

# Is The Wage Gap Between High School And College Graduates Widening? A Panel Analysis

Diamando Afxentiou, New York Institute of Technology, USA  
Paul Kutasovic, New York Institute of Technology, USA

## ABSTRACT

*This study examines the wage growth of high school graduates and college graduates. The NLSY-79 data is employed. The data shows that college graduates earn a premium over high school graduates and the premium is widening over time. A panel regression model was estimated for the years 1982 until 2004. The results show that education has a significant positive effect on wages and it is the primary determinant of the wage gap. Also, age and gender were found to have a significant effect on wages. Testing the impact of occupation, only managerial, clerical, and service jobs had a significant effect on wages. Production jobs were statistically insignificant as suggested by the labor market polarization theory.*

**Keywords:** Wage inequality, wage polarization, NLSY-79 data, panel regression

## INTRODUCTION

The role of education in impacting wages is an important public policy issue. The question is: Does the investment in a college education pay over time in terms of higher earnings? The conventional argument is that raising the educational level of the workforce would achieve this result since an investment in human capital would produce a return to the individual in the form of higher earnings (Mincer, 1974; Becker 1962). Historically, the data shows a significant gap in the incomes of college and non-college educated workers. What is surprising is that since the early 1980s the wage premium favoring college graduates has widened.

The objective of this study is to:

1. Investigate if the income gap favoring college educated individuals has widen over the period 1982 to 2004 using a different data set than previous studies,
2. Examine factors impacting wage growth while controlling for education,
3. Examine the impact of polarization in the labor market, and
4. Use panel analysis to estimate the determinants of wage growth.

Most previous research on the labor market has used the Panel Study of Income Dynamics (PSID) data and the Current Population Survey (CPS) data. In contrast, this study employs NLSY-79 longitudinal data which provides a rich source of data to study the labor market in connection with wage growth. A panel least squares model is used to estimated wages for the years 1982 until 2004.

The paper is organized as follows: section II provides the background, section III discusses the data and the sample, section IV presents the panel least squares analysis, and the paper ends with the conclusions and recommendations in section V.

## **BACKGROUND**

Recent studies show that college graduates earn a premium over high school graduates (Afxentiou and Kutasovic, 2008; Afxentiou, 2008; Blau and Kahn, 1997; Isaacs, Sawhill and Haskins, 2007; Moretti, 2008). These findings are consistent with the human capital theory of wage determination (Mincer, 1974; Becker, 1962). Human capital refers to the technical skills and knowledge acquired by workers. Education represents an investment in human capital that generates a return through higher earnings. Under this view, the main determinant of earnings is the number of years of schooling. More schooling should be associated with more human capital and thus higher level of wages.

The evidence supports the human capital theory of wages as college educated workers earn a premium over non-college educated workers. But the wage premium that college graduates earn over high school graduates is widening as the wages of college educated workers grow at a faster rate than high school educated workers. The size and change of this wage gap depends on the data source used by the researcher.

Blau, Ferber, Winkler (2002), using census data, found that in 1967 college graduates earned 50 percent more than high school graduates while in 1999 college graduates earned 80 percent more. Piketty and Saez (2003) using tax-return data showed that the earning spread between the upper-end (1%) of the earnings distribution relative to the rest of the workers is widening. Afxentiou and Kutasovic (2008), using NLS-79 data, found that between 1981 and 1992 the wage premium favoring college educated workers was essentially constant with wages for both high school and college educated graduates increasing at about the same rate. But during the 1990's something changed as the wage gap favoring college graduates widen sharply. The study attributed the widening wage gap to the stagnation of the wages of high school graduates with wages steadily increasing for college educated workers. These findings are consistent with Lemieux (2006a) who reports that returns to post-secondary education increased sharply in the period 1973 to 2005 while returns to lower levels of education remained relatively unchanged.

A study by Moretti (2008) using data from the Census of Population found that nominal wages between high school graduates and college or more graduates has increased 20 percentage points between 1980 and 2000. The study found that college graduates concentrate in big cities with higher cost of housing. Adjusting for the higher cost of living the college premium was smaller, 8 – 10 percentage points. The results of all these studies are consistent with the growing trend towards income inequality in the US since the 1980s.

A number of factors have been hypothesized by economists to account for the widening of the wage gap:

1. On the supply side, a slowdown in growth of college educated workers in the 1980s has caused wages for college educated workers to rise (Katz and Murphy, 1992; Card and Lemieux, 2001);
2. On the demand side, globalization has decreased the domestic demand for unskilled workers (Gordon and Dew-Becker 2007) as rising imports and a growing trade deficit eliminates domestic jobs in import competing industries;
3. Also on the demand side, the relative demand for skill labor increased because of technological innovations (skill biased technological changes) that require workers to have higher skills thus higher educational levels and experience. Recent research (Autor, Katz, and Kearney, 2008; Golding and Katz, 2007) shows that technological innovations increase the demand for non-routine abstract jobs, reduce the demand for routine middle-skills jobs that are easily replaced by machines or outsourced, and have little impact on non-routine manual low-wage service jobs. This strong persistent rise in inequality in the upper half of the wage distribution causes what economists call earnings “polarization”.
4. Non-market conditions are another explanation of the increasing wage inequality. The reduction in the real value of the minimum wage (Card and DiNardo, 2002; Lemieux, 2006b) and changes in the labor force composition due to changes in educational attainment and experience (Lemieux 2006b) are the reason for the growing wage inequality. According to this “revisionist” view, wage inequality is a non-market phenomenon thus, only a temporary situation.

The confluence of the above factors accounts for the widening wage gap between college and high school educated workers. On one hand, the wages of college educated workers are rising as the supply of college graduates falls while skill biased technological changes push up their demand. On the other hand, high school wages are falling in response to lower demand for unskilled workers. Both of these effects together contribute to the widening of the gap. In addition, the demand for skill labor changes in a non-monotonic manner; increasing the demand for abstract high-wage jobs and decreasing the demand for routine middle-wage jobs. Thus, wage inequality becomes more persistent in the upper half of the wage distribution causing “polarization” of the labor market.

The present study expands on the Afxentiou and Kutasovic (2008) study by using a panel analysis and the NLSY-79 data to explain wage growth for individuals holding either a high school degree or a college degree from 1982 until 2004.

**DATA**

This study uses the same data as the Afxentiou and Kutasovic (2008) paper. The NLSY-79 data is used from 1979 to 2004. The NLSY-79 data consists of a nationally representative sample of 12,686 individuals aged 14 – 21 in 1979 when they were first interviewed. The survey was contacted annually until 1994 and biennial thereafter. The sample includes individuals who received their high school degree and college degree between 1980 and 1982 in order to control for changes in education and their influence on wages. These individuals were followed until 2004, the year of most currently available data. In order to keep the educational level constant through the test period, the data is verified for each individual to ensure that their level of education didn’t change during this period. The sample included a total of 972 individuals; 886 had a high school diploma and 86 had a college degree. The sample had 502 males and 470 females (Table 1).

**Table1: Data Statistics**

	<b>High School (12)</b>	<b>College (16)</b>	<b>Total</b>
<b>Men</b>	465	37	502
<b>Women</b>	421	49	470
<b>Total</b>	886	86	972

Data shows that college graduates earn more than high school graduates in every year since 1981. Adjusting wages for inflation to obtain the real difference between the wages earned by college and high school educated workers measured in constant 1981 prices revealed that the real difference is growing over time (Table 2).

**Table 2: Wage Comparisons**

<b>Year</b>	<b>Mean Wages (\$)</b>		<b>Real Wages (1981 prices)</b>		
	<b>High School</b>	<b>College</b>	<b>High School</b>	<b>College</b>	<b>Differences</b>
1981	3,662	8,090	3,662	8,090	4,428
1982	5,412	14,163	5,147	13,469	8,322
1984	7,100	18,283	6,297	16,215	9,918
1986	9,684	20,903	8,200	17,701	9,500
1988	12,048	23,509	9,362	18,268	8,906
1990	14,243	30,127	9,964	21,077	11,112
1992	20,221	34,350	13,319	22,625	9,306
1994	17,403	36,754	10,871	22,960	12,088
1996	19,619	41,379	11,576	24,415	12,839
1998	21,695	49,115	12,356	27,973	15,617
2000	25,588	53,085	13,734	28,493	14,759
2002	27,900	59,441	14,341	30,555	16,213
2004	27,491	64,410	13,449	31,512	18,062

Over the entire period, college educated workers earned more than high school educated workers both in nominal and real terms and the difference in wages is growing over time.

**PANEL ANALYSIS**

A panel analysis explaining wage growth was estimated using longitudinal data from 1982 until 2004. Cross-sections included 790 observations and the panel observations were 7,242. With panel data, the observations are not necessarily independently distributed over time. Panel data sets are useful for controlling for time constant unobserved factors. To estimate the model, the data is differenced to remove the unobserved effect. A pooled OLS estimation procedure is used.

The specification of the wage equation is similar to those reported in past studies.

$$Wages = \beta_0 + \beta_1 Age + \beta_2 Gender + \beta_3 Race + \beta_4 Educ + \beta_5 FamInc + \beta_6 Occup + \beta_7 Region$$

The dependent variable is the annual wage recorded for each individual in the NLSY-79 database. The independent variables are age, gender, race, education, family income in 1979, occupation, and region of residence. Education is a dummy variable equals to one for individuals holding college degree and zero for individuals holding high school or GED degrees. Race is divided into three categories, white, black, and other races.

**Table 3: Descriptive Statistics and Panel Analysis**

Variable	Descriptive Statistics	Panel Least Squares	t-test
	Median/Proportion	Coefficient	
Wages	\$13,000		
Age	32	1203.34	7.28
Family Income 79	\$15,000	-0.005	-0.06
Gender			
Male	52%	16855.60	6.60
Female	48%		
Race			
White	58%	-5640.78	-1.20
Black	30%	-6773.52	-1.35
Other	11%		
Highest Grade Completed			
High School	91%		
College	9%	23800	4.52
Occupation			
Production	36%	1614.90	0.49
Managerial	17%	13911.71	3.47
Clerical	17%	10632.95	2.77
Sales	9%	10183.64	2.14
Other	21%		
Region			
North east	16%	4601.99	1.17
North central	24%	-3529.06	-1.00
South	41%	-3026.08	-0.90
West	19%		
Panel Observations		7242	
R <sup>2</sup>		0.029	
F		16.76	

The occupation variable consists of five categories and is used to test the labor polarization theory. The first category is production and includes construction, repairs, operators and tenders, transportation and material moving workers. Category two is managerial and includes managerial, technical, and professional occupations. Category

three is office and administrative support occupations (clerical). Category four is sales and related occupations (sales). Finally, category five includes the remaining occupations including service occupations, farming, forestry, fishing and military occupations. Under polarized labor markets, high-wage and low-wage jobs grow at the expense of middle-wage jobs. Category one jobs should thus be adversely impacted.

Region of residence is divided into four areas, North East, North Central, South, and West. Summary statistics for these variables is presented in Table 3.

The panel Least Squares results are shown in Table 3. Age, gender, and education have a strong positive effect on wages. Occupations had a significant effect on wages with the exception of production jobs which were statistically insignificant. This result is consistent with the wage polarization theory which believes that technology compliments high skill, “abstract” jobs like managerial and professional jobs and reduces the demand for mechanical skill “routine” jobs like manufacturing production jobs. According to the polarization theory, technology has little impact on non-routine “manual” jobs like low skill service jobs.

Race and region were insignificant despite the disparity in grow among regions in the US. Family Income in 1979 was also statistically insignificant even though data shows that high school graduates had a mean family income in 1979 of \$16,515 while the college graduates had a mean family income of \$23,725. Family income influence people’s decision to acquire education but in the long run it doesn’t affect wages.

## **CONCLUSIONS AND RECOMMENDATIONS**

A large number of studies have examined the changing wage structure in the US since the 1980s. This study focused on wage differentials by education. Utilizing the NLSY-79 data and panel analysis, the study finds the wage gap favoring college educated workers has widened sharply since the early 1990s.

The literature suggests two possible explanations for the growing wage gap. First, the traditional view attributes the widening of the wage gap to shifts in labor supply and demand. Under this view, there will be a growing dispersion of earnings over time and a growing gap in earnings. In contrast, the revisionist view argue that nonmarket factors like the erosion of labor unions and the decline in the real minimum wage explain the widening of the gap that occurred in the 1980s. Proponents of the revisionist view state that the widening of the wage gap is mainly a one-time (episodic) event.

The results of the current study, based on NLSY-79 data source, show little support for the revisionist view. The present study found that the wage gap was relatively constant in the 1980s, contrary to the revisionist view. Then in the early 1990s through the last data point in 2004 the wage gap continued to grow with the wages of non-college educated workers stagnate. Clearly, the wage gap was not a one-time event but due to ongoing shifts in labor supply and demand.

The panel analysis suggests that most of the wage gap is due to education and the higher returns to college educated workers. Age, which is a proxy for experience and a component of human capital, also had a positive and significant impact on wages in the panel analysis.

The trend toward labor polarization is evident in the interpretation of the occupation variable. Occupation had a positive effect on wages with the exception of production workers and consistent with the labor market polarization theory. Low skill service jobs (manual) and managerial jobs (abstract) had significant effect on wages while production jobs (routine) were statistically insignificant. Finally, race didn’t have an impact on wages while gender had a strong significant effect.

The results clearly show that the returns to education are significant and likely to remain so in an economy with skill biased technological changes. The problem is that the educational attainment of the US work force is not keeping pace with the demand. This supply and demand imbalance largely accounts for the surge in the college wage premium. Increasing the educational attainment of the US work force is the key to narrowing the wage gap.

Further changes in the wage structure in the US are likely given the move towards global integration and outsourcing. As more data becomes available, the NLSY-79 data is an excellent source to study the impact of these factors in the evolution of the US labor market.

#### **AUTHORS INFORMATION**

**Diamando Afxentiou**, Ph.D. received her MA degree from The New School for Social Research and her Ph.D. degree from West Virginia University. She joined the faculty of New York Institute of Technology in 1990 and is currently an Associate Professor and an Associate Dean in the School of Management. Her research interest is in the area of labor economics and public policy.

**Paul R. Kutasovic**, Ph.D. received his MA and Ph.D. degrees from Rutgers University. He joined the faculty of New York Institute of Technology in 1988 and is currently a Professor and the Chair of the Economics Department. His research interest is in the area of financial markets, regional economics and economic indicators.

#### **REFERENCES**

1. Afxentiou, D. and P. R. Kutasovic, Does College Education Pay? Evidence from the NLSY-79 Data, *Northeast Business & Economics Association Proceedings*, Vol. 35, pp. 96-98, 2008.
2. Afxentiou, D., A Comparative Analysis of Gender Wage Inequality in the Early 2000's, *A.T. Business Management Review*, Vol. 4, No. 2, pp. 65-73, 2008.
3. Autor, D. H., L. F. Katz and M. S. Kearney, Trends in U.S. Wage Inequality: Revising the Revisionist, *The Review of Economics and Statistics*, Vol. 90, No. 2, pp. 300-323, 2008.
4. Becker, G. S., *The Economics of Discrimination*, 2<sup>nd</sup> ed. Chicago: University of Chicago Press, 1971.
5. Blau, F.D. and L. M. Kahn, Swimming Upstream: Trends in the Gender Wage Differential in the 1980s, *Journal of Labor Economics*, Vol. 15, No. 1, pp. 1-42, 1997.
6. Blau, F. D., M. A. Farber and A. E. Winkler, *The Economics of Women, Men, and Work*, 4<sup>th</sup> ed. Upper Saddle River, NJ: Prentice Hall, 2002.
7. Card, D. E. and T. Lemieux, Can Falling Supply Explain the Rising Return to College for Young Men? *Quarterly Journal of Economic*, Vo. 116, (May), pp. 705-746, 2001.
8. Card, D. and J. E. DiNardo, Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles, *Journal of Labor Economics*, Vol. 20, pp. 733-783, 2002.
9. Goldin, C. and L. F. Katz, Long-Run Changes in the U.S. Wage Structure: Narrowing, Widening, Polarizing, Presented at Brookings Panel on Economic Activity, Washington, D.C., September 7, 2007.
10. Gordon, R. J. and I. Dew-Becker, Unresolved Issues in the Rise of American Inequality, Presented at Brookings Panel on Economic Activity, Washington, D.C. September 7, 2007.
11. Isaacs, J. B., I. V. Sawhill and R. Haskins, Getting Ahead or Losing Ground: Economic Mobility in America, The Brookings Institution, 2007.
12. Katz, L. F. and K. M. Murphy, Changes in Relative Wages, 1963-87: Supply and Demand Factors, *Quarterly Journal of Economics*, Vol. 107, (February), pp. 35-78, 1992.
13. Lemieux, T., Post-Secondary Education and Increasing Wage Inequality, NBER working paper no. 12077, 2006a.
14. Lemieux, T., Increased Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill, *American Economic Review*, Vol. 96, pp. 461-498, (June) 2006b.
15. Mincer, J., *Schooling, Experience, and Earnings*. N.Y.: National Bureau of Economic Research, 1974.
16. Moretti, E., Real Wage Inequality, National Bureau of Economic Research, MA, 2008.
17. Piketty, T. and E. Saez., Income Inequality in the United States, 1913 – 1998, *Quarterly Journal of Economics*, Vol. 118, No.1, pp.1-39, 2003.