The Impact on Labour Productivity in Malaysia Industries

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ABSTRACT

Labour productivity is a crucial determinant of economic growth, reflecting how efficiently a nation utilises its inputs and workforce. In Malaysia, persistent productivity gaps between primary and secondary industries raised concerns about the effects of capital intensity, intermediate input efficiency, and labour composition. This study examined the long-run relationship between intermediate input, capital, labour composition (local and foreign), wages, and labour productivity across Malaysia's major industries. Using the annual panel data from 2001 to 2021, the analysis adopted Fully Modified Ordinary Least Squares (FMOLS) estimation technique to correct endogeneity and serial correlation in cointegrated panels, providing robust long-run elasticities. The results revealed substantial heterogeneity across industries. In the agriculture industry, intermediate input of (0.9132, $p < 0.01$) and capital (0.3454, $p = 0.0227$) significantly enhanced productivity, while wages have a negative effect (-0.6978, $p = 0.0195$), reflecting inefficiencies from low-skilled employment. The mining and quarrying industry showed productivity driven mainly by intermediate input (0.9203, $p = 0.0249$), whereas capital (-0.4169, $p = 0.0836$) has a negative effect, indicating overcapitalisation and resource depletion. In the manufacturing industry, the intermediate input of (0.9012, $p < 0.01$), salary (0.1313, $p < 0.01$), and foreign labour (0.0482, $p = 0.0403$) exhibited significant positive effects, demonstrating strong complementarities between skilled migrant labour and technology adoption. The construction industry showed significant positive effects of intermediate input (0.7556, $p < 0.01$) and capital (0.2520, $p < 0.01$), confirming increasing returns to scale through capital deepening and efficient material utilisation. Overall, the findings confirmed that Malaysia's long-run productivity growth is driven primarily by capital accumulation and intermediate input efficiency, consistent with the Solow Growth Model. Policies promoting technological upgrading, mechanization, digitalization, and skill development are essential to sustain productivity towards achieving Malaysia's Vision 2030 aspirations for a high-income, innovation-based economy.

Keywords: Labour Productivity, MOLS, Intermediate Input, Capital, Foreign Labour, Malaysia

INTRODUCTION

Malaysia, a developing nation, has undergone a remarkable economic transformation from an agriculture-based economy to a manufacturing- and service-oriented economy since the 1970s. This structural shift has been central to the country's development strategy, allowing it to harness comparative advantages, expand industrial capacity, and diversify sources of growth. Today, the services sector has emerged as the main engine of national economic growth, contributing over 50% of Malaysia's gross domestic product (GDP) in 2022, followed by manufacturing at 22.1%, mining at 7.1%, and agriculture at 6.6% (Department of Statistics Malaysia, 2022). Sub-sectors of the services industry include transportation and storage; food, beverage, and accommodation; wholesale and retail trade including motor vehicle repairs; administration and support services; personal services; and private health and social work. These sectors collectively generate substantial employment opportunities, ranging from unskilled to highly skilled labour, and simultaneously support domestic consumption and downstream industrial activities (Azer et al., 2018; Setiawan, Wakhyuni, & Siregar, 2020).

Employment generation in Malaysia had consistently risen across all industries. By 2021, there were approximately 16 million employees, including 2.4 million foreign workers (Department of Statistics Malaysia, 2022). Table 1 illustrates the steady growth in local employment across decades and the rising

participation of foreign workers since 1985. It highlighted the upward trend, emphasising the significant role of foreign labour in supporting various industries. The presence of foreign workers has been instrumental in supplementing domestic labour shortages, particularly in labour-intensive sectors such as construction, agriculture, and selected manufacturing segments. However, this growing reliance on foreign labour also introduced uncertainties in productivity dynamics, as differences in skill levels, experience, and integration with domestic labour can affect efficiency and output per worker.

Table 1: Increasing Trend of Employment in all sector and Foreign Labour participation, from year 1986 to 2021

Years	1986	1996	2006	2016	2020	2021
Local Labour Employment	5,558.7	7,499.1	9,255.6	11,958.4	13,107.9	13,414.8
Foreign Workers	202.0	900.2	1,019.8	2,205.3	3,051.5	2,673.1

Source: Department of Statistics Malaysia, 2022

Despite Malaysia's industrial growth, the pressures of globalisation, liberalisation, and rapid technological change have created challenges for sustaining labour productivity across sectors (Zhao et al., 2023; Ayhan & Elal, 2023). Researchers have identified several productivity-related constraints, including limited skills in exploring new markets, inefficiencies in production processes, and challenges in improving quality and operational efficiency (Tadesse et al., 2021; Birhanu et al., 2021; Bold et al., 2022; Sahudin et al., 2014; Nor et al., 2023). Additional barriers include rising raw material costs, high initial capital requirements, limited government support, labour shortages, and intense global competition. Industries also faced operational inefficiencies, such as project delays, fragmentation, hazards, and waste generation (Smol et al., 2021). Rapid industrialisation has further intensified environmental concerns, with increased waste and pollution affecting sustainability in Malaysia and other developing nations (Aziman et al., 2023; Ehigiamusoe et al., 2021).

While the manufacturing and services sectors have shown relatively high productivity, sectors such as construction and agriculture remained less productive. In 2021, construction labour productivity was RM36,669 per worker; lower than agriculture (RM52,786), services (RM84,716), and manufacturing (RM128,807) (Department of Statistics Malaysia, 2022). Table 2 illustrates these sectoral productivity trends, highlighting the declining trajectory of construction productivity between 2019 and 2021. These disparities underscored the importance of understanding how input factors such as, capital, intermediate input, local labour, foreign labour, and wage, affecting productivity differently across industries.

Table 2 Sector Labour Productivity, 1985-2021 ('000)

Table 2: Decreasing Trend of Labour Productivity for each Sector, from year 2019 to 2021 Source: Department of Statistics Malaysia, 2022

Years	2019	2020	2021
Construction	45,421	38,322	36,669
Agriculture	54,225	53,114	52,786
Manufacturing	123,881	120,645	128,807
Services	89,568	84,336	84,716

Within the framework of the Solow Growth Model, long-term economic growth is driven by the accumulation of capital, expansion of labour, and improvements in production efficiency. In this context, the variation in labour productivity across Malaysian industries can be interpreted through differences in capital intensity, workforce composition, and the effective utilisation of intermediate inputs. Capital deepening is essential to enhance the marginal productivity of labour, while an optimal mix of local and foreign labour ensured that labour shortages are mitigated without diminishing overall efficiency. The Solow framework thus provided a

theoretical lens to evaluate the long-run determinants of labour productivity and the potential impact of structural and compositional factors in the Malaysian context.

Given the growing presence of foreign labour in Malaysia's primary and secondary industries, the relationship between workforce composition and productivity has become a central concern for policymakers and researchers. While foreign workers alleviated labour shortages, excessive reliance on low-skilled migrants might reduce incentives for firms to invest in technological upgrades, automation, and skills development. Consequently, productivity gains from capital and intermediate inputs might not be fully realised if labour composition is suboptimal. This uncertainty highlighted the need to examine the nuanced interplay between capital, intermediate inputs, local labour, and foreign labour in shaping long-run productivity outcomes.

The importance of this issue extended beyond economic growth alone. Enhancing labour productivity contributed directly to higher income levels, reduced unemployment, and improved socio-economic well-being. By identifying the factors that drive or constrain productivity, policymakers can implement targeted interventions to optimise labour utilisation, capital investment, and input efficiency. Moreover, understanding industry-specific productivity dynamics supports Malaysia's national development agenda, including Vision 2030 and the Twelfth Malaysia Plan, which emphasised sustainable growth, industrial competitiveness, and employment creation.

This study addressed these critical issues by investigating the long-run effects of five key determinants such as intermediate input, capital, local labour, foreign labour, and wages on labour productivity across Malaysia's primary and secondary industries. Employing the Fully Modified Ordinary Least Squares (FMOLS) approach, the analysis utilised panel data from 2001 to 2021, combining cross-sectional and time-series observations to generate robust estimates of long-run relationships. By focusing on industries with a higher proportion of foreign labour, this study explicitly examined whether workforce composition significantly affects labour productivity and how other input factors interact with this effect.

In detailing the research methodology, this study departed from prior literature that predominantly examined single industries or short-run relationships. By applying FMOLS to the industry-specific panel data, this study captured the long-run elasticities of labour productivity with respect to each input factor. The results are expected to show differential impacts of local and foreign labour, highlighting which industries gain or lose productivity advantages from workforce composition. Table 1 and Table 2 provide empirical context for these analyses by illustrating employment trends and historical productivity patterns across sectors.

The novelty of this research lies in its comprehensive industry-level examination of labour productivity determinants in Malaysia using a long-run estimation framework. While previous studies often focused on aggregate productivity trends or single-sector analyses, this study quantified the contributions of capital, intermediate input, and labour composition across multiple industries simultaneously. By doing so, it bridged gaps in the literature regarding the role of foreign labour in shaping productivity dynamics within primary and secondary sectors. The findings are anticipated to offer actionable insights for policymakers, enabling them to formulate productivity-enhancing strategies tailored to each sector, including targeted investment in capital, skills development for local labour, and optimal management of foreign workforce participation.

Finally, the roadmap of the paper is as follows: Section 2 presents the review of relevant literature on labour productivity determinants in Malaysia, contextualised within the Solow Growth Model framework. Section 3 outlines the methodology, data sources, and FMOLS estimation technique. Section 4 provides empirical results and discussion, followed by Section 5 which concludes the study, highlighting the policy implications and recommendations for Malaysia's industrial development and workforce management.

LITERATURE REVIEW

Labour productivity has long been recognised as a central driver of economic growth, efficiency, and competitiveness in both developed and developing economies. In Malaysia, the performance of labour productivity has become a critical policy concern, especially within the primary and secondary industries where capital accumulation, intermediate inputs, and the composition of labour jointly determined the rate of

output growth. The productivity performance of Malaysian industries has been uneven across sectors, with agriculture, manufacturing, and construction lagging behind service-based activities in recent years. The Solow Growth Model provides a relevant theoretical framework to understand these variations, positing that capital deepening and labour quality improvements are essential for long-term output growth. However, productivity in Malaysia remains heavily influenced by the structure of its inputs; particularly capital, intermediate inputs, foreign labour dependence, and wage disparities which collectively shaped efficiency, competitiveness, and sustainable industrial transformation.

Intermediate inputs have become an increasingly important component in explaining variations of productivity, especially in industries where technological upgrading and resource intensity play a key role. They include goods and services consumed during production, such as raw materials, energy, and services that are not part of fixed capital assets. In the Malaysian context, the value-added contribution of intermediate inputs has been shown to vary significantly across industries, reflecting different technological intensities and production linkages. Recent studies highlighted that the effective utilisation of intermediate inputs can enhance productivity by improving resource allocation, enabling economies of scale, and fostering inter-industry spillovers (Gilles et al., 2022).

In agriculture, for example, productivity has been increasingly driven by the efficient use of fertilizers, machinery services, and technological inputs that function as intermediate goods (Priyanto et al., 2023). The Malaysian Ministry of Agriculture reported that improvements in agricultural input management, such as seed quality and irrigation systems, contributed directly to rising yields per worker between 2020 and 2023. Similarly, manufacturing sectors that rely on high-quality imported inputs, particularly in electronics and petrochemicals have achieved faster productivity growth than those dependent on locally sourced, low-value materials (Khanna & Sharma, 2025). However, industries with weaker linkages to upstream suppliers faced input bottlenecks that constrained output efficiency.

The relationship between intermediate inputs and output growth also embodies the Solowian mechanism of capital deepening through technological absorption. As intermediate goods often embody new technologies, their use contributes indirectly to the accumulation of productive capital and labour efficiency. In Malaysia, this dynamic is most apparent in the manufacturing sector, where intermediate imports served as channels for technology diffusion (Lee et al., 2021). Nevertheless, the increasing reliance on imported intermediate inputs raises concerns about domestic value retention and long-term competitiveness. The literature increasingly calls for a balance between import dependence and local input development to ensure sustainable productivity gains across industries (Pane & Patunru, 2022).

Malaysia's industrial productivity landscape is deeply intertwined with its labour composition, particularly the balance between local and foreign workers. Foreign labour played a significant role in key industries such as agriculture, construction, and manufacturing, yet its impact on productivity had been both positive and negative across studies. The influx of foreign workers had been justified to address domestic labour shortages and sustain production, especially in low-skilled, labour-intensive sectors (Brucker Juricic et al., 2021). Nevertheless, the long-term implications for productivity depend on skill levels, technological adaptation, and management practices within firms.

Empirical evidence suggested that while foreign workers contributed to maintaining output levels, their concentration in low-skill tasks tends to suppress productivity growth when they were not accompanied by technological upgrading or human capital development (Tajuddin et al., 2023). For instance, Malaysia's construction sector that relied heavily on foreign labour had been stagnated in labour productivity despite the rising output volumes, which largely due to the persistence of manual work and limited mechanisation (Nor et al., 2023). Similarly, in the manufacturing industry, overreliance on foreign low-skilled workers had been linked to the declining capital-to-labour ratios, indicating a slowdown in productivity-enhancing investment (Tajuddin et al., 2023).

Conversely, sectors that had effectively integrated foreign workers through skill-based employment and training recorded productivity improvements. For instance, in export-oriented manufacturing industries such as electronics and electrical products, selective recruitment of semi-skilled foreign workers had supported the

scaling of production and improved labour utilisation efficiency (Goldar, 2023). Moreover, the diversification of Malaysia's workforce had spurred the transfer of technical knowledge and international work practices, though this remained concentrated in high-performing firms. A study by Manoharan et al. (2024) found that firms investing in joint skill training programmes for both local and foreign employees reported higher labour productivity compared to firms relying on segmented labour structures.

The Solow Growth Model underlined the importance of labour quality as a driver of output per worker. Malaysia's policy challenge, therefore, lies not merely in balancing foreign labour inflows but in enhancing the productivity capacity of its workforce through human capital investments. The Twelfth Malaysia Plan (2021–2025) emphasised skill upgrading, mechanisation, and productivity-linked wages to reduce the structural dependence on low-skilled migrant labour. However, implementation gaps persisted across industries, especially in agriculture and construction, where technological diffusion and training remain limited.

Capital accumulation had traditionally been regarded as the central determinant of productivity growth is consistent with the Solowian theory, which emphasised on capital deepening. In Malaysia's primary and secondary industries, capital formation continued to influence output through the acquisition of machinery, automation, and infrastructure that enhanced production efficiency. Recent research indicated that the manufacturing and construction sectors experienced notable capital deepening between 2020 and 2024, primarily driven by digitalisation initiatives and public investment programmes (World Bank Malaysia, 2024).

Investment in capital equipment, particularly automation and digital tools, had significantly boosted productivity in manufacturing industries such as automotive, electrical and electronics, along with food processing (Li et al., 2022). For example, automation has enabled firms to increase production capacity while maintaining workforce stability, leading to productivity gains, which is consistent with the Solow framework. In the construction sector, however, capital intensity remained relatively low due to slow adoption of mechanisation and Building Information Modelling (BIM) technologies (Gharaibeh et al., 2024).

The role of capital in agriculture had also evolved. Mechanisation and modern irrigation systems had replaced traditional labour-intensive practices, contributing to higher yield and efficiency per hectare (Gebiso et al., 2024). These developments demonstrated how capital investment complemented labour, enhancing its marginal productivity. Nevertheless, disparities persisted between industries: capital formation is heavily concentrated in urban-based manufacturing and infrastructure projects, while rural-based industries lagged in capital accumulation (Goodfellow, 2020). Such imbalances hindered balanced productivity growth across the economy and contributed to structural dualism between high- and low-productivity sectors.

The relationship between wages and productivity had been a recurring theme in productivity literature and economic policy. In Solowian sense, wages are the reflection of marginal labour productivity under competitive conditions. However, in practice, wage dynamics are influenced by institutional settings, labour market segmentation, and bargaining power asymmetries. Malaysia's wage–productivity relationship has evolved amid rising living costs, automation pressures, and foreign labour inflows.

Empirical studies indicated a mixed linkage between wage growth and productivity improvement. Recent research by Ibrahim and Putit (2020) revealed that wage increases in Malaysia have lagged productivity gains in several manufacturing subsectors, suggesting a decoupling effect that undermined labour motivation and innovation. Similarly, wage disparities between foreign and local workers persisted, with local workers generally earned higher wages even in similar occupations (Storm, 2022). Such wage segmentation could weaken overall workforce morale and impede productivity enhancement.

On the other hand, productivity-linked wage systems (PLWS), promoted by the Malaysian Productivity Corporation (MPC), had been increasingly implemented across firms to align remuneration with performance outcomes. Studies showed that firms adopted PLWS have experienced productivity improvements averaging 8–10% over two years (MPC, 2023). This demonstrated that appropriate wage structures can strengthen the incentive mechanism for efficiency improvements. However, wage growth unaccompanied by productivity increases can lead to inflationary pressures and loss of international competitiveness, especially in export-oriented industries (Nadoveza, 2025). Therefore, wage policies must be balanced to sustain both equity and

efficiency within the broader growth framework.

The reviewed literature underscored the complex interdependencies between intermediate inputs, labour composition, capital investment, and wages in determining productivity within Malaysia's primary and secondary industries. The Solow Growth Model provides a coherent framework for understanding these relationships by highlighting capital accumulation and labour efficiency as the primary engines of long-term growth. However, Malaysia's case illustrated that productivity performance did not solely dependent on the quantity of inputs, but also its quality, allocation efficiency, and technological integration.

The post-pandemic era had further highlighted the urgency of addressing productivity challenges through strategic rebalancing of input structures. Overreliance on foreign labour had constrained technological upgrading in several sectors, while insufficient domestic input linkages had weakened supply chain resilience. Moving forward, policy interventions should focus on enhancing capital formation, promoting intermediate input innovation, and strengthening labour quality through targeted training and digital skill development.

Furthermore, there is a pressing need to align industrial and human capital policies to support inclusive productivity growth. Increasing automation and digitalisation must be complemented with reskilling programmes to prevent technological displacement. Similarly, wage reforms are linked to productivity outcomes, promoting more equitable income distribution while preserving competitiveness. Collectively, these measures would enable Malaysia to progress toward its aspiration of becoming a high-income, innovation-driven economy by 2030.

METHODOLOGY

THEORETICAL FRAMEWORK

This study adopted the Solow growth model as the fundamental theoretical framework to examine the determinants of labour productivity across Malaysia's primary and secondary industries. The Solow model, introduced by Solow (1956), established that economic growth is primarily driven by capital accumulation, labour input, and technological progress. In this context, labour productivity reflects the efficiency, in which labour transforms inputs into output. Within the Solow framework, productivity growth is not solely dependent on labour or capital, but also on how efficiently these inputs are combined with other factors such as intermediate inputs and wages.

The model assumed a Cobb-Douglas production function, which is widely applied in productivity and growth studies for its simplicity, flexibility, and empirical robustness. This functional form allowed the estimation of output elasticities with respect to different production inputs, thereby enabling the identification of the returns to scale and relative contribution of each input to productivity. Following Noor et al. (2011) and Nor et al. (2023), the basic production function is specified as:

$$Y_t = AK_t^a L_t^B Mat_t^\theta \qquad \text{(Equation 1)}$$

where Y_t denotes total output, K_t represents capital, L_t is labour, and Mat_t refers to intermediate inputs used in the production process. A represents total factor productivity, which is assumed to be captured indirectly through the efficiency of the inputs used in this study.

To focus the analysis on labour productivity, each variable is divided by the total number of workers, transforming the function into a labour productivity equation. Moreover, to better capture the structural composition of Malaysia's labour market, labour (L_t) is disaggregated into local labour and foreign labour. This decomposition allows an assessment of the distinct roles played by domestic and migrant labour forces, which is particularly relevant for Malaysia's economic structure, where foreign workers form a significant proportion of the workforce in agriculture, manufacturing, and construction (Hii & Lau, 2025).

The augmented functional form, expressed in logarithmic form to linearise the relationships and stabilise the variance, is as follows:

$$\text{Ln } LPR_{it}t=\alpha+\beta_1 \ln K_{it}+\beta_2 \ln LL_{it}+\beta_3 \ln FL_{it}+\beta_4 \ln INT_{it}+ \beta_5 \ln W_{it}+ \epsilon_{it} \quad \text{(Equation 2)}$$

where:

i=1, …..,N represents the industry (agriculture, mining, manufacturing, construction, etc.),

t=1,…, T denotes the time period (2001–2021),

LPR_{it}= labour productivity, measured as the ratio of GDP to total employment,

K_{it} = capital intensity, calculated as fixed assets per worker,

LL_{it} = local labour share (number of local workers divided by total workers),

FL_{it}= foreign labour share (number of foreign workers divided by total workers),

INT_{it} = intermediate input per worker,

W_{it} = wage rate per worker,

ϵ_{it}= error term capturing unobserved factors.

The transformation of all variables into natural logarithms enables the coefficients to be interpreted as elasticities, indicating the percentage change in labour productivity in response to a one percent change in each determinant. This specification is consistent with the Solow growth framework, where changes in output per worker are determined by proportional changes in input factors and technological efficiency (Ross, McGregor & Swales, 2024).

Data Description and Sources

The study employed panel data consisting of four major industries in Malaysia's primary and secondary sectors: the agriculture, mining and quarrying, manufacturing, and construction, covering the period of 2001 to 2021.These sectors were selected because they represented the key productive pillars of Malaysia's economy and collectively account for a substantial share of employment, foreign labour absorption, and capital formation. The data were obtained from the Department of Statistics Malaysia (DOSM), primarily from the Annual Economic Survey, Labour Force Survey, and the National Accounts Database and compiled in annual basis, ensuring consistency across industries and time. The data were further transformed into logarithmic form to facilitate econometric estimation and mitigate issues of heteroscedasticity.

A brief description of each variable is provided below:

- Labour Productivity (LPR): Calculated as the ratio of industry value added (in constant prices) to total employment in that industry. This measure reflects the efficiency of labour input in generating output and is consistent with productivity metrics adopted by OECD and DOSM.
- Capital (K): Represented by fixed assets divided by total employment. This ratio serves as a proxy for capital intensity and reflects the extent to which physical capital contributes to output generation.
- Local Labour (LL): Measured as the proportion of local workers to total employment, capturing the relative share of Malaysian nationals in each industry's workforce.
- Foreign Labour (FL): Defined as the proportion of foreign workers to total employment. This variable captured the impact of migrant labour on productivity and reflects Malaysia's dependence on foreign manpower.
- Intermediate Input (INT): Includes materials, energy, and services used in production, divided by total employment. It reflects the role of supply chain efficiency and resource utilisation in productivity performance.
- Wages (W): Represented by total compensation paid to employees divided by the total number of workers. This variable captures the wage–productivity linkage and labour market efficiency.

Estimation Technique: FMOLS Approach

The study applied the Fully Modified Ordinary Least Squares (FMOLS) estimation technique to assess the long-run relationships among the variables. The FMOLS estimator, developed by Phillips and Hansen (1990), is particularly suitable for panel data involving non-stationary series that are cointegrated, in which variables that move together in the long run despite being individually non-stationary.

FMOLS corrected both serial correlation and endogeneity bias, which are the common problems in conventional OLS estimation when dealing with integrated variables. This made it superior for long-run estimations in productivity and growth studies (Ahmed et al., 2016; Aziz & Othman, 2019).

The panel FMOLS estimation is conducted in two forms:

1. Group-Mean FMOLS, which estimated an average long-run relationship across all industries.

2. Individual FMOLS, which separately estimated the long-run elasticities for each industry, thereby allowing for industry-specific heterogeneity in the productivity determinants.

Before applying the FMOLS estimator, several preliminary tests were conducted to ensure data suitability and robustness:

Unit Root Test

The first step involved testing the stationarity of each variable using the ADF-Fisher Chi-square test for panel unit roots. This test combined the individual Augmented Dickey-Fuller (ADF) tests for each industry to determine whether the variables are stationary in the level or become stationary after first differencing. Stationarity ensures that the time series properties of the variables do not produce spurious regression results.

Cointegration Test

Once stationarity is confirmed, the Kao panel cointegration test was applied to verify the existence of a long-run equilibrium relationship among the variables. The presence of cointegration implied that the variables shared a stable long-term association, which is an essential condition for applying FMOLS.

The Kao test, based on residual analysis, tested the null hypothesis of no cointegration against the alternative of cointegration. A rejection of the null supports the validity of a long-run relationship between labour productivity, capital, intermediate input, local and foreign labour, and wages.

Estimation and Interpretation

Upon confirming cointegration, the FMOLS estimation was carried out using both pooled and individual industry-specific estimators. The coefficients obtained represent long-run elasticities, capturing the percentage change in labour productivity resulting from a one percent change in each explanatory variable.

Positive coefficients for capital, intermediate input, and wages indicated that increases in these factors would enhance labour productivity, which is consistent with the Solow growth framework. Conversely, negative coefficients for foreign labour might suggest diminishing returns to productivity due to over-reliance on low-skilled migrant workers, a pattern documented in previous studies (Huerta de Soto, 2024).

Analytical Scope and Justification

This methodological framework offers several advantages. First, by employing industry-level panel data, the analysis captured both cross-sectional differences among industries and temporal dynamics over the two-decade period. This dual dimension enhanced the statistical efficiency and explanatory power of the estimates (Baltagi, 2021).

Second, the inclusion of foreign labour and local labour as distinct variables reflected the dual labour market structure in Malaysia. Given that industries such as agriculture and construction are heavily dependent on migrant workers, separating this labour types provided critical policy insights, whether such dependence promotes or hinders long-term productivity growth.

Third, the FMOLS estimator effectively corrected the potential endogeneity arises when inputs such as capital or wages are simultaneously determined with output, ensuring unbiased and consistent long-run parameter estimates.

Finally, this methodological approach is aligned with Malaysia's developmental context under Vision 2030, which emphasised productivity enhancement through efficient resource allocation, technological upgrading, and labour market reform. The study's empirical design thus provided evidence-based insights to formulate policy aimed for achieving sustainable industrial productivity growth.

Summary of Methodological Steps

1. **Model Specification:** The study commenced with the Solow-based Cobb-Douglas production function, reformulated into a labour productivity model by incorporating key inputs: capital, intermediate input, local and foreign labour, and wages.
2. **Data Collection:** Annual industry-level data (2001–2021) were obtained from the Department of Statistics Malaysia.
3. **Transformation:** All variables converted to logarithmic form to interpret coefficients as elasticities.
4. **Unit Root Testing:** ADF-Fisher test applied to verify stationarity.
5. **Cointegration Testing:** Kao panel cointegration test was conducted to confirm long-run relationships.
6. **Estimation:** FMOLS was used to estimate long-run elasticities both for pooled and industry-specific models.
7. **Interpretation:** Results were analysed to identify the most influential factors affecting labour productivity across industries.
8. This step-by-step framework ensures the methodological rigor and robustness of the analysis, enabling a comprehensive assessment of the long-run determinants of labour productivity in Malaysia's primary and secondary industries.

RESULTS AND DISCUSSION

Unit Root Test

Table 1 presents the results of the Fisher-ADF unit root tests for all variables at both levels and first differences.

Table 1: Unit Root Test at Levels and at First Difference

Variables	Fisher-ADF at Levels		Fisher-ADF at First Difference	
	Intercepts	Intercepts and Trends	Intercepts	Intercepts and Trends
Labour Productivity	9.8129	16.8939**	38.4121***	27.3998***
	(0.2784)	(0.0312)	(0.0000)	(0.0006)
Intermediate Input	7.6804	13.1131	33.3120***	21.7412***
	(0.4653)	(0.1080)	(0.0001)	(0.0054)
Local Labour	13.9691	25.0375***	35.8673***	27.4603***
	(0.0826)	(0.0015)	(0.0000)	(0.0006)

Foreign Labour	14.1169	25.4895***	38.8877***	31.9749***
	(0.0788)	(0.0013)	(0.0000)	(0.0001)
Fixed Assets	4.8625	5.4571	47.6097***	32.3919***
	(0.7722)	(0.7078)	(0.0000)	(0.0001)
Salary	4.1273	14.0272	57.3539***	45.1104***
	(0.8455)	(0.0811)	(0.0000)	(0.0000)

Note: statistics are given in parenthetic

Notes: *** significant at level 1%, ** significant at level 5%, and * significant at level 10%

Source: Author's computation based on EViews9

The results in Table 1 revealed that most variables: labour productivity, intermediate input, local labour, foreign labour, fixed assets (capital), and salary are non-stationary at levels but become stationary after first differencing. This pattern indicated that each series was integrated of order one, I(1). Labour productivity, local labour, and foreign labour appeared to show some stationarity at the level with intercept and trend terms; however, their statistical significance is not consistently strong enough to reject the null hypothesis of a unit root across all model specifications.

This finding satisfied the precondition for panel cointegration analysis, which required that variables exhibit non-stationarity in levels but stationarity in first differences. The result indicated that these macroeconomic and industrial variables evolved over time but shared stable long-run relationships, aligning with the logic of the Solow Growth Model. According to Solow (1956), economies converged to a steady-state equilibrium where growth in output per worker depends on capital accumulation, labour inputs, and technological progress. Hence, the existence of unit roots in levels but stationarity in first differences implied that productivity growth and factor accumulation evolved dynamically but maintained a long-run equilibrium path.

These findings are consistent with earlier Malaysian productivity studies, such as Noor et al. (2011), who identified similar integration orders for labour productivity and input factors. More recent empirical work also confirmed that macroeconomic productivity indicators in Malaysia tend to follow the I(1) process (Nor et al., 2023), suggesting structural persistence and adjustment mechanisms within industrial sectors. The presence of I(1) variables reflected the persistence of sectoral shocks such as wage changes, labour migration, or capital investments, which influenced productivity trajectories in both primary and secondary industries.

Cointegration Result

To establish whether these variables share a long-run equilibrium relationship, the Kao (1999) residual-based cointegration test was conducted.

Table 2: Kao Test Regression

Series	ADF-Statistics	
	Statistics	Prob
LLPR = LIN + LLOC + LFOR + LSAL+ LCAP	-3.0389***	0.0012

Notes: ***, ** and * imply significance level at 1%, 5% and 10% respectively.

Source: Author's computation based on EViews9

The test result in Table 2 indicated that the null hypothesis of no cointegration is rejected at the 1% significance level, confirming that labour productivity, intermediate inputs, local labour, foreign labour, salary, and capital are cointegrated in the long run. This finding signified that changes in factor inputs and wages were not independent of productivity growth in Malaysia's industrial sectors over time.

In the context of the Solow Growth Model, this outcome implied that Malaysia's industries exhibited steady-state convergence, where output per worker is jointly determined by capital intensity and effective labour. The long-run relationship further supported the hypothesis that capital accumulation, factor efficiency, and labour composition jointly determined productivity growth paths. Over time, industries adjusted toward equilibrium levels of productivity, consistent with their structural factor endowments and technological capabilities.

Empirical evidence from Malaysian studies corroborated these findings. For instance, (Dehdasht et al.,2022) found significant cointegration between capital and productivity in Malaysia's construction industry, while Shahzad & Miao (2025) highlighted the long-run link between the capital–labour ratio and manufacturing productivity. The Kao test result therefore, confirmed that a long-run equilibrium mechanism governed the dynamics of productivity across Malaysia's primary and secondary industries, reinforcing the theoretical validity of applying the Solow framework in this study.

Fully Modified OLS (FMOLS) Estimation

The Fully Modified Ordinary Least Squares (FMOLS) estimator was applied to examine the long-run coefficients of the relationship between labour productivity and its determinants for each industry, as shown in Table 3.

Table 3: Individual Fully Modified OLS Result

Variable	Intermediate Input	Local Labour	Foreign Labour	Capital	Salary
Agriculture Industries	0.9132*** (0.0008)	1.6860 (0.4706)	0.9234 (0.3714)	0.3454 (0.0227)	-0.6978 (0.0195)
Mining And Quarrying Industries	0.9203** (0.0249)	7.6778 (0.1466)	0.8507 (0.1244)	-0.4169 (0.0836)	-0.3499 (0.3798)
Manufacturing Industries	0.9012*** (0.0000)	0.1237 (0.3439)	0.0482 (0.0403)	-0.0199 (0.0860)	0.1313 (0.0000)
Construction Industries	0.7556*** (0.0000)	-0.5456 (0.3143)	-0.0831 (0.5371)	0.2520 (0.0000)	0.0344 (0.5308)

Notes: ***, ** and * imply significance level at 1%, 5% and 10% respectively.

Source: Author's computation based on EViews9 (2024)

The FMOLS estimator, proposed by Pedroni (2001), corrected serial correlation and endogeneity inherent in cointegrated systems, providing reliable long-run parameter estimates even in small samples. This approach is particularly suitable for Malaysia's industrial data, which exhibited cross-sectoral heterogeneity. The results in Table 3 revealed interesting and sector-specific dynamics between productivity and its determinants.

Agriculture Industry

In the agriculture industry, intermediate input (0.9132) showed a strong and statistically significant positive effect on labour productivity at 1% level. This suggested that improvements in agricultural inputs such as fertilizers, machinery, irrigation, and modern farming technology significantly enhanced productivity. This finding is aligned with Kamaruddin & Abd. Rashid (2025), who found that mechanisation and modern input adoption could drive productivity growth in Malaysian agriculture.

However, capital also showed a positive and significant relationship (0.3454, p = 0.0227), implying that higher levels of fixed asset investment contributed positively to long-run productivity gains. The capital-deepening process is central to the Solow model, which postulated that increasing the capital-to-labour ratio enhanced output per worker until diminishing returns set in. This evidence supported Malaysia's ongoing agricultural modernisation initiatives aimed at mechanising rural production to overcome labour shortages and improve efficiency.

Conversely, local labour and foreign labour both showed insignificant effects, while salary has a significant negative relationship (-0.6978, p = 0.0195). The negative wage coefficient could reflect rigid wage structures and overemployment in lower-skilled agricultural jobs, leading to inefficiencies in productivity. Study by Feist (2024) highlighted that sectors which heavily reliant on low-skilled labour often faced wage productivity imbalances, reducing overall efficiency. Hence, while capital and intermediate inputs enhanced productivity, labour composition and wage inefficiency remained as structural challenges in Malaysia's agricultural sector.

Mining and Quarrying Industry

In the mining and quarrying sector, intermediate inputs also showed a significant positive impact (0.9203, p = 0.0249) on productivity, consistent with the global findings: higher input quality such as modern extraction tools and refined energy inputs drives output efficiency (Kamaruddin & Abd. Rashid, 2025). However, both local labour and foreign labour displayed insignificant relationships, and capital has a negative coefficient (-0.4169, p = 0.0836), indicating possible overcapitalisation or inefficiency in asset utilisation.

This pattern might stem from the declining resource quality and rising extraction costs, which reduced the productivity returns on capital investment. Moreover, salary exhibited a negative, though insignificant relationship, suggesting that wage adjustments have limited impact on the output growth. Overall, the results implied that productivity in Malaysia's mining sector is primarily driven by technological efficiency in intermediate inputs rather than labour or capital expansion, aligning with Solow's notion that technological progress is the key driver of long-run growth beyond capital accumulation.

Manufacturing Industry

In the manufacturing sector, both the intermediate input (0.9012, p = 0.0000) and salary (0.1313, p = 0.0000) had strong positive and significant relationships with labour productivity, while foreign labour (0.0482, p = 0.0403) was also significant at the 5% level. The positive relationship between foreign labour and productivity suggested that skilled or semi-skilled migrant workers played a complementary role in the manufacturing process, supporting production continuity and reducing labour shortages. This finding supported Hii and Lau (2025), who argued that foreign workers enhanced output efficiency in certain high-demand industries.

However, capital exhibited a slightly negative and insignificant relationship (-0.0199, p = 0.0860), implying that the sector might already be operating near capital saturation, with diminishing returns on further fixed asset investments. This result corresponded with the Solow model's steady-state outcome, where increases in capital have limited impact on productivity without technological advancement. The positive relationship between salary and productivity might reflect higher labour motivation and retention in firms that aligned wage growth with productivity gains (Ibrahim and Putit, 2020)

Construction Industry

In the construction sector, intermediate input (0.7556, p = 0.0000) and capital (0.2520, p = 0.0000) have significant positive relationships with labour productivity, indicating that both material efficiency and equipment investment played critical roles in output performance. These results are aligned with Gharaibeh et al. (2024), who emphasised that efficient material usage and the adoption of modern technologies such as Building Information Modelling (BIM) enhanced productivity in construction.

However, local labour and foreign labour showed negative but insignificant effects, implying that the sector

remains labour-intensive yet struggles with skill mismatches and inefficiencies. Salary also had an insignificant positive coefficient (0.0344), suggesting a weak wage with productivity alignment. Consistent with the Solow framework, this sector demonstrated partial capital deepening but was constrained by human capital quality and labour composition inefficiencies.

Panel Group FMOLS Estimation

To capture the overall long-run relationships across all industries, a Panel Group FMOLS estimation was conducted, as shown in Table 4.

Table 4: Panel Group Fully Modified OLS Result

Variable	Intermediate Input	Local Labour	Foreign Labour	Capital	Salary
Coefficient	0.4451*** (0.0000)	-0.9768 (0.0295)	-0.6289 (0.0000)	0.3287 (0.0000)	0.1883 (0.1317)

Notes: ***, ** and * imply significance level at 1%, 5% and 10% respectively.

Source: Author's computation based on EViews9 (2024)

The results showed that intermediate input (0.4451, p = 0.0000) and capital (0.3287, p = 0.0000) have significant positive effects on labour productivity across all industries. These findings affirmed that material input efficiency and capital investment remained the most critical determinants of long-term productivity in Malaysia's industrial sectors. The results were consistent with the Solow Growth Model's prediction where increases in capital and technological efficiency (proxied by intermediate input usage) would drive higher steady-state output per worker.

On the other hand, local labour (-0.9768, p = 0.0295) and foreign labour (-0.6289, p = 0.0000) exhibited significant negative effects on productivity. This suggested that excessive reliance on both categories of labour especially unskilled and low-productivity workers might hinder output growth. Nor et al. (2023) reported similar findings in Malaysia's construction sector, where foreign worker dependency reduced marginal productivity of labour due to the limited skill transfer and over-saturation of low-cost labour. This result emphasised the need for Malaysia to transform towards a more capital-intensive and skill-based production structure.

Finally, salary (0.1883, p = 0.1317) showed a positive but insignificant effect, implying that wage adjustments alone did not directly drive productivity unless accompanied by improvements in human capital and technological adoption. This outcome reinforced Ibrahim and Putit (2020) argument that Malaysia's wage productivity decoupling limits the effectiveness of wage increases in enhancing competitiveness.

DISCUSSION AND THEORETICAL IMPLICATIONS

The overall findings provided robust evidence that intermediate input efficiency and capital accumulation are the main long-run drivers of labour productivity in Malaysia's primary and secondary industries. This outcome aligned closely with the Solow Growth Model, which posited that economic growth depends on the accumulation of physical capital and the efficiency of production inputs, moderated by diminishing returns. Over time, total productivity growth is sustained by technological progress and improved factor utilisation.

The insignificant or negative coefficients on labour variables highlighted the structural weaknesses in Malaysia's labour market, particularly overdependence on low-skilled workers and limited human capital formation. Such trends constrained technological absorption and productivity growth, reflecting the "middle-income trap" dynamics as described by Simpasa (2024). The findings underscored the need for upskilling, automation, and innovation-driven strategies to complement capital investment and material efficiency.

In the agricultural and construction sectors, the positive capital coefficients indicated the strong capital intensity and potential for modernisation, while manufacturing demonstrated foreign labour complementarity and salary-driven motivation effects. The mining sector, however, revealed limited productivity response to capital and labour inputs, suggesting structural exhaustion and declining resource-based growth potential.

From a policy standpoint, these results implied that Malaysia's long-term productivity growth required a dual focus on capital deepening and technological upgrading. Investments in digitalisation, mechanisation, and process innovation especially in manufacturing and agriculture sectors would enhance intermediate input efficiency and capital productivity. Simultaneously, labour market policies should prioritise skill upgrading, targeted foreign labour management, and wage structures that incentivise productivity improvements.

CONCLUSION

Fundamentally, the main objective of this study is to determine the factors that affect labour productivity across four major industries in Malaysia, namely the agriculture, mining and quarrying, manufacturing, and construction. These sectors were selected because they represented the backbone of Malaysia's primary and secondary economic structure, each contributing differently to the nation's output, employment, and long-term development trajectory (Department of Statistics Malaysia [DOSM], 2023). This study considered five main explanatory variables that theoretically and empirically influenced labour productivity: intermediate input, local labour, foreign labour, capital, and salary. Using panel data from 2001 to 2021, this research sought to capture the dynamic relationship between these variables and labour productivity over time, acknowledging both cyclical and structural shifts in Malaysia's industrial landscape.

To establish a robust theoretical and econometric foundation, this study adopted the Cobb–Douglas production function framework, which is one of the most widely accepted models for understanding production and productivity behaviour (Solow, 1957; Mankiw, 2019). Within this framework, the output (or productivity) is a function of capital and labour inputs, allowing the researcher to examine the elasticity and returns associated with each input. The econometric procedure began with the panel unit root test using the Augmented Dickey Fuller (ADF) Fisher Chi-square method to determine the stationarity of each variable.

Establishing stationarity is crucial to ensure that the empirical relationships identified are not spurious (Gujarati & Porter, 2009). Following this, the Kao panel cointegration test was employed to verify the existence of long-run equilibrium relationships between the variables. The presence of cointegration implied that although short-term fluctuations might occur, the variables move together in the long run, signifying stable interdependencies among inputs and labour productivity (Pedroni, 2004).

The FMOLS estimation results indicated that, overall, the intermediate input and capital had a significant and positive effect on labour productivity across the four industries studied. This suggested that greater utilisation of quality intermediate inputs and investment in capital resources contributed to enhance the efficiency and productivity of workers in the long term (Priyanto et al., 2023). Intermediate inputs such as materials, energy, and services used in the production process reflected the technological and operational sophistication of an industry. When these inputs were of higher quality and efficiently managed, they tend to complement human labour, allowing workers to produce more output with the same or fewer resources. Similarly, capital accumulation whether in the form of machinery, infrastructure, or equipment enhanced the productive capacity of industries, allowing for more output per worker through mechanisation, automation, and improved efficiency (Axunjonova, 2024).

On the other hand, the results demonstrated that both local labour and foreign labour tend to have a negative relationship with labour productivity. This pattern implied that increases in labour input, without corresponding improvements in efficiency or technology, might dilute productivity levels. In other words, when more workers are added without proportionate gains in skills, capital, or intermediate inputs, the marginal productivity of labour declined, a result consistent with the law of diminishing returns in classical production theory (Huerta de Soto, 2024).

However, the industries' specific findings revealed important nuances. For instance, both the agriculture and

construction industries appeared to be more capital-intensive rather than labour-intensive. The positive and significant relationship between capital and productivity in these sectors indicated that investments in machinery, technology, and infrastructure have a direct impact on output per worker. In contrast, the negative relationship between labour and productivity suggested that these sectors might still be over-reliant on low-skilled or manual labour, which constrained efficiency gains (Lajom & Sibunruang, 2024). In agriculture, mechanisation remained partial, with many smallholders depending on traditional farming practices (Amponsah et al., 2025). Similarly, in construction, the heavy dependence on foreign manual workers had contributed to a slow transition towards Industrialised Building Systems (IBS) and digitalisation (Yusof et al., 2024).

In the manufacturing sector, the results portrayed a somewhat different dynamic. Here, foreign labour contributed positively to productivity, while capital exhibited a negative relationship with productivity. This finding might reflect the adaptive capacity of foreign workers in export-oriented manufacturing industries, particularly in electronics and assembly lines, where they often possessed the technical discipline and efficiency demanded by employers (Salimova, 2022). Meanwhile, the negative sign for capital might indicate the presence of underutilised or outdated machinery, or capital stock that did not directly translate into labour efficiency (Martin & Jones, 2022). Interestingly, salary in this sector showed a positive and significant relationship with productivity, supporting the efficiency wage theory, which posited that higher wages could enhance motivation, reduce turnover, and attract skilled labour, thereby improving productivity outcomes (Ibrahim and Putit, 2020).

The mining and quarrying sector, however, presented a more complex scenario. The analysis revealed that neither labour factors nor capital intensity showed a significant contribution to labour productivity. This could be attributed to the high dependency of the mining sector on natural resource endowments rather than human or capital inputs (World Bank, 2023). In such industries, productivity tends to be influenced more by commodity prices, and extraction technologies than by conventional factor inputs. The result also suggested that both capital and labour in this sector might not been efficiently allocated or technologically upgraded to enhance productivity performance during the study period (Awan & Yaqoob, 2023).

Overall, these findings have several theoretical and policy implications. From the perspective of Classical

Production Theory, the observed variation in returns to scale across industries indicated that Malaysia's industrial structure is still in the process of transitioning towards higher efficiency and technological maturity (Hashim & Fahmy-Abdullah, 2024). The Solow Growth Model also supported this interpretation, as productivity improvements depend on the effective combination of capital accumulation and technological progress (Solow, 1957). In sectors where capital and technology are underdeveloped, labour additions alone could not sustain productivity growth. Similarly, from the Labour Market Theory standpoint, wage structures and skill development played a critical role in aligning worker incentives with productivity outcomes (Becker, 1964).

Policy Implications

Labour Policy

To address the structural weaknesses identified in the analysis, several policy recommendations were proposed. First, consistent with Kvirchishvili (2023), it is crucial to enhance managerial, technical, and operational skills within the workforce. The Malaysian industries should intensify training initiatives for workers and professionals, focusing on both technical capabilities and managerial competencies to strengthen competitiveness at both domestic and international levels. Without adequate skill formation, the productivity gap between high-tech and traditional industries will persist, thereby limiting Malaysia's ability to achieve sustained productivity-led growth.

Furthermore, it is recommended that the government strengthen the industry-based skills training for local workers by fostering collaboration with industry experts, training institutes, and universities (Varaprasad, 2022). These partnerships can facilitate the designing of curricula that are directly aligned with industrial

needs, thereby producing a workforce that is more responsive to technological advancements and evolving production systems. The aim is to create a virtuous cycle in which human capital development leads to productivity growth, which in turn supports higher wages and better job quality (Ibrahim & Putit, 2020).

Equally important is the need to attract and retain more motivated local workers, especially in industries where labour productivity showed a negative relationship with wages. Sectors such as agriculture, mining and quarrying, and construction continue to struggle with low labour participation among locals due to unattractive working conditions and limited career progression opportunities (Elsharnouby et al., 2024). To reverse this trend, the government should implement targeted incentives such as performance-based bonuses, productivity-linked allowances, and recognition programmes that reward excellence and innovation (Nikiforakis, Oechssler, & Shah, 2019; Mohd Fateh et al., 2022). Such measures not only motivate employees to perform better but also create a culture of productivity improvement at the workplace level.

Foreign Labour Management

In addition, it is necessary for the government to carefully manage the inflow of foreign labour. While foreign workers play an important role in filling the gaps in Malaysia's labour market, excessive dependence on them can reduce incentives for firms to invest in automation, skill upgrading, and local talent development (Souto-Otero, 2023). The findings from this study suggested that in industries such as agriculture, mining, and construction, foreign labour has a negative impact on productivity, implying that the marginal contribution of additional foreign workers is diminishing. Therefore, the policy direction should focus on reducing the intake of low-skilled foreign workers while promoting the recruitment of higher-skilled migrant workers who can complement rather than substitute local labour. Moreover, stricter monitoring mechanisms can ensure that foreign labour recruitment aligns with national productivity objectives rather than short-term cost minimisation goals (World Bank, 2023).

Capital Investment and Technological Advancement

Capital investment also requires strategic attention. This study recommended that the government and industry stakeholders should prioritise upgrading capital stock, particularly in the mining, quarrying, and manufacturing sectors, where the capital is currently exhibited a negative or insignificant effect on productivity. As demonstrated by Cammeraat, Samek, and Squicciarini (2021), physical capital intensity is positively and significantly associated with productivity in the construction industry. Similarly, Czubak & Pawłowski (2024) found that increased investment in fixed assets in agriculture significantly contributed to labour and land productivity growth, as well as investment efficiency. Applying these insights to the Malaysian context, policymakers should encourage technological upgrading and capital modernisation through fiscal incentives, low-interest financing schemes, and public–private partnerships.

At a broader level, the study's findings reinforced the importance of a balanced approach to productivity policy that integrated physical capital investment, skill development, technological adoption, and institutional reform. The productivity challenges observed in Malaysia are not merely technical but also structural, rooted in institutional arrangements, wage rigidities, and industry-specific constraints. Thus, reforms aimed at improving governance, innovation systems, and business ecosystems are essential complements to sectoral interventions (OECD, 2022).

From an academic standpoint, this study contributed to the literature by providing empirical evidence on the long-run relationships between the key production inputs and labour productivity across four critical Malaysian industries using the FMOLS estimation method. The analysis confirmed the heterogeneity of productivity determinants across sectors, highlighting that one-size-fits-all policy solutions are ineffective. Instead, productivity enhancement strategies should be industry-specific, reflecting the distinct technological, organisational, and labour market realities of each sector.

Although, this study presented strong long-run empirical evidence on the structural drivers of labour productivity across Malaysia's industrial sectors, several limitations should be acknowledged. The analysis primarily focused on quantitative inputs such as capital, labour composition, wages, intermediate inputs, and

total factor productivity, without directly accounting for qualitative dimensions of human capital, such as education level, experience, and skill intensity. Furthermore, the exclusion of research and development (R&D), innovation capacity, and technology diffusion indicators might understate the true impact of knowledge-based factors on productivity growth, particularly in manufacturing and service-oriented sectors. Future research should therefore integrate more comprehensive measures of innovation, education quality, and technological capability indices to capture the evolving dynamics of Malaysia's transition towards a knowledge-driven economy. Incorporating such variables, alongside regional and firm-level heterogeneity, could provide a deeper understanding of productivity convergence and structural transformation. These extensions would not only enrich the theoretical underpinnings of productivity studies but also offer more granular policy insights for advancing industrial upgrading, human capital development, and sustainable economic competitiveness.

Finally, this study opens avenues for future research. Future investigations could extend the analysis by incorporating additional factors such as research and development (R&D), innovation, digitalisation, and human capital quality indicators. Exploring these dimensions would provide a deeper understanding of the mechanisms through which productivity improvements occur, especially in the context of Malaysia's ongoing industrial transformation and the global shift toward knowledge-based economies (Lammi, 2024). Moreover, subsequent studies could employ more advanced econometric techniques, such as dynamic panel models or causality frameworks, to explore the direction and causality of these relationships over time.

In summary, the findings of this research underlined the multifaceted nature of productivity growth in Malaysia. While intermediate input and capital investment are crucial for enhancing productivity, their effectiveness depends heavily on the quality of labour, the level of technology adoption, and the efficiency of institutional frameworks. Therefore, improving productivity requires a coordinated effort involving government policy, industry innovation, and labour market reforms. If Malaysia successfully strengthens these interlinkages, the country will be well-positioned to sustain its productivity growth and competitiveness in an increasingly challenging global economic environment.

REFERENCES

1. Amponsah, S. K., Kumi, F., Akolgo, G., & Azumah, D. D. (2025). A Review of Transforming Rice Harvesting in Sub-Saharan Africa: Addressing Constraints, Leveraging Mechanization, and Enhancing Productivity. Advances in Agriculture, 2025(1), 5523207.
2. Awan, A. G., & Yaqoob, R. (2023). Economic value of introducing technology to improve productivity: An ARDL approach. Innovation and Green Development, 2(3), 100069.
3. Axunjonova, M. K. Q. (2024). Unlocking Economic Potentials: The Roles Of Technological Progress, Physical Capital And Human Capital In Labour Productivity. American Journal of Business Practice, 1(8), 30-34
4. Ayhan, F., & Elal, O. (2023). The IMPACTS of technological change on employment: Evidence from OECD countries with panel data analysis. Technological Forecasting and Social Change, 190, 122439. https://doi.org/10.1016/j.techfore.2023.122439.
5. Aziman, E. S., Ismail, A. F., & Rahmat, M. A. (2023). Balancing economic growth and environmental protection: A sustainable approach to Malaysia's rare-earth industry. Resources Policy, 83, 103753.
6. Baltagi, B. H. (2021). Econometric analysis of panel data (6th ed.). Springer. Bank Negara Malaysia. (2019). Bank Negara Annual report of 2018. Bank Negara Malaysia, (March), 1–192. https://doi.org/10.1111/j.1755- 6988.1986.tb00583.x.
7. Becker, G. S. (1964). Human capital: A theoretical and empirical analysis, with special reference to education. Columbia University Press.
8. Birhanu, M. Y., Alemayehu, T., Bruno, J. E., Kebede, F. G., Sonaiya, E. B., Goromela, E. H., ... & Dessie, T. (2021). Technical efficiency of traditional village chicken production in Africa: Entry points for sustainable transformation and improved livelihood. Sustainability, 13(15), 8539.
9. Bold, T., Ghisolfi, S., Nsonzi, F., & Svensson, J. (2022). Market access and quality upgrading: Evidence from four field experiments. American Economic Review, 112(8), 2518-2552.

10. Brucker Juricic, B., Galic, M., & Marenjak, S. (2021). Review of the Construction Labour Demand and Shortages in the EU. Buildings, 11(1), 17.
11. Cammeraat, E., Samek, L., & Squicciarini, M. (2021). The role of innovation and human capital for the productivity of industries (No. 103). OECD Publishi
12. Czubak, W., & Pawłowski, K. P. (2024). The Impact of Agricultural Investments on the Economic Efficiency of Production Factors: An Empirical Study of the Wielkopolska Voivodeship. Agriculture, 14(12), 2217.
13. Dehdasht, G., Ferwati, M. S., Abidin, N. Z., & Oyedeji, M. O. (2022). Trends of the construction industry in Malaysia and its emerging challenges. Journal of Financial Management of Property and Construction, 27(2), 161-178.
14. Department of Statistics Malaysia (DOSM). (2022). Labour Force Survey Report, Malaysia 2021. Putrajaya: DOSM.https://www.dosm.gov.my.
15. Ehigiamusoe, K., Lean, H., & Somasundram, S. (2021). Unveiling the non-linear impact of sectoral output on environmental pollution in Malaysia. Environmental Science and Pollution Research, 29, 7465-7488. https://doi.org/10.1007/s11356-021-16114-4.
16. Elsharnouby, T. H., Elbanna, S., Obeidat, S. M., & Mauji, N. I. (2024). Exploring local job seekers' perception toward employment in the private and public sectors in Qatar: implications for workforce nationalization policies. Personnel Review, 53(6), 1425-1442.
17. Feist, L. (2024). Imbalances between supply and demand: Recent causes of labour shortages in advanced economies (No. 115). ILO Working Paper.
18. Gebiso, T., Ketema, M., Shumetie, A., & Feye, G. L. (2024). Impact of farm mechanization on crop productivity and economic efficiency in central and southern Oromia, Ethiopia. Frontiers in Sustainable Food Systems, 8, 1414912.
19. Gharaibeh, L., Matarneh, S., Lantz, B., & Eriksson, K. (2024). Quantifying the influence of BIM adoption: An in-depth methodology and practical case studies in construction. Results in Engineering, 23, 102555.
20. Gilles, E., Deaza, J., & Vivas, A. (2022). The role of imported intermediates in productivity change. Economic Systems Research, 35, 211 - 227. https://doi.org/10.1080/09535314.2022.2062301.
21. Goldar, B. (2023). Export Participation and Employment of Contract Workers in Organized Manufacturing Plants in India. Journal of South Asian Development, 19, 278 - 311. https://doi.org/10.1177/09731741231160966.
22. Goodfellow, T. (2020). Finance, infrastructure, and urban capital: The political economy of African ‘gap-filling’. Review of African Political Economy, 47(164), 256-274.
23. Gujarati, D. N., & Porter, D. (2009). Basic Econometrics Mc McGraw-Hill International Edition.
24. Hashim, N., & Fahmy-Abdullah, M. (2024). Technical efficiency in the Malaysian electric and electronic manufacturing industry: A stochastic frontier analysis approach. Asian Economic and Financial Review, 14(2), 88.
25. Hii, N. L., & Lau, E. (2025). Asymmetric Effects of Foreign Worker Employment on Sectoral Labor Productivity: A Malaysian Perspective. Economies, 13(5), 127.
26. Huerta de Soto, J. (2024). The Law of Diminishing Marginal Returns or Productivity. In Lectures in Austrian Economics, Volume I: Human Action, Competition Theory, Entrepreneurship, and Price Theory (pp. 193-198). Cham: Springer Nature Switzerland.
27. Ibrahim, N. A., & Putit, L. (2020). Effects of wages and global financial crisis on labour productivity - Does size matter? Int J Trade Econ Financ, 12(3), 76-9.
28. Kamaruddin, R., & Abd. Rashid, N. N. (2025). Sustainable farming management: key factors and impact on paddy yields in Malaysia’s granary areas. Agriculture & Food Security, 14(1), 4.
29. Khanna, R., & Sharma, C. (2025). Imported inputs and productivity: Unravelling the dynamics in India's manufacturing sector. Managerial and Decision Economics, 46(1), 409-424.
30. Kvirchishvili, L. (2023,). The Evolving Workforce: Technological Advancements and Their Impact on Employee Skills and Characteristics. In International Scientific-Practical Conference (pp. 81-96). Cham: Springer Nature Switzerland.
31. Lajom, J. A. L., & Sibunruang, H. (2024). The rise of flexible working in Southeast Asia: insights from Thailand and the Philippines. In Work-Life Research in the Asia-Pacific: Implications for Justice, Equity, Diversity, and Inclusion (pp. 23-45). Cham: Springer Nature Switzerland.

32. Lammi, D. (2024). Focal issues of Sustainable Development presented by the World Economic Forum 2024.
33. Lee, K., Qu, D., & Mao, Z. (2021). Global value chains, industrial policy, and industrial upgrading: Automotive sectors in Malaysia, Thailand, and China in comparison with Korea. The European Journal of Development Research, 33(2), 275-303.
34. Li, D., Chen, Y., & Miao, J. (2022). Does ICT create a new driving force for manufacturing? - Evidence from Chinese manufacturing firms. Telecommunications Policy, 46(1), 102229
35. Liu, Y., Shi, X., & Gao, F. (2022). The impact of agricultural machinery services on cultivated land productivity and its mechanisms: A case study of Handan city in the North China plain. Frontiers in Environmental Science, 10, 1008036.
36. Mankiw, N. G. (2021). Principles of Economics (9th ed.). Cengage Learning.
37. Manoharan, K., Dissanayake, P., Pathirana, C., Deegahawature, D., & Silva, R. (2024). Assessing the performance and productivity of labour in building construction projects through the application of work-based training practices. Construction Innovation, 24(2), 558-583.
38. Martin, J., & Jones, K. (2022). An Occupation and Asset Driven Approach to Capital Utilization Adjustment in Productivity Statistics (No. ESCoE DP-2022-11). Economic Statistics Centre of Excellence (ESCoE).
39. Mohd Fateh, N. S., Nasir, M., & Rahim, R. A. (2022). Enhancing worker motivation through incentives: Evidence from Malaysia. Malaysian Management Review, 57(1), 33-49
40. Nadoveza, O. (2025). Do increases in public sector wages affect inflation? Public sector economics, 49(1), 1-44.
41. Nikiforakis, N., Oechssler, J., & Shah, A. (2019). Incentives, bonuses, and employee performance: Experimental evidence. Journal of Economic Behavior & Organization, 162, 101-115.
42. Noor, Z. M., Isa, N., Said, R., & Abd Jalil, S. (2011). The impact of foreign workers on labour productivity in Malaysian manufacturing sector. International Journal of Economics and Management, 5(1), 169-178.
43. Nor, S. M., Subramaniam, G., & Sahudin, Z. (2023). The effects of foreign labor on labor productivity in construction industries. Information Management and Business Review, 15(2), 116-127.
44. OECD (2022). Digital Transformation in the Retail Sector.
45. Pane, D., & Patunru, A. (2022). The role of imported inputs in firms' productivity and exports: evidence from Indonesia. Review of World Economics, 159, 629-672. https://doi.org/10.1007/s10290-022-00476-z.
46. Pedroni, P. (2004). Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric theory, 597-625.
47. Phillips, P. C. B., & Hansen, B. E. (1990). Statistical inference in instrumental variables regression with I(1) processes. Review of Economic Studies, 57(1), 99-125. https://doi.org/10.2307/2297545.
48. Priyanto, M. W., Pratama, A. P., & Prasada, I. Y. (2023). The Effect of Fertilizer and Agricultural Machinery Subsidies on Paddy Productivity: A Feasible Generalized Least Squares Approach. SEPA: Jurnal Sosial Ekonomi Pertanian Dan Agribisnis, 20(1), 56-68.
49. Ross, A. G., McGregor, P. G., & Swales, J. K. (2024). Labour market dynamics in the era of technological advancements: The system-wide impacts of labour augmenting technological change. Technology in Society, 77, 102539.
50. Sahudin, Z., Mahmood, W. M. W., Isa, Z., & Shari, A. (2014). Efficiency and its Determinant: Evidence from Malaysia Shariah Compliant Construction Firms. Journal of Applied Environment and Biological Sciences, 4(5), 47-53.
51. Salimova, G., Ableeva, A., Galimova, A., Bakirova, R., Lubova, T., Sharafutdinov, A., & Araslanbaev, I. (2022). Recent trends in labor productivity. Employee Relations: The International Journal, 44(4), 785-802.
52. Shahzad, U., & Miao, C. (2025). Growth in motion: the effects of terms of trade components, labor, capital, and investment on US economic performance. Discover Sustainability, 6(1), 381.
53. Simpasa, A. (2024). Nigeria: Challenges and Opportunities to Avoid the Middle-Income Trap. Avoiding the Middle-Income Trap in Africa: Economic Challenges and Policy Responses, 169-205.

54. Smol, M., Marcinek, P., & Koda, E. (2021). Drivers and Barriers for a Circular Economy (CE) Implementation in Poland - A Case Study of Raw Materials Recovery Sector. Energies, 14, 2219. https://doi.org/10.3390/en14082219.
55. Solow, R. M. (1956). A contribution to the theory of economic growth. Quarterly Journal of Economics, 70(1), 65-94. https://doi.org/10.2307/1884513
56. Solow, R. M. (1957). Technical change and the aggregate production function. The Review of Economics and Statistics, 39(3), 312–320.
57. Souto-Otero, M., Brown, P., & Freebody, S. (2023). High-skilled workplaces, technological change, and employment: Can educational reform do it? International Journal of Educational Research, 122, 102265.
58. Storm, E. (2022). Task specialization and the Native-Foreign Wage Gap. Labour, 36(2), 167-195.
59. Tadesse, B., Tilahun, Y., Bekele, T., & Mekonen, G. (2021). Assessment of challenges of crop production and marketing in Bench-Sheko, Kaffa, Sheka, and West-Omo zones of southwest Ethiopia. Heliyon, 7(6). https://doi.org/10.1016/j.heliyon.2021.e07319.
60. Tajuddin, S. A. F. S. A., Abd Halim, M. S., Foziah, N. H. M., Zain, F. A. M., Abdullah, H., & Abidin, A. F. Z. (2023). An empirical study in assessing the impact of foreign workers on labour productivity in the Malaysian manufacturing sector. Asian Development Policy Review, 11(3), 123-135.
61. Varaprasad, N. (2022). Vocational education and training in Singapore. In International Handbook on Education in Southeast Asia (pp. 1021-1045). Singapore: Springer Nature Singapore.
62. World Bank Malaysia. (2023). Malaysia Economic Monitor: Expanding Malaysia's Productive Potential. Washington, DC: World Bank
63. World Bank. (2023). Malaysia Economic Monitor: Expanding Malaysia's Productive Potential. Washington, DC: World Bank
64. Yusof, M. R., Jabar, I. L., Nawawi, A. H., & Mohd Nawi, M. N. (2024). A review of current issues in Industrialised Building System (IBS) for construction projects. Built Environment Journal, 21(1), 109-117.
65. Zhao, Z., Pal, S., Mahalik, M., & Gozgor, G. (2023). Effects of Financial and Trade Globalization on Total Factor Productivity Growth in Emerging Economies. Emerging Markets Finance and Trade, 60, 328 - 344. https://doi.org/10.1080/1540496x.2023.2223934