Innovation-Driven Labour Productivity Growth: Empirical Evidence from Developing Economies

Preeti Puja, Nalin Bharti

Indian Institute of Technology Patna, India

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ABSTRACT

Innovation is widely recognised as a fundamental engine of economic growth and productivity enhancement. In the context of developing economies, where there is the existence of structural challenges and dynamic opportunities, innovation plays a crucial role in transforming production processes and improving the productivity of the workforce. This study investigates the relationship between innovation indicators and labour productivity in developing economies, including China, India, Brazil, Thailand and Indonesia. Recognising the challenges and opportunities these countries face, the research provides a comparative analysis to identify key factors influencing labour productivity growth through innovation. This research employs a quantitative approach, utilising data from the World Bank, the International Labour Organisation, and various national statistical agencies. Using panel data analysis covering the period from 2007 to 2022, the study evaluates the impact of key innovation indicators, such as R&D expenditure, patent filings and technological adoption, on Labour productivity growth across the selected developing nations. The empirical results show the importance of innovation determinants in enhancing the value added by workers in the economy's production process. The findings highlight the varying pace and effectiveness of innovation-driven growth in productivity among the countries studied and offer insights into the key drivers of innovation for enhancing labour productivity. The policy recommendations include targeted investments in education and skills training, fostering a conducive regulatory environment for innovation, and improving investment in the R&D sector to drive growth in labour productivity. These strategies are essential for enabling sustained productivity growth and inclusive economic development in the developing world.

Keywords: Innovation, Labour Productivity, developing countries, panel data.

INTRODUCTION

The ability to create new and potentially valuable ideas in any activity and transform these ideas into a commercial reality is termed 'Innovation'. The advent of globalisation with the development of information technology and media represents the premises for economic growth and improving the public and private sectors' financial performance. Therefore, innovation, technology, and increased research and development expenditures are prerequisites to competitiveness and progress, further leading to sustainable economic growth. Today, developed countries spend more on research and development than developing and underdeveloped countries. That is one of the main driving forces that make developed countries more developed than the other follower countries. To become a global leader, long-term sustainable economic growth is one of the most desired goals for any country. A country can achieve this goal by increasing its output, that is, GDP (Gross Domestic Product), which is the total output produced by a country in a given period. GDP can be increased by increasing the number of inputs used in output production and the productivity of inputs. Productivity can be increased by innovating new products or production processes. When we say input, we consider both capital and labour. Existing literature argues that Innovation also increases the efficiency and productivity of capital and the labour force. Technological progress and innovation improve the production processes, and in this process, significant changes happen in the quality of the labour force. Developments related to various technologies, especially information and communication technology (ICT), provide opportunities for countries with a high population and labour force to excel due to an increase in efficiency and productivity of the labour force, which also helps them to have easier and faster economic growth. However, understanding this intricate relationship between innovation and labour productivity growth has become paramount in global economic development.

Technology and innovation are key catalysts of economic growth, with R&D investments playing a pivotal role in driving economic growth and productivity. According to Greenhalgh and Rogers (2010), the Innovation process follows three stages- Research and Development, Commercialisation and Diffusion. Each stage of the process involves activities requiring inputs of knowledge embodied in either skilled personnel or any specialised equipment and investment of time in using these resources. Later, if successful, each stage produces a knowledge output applied to goods for sale and service activities. The innovation process's first stage (Research and Development) produces basic scientific knowledge, blueprints and initial prototypes of new products or processes. This activity is frequently done by various agents, including public scientific institutions, universities, lone inventors and firms. The second stage (commercialisation) is where investors are introduced to the new innovative product or process and decide to invest if the product is marketable. This commercialisation phase introduces another chain of activities, broadly characterised as Diffusion, the third stage. The third stage covers the market's widespread adoption of new products or processes. So, the innovation system is run by two parallel economies, research and commercial. While fundamental research is the key driver of the research economy, the commercial economy is primarily driven by the marketplace.

These knowledge inputs and outputs, which we discussed in the stages of innovation, are used to measure the innovation. The Global Innovation Index Report published by the World Intellectual Property Organisation (WIPO) mentions the Innovation Index framework, which includes the Innovation input sub-index and Innovation output sub-index. While the input sub-index includes human capital and research, infrastructure, institutional environment, and market and business sophistication, the output sub-index includes knowledge outputs and knowledge diffusion. Conceptually, innovation requires one or more inputs, but the most important input is often considered Research and Development (R&D). This is generally measured in terms of R&D expenditure (% of GDP), calculated by the World Bank, including capital and current expenditures in the four main sectors: business enterprise, Government, Higher education and Private non—profit organisation. India's gross expenditure on R&D is only 0.7% of its GDP, which is too low compared to other developed countries and a few developing countries.

Based on stages of development, the International Monetary Fund (IMF) divides the world into three major groups: Developed or Higher-income economies, developing or middle-income economies, and less-developed or low-income economies. Developing or middle-income economies are further categorised into Upper and Lower middle income. Among all developing economies, China and India are two largely populated countries with high growth rates in recent years. When we see the innovation system of these economies, China started its growth by using technology from abroad in the form of both FDI (Foreign Direct Investment) and joint ventures. Many large multinational companies (MNCs) invest in China to source their production by transferring knowledge and technology to Chinese factories. Investment in R&D also increased substantially: Gross expenditure in R&D (GERD) to GDP ratio increased from 0.6% in 1996 to 2.46% in 2023. A notable feature of China's R&D is that multinationals drive it; around 29% of China's manufacturing R&D is carried out by foreign firms (Lundin & Serger, 2007). Conversely, India has focused on science and technology, including expanding university education since its independence. India's GERD to GDP ratio increased from 0.17% in 1958 to 1% in 1987, and since then, it has declined to around 0.7%. This shows a wide range of heterogeneity in innovation systems across developing economies. To capture this diversity and conduct a robust comparative analysis, the present study selects a sample of the top 25 innovating developing economies, as identified through the recent Global Innovation Index (GII) rankings.

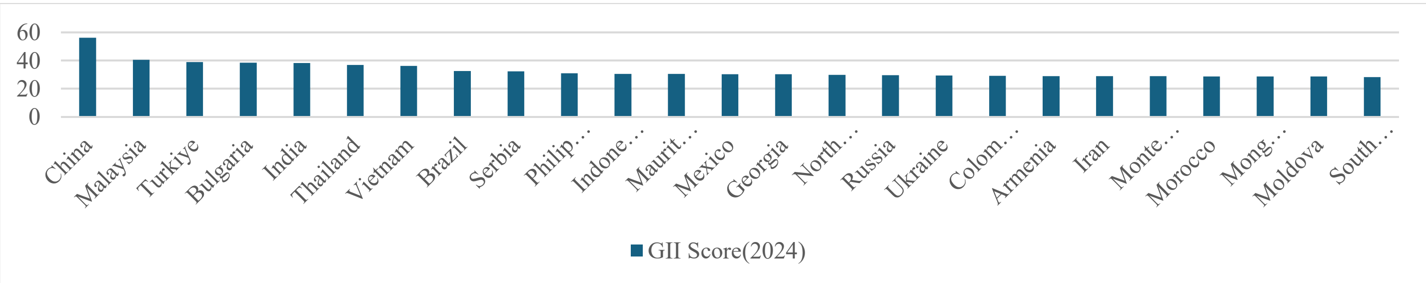

Figure 1: Global Innovation Index (GII) Score of selected countries in 2024
Source: Global Innovation Index Report 2024

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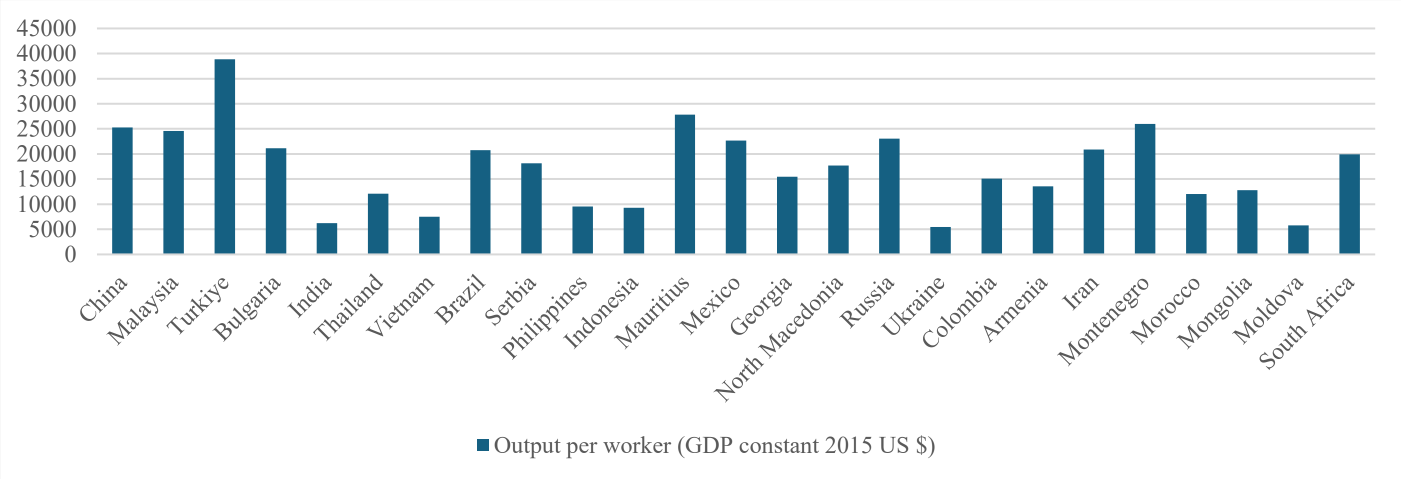

Figure 2: Labour Productivity of selected countries in 2025
Source: International Labour Organisation Database

Figure 1 illustrates the Global Innovation Index (GII) Scores 2024 for the top 25 innovating developing economies. China leads the group by a substantial margin with a GII score nearing 60. Malaysia, Turkey, Bulgaria and India also display relatively high innovation performance with scores between 35 and 45. In contrast, countries such as Morocco, Moldova, and South Africa have lower GII scores under 30. Countries like Thailand, Brazil, Vietnam, and Mexico have moderate innovation capabilities.

Figure 2 shows data on labour productivity across the 25 developing countries, which is being measured as an output per worker (in constant 2015 USD). Among the observer economies, there are disparities in the productivity levels. Bulgaria reflects the highest workers' productivity, approaching 40,000 USD, which indicates efficiency in labour utilisation. Malaysia, Turkey, Russia and China also record high productivity levels, each exceeding 20,000 USD per worker. Conversely, countries such as India, Vietnam, Indonesia, Philippines and Morocco show significantly lower productivity levels below 15,000 USD. South Africa, Mexico, and Thailand represent mid-range productivity economies of 15,000 and 20,000 USD.

The comparative innovation and labour productivity performance patterns across the sample developing economies reveal a strong rationale for prioritising innovation-driven growth strategies. As demonstrated in Figure 2, economies such as Bulgaria, China and Malaysia exhibit higher levels of output per worker, and this trend aligns closely with Figure 1, which shows that these same countries also score higher on the GII scores, indicating a robust national innovation system. Conversely, countries including India, Vietnam, Indonesia, Morocco and South Africa exhibit lower labour productivity levels and modest GII scores. This suggests a positive correlation between a country's innovation capacity and its ability to generate economic output per worker. So, the primary objective of this research is to examine the extent to which innovation contributes to labour productivity growth in developing economies.

The remainder of this paper is organised as follows. Section 2 provides a review of related literature. Section 3 presents the methodology of this study. Section 4 introduces the empirical results and findings. Finally, Section 5 provides conclusions and policy insights.

RELATED LITERATURE

This section is divided into two subsections. The first section provides the theoretical background linking innovation to economic growth and productivity, and the second section presents a review of the literature related to innovation and labour productivity, followed by research gaps and objectives of the study.

Innovation and Growth in Productivity

The literature on innovation and economic growth highlights the importance and necessity of innovation for a country's long-term development. One of the earliest foundational contributions came from Schumpeter (1934), who conceptualised innovation as anything new, whether a product, a process or a raw material source. Further, Solow (1956) introduced a growth model that empirically demonstrated the significant contribution of technological advancement to economic output. He considered technology as an exogenous factor to integrate innovation into the growth. However, in contemporary growth theory, technological progress is considered an endogenous factor which sustains long-term growth (Romer, 1986; Lucas,1986). These theories explained that technological change arises internally within the economy and can be sustained through knowledge accumulation. Knowledge and investment in R&D are identified as crucial mechanisms for generating ideas and sustaining innovation. Aghion and Howitt (1990), who developed a Schumpeterian growth model, also stated that the growth of any economy results from its technological progress. Later, Grossman & Helpman (1994) confirmed that economies with faster technological progress and favourable demographic trends are more likely to attain higher per capita income levels over time in the steady-state phase of growth.

Moreover, Zvi Griliches made significant contributions to understanding the innovation and productivity relationship. In his works, Griliches (1957, 1964) examined how R&D expenditures contribute to industrial productivity growth and how technological innovation diffuses across sectors. Also, he explored the connections between economic conditions and inventive activity (Griliches & Schmooker, 1963). These studies established the R&D investment as a reliable proxy for innovation input and highlighted the importance of understanding innovation not only as an invention but also as diffusion and application. Other existing literature, such as that of Crepon, Duguet, and Mairesse (1998), examined the link between firm-level research activity, innovation output, and productivity. Their findings indicate that the probability of engaging in research for a firm increases with its size and technology push factors. This further increases the innovation output, which in turn shows a strong positive influence on firm-level productivity. Crespi & Zuniga (2012) provided evidence through an econometric comparison using micro-level data. They found a significant relationship between innovation input, innovation output and productivity.

Innovation and Labour Productivity

We further reviewed more literature focusing on innovation's relationship with labour productivity, which shows a positive relationship between innovation and labour productivity. Arvanitis (2006) investigated the determinants of innovation performance and the impact of innovation performance on the labour productivity of Swiss manufacturing. Results show a clear-cut positive effect of innovation on labour productivity. Khanna & Sharma (2018) explore the effects of technological investments on the labour productivity performance of firms by looking at investments in IT and R&D. The results imply a complementarity between IT and R&D in generating labour productivity growth. Bhattacharya & Rath (2020) find that innovation affects labour productivity for Chinese and Indian manufacturing firms. However, its impact on firm productivity is relatively weak in India compared to China. Naveed & Wang (2023), by using a global sample from 1996 to 2013 for a panel of 65–87 countries, find a positive and significant effect of innovation on both structural change weighted productivity and unweighted average productivity and that the impact on structural change weighted productivity is more substantial.

These pieces of literature, from foundational theory to firm-level empirical analysis, provide both the conceptual and methodological basis for investigating how innovation contributes to labour productivity growth. However, existing studies are more region-specific, provide limited insights into developing nations and lack sufficient country-level analyses. This highlights the need for more cross-country studies to understand regional variations in the innovation and labour productivity nexus.

METHODOLOGY

The data source for this research is secondary, and the research methodology is quantitative. The study is done by using appropriate econometric applications. A panel regression model is used in this study to analyse how innovation affects labour productivity. Data are collected for top twenty-five innovating developing countries (China, Malaysia, Turkiye, Bulgaria, India, Thailand, Vietnam, Brazil, Serbia, Philippines, Indonesia, Mauritius, Mexico, Georgia, North Macedonia, Russia, Ukraine, Colombia, Armenia, Iran, Montenegro, Morocco, Mongolia, Moldova, and South Africa) for the period 2007-2022. Due to data limitations, the analysis is confined to the period ending in 2022. Data are collected from the International Labour Organisation (ILO) Statistics, World Development Indicators (WDI) and World Intellectual Property Rights (WIPO) Statistics.

Table 1 provides descriptions of all variables used in this study. The dependent variable is labour productivity, which is output per unit of labour input and is measured as output per worker (GDP constant 2015 US$) in this study. It is an important indicator of economic growth and the standard of living within an economy. It represents the total volume of output (measured in terms of Gross Domestic Product, GDP) produced per unit of labour (measured in terms of the number of employed persons or hours worked) during a given period. The explanatory variables used are predominantly categorised into two parts- Input and Output measures. The input measures for this study include Research and Development Expenditure (% of GDP) and tertiary school enrolment (% gross). Output measures are the total number of patent applications filed by residents, scientific and technical journal articles, and medium- and high-tech exports. The control variables used in the model include Gross Fixed Capital Formation (% of GDP) and consumer price inflation (annual %), foreign direct investment (FDI) inflows, and trade openness. These macroeconomic indicators could often influence labour productivity.

Table 1. Definition of Variables

	Variable	**Description**
Dependent Variable	OPW	Output Per Worker (GDP constant 2015 US$)
	Patent	Total number of Patent applications filed by the residents
Independent Variables	Scipub	Total number of Scientific and Technical journal articles
	MHTEXP	Exports of medium- and high-technology manufactured goods (US$)
	R&D	Research and Development Expenditure (% of GDP)
	GFCF	Gross fixed Capital Formation (% of GDP)
Control Variables	Inflation	Inflation, consumer prices (annual %)
	FDI	Foreign direct investment, net inflows (% of GDP)
	TRADEOPEN	Trade Openness [(Exports+Imports)/GDP]

Model Specification

Labour Productivity Growth Model

A neoclassical growth model can be written as a function of output (Y), Labour (L), and Capital (K).

$$Y = f\,(L, K). \qquad (1)$$

In this model, if both sides of the equation are divided by L, then the equation is

$$Y/L = f(K). \qquad (2)$$

The left side of the equation is Output per unit of Labour, which can be named labour productivity, and by adding the innovation variable to the right side of the equation, we examine the impact of innovation on labour productivity. The function can be written as below.

$$Y/L = f\,(K, Innovation). \qquad (3)$$

The primary objective is to examine the relationship between labour productivity and innovation, controlling for other factors:

Labour Productivity = *f*(Innovation, Control Variables) + error term

In this formulation, the error term is decomposed into two parts: a country-specific, time-invariant component that captures country-specific characteristics, and a random error term that represents random volatility uncorrelated with the other variables.

In the study, we estimate a model that tests the innovation's effect on labour productivity in the sample countries. The Ordinary Least Squares (OLS), Random Effects (RE) and Fixed Effects(FE) methods are used in the model. After conducting the Hausman test, the most appropriate method is identified, and the results are evaluated statistically. The regression equation for innovation and labour productivity is presented in Eq. (4).

$$OPW_{it} = a + \beta_1 R\&D_{it} + \beta_2 Patent_{it} + \beta_3 MHTEXP_{it} + \beta_4 Scipubit + \beta_5 X_{it} + \alpha_i + \lambda_t + \varepsilon_{it} \quad (4)$$

The explanatory variables in Eq.(4) are all innovation proxy variables. X_{it} represents the control variables, including gross fixed capital formation, inflation, foreign direct investment inflows, and trade openness. ε_{it} is an error term; *i* represents the country, and *t* denotes the year. The description of all the variables is mentioned in Table 1. The summary statistics of all variables are presented in Table 2.

Table 2. Summary statistics of all variables.

Variable	Min	Max	Mean	Std. Dev.	Observations
OPW	2992.57	37264.08	13855.07	7000.24	400
RD	0	2.54	0.59	0.45	400
Patent	0	1464605	37681	193759.8	400
MHTEXP	0	2.08e+12	9.16e+10	2.57e+11	400
Scipub	52.09	669744.3	32075.02	90566.57	400
FDI	-37.17	43.91	4.246	5.428	400
TRADEOPEN	0.221	1.924	0.826	0.364	400
GFCF	11.86	48.41	24.74	6.64	400
Inflation	-1.41	72.3	6.17	7.24	400

EMPIRICAL RESULTS

Stationary and Cointegration Test

In our econometric analysis, we first conduct pre-estimation tests, including a stationary test on the data and employ the Fisher-ADF test to determine the stability of all variables. The null hypothesis of this test is that the variable has a unit root, and the alternative hypothesis is that the panel is stationary. Unit root equations for all variables include the constants and time trends. The result shows that all variables are stationary at the level (see Table 3). Further, we conduct a cointegration analysis of equations (4) variables to address the spurious regression phenomenon. Before estimating the panel data parameters, this test must be done to check the existence of a long-run relationship between dependent and independent variables. The result shows that the t-statistic of Equation (4) is 2.06 (p=0.01), which means panel cointegration relationships reside between dependent and independent variables.

Table 3: Results of Fisher-ADF Panel Unit Root Tests

Variables	Level	Conclusion
OPW	83.74**	Stationary
R&D	73.21**	Stationary
Patent	99.54**	Stationary

MHTEXP	84.90**	Stationary
Scipub	102.53**	Stationary
FDI	212.57***	Stationary
TRADEOPEN	122.01***	Stationary
GFCF	194.67***	Stationary
Inflation	75.82***	Stationary

Note: ***,**, and * indicate significance at the 1, 5, and 10 per cent levels, respectively
Source: Authors' computation using STATA software

Test of Cross-Sectional Dependence

To check for cross-sectional dependence in the panel data, Pesaran's CD test is employed. The null hypothesis of the test is that the residuals are cross-sectionally independent. The result shows that the value of the test statistic is -0.88 with a p-value of 0.37. This indicates that the null hypothesis of cross-sectional dependence cannot be rejected. Hence, there is no evidence of significant cross-sectional dependence in the residuals of the model.

Test of Multicollinearity

To assess the potential multicollinearity among the independent variables, the Variance Inflation Factor (VIF) is calculated following the estimation of the regression model. The result shows that the mean VIF is 4.59, which is below the commonly accepted threshold of 10. This indicates that multicollinearity is not a significant concern in the model.

Test of Heteroskedasticity

To check for heteroskedasticity in the panel dataset, the modified Wald test is conducted. The results of the modified Wald test (p=0.00) are significant, indicating strong evidence of heteroskedasticity. This means that the variance of errors differs across countries in the sample. We take robust standard errors in our regression analysis to address this issue.

Analysis of Regression

The estimated regression results of the equation. (4) are shown in Table 4. Pooled OLS, Fixed effect and random effect model results are achieved through Static panel data analysis, with all independent variables presented in Table 1. Models 1-3 report their respective results. Each method provides different insights into the data. The Hausman test result (p=0.00) shows that a fixed effect is appropriate. Here, the fixed-effect model controls for time-invariant unobserved heterogeneity across countries. With an R-squared value of 0.64, this model explains approximately 64% of the within-country variation in the dependent variable. The results show that all the independent variables are positively and statistically significant at the 1% level, while controlling for other variables. This reflects that all the innovation proxy indicators positively impact labour productivity. The coefficient of R&D (0.127) is positive and statistically significant at the 1% level, which indicates that a one-unit increase in R&D expenditure causes a 0.127-unit increase in labour productivity within the countries over time. Patent coefficient (0.024) demonstrates a positive and statistically significant relationship with the dependent variable. Though the magnitude is smaller, it actively contributes to the outcome measure, with each additional unit corresponding to a 0.024 unit increase in the dependent variable. With a coefficient of 0.068, scientific and technical publications show a significant positive association with the dependent variable, underscoring the potential value of academic research outputs within the model. Among all independent variables, medium and high-tech exports exhibit the most substantial effect with a coefficient of 0.151. This highly significant relationship suggests that technological exports are crucial in determining the workers' productivity.

Table 4. Pooled OLS, Fixed effect and Random effect results.

Variables	**Pooled OLS (1)**	**Fixed effect (2)**	**Random effect (3)**
R&D	0.748*** (0.240)	0.127*** (0.026)	0.136*** (0.027)
Patent	-0.231*** (0.080)	0.029*** (0.011)	0.018 (0.011)
Scipub	0.191 (0.127)	0.088*** (0.012)	0.092*** (0.013)
MHTEXP	0.005 (0.068)	0.151*** (0.015)	0.134*** (0.016)
Constant	9.324*** (1.113)	4.994*** (0.312)	5.443*** (0.329)
Controls	YES	YES	YES
Observations	381	381	381
R-squared	0.41	0.64	
Number of Countries	25	25	25

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

Our analysis demonstrates that both innovation inputs and outputs exert a statistically significant and positive influence on workers' productivity across the sample countries. The positive impact of R&D expenditure on labour productivity is consistent with the findings of Griffith et al. (2004), who highlighted the importance of R&D spending in stimulating firm-level productivity. R&D serves not only as a direct contributor to technological development but also as a means of strengthening the country's absorptive capacity for knowledge spillovers and productivity.

The modest and significant effect of patent activity aligns with the Hall & Ziedonis (2001) findings, which highlighted that patent application growth reflects increased technological advancements. Over time, these advancements accumulate and lead to improvement in productivity and economic performance. Patent activity, therefore, serves as an important proxy for the technological progress and commercialisation of innovation. Scientific and technical publications, used in this study as a proxy for research capability and academic output, also show a strong and positive association with labour productivity. This aligns with the study of Furman et al. (2002), which emphasised the importance of knowledge generation in shaping a country's technological trajectory and productivity levels. Notably, the coefficient of medium and high-tech exports confirms the findings of Lall (2000), who observed that export-led industrialisation, particularly driven by sectors with high technological intensity, plays a vital role in boosting labour productivity by shifting economies towards higher value-added production.

In the context of developing economies, where innovation systems are still evolving, these results provide relevant evidence that contributes to a body of literature historically focused on advanced countries (Aghion & Howitt, 2006). Ultimately, the findings support the primary objective of the study that innovation significantly contributes to labour productivity growth across developing economies.

CONCLUSION AND POLICY INSIGHTS

This study examines the impact of innovation on labour productivity and provides a pathway through which innovation activities influence labour productivity in various developing economies. First, expenditure on research and development positively impacts labour productivity, highlighting the importance of consistent investment in the research domain. Second, patent activity contributes significantly to productivity outcomes, which suggests that technological progress and intellectual property systems are crucial for innovation-led growth. Third, scientific and technical publications, as a proxy of innovation output and research capability, also reflect a positive and significant influence on productivity. Lastly, medium and high-tech exports show the most substantial effect among all indicators. It underscores the importance of technology-driven production and integration into global value chains.

These concluding points direct us to several important policy implications. First, supporting R&D activities and formulating policies that encourage more research and development investments within the countries could yield more benefits. Second, countries should focus on improving the efficiency and accessibility of patent systems within the country. Third, policymakers should prioritise strengthening university research capacity and facilitating knowledge transfer between academia and industry. Fourth, countries should emphasise developing good international trade relations for better technological exports to other countries. Developing economies must adopt a holistic approach to integrate technological dimensions to foster workers' productivity growth. For future research, investigating the potential non-linearity in these relationships would provide valuable insights for policy formulation. Additionally, comparing the changes in innovation and labour productivity trends before and after global events will give a more robust understanding.

REFERENCES

1. Aghion, P., & Howitt, P. (2006). Appropriate Growth Policy: A Unifying Framework. Journal of the European Economic Association, 4(2–3), 269–314. https://doi.org/10.1162/jeea.2006.4.2-3.269
2. Arvanitis, S. (2006). Innovation and labour productivity in the Swiss manufacturing sector: An analysis based on firm panel data [Application/pdf]. 34 p. https://doi.org/10.3929/ETHZ-A-005277662
3. Bhattacharya, P., & Rath, B. N. (2020). Innovation and Firm-level Labour Productivity: A Comparison of Chinese and Indian Manufacturing Based on Enterprise Surveys. Science, Technology and Society, 25(3), 465–481. https://doi.org/10.1177/0971721820912902
4. Crépon, B., Duguet, E., & Mairessec, J. (1998). Research, innovation and productivi [ty: an econometric analysis at the firm level. Economics of Innovation and new Technology, 7(2), 115-158.
5. Crespi, G., & Zuniga, P. (2012). Innovation and Productivity: Evidence from Six Latin American Countries. World Development, 40(2), 273–290. https://doi.org/10.1016/j.worlddev.2011.07.010
6. Furman, J. L., Porter, M. E., & Stern, S. (2002). The determinants of national innovative capacity. Research policy, 31(6), 899-933.
7. Greenhalgh, C., & Rogers, M. (2010). Innovation, intellectual property, and economic growth. In Innovation, intellectual property, and economic growth. Princeton University Press.
8. Griffith, R., Redding, S., & Reenen, J. V. (2004). Mapping the two faces of R&D: Productivity growth in a panel of OECD industries. Review of economics and statistics, 86(4), 883-895
9. Griliches, Z. (1957). Specification bias in estimates of production functions. Journal of farm economics, 39(1), 8-20.
10. Griliches, Z. (1964). Research expenditures, education, and the aggregate agricultural production function. The American Economic Review, 54(6), 961-974.
11. Griliches, Z., & Schmookler, J. (1963). Inventing and maximizing. The American Economic Review, 53(4), 725-729.
12. Hall, B. H., & Ziedonis, R. H. (2001). The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995. The RAND Journal of Economics, 32(1), 101. https://doi.org/10.2307/2696400
13. International Labour Organization (ILO). (2025). ILOSTAT database. Retrieved 12 April, 2025, from https://ilostat.ilo.org
14. Khanna, R., & Sharma, C. (2018). Testing the effect of investments in IT and R&D on labour

productivity: New method and evidence for Indian firms. Economics Letters, 173, 30–34. https://doi.org/10.1016/j.econlet.2018.09.003

15. Lall, S. (2000). The Technological Structure and Performance of Developing Country Manufactured Exports, 1985-98. Oxford Development Studies, 28(3), 337–369. https://doi.org/10.1080/713688318
16. Lucas Jr, R. E. (1988). On the mechanics of economic development. Journal of monetary economics, 22(1), 3-42.
17. Naveed, A., & Wang, C. (2023). Innovation and labour productivity growth moderated by structural change: Analysis in a global perspective. Technovation, 119, 102554. https://doi.org/10.1016/j.technovation.2022.102554
18. Romer, P. M. (1986). Increasing returns and long-run growth. Journal of political economy, 94(5), 1002-1037.
19. Schumpeter, J. A. (1934). The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle. United Kingdom: Transaction Books.
20. Solow, R. M. (1956). A contribution to the theory of economic growth. The quarterly journal of economics, 70(1), 65-94.
21. World Intellectual Property Organization., Dutta, Soumitra., Lanvin, Bruno., Rivera León, Lorena., & Wunsch-Vincent, Sacha. (2024). Global Innovation Index 2024: Innovation in the face of uncertainty. (p.? pages :). World Intellectual Property Organization,. https://doi.org/10.34667/TIND.50062
22. World Bank. World Development Indicators**.** 2025. Retrieved from https://databank.worldbank.org/source/world-development-indicators. Accessed 12 April. 2025.