Proceedings of the 3rd International Conference on Financial Technology and Business Analysis
DOI: 10.54254/2754-1169/137/2024.18602

Analysis of Productivity Growth and Its Determinants in India

Jiachen Du[1,a,*]

[1]*Business School, University of Nottingham Ningbo China, Ningbo, China*
a. Biyjd14@Nottingham.edu.cn
**corresponding author*

Abstract: For the past decades, India witnessed a great development in economy and its GDP grew significantly. The key factor behind this is the productivity growth. This paper analyzes India's productivity growth concerning its two determinants, capital accumulation and technical progress. This paper first analyzes the capital accumulation in India and finds that more plants and machinery have accumulated rapidly in India mainly due to the implementation of strict labor regulations and the deepening of the Indian financial market. Besides, the paper also discovers that India's human capital accumulated through investments in education and healthcare. Regarding technical progress, this paper shows that India adopts new technologies from other countries to enhance production efficiency during this period, and that the government of India has also enacted new policies and set up research parks to encourage Indian firms and businesses to improve technologies through its Research and Development(R&D) process. Then, this paper investigates challenges faced by India for future development. The benefits of productivity growth from its initial capital accumulation diminish over time, and India's human capital development is relatively slow compared to other developing countries such as Sri Lanka because of insufficient and inconsistent government support. Taking into account the development experience of other countries, this paper suggests that India needs to transform to more advanced technologies to sustain further growth, and that India's government needs to be aware of the importance of public expenditure and expand its spending on human development sectors such as education and healthcare.

Keywords: Productivity growth, capital accumulation, technical progress, India.

1. Introduction

As a developing country in the world, India has witnessed significant development in its economy in the past decades. The country's gross domestic product (GDP) continued to increase since 2000 and reached 293,9 trillion (measured by current LCU) in 2023, which is over tenfold higher than it was at the beginning of this century, as shown in Figure 1 [1]. In 2024, with a 7% GDP growth rate, India ranked 5th in the top 10 largest economies worldwide [2]. An essential contributing factor behind this rapid economic growth in India is productivity. While measuring goods and services produced from each unit of labor input, productivity represents a country's production capacity. With more productive workers, an economy can gain more output, representing a higher GDP. Moreover, a high-GDP country tends to have a better quality of life. Thus, productivity also acts as a key determinant

DOI: 10.54254/2754-1169/137/2024.18602

of a country's living standards and happiness of residents. Therefore, considering the importance of productivity in improving a country's living standard and happiness and sustaining GDP growth, it is crucial to analyze the growth in productivity and its determinants. Regarding India, as shown in Figure 2, its labor productivity growth rate kept rising dramatically and peaked at 9.15% in 2016. After that, the growth rate started to slow down. In recent years, this growth rate maintained at approximately 2.5% despite some fluctuations [3].

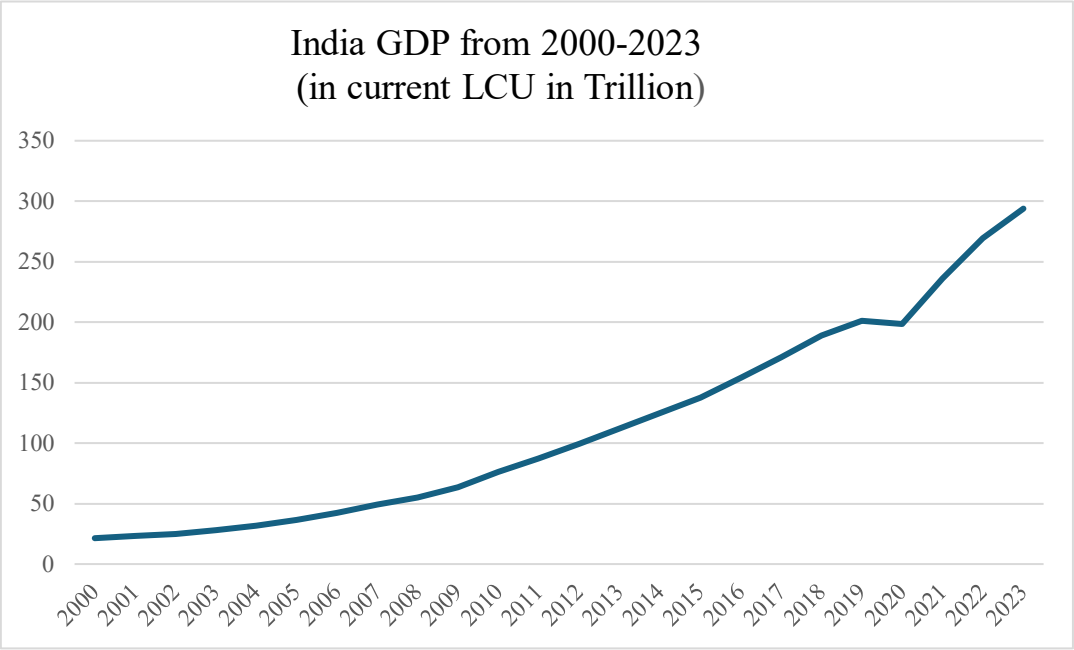

Figure 1: India GDP from 2000-2023 (in current LCU in Trillion).
Data from World Bank Group.

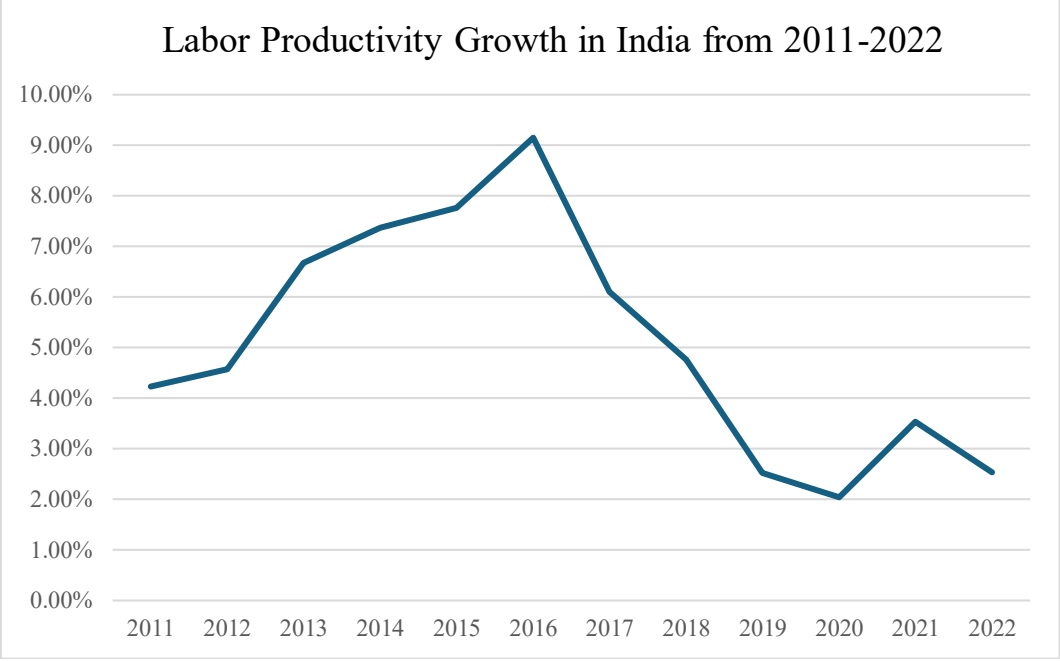

Figure 2: Labor Productivity Growth in India from 2011-2022.
Data from World Bank Group.

DOI: 10.54254/2754-1169/137/2024.18602

Conceptually, according to the neoclassical growth model, there are two key determinants of productivity growth: capital accumulation and technical progress. The former refers to those broadly defined investments that provide a payoff in the future, such as tangible asset expenditures and human capital accumulation. These capital investments can drive productivity growth but only in the short run as the benefit earned is diminishing over time. The latter, which mainly measured by the Solow residual, or the total factor productivity (TFP) growth, however, is the elixir for the long-run growth in productivity [4]. To explicit the promoting effects of capital accumulation and technical progress on productivity growth in social production practice, the productivity growth in India, particularly for the period after 2000, concerning these two determinants will be analyzed in this paper, and challenges encountered during this period as well as relevant suggestions will be provided.

2. Determinants of Productivity Growth

2.1. Capital Accumulation

In terms of capital accumulation, physical and intangible assets have accumulated in India. In other words, various Indian industries make large investments in tangible or intangible assets, such as plants, machinery, or newly-issued patents. This can be measured by the capital-labor ratio, or the capital intensity. In India, there is a noticeable increase in capital intensity. Its capital-worker ratio doubled from 2.8 between 1994 and 2002 to 5.6 between 2003 and 2017, especially for the manufacturing and utilities sectors [5]. Research also shows that in a sample of 63 countries, India ranks 28th in capital intensity used in the manufacturing industry. When compared to countries with similar development level, such as China, India uses more capital-intensive techniques in manufacturing production [6]. This high capital intensity can explain the rapid growth in India's productivity before 2016. The high capital-labor ratio, or capital intensity, indicates that workers have sufficient capital needed, such as machines, to produce output, and thus each worker tends to have a higher marginal productivity, contributing to a higher overall labor productivity.

One driving force behind this high capital-labor ratio is labor regulation, that is, more restrictive labor regulations are associated with higher capital intensity. The implementation of strict labor regulations on hiring and firing workers in India leads to an increase in indirect labor costs, reducing the labor demanded by the formal manufacturing sector and pushing the industry towards using more capital-intensive techniques of production. Therefore, though considered a labor-abundant country, India has much higher capital intensity than its counterparts, and even some capital-abundant countries, such as the U.S., have a lower capital-worker ratio compared to India [6]. Another factor that drives this high capital intensity is financial system development. With greater financial development, the capital-labor ratio is more likely to be high. A financial system, consisting of financial markets, financial instruments, and financial intermediation, plays a crucial role in allocating savings for productive use and reducing the risks in productive processes. With a well-functioning financial system, the level of financial deepening and widening, which implies the ability of firms and businesses in a country to mobilize savings for capital investments efficiently, can be improved and promoted [7]. For India, its government makes sincere efforts, such as increasing the range of financial assets, to deepen the financial development, thereby increasing the liquidity of the market and reducing risks associated with capital investments. Thus, firms and businesses can acquire and sell assets at a more attractive price and are more willing to make investments [7], which also contributes to the high capital-labor ratio.

Human capital has also accumulated in India. While human capital refers to the abilities, knowledge, and skills of human resources in a country [8], it can be accumulated through investing in education and healthcare. Education is consistently considered as the prime factor in human capital development that leads to productivity growth as plentiful previous empirical literature has proved its

DOI: 10.54254/2754-1169/137/2024.18602

significance in improving workers' knowledge and skills as well as increasing their productivity. Generally, those educated workers enjoy comparative advantages in processing new information and adapting to new technologies, thereby being more productive than others [9]. The Government of India accepted the concept of investing in education in 1968 and has been enacting and revising a series of national policies on education since 1986 [8]. Moreover, the proportion of government educational expenditure on GDP in India experienced an overall upward trend after 2010 and reached 4.6% in 2021 [10]. These actions indicate that the Indian government is continuously trying to further enhance national education and push labor productivity to a higher level, thereby improving the national economy. The efforts of the Indian government are not fruitless. The proportion of school enrollment for tertiary education on total school enrollment in India has been increasing since 2000, skyrocketing from 9% in 2000 to 33% in 2023 [11], implying the educational level in India kept rising during the past decades. This largely contributes to the continuous growth in productivity in India, particularly in recent years as technological advancements require a more comprehensive ability from workers. Healthcare, although indirectly, also positively influences human capital development and accumulation. A bunch of empirical studies show that improvement in the public provision of healthcare in developing countries can assist residents, especially those in unfavorable social status, and release resources for other investments, such as education [8]. The Indian government spends on the development of health infrastructure and controls communicable diseases by immunizing and improving water supply and sanitation, leading to the enhancement of health status in India [8]. India's life expectancy keeps increasing and has gone up from 63 in 2000 to 71 in 2019 [12]. As a result, labor productivity also kept growing significantly during this period, as workers with good health and long life expectancy had stronger incentives to enrich their knowledge and skills, thereby reducing the loss of productivity due to incapacity and debility [8].

Overall, India witnessed both physical and intangible accumulation and human capital accumulation for the past decades, contributing to the rapid productivity growth, particularly before 2016. It enjoys a high capital intensity and uses capital-intensive techniques, facilitating workers with plants and machines needed and improving their productivity. Moreover, policies and programs initiated in India enhance its educational level and health status, reducing the loss caused by workers' ignorance or illnesses. With this enhancement, Indian workers are more likely to be productive and skillful.

2.2. Technical Progress

Regarding technical progress, it plays a significant role in sustaining long-term productivity growth as the gains from it would not diminish over time. With technology advancements, automation can be realized, and more advanced machines as well as more time-saving techniques can be used, enhancing production efficiency, and thereby contributing to the improvement in labor productivity. One measurement of technical progress is the rate of TFP growth. This rate captures the effects of factors other than labor and capital, and in the neoclassical model, mainly the impact of technology improvement, on production and operation efficiency. In India, this growth rate increased dramatically after 2001, and between 2010 and 2016, it kept at a level of around 3% annually on average. Although this growth rate started to moderate in 2017, the average from 2010 to 2019 was still around 2.2% and was much higher than other emerging markets which only bore a -0.3% average for the same period [13]. This trend can be reflected in the fluctuations of productivity growth rate. As mentioned previously, the productivity growth rate kept before 2016, which matches the high TFP growth rate for the same period, and after 2017, that is when the TFP growth rate started to slow down, the productivity growth rate also began to decline.

There are two major sources of technical progress in a country, adopting from other developed countries and developing by itself through innovations. For emerging markets such as India,

DOI: 10.54254/2754-1169/137/2024.18602

importing foreign new technologies can help them release the burden brought by Research and Development(R&D) and avoid related uncertainties [14]. During the 1990s, the rapid technological change in the U.S. in the information and communication technology (ICT) sector resulted in a significant drop in the price of ICT goods. This price decline benefits India by lowering India's costs of importing ICT from the U.S. and accelerates its speed of technology adoption, which leads to the enhancement in India's technology level and the substantial substitution of other forms of capital by ICT in India. This provides Indian firms and businesses with the spillover effect, such as a better network for communication, collaboration, and information diffusion, helping them reorganize production more effectively and thus improving their productivity [15]. Besides, national technology improvement can also be generated from innovative activities, particularly through the R&D process. Empirical study done previously shows that the rising R&D expenditures have a positive influence on generating patents which can drive technological progress [16]. India, with decades of economy development, also started to new technologies on its own. Its gross R&D expenditure increased noticeably, from 6,01,968 million INR between 2010 and 2011 to 12,73,810 million INR between 2020 to 2021. Moreover, the Indian Government implemented new policies and built up research parks to motivate and facilitate the R&D activities among corporations and industries as well as to reinforce the domestic research culture [17]. This implies India is trying to push the technology to a higher level through its R&D activities, which eventually can lead to productivity growth.

In short, technologies have developed in the past decades in India. Although it seems to moderate recently, the average level of technical progress in India is still much higher than other emerging markets. The main sources of this progress are the adoption of new technologies, such as ICT, from the rest of the world and the internal R&D processes. Such progress brings India a better network for cooperation and information diffusion between industries, thereby improving its production efficiency and bolstering aggregate productivity growth.

3. Challenges and Recommendations

Though India's productivity keeps growing, the global economic recession in recent years as well as the national structural transformation in India still bring challenges that impede its productivity development. One of the imminent challenges faced is the diminishing returns from capital accumulation. To be more precise, the marginal gain in productivity growth is reducing even though more capital is accumulated. In India, while its capital intensity remains at a relatively high level, its productivity growth already started to slow down, indicating its aggregate labor productivity is increasing at a decreasing rate. A way to address this problem is relying on technical progress. Instead of focusing on investing in plants and machinery that use current technologies, the Indian government can encourage corporations and firms to import edge-cutting technologies from other countries or develop new technologies by providing subsidies. Especially, India can take advantage of recent technological changes in artificial intelligence (AI). Various research shows that involving advanced AI systems in work can substantially improve work performance and accelerate innovations, and thus its widespread adoption is expected to revive sluggish productivity growth [18]. Therefore, using an advanced AI system can be a good way for India to sustain productivity growth. Another challenge encountered is the slow progress in human capital development in India which can slack the productivity growth. The gains from its investments in education and healthcare are unpronounced compared to its counterparts.

Regarding education, impeded by the severe problem of out-of-school children, India's upper primary enrollment has increased only by 4.18% per annum over the past decades, and its ambition of achieving universalization of primary education remains a dream [8]. For healthcare, the increase in life expectancy in India is still well below that of many similarly placed developing countries such as Sri Lanka [8]. As a result, the aggregate productivity of India is still relatively low compared to

DOI: 10.54254/2754-1169/137/2024.18602

other countries. In 2024, its productivity, measured per hour worked, is 8 USD and merely ranks 133rd in the world [19]. These phenomena indicate human capital accumulation is slow and needs acceleration to speed up productivity growth. This can be solved by continuing to expand government spending on education and healthcare. In India, even though its government has initiated various policies to develop national healthcare and education, the overall expenditures on such human development sphere are still insufficient and inconsistent. The government expenditure on education merely takes up 3% to 4% of total GDP in recent years [10], which is relatively low compared to other developing countries and results in slow progress in education. Besides, private is the dominant model in India's healthcare sector. The public expenditure on healthcare is inadequate and lacks systematic national accounts, leading to unsatisfactory performance in national health status [8]. Therefore, the Government of India must realize the importance of public expenditure on human capital development and increase its spending on such sectors. Only with more support from the government, can India better enhance and utilize its human capital and accelerate its productivity growth.

4. Conclusion

In conclusion, productivity growth is an essential factor in the overall economic development of a country. This paper analyzes India's productivity growth regarding its two main determinants and provides some challenges India faces as well as related recommendations. Productivity in India has been increasing for the past decades, although it started to slow down in recent years. This sustained growth can be attributed to two key determinants, capital accumulation and technical progress. In terms of capital accumulation, more physicals and intangibles have accumulated in India during the past decades. This indicates India's workers have sufficient plants and machines in the production process, thereby improving their productivity. One reason behind this high capital intensity is the implementation of strict labor regulations. This increases labor costs and pushes industries in India to use more capital-intensive techniques. Another reason lies in the development of India's financial market. With the growing maturity of India's financial market, the risks related to capital investments are reduced, and Indian firms and businesses are more encouraged to invest, which contributes to physical and intangible accumulation. Moreover, human capital is also accumulated during the same period. With efforts from the government, India's educational level and national health status have improved. Those healthier and better-educated workers can reduce the loss due to incapacity and illness, leading to greater labor productivity. Regarding technical progress, it can provide more time-saving techniques thereby improving production efficiency. India relies on both adoption from developed countries as well as its R&D process to gain technical progress, facilitating the cooperation between industries and information diffusion, which enhances efficiency and benefits the growth of productivity. However, India still faces several challenges during productivity development. The benefits from capital accumulation are diminishing in India, suggesting it should more on technical progress to sustain growth and the government can provide more incentives, such as subsidies, to businesses to encourage them to embrace new technologies such as AI. Another challenge is the slow progress in human capital accumulation due to a lack of government support, implying the Indian government needs to raise its awareness of the significance of public expenditure on human capital development and keep expanding its spending on such sectors.

References

[1] *World Bank Group. (2023) GDP (Current LCU)-India. World Bank Group. GDP (current LCU) - India | Data (worldbank.org).*

[2] *Forbes India. (2024) The Top 10 Largest Economies in the World in 2024. Forbes India. World GDP Rankings 2024 | Top 10 Countries Ranked By GDP - Forbes India.*

DOI: 10.54254/2754-1169/137/2024.18602

[3] Rathore, R. (2024) Year-On-Year Labor Productivity Growth in India from 2013 to 2021. Statista.
[4] Stiroh, K.J. (2001) What Drives Productivity Growth? Economic Policy Review, 7(1).
[5] Bardhan, R.A., Sarkar, D. (2024) Structural Transformation Driving Services-Led Employment Generation in India. Orfoline.
[6] Hasan, R., Mitra, D., Sundaram, A. (2013) What Explains the High Capital Intensity of Indian Manufacturing? Indian Growth and Development Review, 6(2), 212-241.
[7] Chakraborty, A. (2014) Financial Deepening, Economic Development and Capital Market: Evidence from India. Prestige International Journal of Management & IT-Sanchayan, 3(2), 59.
[8] Haldar, S.K., Mallik, G. (2010) Does Human Capital Cause Economic Growth? A Case Study of India. International Journal of Economic Sciences & Applied Research, 3(1).
[9] Kathuria, V., Raj, R. S. N., Sen, K. (2010) Human Capital and Manufacturing Productivity Growth in India. In International Conference on: Science, Technology and Economy: Human Capital and Development.
[10] World Bank Group. (2024) Government Expenditure on Education, Total (% of GDP)-India. World Bank Group. Government Expenditure on Education.
[11] World Bank Group. (2024) School Enrollment, Tertiary (% gross)-India. World Bank Group.
[12] World Bank Group. (2022) Life Expectancy at Birth, Total (year)-India. World Bank Group.
[13] Goldar, B., Chattopadhyay, S.K., Nath, S., Sengupta, S., Das, P.C. (2023) Determinants of Total Factor Productivity Growth in India. Theoretical Economics Letters, 13(3), 683-718.
[14] Ghosh, B., Neogi, C. (1993) Productivity, Efficiency and New Technology: the Case of Indian Manufacturing Industries.
[15] Erumban, A.A., Das, D.K. (2016) Information and Communication Technology and Economic Growth in India. Telecommunications Policy, 40(5), 412-431.
[16] Zachariadis, M. (2003) R&D, Innovation, and Technological Progress: a Test of the Schumpeterian Framework Without Scale Effects. Canadian Journal of Economics/Revue canadienne d'économique, 36(3), 566-586.
[17] Nextias. (2024) Analysis of India's R&D Funding. Nextias. Analysis of India's R&D Funding - Current Affairs.
[18] Filippucci, F., Gal, P., Jona-Lasinio, C., Leandro, A., Nicoletti, G. (2024) The Impact of Artificial Intelligence on Productivity, Distribution and Growth: Key Mechanisms, Initial Evidence and Policy Challenges.
[19] Khan, S. (2024) List of World's Top 10 Countries by GDP Per Hour Worked. The Siasat Daily. List of World's Top 10 Countries by GDP per Hour Worked.