Analysis of Human Potential Resources Quality in High Growth Industrial Sectors in Indonesia

Nur Siti Annazah[1*], Yusuf Faisal Martak[2], Muhammad Alfi Aulia Ilma[2], dan Rezky Aries Munandar[1]

[1]*Ministry of Manpower*
[2]*Researcher Article 33*

Email Correspondence: anazah.siti@gmail.com

Abstract

This study addresses the persistent mismatch between sectoral growth and human capital quality in Indonesia. It investigates whether regions experiencing simultaneous economic expansion and improvements in tertiary-educated labor achieve higher wage outcomes. Specifically, it asks: to what extent does the alignment between sectoral development and human capital influence wage growth, and how does training strengthen this effect? Using longitudinal Sakernas data (2012–2022) at the district–sector level and panel regressions with province fixed effects, the analysis assesses wage dynamics based on sectoral shifts, education attainment, and training participation. Findings indicate: (1) only 12.73% of regions are "high–high," yet they record approximately 74% higher wage levels (around 52% after fixed effects), and (2) education (4–8%) and training (5–7%) individually contribute modest wage gains. Policy implications highlight the need to: (a) integrate human capital strategies with sectoral development planning, and (b) prioritize education and training investments in high-potential sectors to maximize wage outcomes and reduce regional disparities.

Keywords: economic sectors, human resources, labor quality, wage

1. Introduction

Human resources (HR) play a pivotal role in national development, particularly in emerging economies pursuing accelerated growth. In this context, the quality and distribution of human capital are key determinants of economic progress. Over the past decade, Indonesia has experienced structural shifts across labor markets, with employment gradually moving from traditional sectors toward emerging industries such as manufacturing and information technology. However, this sectoral expansion has not consistently been accompanied by

improvements in workforce quality, particularly in terms of formal education and vocational competencies.

Figure 1 illustrates the trend in the Open Unemployment Rate (OUR/TPT) by educational attainment from 2012 to 2022. The data show that senior high school graduates continue to record the highest unemployment rates, indicating a persistent mismatch between their skill profiles and labor market demands. Conversely, unemployment among tertiary-educated individuals remains relatively low, supporting human capital theory which argues that investment in education enhances productivity (Becker, 1964). Nevertheless, fluctuations in unemployment rates among university graduates suggest that higher education alone is insufficient without alignment with industry-relevant competencies
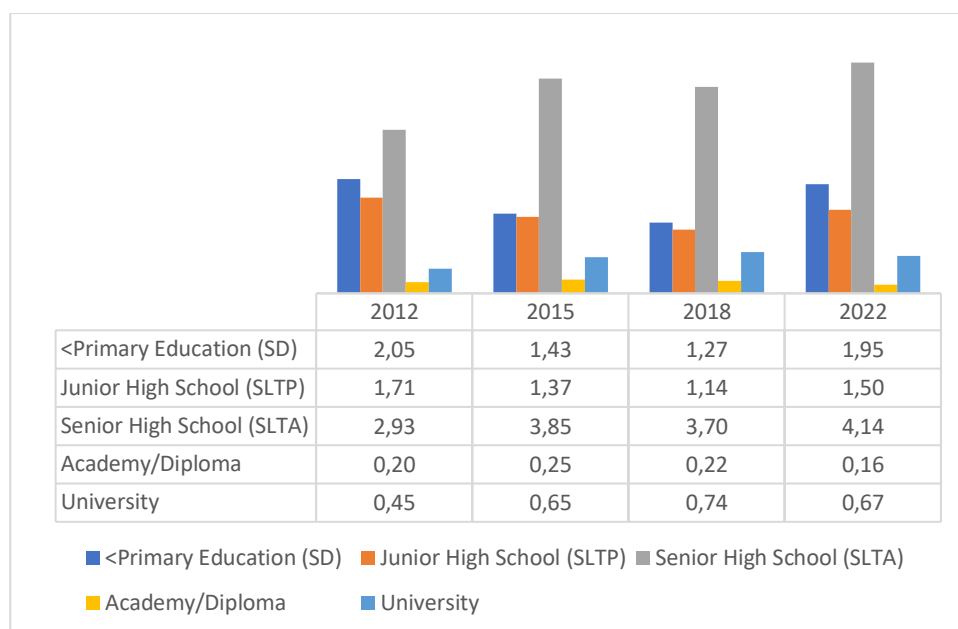

	2012	2015	2018	2022
<Primary Education (SD)	2,05	1,43	1,27	1,95
Junior High School (SLTP)	1,71	1,37	1,14	1,50
Senior High School (SLTA)	2,93	3,85	3,70	4,14
Academy/Diploma	0,20	0,25	0,22	0,16
University	0,45	0,65	0,74	0,67

■ <Primary Education (SD)   ■ Junior High School (SLTP)   ■ Senior High School (SLTA)
■ Academy/Diploma   ■ University

Figure 1. TPT by Education Completed in Indonesia 2012, 2015, 2018, 2022
Source: BPS (2012—2022)

As shown in Figure 2, most university graduates are employed in education services (34.0%), public administration and social security (14.0%), and trade-related sectors (12.3%). In contrast, key strategic sectors such as information and communication, manufacturing, and technology-related services absorb a relatively small share of highly educated labor. These figures indicate underutilization of human capital within sectors expected to drive innovation under digital transformation and Industry 4.0. Prior studies (Oktaviani & Maulana, 2020; World Bank, 2020; Prayudhani, 2020; OECD, 2022) consistently highlight that higher education outputs are not yet optimally aligned with sectoral competency requirements, contributing to both unemployment and skills mismatch.
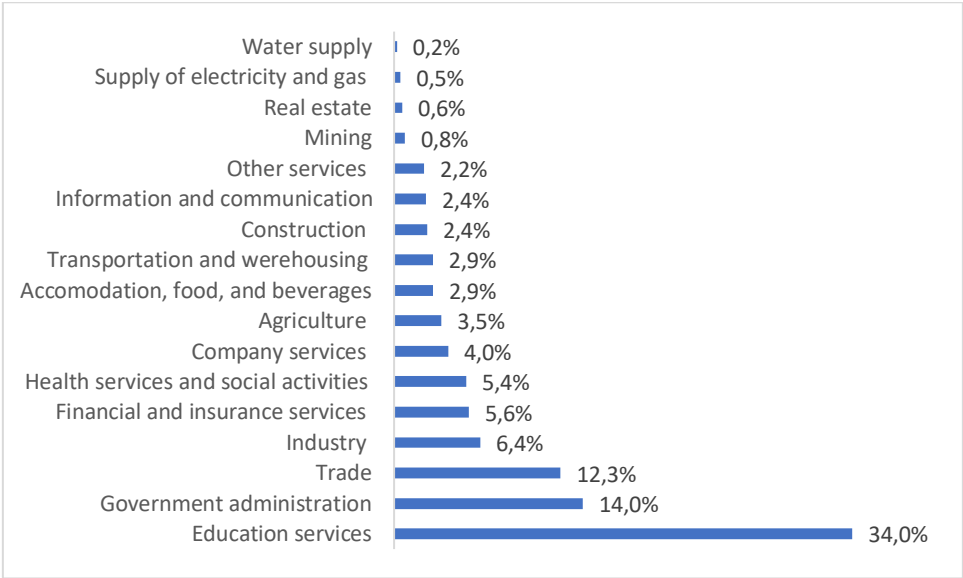
Figure 2. Number of University Graduates Employed by Sector
Source: (BPS, Augustus 2022)

This pattern raises critical concerns regarding the effectiveness of national human capital strategies in supporting productivity-based sectoral growth. Technology- and knowledge-intensive industries such as IT services, automation-based manufacturing, and professional technical services—which should theoretically absorb top talent—have not demonstrated sufficient absorption capacity, reflecting a structural disconnect between economic transformation and human capital readiness.

To address this issue, this study conducts a longitudinal analysis of Sakernas data (2012 and 2022) and complementary 2024 training program data at the district–sector level. The research aims to answer two key questions: (1) *To what extent have high-growth sectors successfully absorbed qualified human capital, and does this alignment contribute to higher wage growth?* and (2) *Does access to vocational training strengthen the effect of human capital quality on wage improvement?*
This approach fills a gap in the literature, as previous research has not explicitly analyzed the alignment between sectoral growth and workforce quality at the district–sector level over time, nor examined its implications for long-term wage dynamics.

This study contributes empirically by combining sectoral shifts with human capital indicators to assess their interaction effects on wage performance, offering a more granular analysis than studies using aggregate or province-level data. In addition, it provides policy-relevant evidence to inform more targeted labor market interventions, particularly regarding the integration of education, training, and sectoral planning at both national and subnational levels.

2. Research method

2.1. Data Source and Indicators

2.1.1. Data Source

This analysis utilizes data from the National Labor Force Survey (Survei Angkatan Kerja Nasional/Sakernas) for the years 2012 and 2022, conducted by Statistics Indonesia (Badan Pusat Statistik/BPS). The unit of analysis is the district/city–sector cell observed in both 2012 and 2022, allowing us to construct sector-disaggregated labor market indicators at the subnational level. In total, the Sakernas covered 517,713 individuals in 2012 and 752,688 individuals in 2022.

2.1.2. Indicators

1. Dependent variable: Average annual wage delta per individual (2012–2022), calculated at the district/city and sector levels. This variable measures the average yearly change in workers' wages over a decade, indicating the direction and pace of labor welfare growth across sectors and regions.

$$\Delta Wage\_(i, s) = (Wage\_(i, s, 2022) - Wage\_(i, s, 2012))$$

where iii represents district/city and sss represents sector. *Alternatively, log-transformed values are used in regression specifications to improve interpretability.*

2. Independent Variables:

   a. Sectoral employment share by district/city in 2012 and 2022. This variable reflects the distribution of the workforce across economic sectors over the past ten years and helps identify sectoral shifts, indicating which sectors have expanded or contracted as sources of employment.
   b. Percentage of individuals with higher education by sector and district/city in 2012 and 2022. This variable measures the proportion of workers holding tertiary qualifications within each sector and region, offering insights into the quality of the workforce and its relation to wage dynamics and sectoral competitiveness.
   c. Percentage of individuals who received training by sector and district/city in 2022. This indicator shows the proportion of workers who received training or capacity-building interventions in 2022, which may influence sectoral transformation and wage outcomes.

3. Province Fixed-effect Indicator: This variable is employed as a control to eliminate the influence of time-invariant characteristics at the provincial level. By incorporating fixed effects, the model aims to improve estimation accuracy by isolating the impact of independent variables on wage delta from unobserved inter-provincial differences (e.g., geographic or infrastructural disparities).

2.2. Analytical Methods

2.2.1. Descriptive Analysis

This stage aims to provide an initial mapping and identify key patterns based on quantitative data from Sakernas. The descriptive analysis maps sectoral shifts, workforce education profiles, and wage changes. The analysis is carried out in three steps:

1. Identification of the most dynamic sectors in each district/city, based on the increase in the proportion of employment from 2012 to 2022. This step is used to highlight sectors that have experienced significant growth and may serve as key drivers of the local economy.

2. Linking sectoral growth to the educational attainment of workers employed in those sectors. By calculating the share of workers with tertiary education within the growing sectors, the analysis assesses the extent to which sectoral expansion is associated with the quality of the human capital involved.

3. Comparison between the highest sectoral wage delta and the increase in higher education attainment. The aim of this step is to explore the relationship between labor quality (represented by education level) and wage growth, and to identify whether increased levels of tertiary education within specific sectors are associated with improvements in economic welfare (as reflected in wage increases).

2.2.2. Empirical Analysis

At this stage, we examine the relationship between key variables more systematically using a panel-data regression approach at the district/city–sector level. We include province fixed effects (Yp) to control for time-invariant provincial characteristics (e.g., geography, infrastructure). The objective is to test whether long-term wage growth (2012–2022) is driven by sectoral expansion, the quality of the workforce, and recent human capital investments.

1. Assessing the benefits of sectoral growth when supported by a competent workforce. This model examines whether sectors with high labor absorption experience greater wage increases when predominantly composed of tertiary-educated workers. In essence, it investigates whether higher education acts as a reinforcing factor for economic welfare in growing sectors.

$$\Delta Wage(i,s) = \beta_1\, HighGrowthSector(i,s) + \beta_2\, HighEdu(i,s) \\ + \beta_3\, [HighGrowthSector(i,s) \times HighEdu(i,s)] + \gamma_\mathrm{p} + \varepsilon(i,s)$$

In sum, the model is shown above

$$\Delta Wage(i,s) = \beta_0 + \beta_1\, HighHigh(i,s) + \gamma_\mathrm{p} + \varepsilon(i,s)$$

2. Assessing the impact of vocational training on dynamic sectors dominated by tertiary-educated labor. This model evaluates whether training received by the workforce in 2024 can amplify the positive effects of sectoral growth and the prevalence of higher education

on wage increases. It reflects the effectiveness of capacity development interventions in promoting the transformation of local economic sectors.

$$\Delta Wage\_\{i,s\} = \beta_1 \Delta HighEdu\_\{i,s\} + \beta_2 \Delta Training\{i,s\} + \gamma\_p + \varepsilon\_\{i,s\}$$

In sum, this analytical approach not only captures the conditions and transformations that have occurred over the past decade but also explicitly links sectoral growth, labor force characteristics, and economic welfare. The results are expected to provide a strong empirical foundation for evidence-based labor policy formulation at both national and regional levels.

3. Results and Discussion

3.1. Descriptive Analysis: Most High-Growth Sectors Are Not Accompanied by Growth in Qualified Human Resources

The descriptive analysis reveals a clear imbalance between sectoral expansion and improvements in labor quality. While many sectors registered strong growth from 2012 to 2022, only a small share of districts/cities simultaneously experienced an increase in the proportion of tertiary-educated workers.

Figure 3 illustrates that postal services, telecommunications, broadcasting, and electronic systems and transactions were the dominant high-growth sectors, accounting for 26.88% of districts/cities. These were followed by transportation (23.83%) and trade (16.50%), while the remaining 14 sectors collectively contributed to only 32.79%. Despite this rapid expansion, most of these sectors did not show parallel improvement in human resource quality.
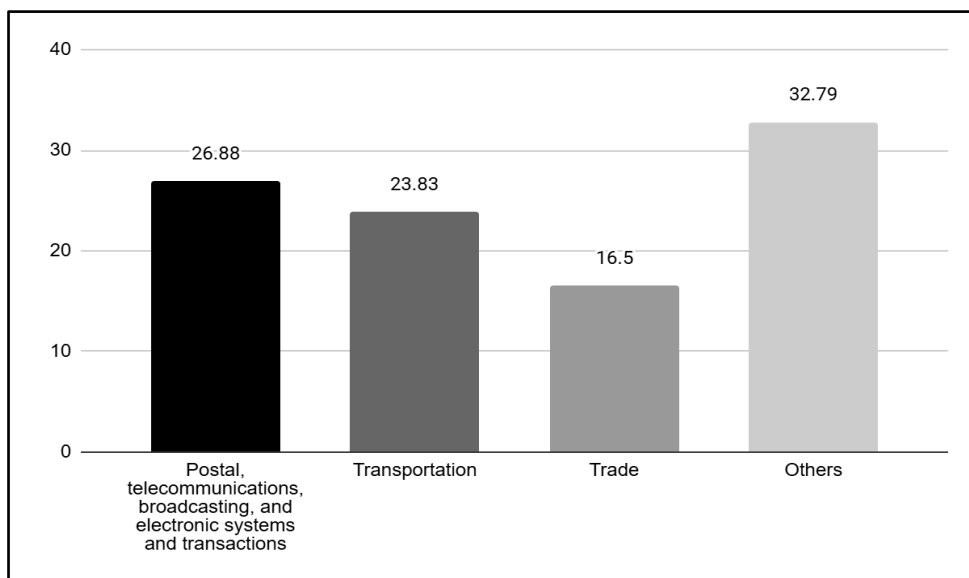

Figure 3. Percentage of Districts/Cities with the Top 3 Highest-Growth Sectors, 2012-2022
Source: Sakernas 2012 and 2022, processed

On the other side, Table 1 highlights the extent of this misalignment: only 12.73% of districts/cities experienced growth in both sectoral employment and the share of higher-educated workers, whereas 87.27% saw sectoral growth without sufficient improvement in tertiary-level labor absorption. This indicates that the majority of high-growth sectors are being driven by a workforce that may lack the advanced skills required to sustain innovation and long-term productivity.

Table 1. Comparison Between Sectoral Growth and Increase in Tertiary-Educated Workforce Across Districts/Cities

Criteria	Percentage
Districts with rapidly growing sectors accompanied by a significant increase in highly educated human resources	12.73%
Districts with rapidly growing sectors *not* accompanied by a significant increase in highly educated human resources	87.27%

Source: Sakernas 2012 and 2022, processed

Further comparison between sectoral growth delta and the delta in tertiary-educated workforce absorption reinforces this misalignment. Figure 4 illustrates that sectoral change averaged 8.23 percent, while the increase in highly educated workers was only 4.31 percent. Districts and cities positioned above the diagonal line reflect faster sectoral growth relative to improvement in labor quality.

On average, the sectoral change delta is 8.23%, while the delta for the proportion of tertiary-educated workers is only 4.31%. This reinforces the earlier observation that rapid sectoral expansion is not being matched by an equivalent improvement in human capital quality.
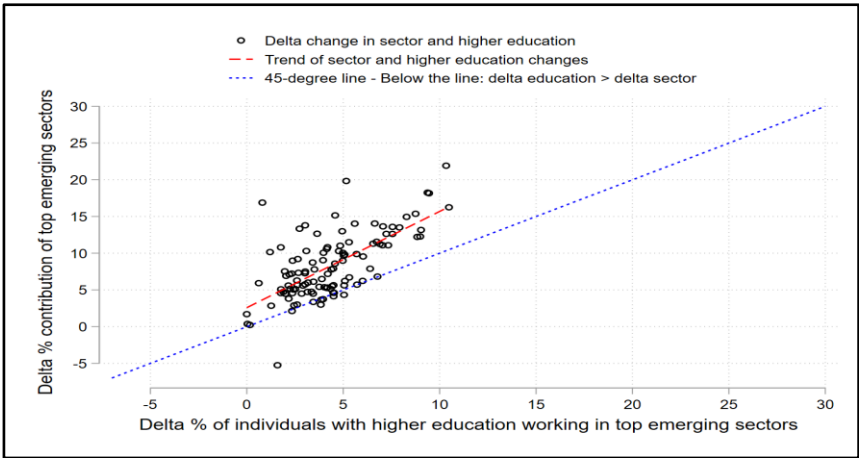

Figure 4. Comparison Between Sectoral Growth Delta and Delta in Tertiary-Educated Labor Absorption
Source: Sakernas 2012 and 2022, processed

The contribution of high-growth sectors to regional economies varies depending on natural resources, human capital, and infrastructure. Regions such as Kalimantan and Sumatra, rich in natural resources, tend to rely on extractive industries, while provinces like West Java and East Java with stronger infrastructure and higher educational attainment show greater development in manufacturing and technology sectors. Improvements in human capital, as reflected in the Human Development Index, are closely linked to economic growth (Harahap and Adry, 2020), and infrastructure plays a key role in driving investment and high-value sector development (Supriyatno et al., 2024).

However, rapid sectoral growth does not guarantee higher absorption of qualified labor. Around 32.5 percent of Indonesian workers experience vertical mismatch, where their education does not align with job requirements (Sari and Ahmad, 2023), a challenge also observed in Vietnam where university graduates struggle to access appropriate employment due to limited labor market information (Tran et al., 2022). A regressive trend in Indonesia's manufacturing sector further indicates that increased production has not been accompanied by higher skilled labor absorption (Nababan and Purba, 2023).

From a policy perspective, sectoral expansion is easier to accelerate than improvements in labor quality. Education reforms have limited short-term impact and require time to translate into productivity gains (Utama et al., 2004), while the effects of digitalization remain suboptimal in Indonesia compared to Malaysia and the Philippines. Foreign direct investment contributes more effectively to skill development in service-related sectors than in traditional production industries (Nguyen et al., 2024). In addition, the dominance of informal employment in Indonesia, affecting two out of every three workers, constrains productivity and access to social protection (ILO, 2023), limiting the absorption of higher-skilled labor.

3.2. Empirical Analysis: High-Growth Sectors Coupled with Qualified Human Resources Tend to Generate Higher Wage Growth, Especially for Trained Individuals

The empirical analysis confirms that districts/cities with high-growth sectors accompanied by an increasing proportion of tertiary-educated workers (high–high regions) tend to exhibit substantially higher wage growth. Figure 5 shows that sectors with both rapid expansion and improvements in human capital experienced an average wage increase of IDR 1,756,085 over 2012–2022, compared to only IDR 996,952 in sectors with high growth but stagnant human capital development.

In 2022, the average wage in high–high regions reached IDR 3,023,188, higher than the IDR 2,364,953 recorded in regions with sectoral growth but without improvement in tertiary education levels. These findings highlight the importance of aligning sectoral expansion with enhancements in labor quality to maximize wage growth.
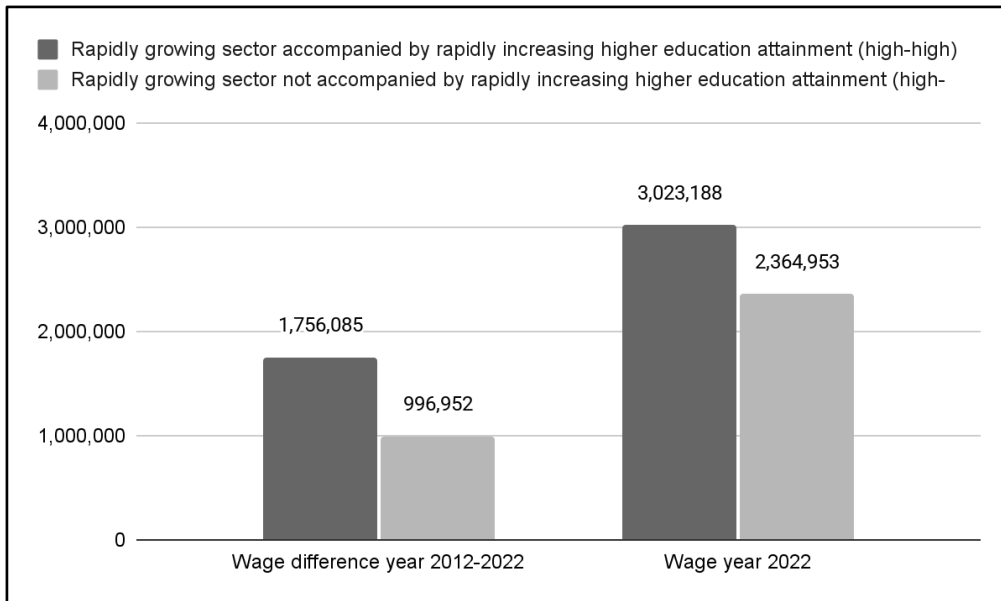
Figure 5. Comparison of Wage Growth (Delta Wages) 2012–2022 and Average Wages in 2022 between Regencies/Municipalities with Sectoral Growth Accompanied and Unaccompanied by an Increase in Tertiary Education Attainment. The result is significant differ using t-test
Source: Sakernas 2012 and 2022, processed

Regression results provide further support. As shown in Table 2, high–high regions are associated with higher wage levels, indicated by a log-wage coefficient of 0.554, statistically significant at the 1% level. This can be interpreted as approximately 74.02% higher wage levels compared to other regions. After controlling for province fixed effects, the coefficient remains substantial at 0.422, equivalent to around 52.53% higher wages. These effects are notably larger than those associated with increases in education alone (Regressions 3 and 4, 7–8%) or participation in training (Regressions 5 and 6, 6–7%).

Table 2. Regression result

VARIABLES	_1 Log delta wage	_2 Log delta wage	_3 Log delta wage	_4 Log delta wage	_5 Log delta wage	_6 Log delta wage	_7 Log delta wage	_8 Log delta wage
High growth sector & High Growth of High Education Completed	0.554***	0.422***						
	(0.0898)	(0.0995)						
Delta of High Education Completed			0.0747***	0.0796***			0.0381***	0.0433***
			(0.0109)	(0.0108)			(0.0133)	(0.0131)
Delta % training					0.0666***	0.0693***	0.0469***	0.0465***
					(0.00680)	(0.00671)	(0.00805)	(0.00777)
Constant	13.79***	13.74***	13.92***	13.62***	13.86***	13.56***	13.87***	13.57***
	(0.0433)	(0.139)	(0.0118)	(0.0518)	(0.0149)	(0.0538)	(0.0153)	(0.0526)

VARIABLES	_1 Log delta wage	_2 Log delta wage	_3 Log delta wage	_4 Log delta wage	_5 Log delta wage	_6 Log delta wage	_7 Log delta wage	_8 Log delta wage
Province fixed-effect	No	Yes	No	Yes	No	Yes	No	Yes
Observations	721	721	5,784	5,784	5,784	5,784	5,784	5,784
R-squared	0.031	0.106	0.013	0.070	0.015	0.072	0.017	0.075

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 6 further demonstrates that the simultaneous development of sectoral growth and qualified human resources has a significantly stronger effect on wage levels than individual factors such as education or training alone.
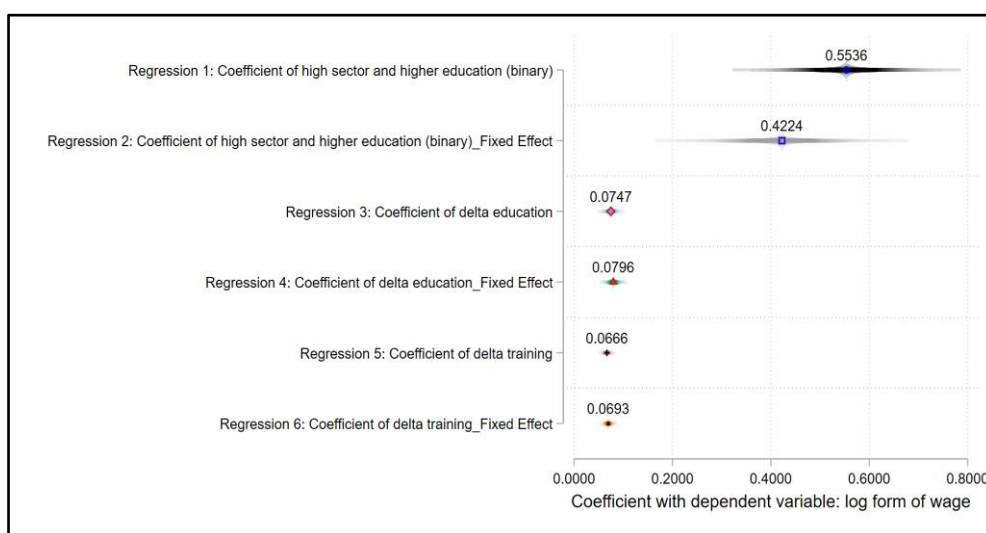

Figure 6. Regression Coefficients of Single-Variable Models on Logarithmic Wage Levels
Source: Sakernas 2012 and 2022, processed

Complementing the prior analysis, Figure 7 presents results from multivariable regression including the change in the proportion of tertiary-educated individuals and the proportion participating in vocational training. Regression 7 (without fixed effects) shows that an increase in tertiary education contributes **0.0381** to log wages, while vocational training contributes **0.0469**. After accounting for fixed effects, the coefficients rise slightly to **0.0433** (education) and **0.0465** (training). These results suggest that both education and training contribute positively to wage increases, although their impact is lower than the effect of being in a high–high region.
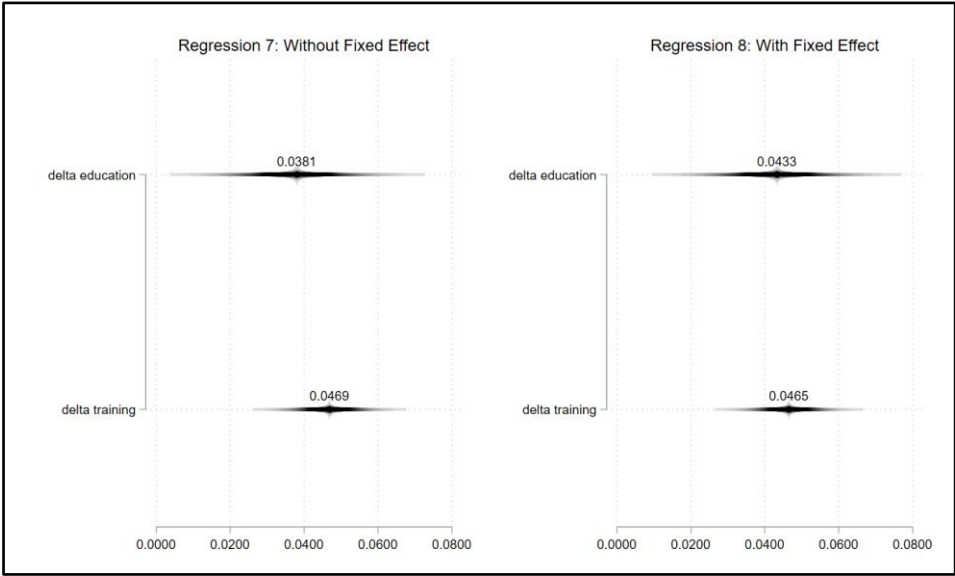
Figure 7. Coefficients from Multivariable Regression on Log Wages: Simultaneous Effects of Education and Training

Source: Sakernas 2012 and 2022, processed

As shown in Table 2 regression 7 and 8, the combined effect of education and training is beneficial but does not match the magnitude of wage gains observed in high–high regions, indicating that human capital strengthening is most effective when aligned with sectoral transformation.

These findings are consistent with the broader literature. Reports from the Asian Development Bank (2021) and the OECD (2022) emphasize that sectoral transformation, particularly in the context of digitalization and automation, requires the availability of skilled labor to sustain productivity and wage growth. For Indonesia, Harahap and Adry (2020) also highlight that improvements in human capital, as reflected in the Human Development Index, are strongly associated with economic performance, while Supriyatno et al. (2024) stress the importance of supporting infrastructure in enabling sectoral expansion.

Despite this, sectoral growth alone does not guarantee enhanced labor welfare without concurrent improvements in skill alignment. Sari and Ahmad (2023) find that around 32.5 percent of workers experience vertical mismatch, indicating that increasing education levels are not always matched by demand for medium- and high-skilled labor. Similar evidence is observed in Vietnam, where increases in university graduates do not translate into proportionate employment outcomes due to limited labor market signaling (Tran et al., 2022). In Indonesia's manufacturing sector, Nababan dan Purba (2023) show that while production levels have risen, absorption of skilled workers has declined across several subsectors.

From a long-term development perspective, Utama et al. (2004) argue that education reform has limited short-term impact and requires time to translate into productivity gains. Nguyen et

al. (2024) further demonstrate that foreign direct investment contributes more effectively to skill formation when placed in service, logistics, and knowledge-intensive industries rather than traditional production sectors. Finally, the widespread prevalence of informal employment in Indonesia (ILO, 2023) constrains the absorption of highly educated labor, dampens productivity, and limits the potential impact of sectoral growth.

Overall, the results underscore that while improvements in education and participation in training programs positively influence wage growth, their impact is significantly more pronounced when aligned with expanding economic sectors. Human capital strategies must therefore be integrated with sectoral development policies to maximize economic returns, enhance labor welfare, and reduce structural disparities in wage outcomes.

4. Conclusion and Recommendations

4.1. Conclusion

This study finds that the alignment between sectoral growth and human capital quality is a critical determinant of wage performance at the district–sector level. While several sectors have experienced rapid expansion over the last decade, including postal and telecommunications, transportation, and trade, only 12.73% of districts/cities simultaneously recorded sectoral growth and rising shares of tertiary-educated workers (high–high regions). These high–high regions exhibit log-wage levels approximately 55.36% higher than other areas, whereas the effects of education and training individually are considerably smaller (around 4–8%). This indicates that human capital interventions alone are insufficient without corresponding sectoral expansion.

This study extends the existing literature by providing novel empirical evidence at the district–sector level, demonstrating that the economic returns to education and training are maximized when they occur in high-growth sectors. Unlike previous analyses that focus primarily on aggregate or provincial data, this approach captures regional and sectoral heterogeneity and highlights the strategic importance of integrating human capital development with sectoral transformation. The findings emphasize that regions with well-aligned growth dynamics and skilled labor not only generate higher wages but also possess greater potential for sustaining long-term productivity.

From a policy perspective, strengthening the quality of human resources through education and training remains essential. However, the study shows that the greatest impact occurs when these efforts are closely linked with sectors experiencing rapid expansion. Therefore, human capital policies must be strategically interwoven with sectoral development initiatives to deliver meaningful economic outcomes and reduce structural wage disparities. Future research could explore the role of labor market institutions, reskilling mechanisms, or the dynamics of technology adoption to further enhance alignment between labor supply and demand.

4.2. Policy Recommendation

To enhance the productivity and sustainability of rapidly growing sectors, policy strategies must be aligned with the empirical findings of this study. In particular, the fact that only 12.73% of districts/cities qualify as high–high regions, and that the combined effect of sectoral growth and human capital (≈74.02% wage gain) far exceeds the isolated effects of education (≈4–8%) and training (≈5–7%), suggests that interventions must be integrative rather than standalone. Based on this evidence, several strategic recommendations are proposed:

1. Local governments need to develop and regularly update a forward-looking map of high-growth sectors based on district–sector data analysis. This mapping should identify regions with potential to transition into high–high status and be used to align regional education policies, vocational training programs, and local economic planning. Integration of Sakernas data into local labor market forecasting and human capital planning is essential to bridge the current disconnection.

2. The central government, in collaboration with local governments and industry, should expand targeted access to tertiary education and skill pathways specifically for sectors with high transformation potential. This may include scholarship schemes and dual-system vocational models, as well as incentives for higher education institutions and training centers to tailor curricula toward emerging regional economic needs.

3. Employers and government agencies should expand and target demand-driven training programs, particularly within high-growth sectors, to enhance the capabilities of the existing workforce. Given the regression findings showing limited effects of training alone, training agendas must be strategically directed toward sectors showing strong potential for productive growth, and supported by mechanisms such as tax incentives, competency-based certification, and industry–education partnerships.

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