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Remuneration management in an innovation-oriented economic policy

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ABSTRACT

Purpose: This paper aims to contribute to the ongoing discourse on wage determination by proposing a topical approach that incorporates three key factors, working hours, education, and experience, and to provide a robust, strategic, evidence-based framework for formulating wage improvement policies. **Methodology:** Using a rigorous econometric approach, we analyze a dataset comprising 545 observations of full-time employed males from the National Longitudinal Survey of Youth, spanning 1980 to 1987. We then apply the results of their combined effects to derive detailed explanatory guidelines. **Findings:** The results reveal a statistically significant negative relationship between annual hours worked and wages, indicating diminishing returns to earnings as working hours increase. In contrast, education and experience exhibit strong positive correlations with wages, with each additional year of education associated with a 10.55% increase in earnings, and each additional year of experience linked to a 13.81% wage increase. Notably, the non-linear experience-wage relationship demonstrates diminishing returns at higher levels of experience. **Originality and contribution:** The study introduces a novel framework emphasizing that the marginal utility of working hours varies with educational attainment, and that the quality of experience is shaped both by the number of hours worked and the conditions under which those hours are performed. Additionally, the concept of the experience-education multiplier effect highlights how education amplifies the value of experience, particularly in knowledge-intensive sectors.
Keywords: wage policy; experience-education multiplier; working hours; labor market dynamics; compensation framework

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ОРИГИНАЛЬНАЯ СТАТЬЯ

Внедрение политики, способствующей развитию инновационной экономики при определении оплаты труда

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АННОТАЦИЯ

Цель: Настоящая статья призвана внести вклад в научную дискуссию по вопросам определения заработной платы путем предложения актуального подхода, учитывающего три ключевых фактора — рабочее время, образование и опыт, а также на формирование надежной, стратегической, основанной на эмпирических данных основы для разработки политики в области оплаты труда. **Методология:** В работе применяется строгий эконометрический подход: анализируется выборка, включающая 545 наблюдений занятых полный рабочий день мужчин из Национального лонгитюдного исследования молодежи за период 1980–1987 гг. Полученные **результаты** выявляют статистически значимую отрицательную зависимость между годовым количеством отработанных часов и заработной платой, что указывает на убывающую отдачу по мере увеличения рабочего времени. В то же время образование и опыт демонстрируют сильную положительную корреляцию с заработной платой: каждый дополнительный год обучения связан с ростом дохода на

10,55%, а каждый дополнительный год опыта — на 13,81%. Примечательно, что нелинейная зависимость между опытом и заработной платой характеризуется убывающей отдачей на более высоких уровнях опыта. **Научная новизна и вклад:** В исследовании предложена новая аналитическая модель, подчеркивающая, что предельная отдача рабочего времени варьируется в зависимости от уровня образования, а качество опыта определяется как количеством отработанных часов, так и условиями их выполнения. Кроме того, введено понятие «мультипликативного эффекта взаимодействия опыта и образования», демонстрирующее, как последнее усиливает ценность опыта, особенно в наукоемких секторах.
Ключевые слова: политика оплаты труда; мультипликатор опыта и образования; рабочее время; динамика рынка труда; система оплаты труда

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INTRODUCTION

The equitable and efficient determination of wages remains a persistent challenge for organizations, governments, and societies alike. Traditional wage-setting mechanisms, often based on simple hourly rates or fixed salaries, may not adequately capture the nuanced contributions of employees, particularly in knowledge-intensive and dynamic sectors. As the global economy evolves, there is a growing need for more sophisticated wage determination policies that recognize the multifaceted nature of work and the diverse skills and experiences of the workforce. Working hours, education, and experience have long been recognized as key determinants of wage levels; however, the relationship between these variables and wages, as well as the corresponding policy implications, remains a subject of ongoing debate.

Working hours, as a fundamental aspect of employment, have long been recognized as a determinant of wage levels. However, the precise nature of this relationship is complex and is often shaped by contextual factors such as industry, occupation, and labor market conditions [1]. Examining the impact of working hours on wages can provide valuable insights into the trade-offs between time and compensation. Education, as a measure of human capital, is widely acknowledged as a significant predictor of earnings. Higher levels of education are associated with increased productivity, innovation, and adaptability, which, in turn, can lead to higher wages [2]. However, returns to education may vary across fields of study, geographical regions, and economic cycles. Therefore, it is essential to examine the specific effects of education on wages in order to optimize wage-setting policies. In addition to these variables, experience, representing the accumulation of knowledge, skills, and networks over time, is another critical factor in wage determination. As individuals gain experience, they typically become more efficient, effective, and valuable to organizations, and are therefore often rewarded with higher wages [3]. However, the relationship between experience and wages may be non-linear, with diminishing returns emerging after a certain threshold.

Integrating working hours, education, and experience into a comprehensive framework enables a more nuanced and equitable approach to wage determination. Such an approach can help organizations attract and retain talent, improve employee motivation and satisfaction, and enhance overall organizational performance. Moreover, it can contribute to social justice by ensuring that individuals are compensated fairly for their contributions, regardless of background or circumstances.

Specifically, this study addresses the following research questions:

- What is the impact of working hours, education, and experience on wage levels?
- Are there non-linear effects of experience on wages? What are the implications of these findings for wage determination policies?

The empirical analysis in this paper utilizes a large and diverse dataset to examine the relationship between working hours, education, experience, and wages. Key econometric techniques are employed to control for confounding factors and to isolate the causal impact of each variable on wages. Based on this empirical evidence, the study seeks to identify the optimal weights to assign to each factor in a wage determination framework.

The findings of this study have significant implications for policymakers, employers, and labor unions. By providing a data-driven approach to wage setting, the study contributes to fairer and more efficient labor markets, reduced wage inequality, and enhanced economic growth. Furthermore, the research informs future studies on wage determination, human capital development, and labor economics.

In the following sections, the paper provides a comprehensive review of the existing literature on wage determination, highlighting the theoretical foundations and empirical findings of previous studies; outlines the research methodology, including data sources, sample selection, and econometric techniques; presents the

empirical results, discussing estimated coefficients and their statistical significance; and concludes by summarizing the key findings, discussing policy implications, and identifying potential avenues for future research.

LITERATURE REVIEW

Wage determination is a critical aspect of labor economics, influencing both individual livelihoods and broader economic stability. A substantial body of literature has examined the various factors contributing to wage levels, with particular attention to working hours, education, and experience. In this section, we synthesize key findings from existing studies, highlighting the complexity and interrelationships among these variables, and providing a foundation for the formulation of effective wage determination policies.

Economic theories offer different perspectives on the complex and multifaceted relationship between working hours and wages. Efficiency wage theory suggests that higher wages can motivate workers, leading to increased productivity. However, the impact of working hours on productivity is not linear. While overtime work, often compensated at a premium, can initially increase output, excessive working hours may lead to fatigue, burnout, and reduced productivity [4]. Human capital theory posits that longer working hours may provide opportunities for on-the-job learning and skill development, thereby enhancing earning potential. However, this depends on the nature of the work and the quality of learning opportunities [5]. Bargaining power theory suggests that workers with stronger bargaining power, such as unionized employees or those with specialized skills, may secure higher wages and more favorable working conditions, potentially including reduced working hours [6]. Beyond these theoretical perspectives, empirical evidence on the relationship between working hours and wages remains mixed. Some studies report a positive correlation, particularly at moderate levels of working hours [7], while others identify a negative or non-linear relationship, with diminishing returns to longer working hours [8]. Research on overtime work indicates that, although overtime pay is typically higher than regular wages, the overall effect on earnings is ambiguous due to potential productivity losses [9]. Recent studies have also examined flexible work arrangements, such as remote work and flexible schedules, finding that such arrangements may enhance employee satisfaction and productivity, and potentially lead to higher wages [10].

At first glance, education plays a pivotal role in shaping individual earnings. Human capital theory emphasizes the role of education in increasing individuals' skills and knowledge, making them more productive and enabling them to command higher wages. Education enhances cognitive abilities, problem-solving skills, and adaptability, all of which are highly valued in the labor market [11]. Signaling theory argues that education serves as a signal to employers regarding an individual's ability and work ethic. Higher levels of education demonstrate commitment, perseverance, and the capacity to learn and adapt, making graduates more attractive to employers [12]. Screening theory suggests that education functions as a mechanism for employers to identify suitable candidates for specific roles, with educational attainment acting as a filter for required skills and qualifications [13].

However, in the pursuit of higher wages, individuals should not focus solely on education but also on work experience. While academic achievement is essential for future success, exclusive focus on studying may limit earning potential. Practical, real-world experience gained through work provides valuable skills and knowledge that cannot be acquired through textbooks alone [14]. Work exposes individuals to diverse environments, develops problem-solving abilities, strengthens communication and teamwork skills, and fosters a strong work ethic. These practical competencies are highly valued by employers and can significantly increase earning potential [15]. Moreover, early work experience enables individuals to explore their interests, identify strengths and weaknesses, and make more informed career choices. Empirical evidence consistently supports a strong positive correlation between education and wages, with higher educational attainment associated with significantly higher earnings across occupations and industries [16]. Research has also examined returns to different types of education, such as college versus vocational training, as well as returns across fields of study, finding that outcomes vary depending on the type and level of education and prevailing labor market conditions [17]. Recent studies further highlight the role of non-cognitive skills, such as personality traits and social skills, in shaping the education-wage relationship, suggesting that these skills complement educational attainment and contribute to higher earnings [18].

Experience is another crucial factor influencing wage outcomes. Employers and governments often view experience as an investment in human capital, as individuals acquire job-specific skills and knowledge through on-the-job training and accumulated experience [19]. The concept of learning-by-doing emphasizes the importance of hands-on experience in acquiring and refining skills. As individuals gain experience, they become more efficient and productive, which in turn leads to

higher wages [20]. Job tenure is also frequently associated with higher wages, reflecting the accumulation of firm-specific knowledge and the development of strong relationships with colleagues and supervisors [21].

Empirically, the relationship between work experience and wages is a well-documented phenomenon in labor economics, with numerous studies indicating that increased experience is typically associated with higher income levels. This relationship can be attributed to several factors, including the accumulation of skills, knowledge, and professional networks over time [22]. As workers gain experience, they often develop specialized competencies that enhance their productivity, making them more valuable to employers. For instance, research shows that individuals with extensive work experience tend to command higher salaries due to their demonstrated ability to perform tasks efficiently and effectively [23]. In addition, experienced workers may possess stronger bargaining power in salary negotiations, as they can demonstrate a proven track record of success in their roles [24].

Furthermore, the concept of human capital plays a significant role: as individuals invest time in their careers, they acquire not only technical skills but also soft skills such as communication and problem-solving abilities, which are highly valued in the labor market [25]. Studies also highlight diminishing returns to wages as experience increases; while the initial years of experience tend to generate substantial wage growth, subsequent years often yield smaller increments [26]. This suggests that although experience is crucial for wage determination, its impact varies depending on career stage and industry context [27]. Recent research has also examined the role of technology and automation in shaping the relationship between experience and wages. As technological progress continues, the demand for certain skills may change, potentially affecting the value of experience in the labor market [28].

The combined effects of working hours, education, and experience on wages are likely to be complex and interdependent. For example, the impact of working hours on wages may vary depending on an individual's level of education and experience [29]. Highly educated individuals may be better able to leverage longer working hours to advance their careers and increase earnings compared to those with lower levels of education. Similarly, more experienced individuals may be able to negotiate better working conditions, including more flexible hours and reduced overtime, while maintaining higher earnings. However, econometric research on the interaction effects of these variables remains limited. Some studies have explored how these factors jointly influence career progression and earnings trajectories, but further research is needed to fully understand their interplay and implications for wage determination policies.

Understanding the relationships between working hours, education, experience, and wages is essential for formulating effective wage determination policies. Such policies should aim to promote fair wages and equitable outcomes while also incentivizing productivity and skill development. This may include measures such as minimum wage regulations, overtime rules, and policies supporting education and training [30]. Promoting flexible work arrangements can benefit both employers and employees, as flexibility can improve work-life balance, enhance productivity, and attract and retain talent [31]. Policy frameworks should encourage the adoption of flexible work arrangements while ensuring that workers' rights and protections are maintained [32]. Finally, investment in education and training remains essential for enhancing human capital and supporting economic growth [33]. Policies should facilitate access to quality education and training opportunities for all individuals, regardless of socioeconomic background, including through financial aid, scholarships, and apprenticeship programs [34].

MATERIALS AND METHODOLOGY

1. Data and Sample Selection

This section provides empirical evidence to confirm the theoretical relationship assumptions before developing a novel framework that integrates the synergistic effects of education, experience, and working hours to offer a more holistic understanding of labor market dynamics, supported by detailed explanatory analysis.

The data, drawn from the National Longitudinal Survey of Youth (an American survey), comprise a sam-

Table 1

Description of Variables

Variables	Definition	Category
lwage	Logarithm of wage	Dependent variable
hours educ exper expersq	Annual hours worked Years of schooling Labor market experience (age-6-education) Squared labor market experience	Independent variables
hourssq married black rur	Squared annual hours worked Being married in marital status Being Black males Living in rural area	Control variables

Source: compiled by the authors.

Table 2

Summary Statistics

Variables	Observations	Mean	Standard Deviation	Min	Max
lwage	4,360	1.65	.53	-3.58	4.05
hours	4,360	2,191.26	566.35	120	4,992
educ	4,360	11.77	1.75	3	16
exper	4,360	6.51	2.83	0	18
expersq	4,360	50.42	40.78	0	324
hourssq	4,360	5,122,290	2,689,537	14,400	2.49*e*+07
married	4,360	.44	.50	0	1
black	4,360	.12	.32	0	1
rur	4,360	.20	.40	0	1

Source: compiled by the authors.

ple of full-time employed males who completed their schooling by 1980 and were followed from 1980 to 1987. The dataset excludes individuals who did not provide sufficient information for all years of observation, resulting in a final sample of 545 observations.

All variables used in this study are presented in *Table 1*. Regarding the control dummy variables married, black, and rur, the value equals 1 if the respondent is married, Black, or resides in a rural area, respectively, and 0 otherwise.

Table 2 presents the summary statistics of the variables used in the study. The dependent variable, lwage, has a mean value of 1.65 and a standard deviation of 0.53. The minimum and maximum values are — 3.58 and 4.05, respectively, indicating a wide dispersion of wage levels among individuals in the sample. The distribution of log wages is right-skewed, suggesting that a larger proportion of individuals earn lower wages, while a smaller share receives significantly higher earnings.

The mean annual hours worked is 2,191.26, with a standard deviation of 566.35, indicating substantial variation in working time across individuals. The minimum and maximum values are 120 and 4,992 hours, respectively, reflecting considerable heterogeneity in work schedules.

The mean years of schooling is 11.77, with a standard deviation of 1.75, suggesting that most individuals have approximately 12 years of education, consistent with high school completion. Education ranges from 3 to 16 years, indicating variation in educational attainment across the sample.

Labor market experience has a mean of 6.51 years and a standard deviation of 2.83 years. The minimum and maximum values are 0 and 18 years, respectively, reflecting differences in workforce entry timing and tenure. The squared experience term has a mean of 50.42 and a standard deviation of 40.78, ranging from 0 to 324, capturing the potential non-linear relationship between experience and wages.

The squared hours worked variable has a mean of 5,122,290 and a standard deviation of 2,689,537, indicating substantial variability in this transformed measure of working time.

Regarding control variables, the marital status indicator has a mean of 0.44, implying that 44% of the sample is married. The race dummy variable has a mean of 0.12, indicating that 12% of respondents identify as Black. The rural residence variable has a mean of 0.20, showing that 20% of the sample resides in rural areas.

2. Model Specification

To study the empirical impact of working hours, education, and experience on wages, we employ a panel data analysis of the above-mentioned statistics with the following models:

$$\text{lwage}_{it} = \beta_0 + \beta_1 \text{hours}_{it} + \beta_2 \text{educ}_{it} + \beta_3 \text{exper}_{it} + \beta_4 \text{exper}_{it}^2 + \varepsilon_{it}; \quad (1)$$

$$\text{lwage}_{it} = \beta_0 + \beta_1 \text{hours}_{it} + \beta_2 \text{educ}_{it} + \beta_3 \text{exper}_{it} + \beta_4 \text{exper}_{it}^2 + \beta_5 X_{it} + \varphi_i + \delta_t + \varepsilon_{it}, \quad (2)$$

where, variables:

- $lwage_{it}$: The natural logarithm of the wage of male *i* at time *t*,
- $hours_{it}$: The number of hours worked by male *i* at time *t*,
- $educ_{it}$: The years of education of male *i* at time *t*,
- $exper_{it}$: The years of labor market experience of male *i* at time *t*,
- $exper_{it}^2$: The square of labor market experience, capturing potential non-linear effects,
- X_{it} : A vector of control variables, such as marital status, race, and rural residence,
- φ_i : Male-specific fixed effect, capturing time-invariant unobserved heterogeneity across males,
- δ_t : Year-specific fixed effect, capturing time-varying unobserved factors affecting all males,
- ε_{it} : The error term, representing the idiosyncratic variation in wages not explained by the other variables;

coefficients:

- β_0 : The intercept term, representing the baseline log wage when all independent variables are zero,
- β_1 : The coefficient on hours, indicating the effect of an additional hour of work on the log wage, holding other factors constant,
- β_2 : The coefficient on education, indicating the effect of an additional year of education on the log wage, holding other factors constant,
- β_3 : The coefficient on experience, indicating the effect of an additional year of experience on the log wage, holding other factors constant,
- β_4 : The coefficient on the squared experience term, capturing the non-linear effect of experience on wages,
- β_5 : The coefficients on the control variables, indicating their respective effects on the log wage.

Equation (1) suggests that the logarithm of a male's wage at time t is determined by a combination of working hours, education, experience, male-specific characteristics, time-specific factors, and a random error term. The model aims to quantify the impact of each of these factors on wages and to assess the overall relationship between wages and the explanatory variables.

Equation (2), used for robustness checks, estimates the impact of working hours, education, and experience on wages while controlling for male-specific and time-specific effects. The coefficients can be interpreted as the elasticity of wages with respect to the corresponding independent variables. The inclusion of male and year fixed effects helps address potential omitted variable bias, as well as time-varying trends that may influence wages.

RESULTS AND INTERPRETATION

Table 3 presents the results of a panel data regression analysis. The table reports three empirical specifications. To avoid omitted variable bias due to collinearity in education, Column 1 of the random-effects GLS regression presents estimated coefficients and standard errors without additional control variables. The results are interpreted as follows:

- hours: The coefficient for working hours is –0.0001 and is statistically significant at the 1% level. This indicates that, holding other factors constant, an additional hour of work is associated with a very small decrease in wages. See Scatter Plot A in *Fig. 1*;
- educ: The coefficient for education is 0.1055 and is statistically significant at the 1% level. This implies that, holding other factors constant, an additional year of education is associated with a 10.55% increase in wages. See Scatter Plot B in *Fig. 1*;
- exper: The coefficient for experience is 0.1381 and is statistically significant at the 1% level. This suggests that, holding other factors constant, an additional year of experience is associated with a 13.81% increase in wages. See Scatter Plot C in *Fig. 1*;
- expersq: The coefficient for the squared experience term is –0.0053 and is statistically significant at the 1% level. This result indicates a non-linear relationship between experience and wages, with diminishing returns as experience increases. See Scatter Plot D in *Fig. 1*.

Column 2 and Column 3 of the fixed-effects regression present the estimated coefficients and standard errors after the inclusion of control variables such as squared working hours, marital status, race, and rural residence. The inclusion of these control variables helps to isolate the effect of the key variables of interest (hours, education, and experience) on wages. The coefficients and their levels of statistical significance are generally consistent with those reported in Column 1, with only minor differences. This suggests that the main findings regarding the impact of working hours, education, and experience on wages are robust to the inclusion of additional controls. Overall, the results in *Table 3* indicate that both education and experience have a positive and statistically significant effect on wages, while the effect of working hours on wages is negative but very small in magnitude.

Fig. 2(A) provides a visual representation of the wage distribution among the sample of full-time working males. The histogram shows that the distribution of log wages is right-skewed, confirming that although there are relatively few individuals with very high wages, the

Table 3

Descriptive Statistics of the Variables Under Consideration

Dependent variable: lwage	(1) Without control	(2) With 1 control	(3) With 3 controls
hours	−0.0001***	0.0002***	−0.0001***
	(0.0000)	(0.0000)	(0.0000)
educ	0.1055***		
	(0.0091)		
exper	0.1381***	0.1352***	0.1386***
	(0.0082)	(0.0083)	(0.0086)
expersq	−0.0053***	−0.0051***	−0.0054***
	(0.0006)	(0.0006)	(0.0006)
hourssq		−0.0000***	
		(0.0000)	
married			0.0481***
			(0.0181)
rur			0.0612**
			(0.0287)
o.educ		–	–
o.black			–
Constant	0.0415	0.9482***	1.2870***
	(0.1121)	(0.0540)	(0.0341)
Male random effects	Yes	No	No
Year random effects	Yes	No	No
Male fixed effects	No	Yes	Yes
Year fixed effects	No	Yes	Yes
R-squared	0.1945	0.2085	0.1971
Number of males	545	545	545
Observations	4,360	4,360	4,360

Source: compiled by the authors.

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, and the standard errors are in parentheses.

majority of the sample earns lower wages. This right-skewed pattern is consistent with standard findings in labor economics, where wage distributions typically feature a concentration of lower-income earners and a long tail of higher-income earners. In addition, the spread of the histogram highlights substantial variation in wages within the sample, underscoring the diversity of earning outcomes among the individuals studied.

Fig. 2(B) provides a smoothed representation of the wage distribution among the sample of full-time working males. The kernel density plot shows that the distribution of log wages is right-skewed, indicating that a larger proportion of individuals in the dataset earn lower wages compared to those earning significantly higher wages. *Fig. 2(B)* offers a more detailed and continuous representation of the log wage distribution than *Fig. 2(A)*. It facilitates visualization of the distribution's shape, central tendency, and dispersion and can be used to identify potential patterns and anomalies.

EXTRA TESTS FOR RELIABILITY CONFIRMATION OF THE MAIN MODEL

1. R-squared test: The R-squared value for Column 1 is 0.1945, indicating that 19.45% of the variation in lwage is explained by hours, educ, exper, and expersq in a non-linear regression model. This relatively low value suggests that the model is not a particularly strong predictor of wages for these males.

2. F test (significance of R-squared): The squared Wald chi-squared value of 984.3 in the regression results leads to an F-statistic of 246.08 (984.3/4), which exceeds the critical values of the F-distribution at 1% (3.32), 5% (2.37), and 10% (1.83) significance levels. Additionally, since the p-values of all independent variables are 0.00, below conventional significance thresholds (0.01, 0.05, and 0.10), the R-squared value is statistically significant. This confirms that the model is well specified and that the independent variables jointly have a significant effect on wages.

3. Adequacy test: The adequacy of the model is supported by the fact that observed wage values lie within the predicted confidence intervals. For example, the constant term (intercept) has a coefficient of 0.04, which falls within the 95% confidence interval of [−0.18; 0.26], indicating that the model is adequate at the 95% confidence level and appropriately captures the baseline wage level when all independent variables are equal to zero.

4. First Gauss–Markov theorem: The first Gauss–Markov assumption states that the expected value of the disturbance term for any observation should be equal to zero [35].

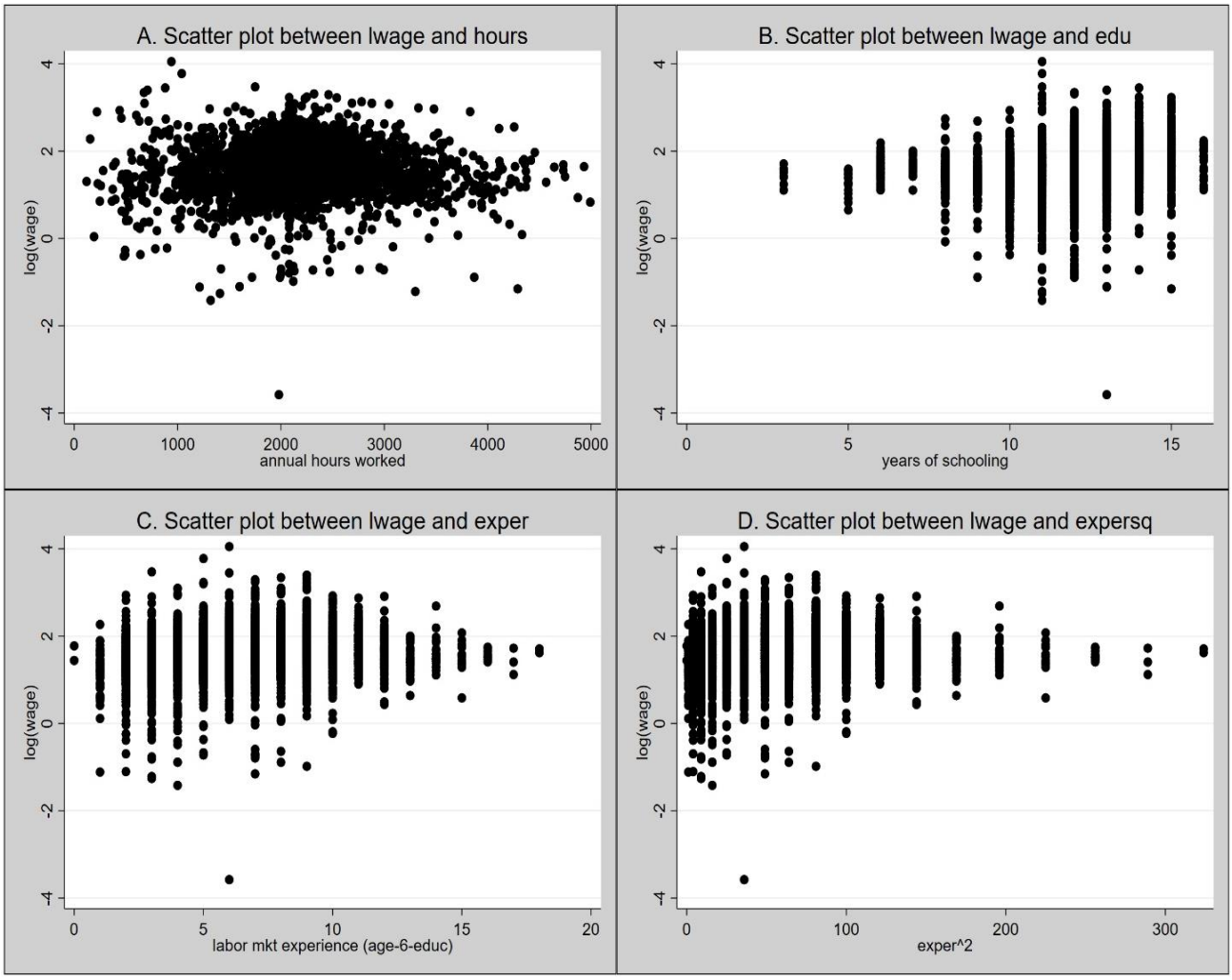

Fig. 1. **Scatter Plots Between lwage and Independent Variables**

Source: compiled by the authors.

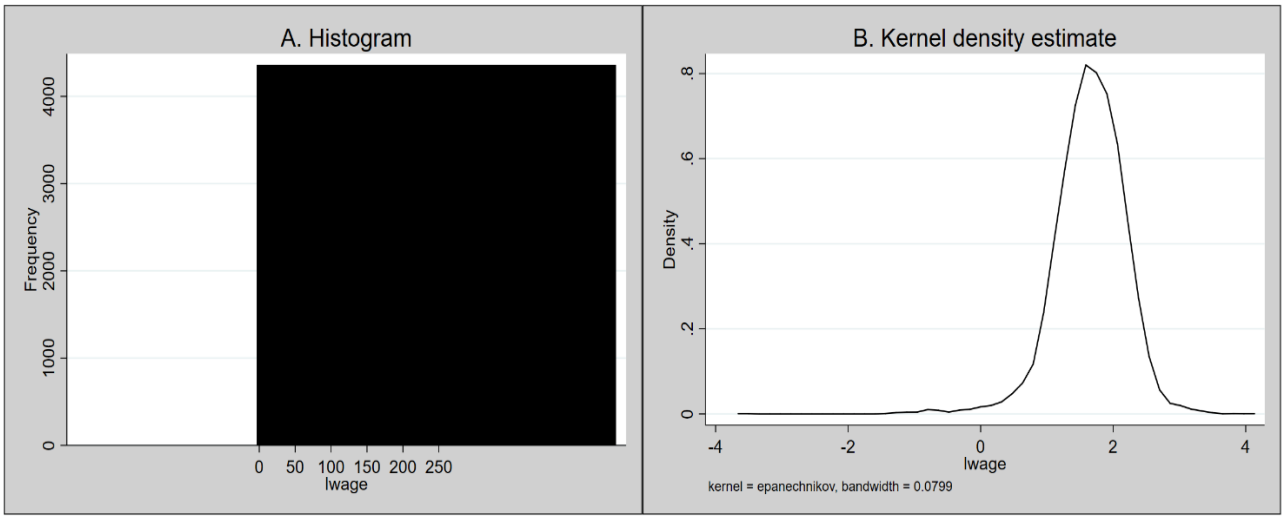

Fig. 2. **Histogram and Kernel Density Estimation of lwage**

Source: compiled by the authors.

$$E(\varepsilon_{it}) = 0. \quad (3)$$

Based on the Stata software calculations, the mean of the residuals is –1.9e-15, which is effectively equal to zero. Therefore, the first Gauss-Markov assumption is satisfied, as the mathematical expectation of the disturbance term corresponds to the average of the residual values.

5. Second Gauss–Markov theorem (Goldfeld–Quandt test): The second Gauss–Markov condition states that the variance of the disturbance term should be constant across all observations [36].

$$\mathrm{Var}(\varepsilon_{it}) \text{ or } \sigma^2(\varepsilon_{it}) = \text{constant}. \quad (4)$$

The Goldfeld–Quandt (GQ) test is applied to verify whether the second Gauss-Markov condition holds. To do so, the values of GQ and 1/GQ are compared with the critical value from the Fisher distribution. Using Stata and grouping the data by education with OLS regressions, a GQ statistic of 1.05, a value of 1/GQ equal to 0.95, and an F critical value of 1.08 are obtained. Since the F critical value is greater than both GQ and 1/GQ, the model satisfies the second Gauss-Markov condition, indicating homoskedasticity.

6. Third Gauss–Markov theorem (Wooldridge test): The third Gauss–Markov assumption states that the residuals are independently distributed [37].

$$\mathrm{Cov}(e_i, e_j) = 0; i \neq j. \quad (5)$$

The Durbin-Watson test is typically applied in OLS regressions to assess whether the third Gauss–Markov condition is satisfied. However, to examine autocorrelation in panel data, the Wooldridge test is more appropriate. Stata results confirm the absence of first-order autocorrelation, with F(1, 544) = 28.49 and Prob > F = 0.00.

The results of the R-squared test, F test, adequacy test, and the first, second, and third Gauss–Markov assumptions indicate that the model is well specified and robust. Therefore, the findings provide reliable insights into the empirical relationship between working hours, education, experience, and wages.

MODERN APPLIED DISCUSSIONS

1. The Relationship and Improvement Framework Between Working Hours and Wages

Under a simplified assumption, higher working hours are often associated with higher wages. However, the empirical evidence presented above indicates a statistically significant negative relationship between annual hours worked and wages, both with and without control variables. These results suggest that, while additional working hours may initially increase earnings, the marginal benefit of extra hours diminishes rapidly.

For example, Liv Soksan, in accordance with the standard requirements of his company, works 8 hours per day but chooses to work 10 or 11 hours due to additional financial needs. On the first day of overtime, his productivity during the 9th hour may remain similar to previous hours; however, from the 10th hour onward, productivity and effectiveness begin to decline and continue to deteriorate in subsequent working periods. This pattern is likely driven by diminishing returns to labor, accumulated fatigue, and reduced efficiency at higher levels of work intensity.

One possible explanation for this counterintuitive result is that individuals working longer hours may be employed in lower-paid occupations or may have weaker bargaining power. Another explanation is potential model misspecification due to omitted variables that influence wages. Additionally, the negative coefficient on working hours may reflect reverse causality, where higher wages enable individuals to work fewer or more flexible hours.

To develop effective wage determination policies, policymakers and employers should take these nuances into account. While productivity incentives and performance-based rewards remain important, excessive working hours should be avoided, as they may lead to burnout, lower job satisfaction, and reduced overall productivity. A balanced approach that promotes work-life balance, reasonable working hours, and fair compensation is likely to produce more sustainable long-term outcomes for both employees and organizations. Based on these findings, wage determination policy should:

- introduce regulations or guidelines limiting the number of working hours per week or month to prevent excessive workloads and support work-life balance;
- promote flexible working arrangements, such as flexible schedules, remote work, or compressed workweeks, to enhance time management, reduce stress, and increase productivity and job satisfaction;
- implement performance-based compensation systems that reward employees based on output rather than hours worked, encouraging efficiency and higher performance;
- ensure adequate rest periods, including weekends, holidays, and annual leave, as these are essential for physical and mental well-being and contribute to higher productivity;
- foster a supportive and positive working environment that prioritizes employee well-being, thereby mitigating the negative effects of long working hours and improving morale and productivity.

2. The Relationship and Improvement Framework Between Education and Wages

The empirical evidence underscores a significant positive correlation between education and wages. The three models, both with and without control variables, consistently reveal a statistically significant and positive coefficient for the education variable. This finding aligns with the established economic principle that higher levels of education are associated with higher productivity and, consequently, higher wages. The inclusion of control variables in Models 2 and 3 further strengthens the robustness of the education effect. These results suggest that individuals with higher levels of education tend to command higher wages, regardless of other factors such as working hours and experience.

In today's rapidly evolving labor market, the integration of soft skills and digital technologies alongside traditional academic disciplines is increasingly recognized as essential for improving employability and supporting higher wages. Soft skills, which include interpersonal competencies such as communication, teamwork, problem-solving, and emotional intelligence, are crucial because they enable individuals to navigate workplace dynamics effectively and foster collaborative environments. Employers often prioritize candidates who demonstrate these competencies, as they significantly contribute to organizational culture and productivity. For instance, a study by the World Economic Forum highlights that 94% of employers consider soft skills critical for workforce success [38].

On the other hand, proficiency in digital technologies, ranging from basic computer literacy to advanced data analysis and programming skills, is equally important in an era where technology permeates all sectors. The growing reliance on digital tools requires employees not only to understand how to use these technologies but also to adapt quickly to new innovations. According to a report by McKinsey & Company, jobs requiring advanced technological skills are projected to grow significantly faster than those that do not [39]. Therefore, individuals who combine academic qualifications with strong soft skills and technological competencies are better positioned in the labor market, often achieving higher starting salaries and greater career advancement opportunities.

Formulating an effective wage determination policy requires policymakers and employers to consider education as a key determinant of wage levels. This can be achieved through various mechanisms, such as implementing progressive wage scales that reward higher educational attainment, providing educational subsidies or incentives to employees, and investing in lifelong learning opportunities. Additionally, it is important to recognize that returns to education may vary across fields of study and industries. Therefore, wage policies should also account for the specific skills and knowledge required in different occupations. Prioritizing education and investing in human capital development can help promote more equitable wage growth and enhance overall economic productivity.

3. The Relationship and Improvement Framework Between Experience and Wages

The empirical analysis presented in this study reveals a significant positive relationship between labor market experience and wages. This finding is consistent with the commonly observed wage-experience profile, where individuals with greater experience tend to receive higher salaries due to accumulated skills, productivity, and professional networks. The regression results indicate that as years of experience increase, so does the natural logarithm of wages. This suggests that employers tend to reward more experienced employees with higher compensation, reflecting the value they bring to organizations in terms of expertise, efficiency, and reliability.

Additionally, the inclusion of a squared experience term indicates that the relationship between experience and wages is non-linear, with diminishing returns at higher levels of experience. This implies that while experience is generally associated with higher wages, the marginal increase in wages becomes smaller as individuals accumulate additional years of experience.

To better illustrate this concept, consider the following example. As a recent PhD graduate, Liv Soksan may start his career with an entry-level salary of $ 50,000. As he gains experience over the first few years, moving from one year to five years, his salary may increase significantly due to his growing skill set and value to employers. For instance, by year three, he might earn $60,000, and by year five, $70,000. This initial stage reflects a strong positive relationship between experience and wages.

However, as Liv Soksan continues to accumulate experience — reaching 15 or 20 years in his field — the incremental increases in salary may become less pronounced. For example, after 20 years of work, he might earn $ 90,000. In this case, although he has gained an additional 15 years of experience compared to an earlier stage (from 5 to 20 years), the wage increase from $70,000 to $90,000 represents only a $20,000 rise, rather than the larger gains observed earlier. This non-linear pattern has important implications for career planning and expectations regarding wage growth over time. Individuals entering the labor market should recognize that while experience is crucial for early wage growth, there is

a point at which additional experience yields diminishing financial returns. This insight may inform decisions regarding further education or transitions into roles or industries where skills command higher returns.

These findings have important implications for the design of effective wage determination policies. First, such policies should recognize the value of experience and incorporate mechanisms that reward employees for tenure and accumulated skills. This may include seniority-based pay increases, performance-based bonuses linked to experience, or structured career progression pathways with higher compensation at senior levels.

Second, wage policies should account for the non-linear nature of the experience-wage relationship and adjust compensation structures accordingly. This may involve differentiated wage scales across experience levels, with steeper increases for early-career employees and more gradual adjustments for highly experienced workers.

Third, policies should recognize the specific skills and expertise developed through experience and ensure that these are appropriately valued and rewarded. This may require periodic job evaluations and skill assessments to identify employees with specialized knowledge and competencies.

Finally, wage determination policies should be transparent and clearly communicated to employees, enabling them to understand how wages are set and how earnings can increase through experience and skill development. Taken together, these considerations can support the development of fair and equitable wage policies that also promote employee retention and productivity.

4. The Interconnectedness of Working Hours, Education, Experience, and Wages: A Novel Framework for Labor Market Dynamics

Education and working hours are often treated as independent determinants of wages; however, their interaction reveals a synergistic effect that remains underexplored in the literature. Highly educated individuals tend to exhibit higher productivity per hour worked, meaning that their wage growth is not linearly tied to the number of hours they work. For instance, a software engineer with a master's degree may produce significantly more output in fewer hours compared to a manual worker with limited education. This suggests that the marginal utility of working hours is higher for educated individuals, as they can leverage cognitive skills and knowledge to enhance productivity within shorter timeframes.

However, this synergy has limits. Excessive working hours may generate diminishing returns even for highly educated workers due to cognitive fatigue and reduced creativity. This results in a non-linear relationship between working hours and wages, where the optimal number of working hours depends on educational attainment. For example, a highly educated professional may experience wage growth up to a certain threshold of working hours, beyond which additional hours generate minimal or even negative returns due to burnout.

Policymakers should consider education-adjusted working hour regulations that reflect differences in productivity across educational groups. For highly educated workers, policies may promote flexible work arrangements that allow productivity optimization without excessive time burden. For less educated workers, policies should prioritize upskilling programs to improve productivity within standard working hours and reduce reliance on overtime.

Experience and education are often treated as parallel determinants of wage growth; however, their interaction forms a more complex dual pathway. In early career stages, individuals with higher education but limited experience may earn less than less-educated but more experienced workers. Over time, as experience accumulates, this gap narrows and may eventually reverse, reflecting the compounding effects of education and experience.

This phenomenon can be described as an experience-education multiplier effect, where education enhances the value of experience by enabling individuals to apply theoretical knowledge more effectively in practical contexts. For example, a recent PhD graduate may initially earn less than a mid-career professional with a bachelor's degree. However, as the PhD graduate gains experience, their ability to apply advanced knowledge accelerates wage growth, potentially surpassing that of less-educated but more experienced workers.

This dual pathway highlights the importance of continuous learning and on-the-job training in maximizing lifetime wage growth. Governments and organizations should develop integrated career pathways that combine education and experience. For instance, apprenticeship programs that integrate formal education with practical training could accelerate wage growth among young workers. In addition, mid-career professionals should be encouraged to pursue continuous education through subsidized courses or employer-sponsored training to ensure that accumulated experience remains relevant in changing labor markets.

Working hours not only influence immediate earnings but also shape long-term wage trajectories through experience accumulation. Excessive working hours may lead to burnout, reducing the quality of experience gained and limiting skill development. In contrast, moderate working hours combined with opportunities for reflection

and learning can enhance the depth and applicability of experience. This implies that the quality of experience depends both on the number of hours worked and on the conditions under which those hours are performed.

For example, a worker consistently engaged in 60-hour workweeks may accumulate more experience in quantity terms, but the quality of that experience may decline due to fatigue and limited time for skill refinement. Conversely, a worker with a 40-hour workweek who participates in training and mentorship may develop more valuable competencies, leading to stronger long-term wage growth.

To improve the quality of experience, policymakers should support structured working hour frameworks that incorporate dedicated time for learning and skill development. For example, organizations may introduce learning hours within the working week for training, mentorship, or collaborative development activities. Such measures would enhance the value of experience and support long-term wage growth.

Although experience is widely recognized as a key driver of wage growth, its effect is subject to diminishing returns that vary across sectors. In knowledge-intensive industries such as technology and finance, diminishing returns may be less pronounced due to continuous skill and technological upgrading. In contrast, in routine-based sectors such as manufacturing, experience may yield faster diminishing returns as automation reduces the value of accumulated task-specific knowledge.

For example, a software engineer with 20 years of experience may continue to earn high wages due to ongoing skill adaptation, whereas a manufacturing worker with similar experience may experience wage stagnation as their skills become less relevant in automated production environments.

Wage policies should therefore be sector-specific. In knowledge-intensive sectors, wage structures may include experience-based premiums that reward continuous learning and adaptability. In routine-based sectors, policies should facilitate transitions into supervisory or training roles where accumulated experience retains higher value.

Wages not only reflect the outcomes of education and experience but also influence future educational investment decisions. Higher wages increase individuals' ability to invest in further education, creating a positive feedback loop between human capital accumulation and earnings. However, this mechanism is often constrained by wage inequality, as lower-income workers face limited access to quality education. For example, higher-paid individuals may invest in additional certifications or advanced degrees, further increasing their earning potential, whereas low-wage workers may be unable to afford such investments, reinforcing inequality. To sustain the wage-education feedback loop, governments may implement wage-linked education subsidies. For instance, individuals below a specified income threshold could receive grants or low-interest loans for higher education or vocational training. This would enhance earning potential while contributing to the reduction of wage inequality.

CONCLUSION AND RECOMMENDATIONS

This study has provided a comprehensive analysis of the intricate relationships between working hours, education, experience, and wages, offering novel insights into the dynamics of wage determination in modern labor markets. Our findings underscore the importance of adopting a multifaceted approach to wage-setting policies — one that recognizes the interplay among these key determinants and their non-linear effects. The empirical evidence reveals that while education and experience significantly enhance wage levels, the relationship between working hours and wages is more nuanced, with diminishing returns at higher levels of work intensity. Furthermore, the non-linear relationship between experience and wages highlights the importance of considering career stages and sector-specific dynamics in wage determination.

The study also introduces a novel framework that integrates the synergistic effects of education, experience, and working hours, offering a more holistic understanding of labor market dynamics. This framework emphasizes that the marginal utility of working hours varies with educational attainment and that the quality of experience is influenced by both the quantity of hours worked and the conditions under which those hours are performed. Additionally, the concept of the experience-education multiplier effect sheds light on how education amplifies the value of experience, particularly in knowledge-intensive sectors.

Based on these findings, we propose several strategic education- and work-related policies and recommendations for formulating equitable and efficient wage determination systems that promote both employee well-being and organizational success, ultimately contributing to more resilient labor markets and economic growth in modern economies. These include:

- Implementing regulations that adjust working hours based on educational levels, promoting flexible arrangements for highly educated workers and upskilling programs for less educated workers to enhance productivity without excessive overtime.

• Developing career pathways that combine education and on-the-job training, such as apprenticeships, to accelerate wage growth for young workers and encourage continuous education for mid-career professionals.

• Introducing structured working hours that include dedicated time for skill development and reflection, such as learning hours, to enhance the quality of experience and long-term wage growth.

• Tailoring wage policies to reflect the sector-specific value of experience, incorporating experience-based premiums in knowledge-intensive sectors and transitioning workers in routine-based sectors into more dynamic roles.

• Providing wage-linked education subsidies, such as grants or low-interest loans, to low-wage workers pursuing further education, thereby breaking the cycle of wage stagnation and reducing inequality.

• Adopting performance-based pay systems that adjust compensation based on the non-linear relationship between experience and wages, offering steeper increases for early-career employees and more gradual increases for experienced workers.

• Encouraging flexible work arrangements, such as remote work and compressed workweeks, to improve work-life balance, reduce burnout, and enhance employee satisfaction and productivity.

• Ensuring that wage determination policies are transparent and effectively communicated to employees, thereby fostering trust and motivation. Regular job evaluations and skill assessments should be conducted to ensure fair compensation based on contributions and expertise.

While this study provides valuable insights into the relationship between working hours, education, experience, and wages, it is important to acknowledge its limitations. The findings are based on a specific dataset and may not be generalizable to all contexts. Future research could explore these relationships in different countries, industries, and time periods to gain a more comprehensive understanding. Additionally, incorporating additional factors such as gender, race, occupation, technological advancements, and evolving labor market conditions could provide further insights into the complex determinants of wage inequality.

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