

RESEARCH ARTICLE

THE DYNAMICS OF EARLY-CAREER WAGE GROWTH IN THE UNITED STATES: AN ANALYSIS OF AGE, EDUCATION, AND GENDER EFFECTS (2012–2024)

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Abstract: This study examines earnings patterns for individuals in full-time work between the ages of twenty-five and thirty-four in the period from two thousand twenty to two thousand twenty-four. The period shows significant changes in the market for work. The analysis uses data from IPUMS CPS and follows a framework relating to development of work ability. The approach uses measures for each separate age to follow change in earnings. The analysis includes factors relating to individuals, work positions, and locations as other variables. Results show that earnings increase with age in a pattern that is significant and positive. This increase shows marked development following age 28. The pattern reaches the main level at age 34. The analysis indicates two main structures that produce differences between groups. The study finds a substantial difference relating to education level that shows increase over time. This difference is particularly large for individuals with degrees following initial degrees. The analysis also reveals a gap between earnings for different groups that remains at 4.7%. This gap appears in data that include other variables as controls. The difference remains across the analysis. The findings suggest that returns relating to time in work differ by level of education. The study shows that these returns are divided into separate patterns. This indicates that education level affects how experience relates to earnings.

Keywords: Dynamics, Gender Effects, Education.

Article Received: 01 July 2026

Revised: 17 July 2026

Accepted: 21 July 2026

INTRODUCTION

The period from age 25 to 34 represents a phase with substantial importance in careers. This decade includes transitions from completion of formal learning to establishment in work contexts. It includes development of capacity through experience. It often includes major decisions in life that relate to economic outcomes. Examining how earnings develop during this period provides understanding of how investment in individual capacity through learning translates to earnings.

It shows how contexts for work provide returns to different forms of credentials. It reveals how structural differences that produce inequality persist across generations. This study examines the pattern showing development of average earnings per hour for individuals in the United States aged 25–34 from 2012 to 2024. The analysis provides particular attention to how these

patterns of development show effects from level of educational attainment and from gender. The structure of wages in the U.S. has shown major changes across recent decades. The structure remained relatively stable in the middle part of the twentieth century. It began to widen rapidly during the 1980s. The widening was followed by a pattern that shows polarization from the late 1980s. These changes occur through complex interactions.

The interactions involve technology change that relates to skills (Acemoglu and Autor, 2011). They involve shifting patterns in labor supply. They involve changes in institutions.

The period of early career covers ages 25 to 34. This period provides an important window. The window allows observation of how large-scale factors appear in individual earnings paths. Workers move from

education to sustained employment during this period. They begin to obtain returns on their investments in human capital during this time.

Recent data show persistent differences in wage outcomes by gender across all education levels. In 2024, women earned less than men at every education level. The gap appears most pronounced among individuals with advanced degrees. Women with advanced degrees earned \$49.45 while men earned \$65.11. The gap remains present even among workers with less than a high school education. Women in this group earned \$15.68 versus \$19.52 for men. These current differences indicate the need to examine how gender and education interact (Blau and Kahn, 2017). The interaction shapes wage development during early career stages.

This research uses the work of Mincer (1974) as a foundation. Mincer developed a function for earnings based on human capital. The function established the framework for analyzing wage patterns across the life cycle. Research by Katz and Murphy (1992) that followed demonstrated the role of supply and demand factors. These factors explain changes in wage structures. Autor, Katz, and Kearney (2008) provided evidence of polarization in the U.S. labor market. They documented implications for wage inequality.

This study draws on insights for estimation of wage profiles in method. The insights include recognition that standard forms may produce estimates that mislead. Alternative forms may better represent patterns that appear in data.

The main questions that this study examines are the following. The first question shows how wages change across ages 25 to 34 for legal workers in the United States. The second question examines how educational differences change these age-wage patterns. The third question examines how gender differences appear in early-career wage patterns. These differences are examined overall and within educational categories. This study uses data from twelve years.

The data are from two thousand twelve to two thousand twenty-four. The data show high frequency. This study provides evidence on early-career wage patterns.

The period that the study examines includes post-Great Recession recovery. This period also includes changes from new forms of work. This period includes a global pandemic.

MODEL AND DATA

Theoretical Framework

The approach that this study uses follows from the theory of earnings relating to investment in education and experience. This theory was developed by Mincer. The theory suggests that wages show investment in education. Wages also show on-the-job experience. This study examines early-career workers. The model that the study uses is different from the standard model. This study uses indicators for single years of age. The study does not use a measure that is continuous for experience.

The approach that allows flexibility is used. Research suggests that less restrictive forms are better than the traditional form that uses a specific function. The traditional form is too restrictive. This approach allows the data to show the shape of wage changes. The changes are between ages twenty-five and thirty-four.

Data and Sample

The data that this study uses come from the IPUMS Current Population Survey. The data are the CPS Basic Monthly data. The data are from January 2020 through December 2024. The sample comes from the Outgoing. All monetary values are converted to constant 2024 dollars using the CPI-U.

Variable Construction

The dependent variable is logarithm of wage per hour that allow comparison. The main independent variables include age indicators for individual years, with age 25 providing the reference point. The analysis considers education in four categories that include completion of high school, some work in higher education, completing a degree at the level of four years, and completing work following that degree.

The analysis also includes an indicator for female individuals. The study controls for factors relating to race and ethnic background, status in marriage, participation in organized labor groups, main categories for type of work and type of industry coded as

separate indicators, and factors relating to location. The analysis includes controls for

state and for specific months in years that account for factors not directly measured relating to location and to time.

Table 1: Variable descriptions and measurement

	Mean	SD	Min	Max	Count
ln_wage	6.3770	1.4159	-4.6351	7.0252	463624
age	29.5718	2.8501	25.0000	34.0000	463624
Education Category	3.2299	0.6735	1.0000	4.0000	463624
Female Dummy	0.4455	0.4970	0.0000	1.0000	463624
Race/Ethnicity Category	4.2276	1.5789	1.0000	5.0000	463624
Industry	5895.3538	2623.6940	170.0000	9290.0000	463624
State FIPS	27.8079	16.3065	1.0000	56.0000	463624
Year-Month	2.02e+05	141.1414	2.02e+05	2.02e+05	463624

EMPIRICAL STRATEGY

Analytical Approach

The primary regression specification is:

$$\ln(w_{ist}) = \beta_0 + \sum_{a=26}^{34} \beta_a \text{Age} + \gamma(\text{education}) + \delta(\text{gender}) + X'\theta + \tau_{\tau} + \eta_{\eta} + \varepsilon_{ist}$$

where:

- $\ln(w_{ist})$ is the natural logarithm of the real hourly wage for individual i in states at time t
- β_0 is the intercept term
- β_a are coefficients for single-year age indicators (with age 25 as the reference category)
- γ represents coefficients for educational attainment categories
- δ is the coefficient for gender (with male as reference)
- $X'\theta$ includes controls for race/ethnicity, marital status, union membership, occupation, and industry

- τ represents year-month fixed effects
- η represents state fixed effects
- ε_{ist} is the error term

The analysis proceeds in steps: 1) a baseline model with age, education, and gender; 2) sequential addition of demographic controls, industry/occupation dummies, and state & time fixed effects. Subsequently, interaction models ($\text{Age} \times \text{Education}$ and $\text{Age} \times \text{Gender}$) are estimated to test for heterogeneity in wage growth trajectories. The inclusion of state and time fixed effects accounts for geographic variation in wage levels and temporal trends affecting all workers.

Regression Results

Table 2: Baseline regression result

	(1)	(2)	(3)	(4)
	ln_wage	ln_wage	ln_wage	ln_wage
Age=25	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)
26	0.0067	0.0066	0.0049	0.0042

	(0.0129)	(0.0129)	(0.0129)	(0.0129)
27	0.0197	0.0192	0.0170	0.0167
	(0.0128)	(0.0128)	(0.0128)	(0.0127)
28	0.0364***	0.0360***	0.0307**	0.0293**
	(0.0127)	(0.0127)	(0.0127)	(0.0127)
29	0.0397***	0.0392***	0.0336***	0.0327***
	(0.0126)	(0.0126)	(0.0126)	(0.0126)
30	0.0460***	0.0455***	0.0394***	0.0381***
	(0.0125)	(0.0125)	(0.0125)	(0.0125)
31	0.0659***	0.0652***	0.0591***	0.0590***
	(0.0125)	(0.0125)	(0.0125)	(0.0125)
32	0.0766***	0.0757***	0.0668***	0.0679***
	(0.0125)	(0.0125)	(0.0125)	(0.0125)
33	0.0692***	0.0683***	0.0606***	0.0611***
	(0.0126)	(0.0127)	(0.0126)	(0.0126)
34	0.0929***	0.0917***	0.0823***	0.0827***
	(0.0126)	(0.0126)	(0.0126)	(0.0126)
Educ=1	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)
3	0.0493***	0.0374**	0.0276*	0.0290*
	(0.0151)	(0.0153)	(0.0155)	(0.0155)
4	0.4208***	0.4047***	0.3245***	0.3158***
	(0.0151)	(0.0155)	(0.0161)	(0.0162)
Female Dummy	-0.0778***	-0.0777***	-0.0483***	-0.0472***
	(0.0057)	(0.0057)	(0.0063)	(0.0063)
Hispanic		0.0000	0.0000	0.0000
		(.)	(.)	(.)
Other		0.0384***	0.0420***	0.0544***
		(0.0075)	(0.0076)	(0.0080)
Industry dummy	No	No	Yes	Yes
State dummy	No	No	No	Yes
Year month dummy	No	No	No	Yes
Constant	6.1564***	6.1389***	6.1694***	6.1779***
	(0.0172)	(0.0175)	(0.0380)	(0.0462)
Observations	272991	272991	272991	272991

Standard Errors in Parentheses

Robust Standard Errors in parentheses.
Fixed effects are included as dummies.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2 shows the main results from the analysis. The first part shows the initial approach using age, education, and the indicator for female individuals. The measures for age show a pattern of positive association with the outcome but this pattern does not follow a simple form. The relationship between age and the measure becomes significant in the data at age 28, showing 3.64 %, with significance below 0.01.

This relationship shows increases in general and reaches the highest point at age 34 (9.29%, $p < 0.01$). The benefit relating to education appears substantial in the data. When the analysis holds age and the female indicator at the same levels, individuals completing four years of higher education

show earnings approximately 42.1% higher than individuals completing high school, and individuals completing work following this degree show earnings about 52.4% more than individuals with the four-year degree. The data reveal a difference of -7.8% relating to female individuals that appears significant.

The following parts add controls in steps. The complete approach in the fourth part indicates the positive pattern relating age to the outcome continues even when the analysis accounts for the complete range of factors, but the measures show some reduction. The benefit relating to education remains large and shows significance even when the analysis controls for type of industry, type of work, and location.

The difference relating to female individuals becomes smaller but remains important in both practical and significance terms at -4.7% when the analysis includes the complete range of controls. This suggests a substantial part that the analysis does not account for.

Table 3: The result of interaction model

	(1)	(2)
	ln_wage	ln_wage
Educ=1	0.0000	0.0000
	(.)	(.)
3	-0.0016	0.0275*
	(0.0305)	(0.0155)
4	0.2798***	0.3245***
	(0.0309)	(0.0161)
Age (Centered at 25)	0.0022	0.0089***
	(0.0052)	(0.0013)
1 # Age (Centered at 25)	0.0000	
	(.)	
3 # Age (Centered at 25)	0.0059	
	(0.0054)	
4 # Age (Centered at 25)	0.0093*	
	(0.0054)	
Female Dummy	-0.0483***	
	(0.0063)	
Hispanic	0.0000	0.0000
	(.)	(.)

Other	0.0419***	0.0420***
	(0.0076)	(0.0076)
Female Dummy=0		0.0000
		(.)
Female Dummy=1		-0.0491***
		(0.0111)
Female Dummy=0 # Age (Centered at 25)		0.0000
		(.)
Female Dummy=1 # Age (Centered at 25)		0.0002
		(0.0020)
Industry dummy	Yes	Yes
Constant	6.2020***	6.1689***
	(0.0449)	(0.0374)
Observations	272991	272991

Standard Errors in Parentheses

Robust Standard Errors in parentheses.
Fixed effects are included as dummies.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 shows results from approaches that examine whether age relates differently to the outcome depending on education and depending on the female indicator. The first part suggests the pattern relating age to the outcome may show a stronger increase for individuals with degrees following the four-year level relative to individuals completing only high school. The measure for this difference shows 0.0093, $p < 0.10$. This implies the benefit relating to education becomes wider across the early period of work.

The second part finds no difference showing significance in how the pattern relating age to the outcome changes between male and female individuals. The difference in levels relating to the female indicator continues but does not become significantly wider or smaller between ages 25 and 34 in this time period.

DISCUSSION

The findings show positive growth in wages during the initial years of work, with important increases occurring between ages 28 and 34. This pattern follows from the theory that links productivity and wages to

experience over time and to the specific training that workers obtain in particular firms.

The results indicate two main aspects of differences in wages. The measure of differences relating to education level shows not only large values but also evidence that these differences increase during the initial career period, with the pattern particularly strong for individuals holding degrees from programs following the initial degree. This suggests that the returns that follow from investment in work and from movement in career position differ substantially between groups with different education, with returns considerably higher for those with the most education, and this pattern may increase differences in economic outcomes between groups.

The analysis also reveals a difference in wages between genders that remains in the data following the use of extensive measures that control for education, for work experience, for the type of work, for the sector of the economy, and for the location of work. The difference in wages between genders shows a value of approximately 4.7%. The analysis indicates that the relationship between age and this gender difference does not show significance, which suggests that the difference appears by age 25 and does not show important change during the period from 25 to 34 in the years from 2020 to 2024.

This indicates the role of factors that the standard measures do not include, such as differences in treatment between groups, differences in outcomes from discussions of compensation, or differences in the effects of responsibilities for providing care that may occur before this age range or that begin during the initial portion of this period.

These patterns appear particularly important in the context of the work market from 2020 to 2024, which the pandemic of COVID-nineteen affected, which showed rapid return to previous levels, and which included high rates of increase in prices. The fact that both the difference relating to education and the difference relating to gender remain through this period suggests that these features represent basic characteristics of the work market in the United States.

CONCLUSION AND POLICY IMPLICATIONS

The study presents findings on the development of wages during the initial career period for workers in the United States from 2020 to 2024. The main findings include a significant positive relationship between age and wages, a large difference that may increase relating to higher levels of education, and a continuing difference in wages between genders that measures do not explain.

The findings suggest that approaches that aim to improve economic movement between positions must address differences in economic outcomes at the point of career beginning and the changes that follow. Approaches to increase wage growth for workers who do not hold degrees from programs following the initial degree, such as programs that provide training in work settings, programs that provide specific training in particular areas, and programs that provide structure for movement in career position, may help to reduce the increasing differences that relate to level of education.

The continuing difference between genders indicates that policy action must continue and must increase in strength, including requirements for providing information on compensation, strong use of regulations that prevent differences in treatment, and resources for providing care that affect

outcomes in the work market with effects that differ between women and men.

A main limitation is the use of data from different time points, which combines effects relating to age with effects relating to the particular group. Work following individuals over time could separate patterns that develop across the life span from patterns specific to particular groups. More work examining the role of movement between jobs, changes in industry, and differences across locations during this period of substantial change would provide more understanding of the process. Also, extending the analysis to include individuals working part-time and other forms of work would provide a more complete view of outcomes in the early part of the career.

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