakdown shows no clear patterns relative to either age or educational level when it comes to
earnings growth and inflation. This is again contrary to our expectations. We had believed that the earnings of individuals with higher levels of education would have had a greater margin of increase over inflation.

**Conclusions**

In this research we studied the data on the changes in mean earnings of individuals over the period from 1995 to 2010 to determine the answers to three questions. In the first question we wanted to know at what age level an individual’s earnings peaked, holding inflation constant and whether this age was a function of educational level. Overall we found that earnings peak for 45 to 54 year olds and that the pattern generally holds true no matter what level of education the individual has attained. Second, we wanted to know about the stability of the age-earnings pattern and whether it was a function of when the data was taken. The preliminary evidence is that sampling error may have an effect on the conclusions about stability. Finally, we wanted to know if earnings by age category and educational level have kept pace with inflation. We found the answer to be yes and it is generally true for all age groups and all levels of education.

Our analysis of the data in this paper has been aggregated and fairly rudimentary. As next steps we plan to break the sample down to see if the patterns we have observed are true by gender and race. In addition, following Rosen and Tubman we will employ more sophisticated statistical analysis techniques to see if the data provide us with any additional insights.

**References**


All income and earnings are as reported by U.S. Bureau of the Census at http://www.census.gov/hhes/www/cpstable/032012/perinc/pinc04_000.htm

Technical documentation for the above may be viewed at http://www.census.gov/hhes/www/cpstable/032012/hhinc/toc.htm


**Web Appendix**

A web appendix for this paper is available at:

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**Citation Information**