APO PRODUCTIVITY OUTLOOK 2022

Manufacturing Labor Productivity: Trends and Linkages

APO

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MANUFACTURING LABOR PRODUCTIVITY: TRENDS AND LINKAGES

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APO Productivity Outlook 2022
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FOREWORD

Sustainable economic growth in the long run depends on productivity gains. Labor productivity growth in Asia, where most countries are in the middle-income classification, depends on crucial contributions from the manufacturing sector. Manufacturing is a pathway to accelerate aggregate productivity growth. Under the impact of the COVID-19 pandemic, manufacturing is expected to play an even more prominent role in enabling rebound and fostering resilience in coming years.

This first edition of the APO Productivity Outlook series delves into the trends and linkages of manufacturing labor productivity. Using the sectoral productivity decomposition approach, the sources of national economic dynamics and characteristics as well as strengths and weaknesses are analyzed. The research confirmed the role of the manufacturing sector in productivity growth regardless of a country's stage of development. Middle-income member countries show the potential for making a leap in economic development through manufacturing. For APO members at the higher-income level, strengthening manufacturing might facilitate the diffusion of new production technologies and practices to other sectors.

The ongoing COVID-19 pandemic has decreased manufacturing outputs. With measures that temporarily slowed or halted production, negative impacts that exacerbated the productivity growth slowdown prior to the pandemic were felt. Trends and challenges for manufacturing productivity are related to the thematic issues of global value chains (GVCs) and ICT development. The positive contributions of GVCs to manufacturing productivity, especially the significant roles of backward linkages in GVC participation and ICT investment, were identified in this study.

It is hoped that the findings presented in the APO Productivity Outlook 2022 will serve as important inputs for economic policy planning in member countries. The collaboration with the Korea Development Institute in undertaking this research added important analytic insights.

Dr. AKP Mochtan
Secretary-General

EXECUTIVE SUMMARY

The discourse on productivity, especially in the manufacturing industry, was at the center of economic prosperity from the early days. With the onset of industrialization, both Adam Smith and Karl Marx perceived economic development as a repercussion of changes in how people produce. Productivity was always and will continue to be the most basic yet pivotal engine of economic growth. In our everyday lives, improved productivity brings forth an increase in wages and living standards, and induces heightened purchasing power of consumers, who are expected to demand greater goods and services. Hence, the literature appreciates productivity growth as the driving force to unravel the growth potential of economies and boost national competitiveness. Regrettably, as the recent outbreak of the novel coronavirus, COVID-19, has led to far-reaching impacts on a global economy that was already struggling with a broadbased slowdown in productivity growth, both advanced and emerging economies are facing fundamental challenges to promote productivity growth.

The main objective of this report is to conduct a focused and in-depth data analysis that can provide evidence-based insights for the manufacturing sectors of APO member countries, including but not limited to the selected countries, namely, India, Indonesia, Japan, the ROK, the Philippines, Thailand, and Vietnam. The study embodies three main deliverables: statistical analysis of labor productivity, a panorama of labor productivity, and provision of evidence-based insights for enhancing labor productivity in the manufacturing sector.

This study first seeks to understand the changing patterns of productivity growth in the manufacturing sector over time and its role from the lens of structural change. It then covers the trends and challenges in productivity growth of APO member countries with two thematic issues of global value chains (GVCs) and information and communication technologies (ICTs). Since we are living in the world of connectivity, analyzing the relationships between productivity and these two thematic issues would provide us insights for better policy designs.

In the first chapter, we carry out a comprehensive examination of how preexisting trends over the period of 2000–18, coupled with the pandemic-induced recession, would add to the challenges and shape the prospects for productivity growths of APO member countries, with a particular focus on the manufacturing sector. We begin with reviewing how manufacturing plays the role of enhancing productivity at a country's different stages of development in the context of industrial structural change. We then turn to exploring existing trends and the initial impact of the COVID-19 crisis on manufacturing productivity, suggesting that the spread of the disease has severely disrupted manufacturing activities, due to strict lockdowns and quarantine measures. This has had negative repercussions on productivity by shrinking manufacturing output associated with unavoidable adjustment in employment at the very initial stage of the pandemic.

Thus, in the short term, the COVID-19 pandemic is projected to lower manufacturing productivity growth through weakened investment and supply-chain linkages across the globe. Despite this dim outlook, however, the adoption of new digital technologies that are being accelerated in response to the pandemic-induced recessions is foreseen to offer novel opportunities to rebound the productivity growth. In the examined period, a broadbased and long-lasting slowdown in productivity growth was found across all sectors of APO member countries, and was particularly pronounced in the manufacturing sector across all income groups. While an undesirable structural change from high-value manufacturing (tradable) to low-value services (non-tradable) and moderate or reducing growth were observed in the studied advanced economies, a productivity-enhancing structural change was boasted before the outbreak of the pandemic in major emerging economies.

Based on the analysis from the first chapter, the second and third chapters uncover two distinct yet intertwined challenges, namely, the GVC and the ICT. The second chapter investigates the relationship between GVC participation and manufacturing productivity, with special attention to the case of APO member countries for the period 2006–18. We start with reviewing the basic concepts of GVCs and the theoretical arguments on potential channels through which GVC participation contributes to productivity enhancement. Then, the current status and main characteristics of GVC participation of APO member countries are extensively examined. In addition, we empirically investigate the linkage between GVC participation and manufacturing productivity in detail.

Here, the GVC involvement is narrowed down to two different types: backward and forward. The former describes countries importing foreign intermediates to produce their exports, while the latter refers to countries exporting domestically produced inputs to their trade partners, or third economies. In the forward GVC participation, those inputs are embodied in the exports of the third economies. This report feeds on the existing empirical evidence that suggests the contribution of GVCs towards productivity enhancement. In particular, our analyses suggest that backward integration is a particularly important channel for productivity growth. However, this finding comes with a caveat that there may be a two-way causal relationship between productivity and GVCs. While GVC participation positively affects productivity, it could also be the case where productivity itself is a decisive determinant of GVC involvement.

The third chapter explores the linkage between ICT and productivity among APO member countries. Examining the data from APO Productivity Database and the Conference Board, we quantify the importance of ICT capital in manufacturing productivity and analyze how ICT affects total factor productivity. The chapter also discusses the current status of digitalization in APO member countries and the challenges they face. The main message is that digitalization can widen, rather than close, the productivity gap between countries and firms. This is because productive entities tend to be agile in adopting and utilizing better digital technologies.

In the same vein, the report emphasizes that not all countries benefit from ICT investment as it has to be accompanied with sufficient support for complementary factors, including management practices and workers' skills. Also, the third chapter unveils considerable heterogeneity in this matter, implying that not all countries benefit equally from ICT investments. While advanced economies enjoy spillover effects that boost total factor productivity, emerging economies do not report discernable deeds. Thus, we recommend that policymakers reflect on how to facilitate the digitalization of the late adopters, mainly small and medium enterprises (SMEs).

While the main implications of the report include limitations to some degree, they do emphasize the needs for robust research and opening an avenue for future studies. Productivity growth is unarguably the most important engine for sustainable socioeconomic development and countries at all development stages are making productivity growth a top policy priority. Although the service sector has gained popularity in recent years and critics view that the share of the service sector in an economy determines whether it is an advanced one or not, countries should be aware of premature deindustrialization and redirect the focus toward improving manufacturing productivity. Even with the advancement of ICT and transition to the knowledge-and-digital economy, the manufacturing sector still plays a pivotal role in determining a country's international competitiveness by integrating the country's economy into the GVC. With the challenges including but not limited to premature deindustrialization, middle-income trap, and the COVID-19 pandemic, this report gladly responds to an increasing call for a distinct discourse on productivity.

PRODUCTIVITY TRENDS AND CHALLENGES

Introduction

Even before the outbreak of COVID-19 in 2020, a broadbased slowdown in productivity growth was already underway in the aftermath of the Global Financial Crisis (GFC) of 2007–09. In this chapter, productivity refers to output or GDP per input of a unit of labor, e.g., value added per worker. The weakening of productivity growth has been spread across sectors but has been sharper in the manufacturing sector [1, 2]. This has raised concerns around prospects for long-term productivity growth since manufacturing development, generally regarded as 'growth engine of national economies,' unleashes dynamic economic performance, which creates employment and income, facilitates trade and investment, and makes outsized contribution to productivity growth, thus leading to sustained economic growth [3, 4].

In developing countries, specifically, manufacturing development provides a pathway of structural change or shift of labor from low-productivity agriculture to higher-productivity manufacturing and services that could accelerate the convergence toward the productivity frontier by raising incomes through large-scale employment creation [5, 6]. For developed economies, it offers a vital source of technological innovation that facilitates industrial upgrading by embracing new technologies and intelligent production processes. This in turns enhances competitiveness of the economy as a whole via diffusion of new production technologies and practices to other sectors.

The ongoing COVID-19 pandemic, however, has either decreased or even halted manufacturing production across the globe, due to the containment measures that were enacted to avoid further contagion. This poses a threat of exacerbating the prolonged deceleration in productivity growth that existed before the pandemic, and raises the question of how the disruption caused by the COVID-19 outbreak would affect the future of productivity. This chapter aims to address this question by investigating how preexisting trends, coupled with the pandemic-induced recession, would add to the challenges and shape prospects for productivity growth, with a particular focus on the manufacturing sector for APO member countries. The chapter puts a spotlight on seven countries that are selected as representatives of differing levels of income groups among APO member countries and points at some pressing challenges where there may be a need for profound support for productivity growth. These seven countries and their income groups are (1) Japan and the ROK as high-income countries (HICs); (2) Thailand as an upper-middle income country (UMIC); and (3) Indonesia, the Philippines, India, and Vietnam as lower-middle income countries (LMICs).

This chapter is organized as follows: The next section begins by exploring sectoral productivity development over the period 2000–18. We focus on this period to examine the conditions existing before and after the 2008–09 global recession. In the section, we document how manufacturing plays the role of enhancing productivity at a country's different stages of development in the context of industrial structural changes. The subsequent section then turns focus on the manufacturing sector, sketching how preexisting trends of manufacturing productivity and the pandemic-driven recessions shape the outlook for productivity growth in the form of COVID-19 disruptions. To this end, we attempt to shed new light on the factors behind the changing patterns of pre-pandemic productivity, and further explore the initial adverse impact on manufacturing productivity. The last section concludes with a summary of key findings and discusses challenges for manufacturing productivity in the context of COVID-19.

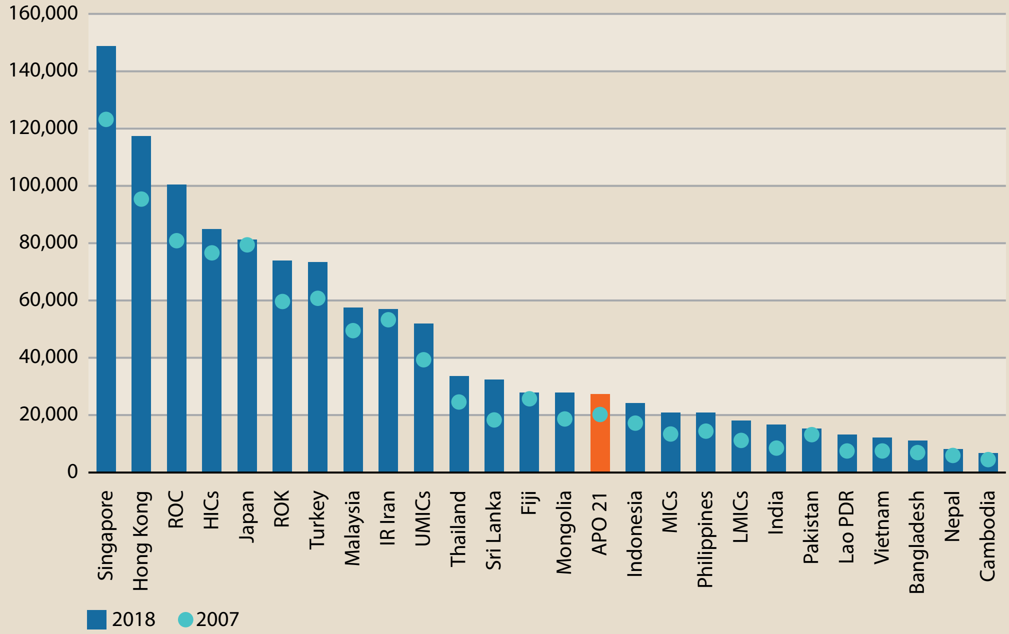
Sectoral Labor Productivity

Sectoral Labor Productivity Gaps

Figure 1 presents economy-wide labor productivity levels. In 2018, overall productivity averaged USD27,323 in APO member countries. The evidence shows large disparities in labor productivity levels across member countries. For instance, Cambodia's labor productivity is equivalent to 25% of APO average, while the levels of labor productivity in Hong Kong and Singapore are four-to-five times the average of APO member countries.

FIGURE 1

ECONOMY-WIDE PRODUCTIVITY OF APO MEMBER COUNTRIES.



Source: Authors' calculations based on APO Productivity Database.
Note: GDP by industry at constant prices per worker, using 2017 PPP.

Figure 2 indicates wide sectoral productivity differentials across APO member countries by their development status. Productivity in all sectors is lower in UMICs and LMICs than in HICs, with some exceptions such as agriculture (agr); mining (min); and transport, storage, and communications (tsc). Notably, productivity of the mining sector in both UMICs and LMICs is higher than that in HICs, in part because some countries show strikingly high mining productivity, e.g., Islamic Republic of Iran (IR Iran) at USD922,652; Malaysia at USD697,932; and Thailand at USD397,274 (see Appendix 1).

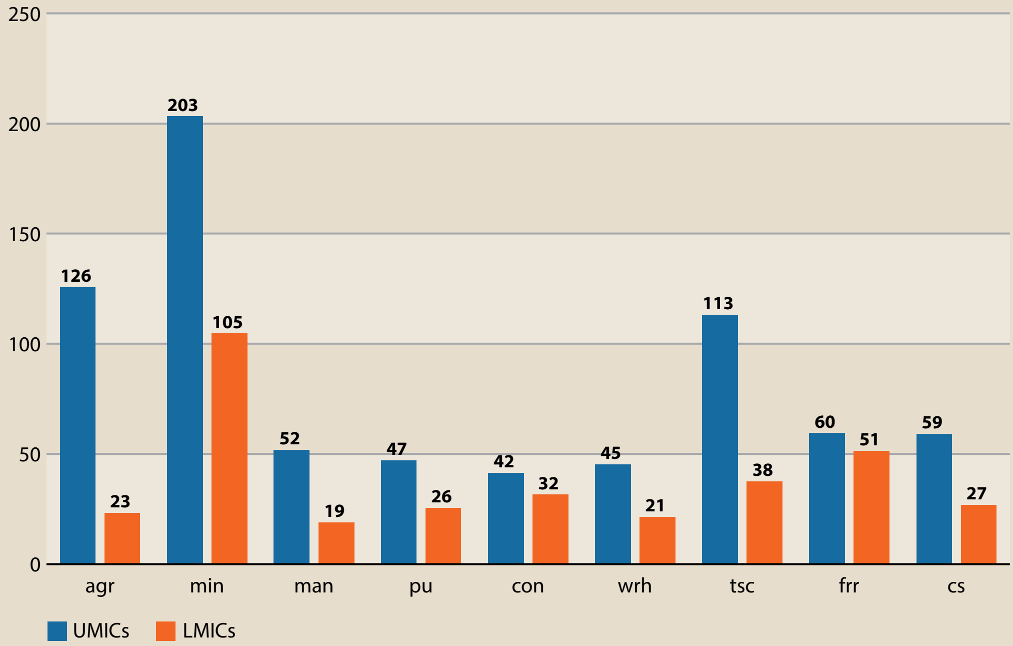
It may be noted here that resource-rich developing countries tend to view the mining sector as a major force of economic development in that it can attract private investment in mining exploration and production, which, in turn, contributes to fiscal and export revenues, employment opportunities, and infrastructure development. This appears to be the case for some APO member countries.

In LMICs, median manufacturing productivity is less than one-fifth of that in HICs. This may partly reflect significant gaps in overall manufacturing capabilities, owing to technological advancements and absorptive capacities of manufacturing firms from the two income groups. These gaps could, however, be narrowed through policy efforts by investing in research and development (R&D) programs as well as accessing frontier knowledge and best managerial practices through trade and foreign direct investment. However, the effective knowledge and technology transfer largely depend on the absorptive capacity of local firms and/or industries, which in turn depends on their quantity and quality of human resources and capital intensity.

Figure 3 describes intersectoral productivity gaps within each APO country. Notably, the gaps tend to be larger in less developed countries such as Vietnam, Lao PDR, and Pakistan, all of which are

FIGURE 2

SECTORAL PRODUCTIVITY OF UMICS AND LMICS RELATIVE TO HICS' MEDIAN (%).



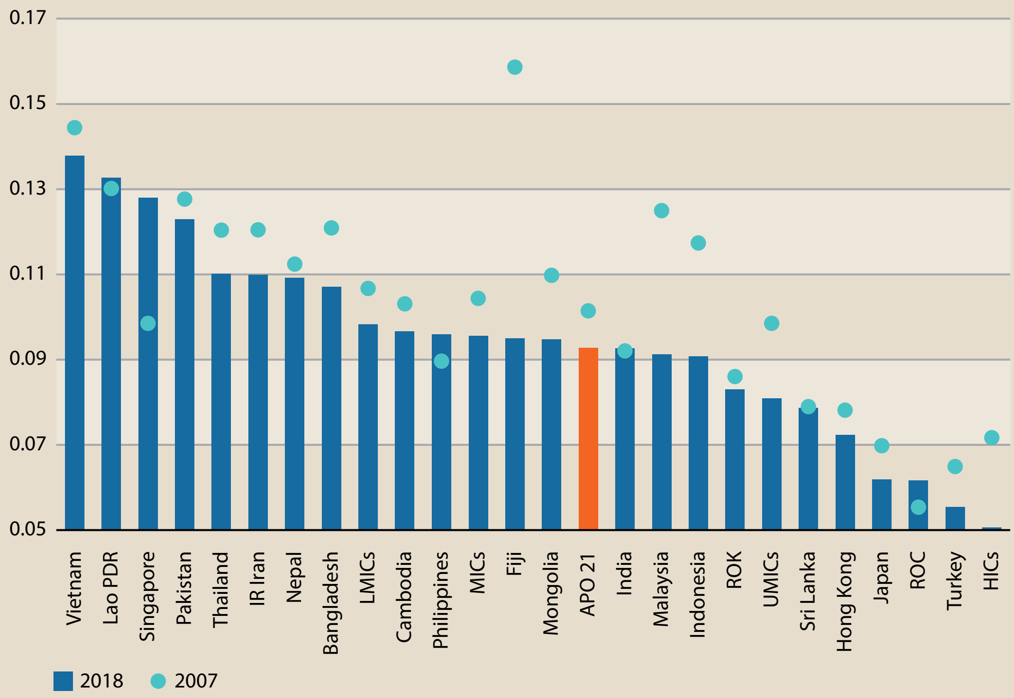
Source: Authors' calculations based on APO Productivity Database.
Notes: 1. GDP by industry is at constant prices per worker, using 2017 PPP.
2. Median productivity of the indicated country groups has been taken.
3. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; and cs = community, social, and personal services.

LMICs. A notable exception among HICs is Singapore, which also has wide intersectoral productivity differentials.

This pattern can also be confirmed in Figure 4, which depicts that UMICs and LMICs are characterized by much larger productivity gaps than HICs across sectors. This feature particularly stands out in public utilities (pu) and mining (min), both of which are natural-resource-based and capital-intensive sectors that are often dominated by local state-owned enterprises (SOEs) and/or foreign multinational companies (MNCs).

FIGURE 3

INTERSECTORAL PRODUCTIVITY GAPS IN APO MEMBER COUNTRIES.



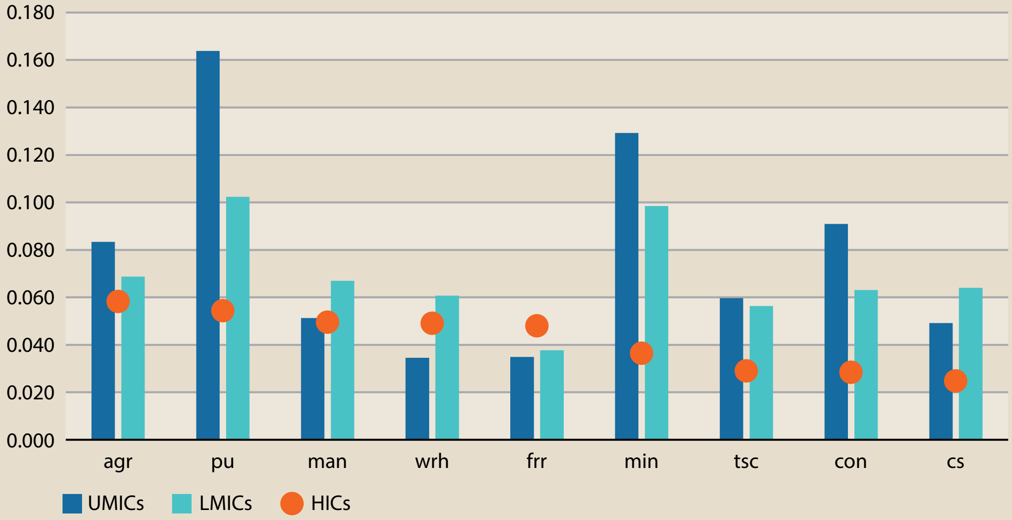
Source: Authors' calculations based on APO Productivity Database.
Notes: 1. GDP is by industry at constant prices per worker, using 2017 PPPs.
2. The coefficient of variation in sectoral labor productivity is within countries (vertical axis).

It may be noted that the improvement of productivity in the extractive sector (mining, oil, and gas, or hydroelectric power) hinges on country-specific circumstances such as adequate institutional quality and absorptive capacity, which may generate significantly heterogeneous effects. Resource-based inward investments, by MNCs for instance, tend to have fewer spillover effects into non-resource sectors of the host country because of less dependence on local suppliers. Moreover, if the government fails to effectively manage SOEs' performance, it can be a significant drag on efforts to ameliorate productivity at the national level. Without sound polices and regulations, many countries may suffer from lagged productivity.

In a nutshell, large productivity gaps across sectors can be found in APO member countries, indicating that they are wider for less developed countries but relatively smaller for developed ones, which is a typical feature of development process [3, 7]. This is supported by the evidence in Figure 5 that shows how intersectoral gaps in productivity and economy-wide productivity diminish over the course of development in APO member countries. The relationship between two measures is negative and statistically significant, thereby implying that higher the overall productivity, lower are sectoral productivity gaps. In other words, narrowing productivity gaps through sectoral reallocation of resources across sectors can create opportunities for overall productivity growth, thus boosting the convergence in economy-wide labor productivities. With this in mind, the growth patterns of sectoral productivity are examined in greater detail in the following section.

FIGURE 4

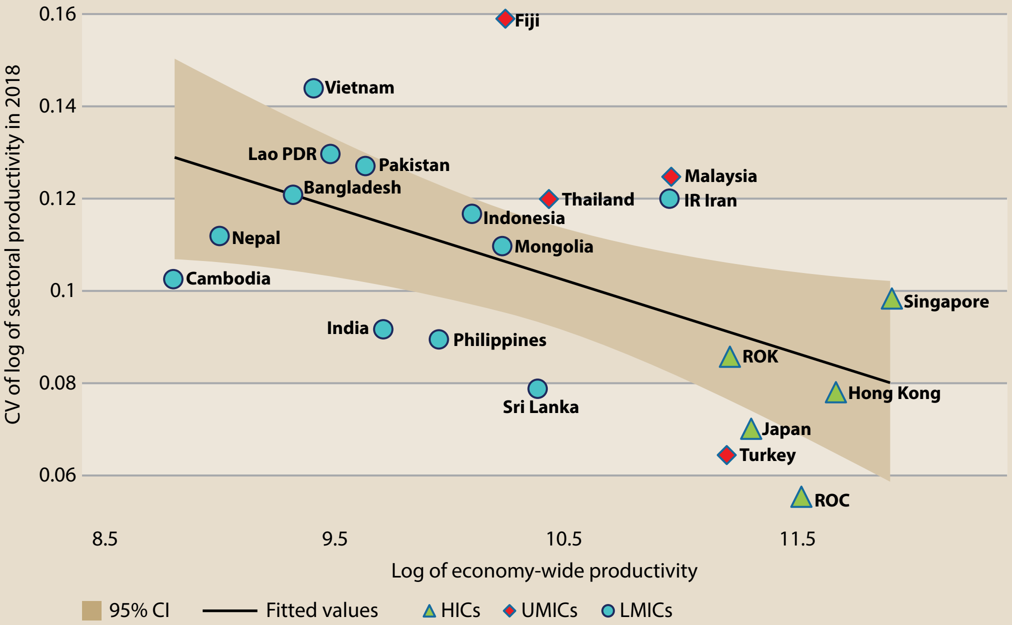
INTERSECTORAL PRODUCTIVITY GAPS IN APO MEMBER COUNTRIES BY DEVELOPMENT STATUS.



Source: Authors' calculations based on APO Productivity Database.
Notes: 1. GDP is by industry at constant prices per worker, using 2017 PPPs.
2. The coefficient of variation in sectoral labor productivity is within countries (vertical axis).
3. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications, frr = financial intermediation, real estate, renting, and business activities; and cs = community, social, and personal services.

FIGURE 5

RELATIONSHIP BETWEEN INTERSECTORAL PRODUCTIVITY GAPS AND ECONOMY-WIDE PRODUCTIVITY.



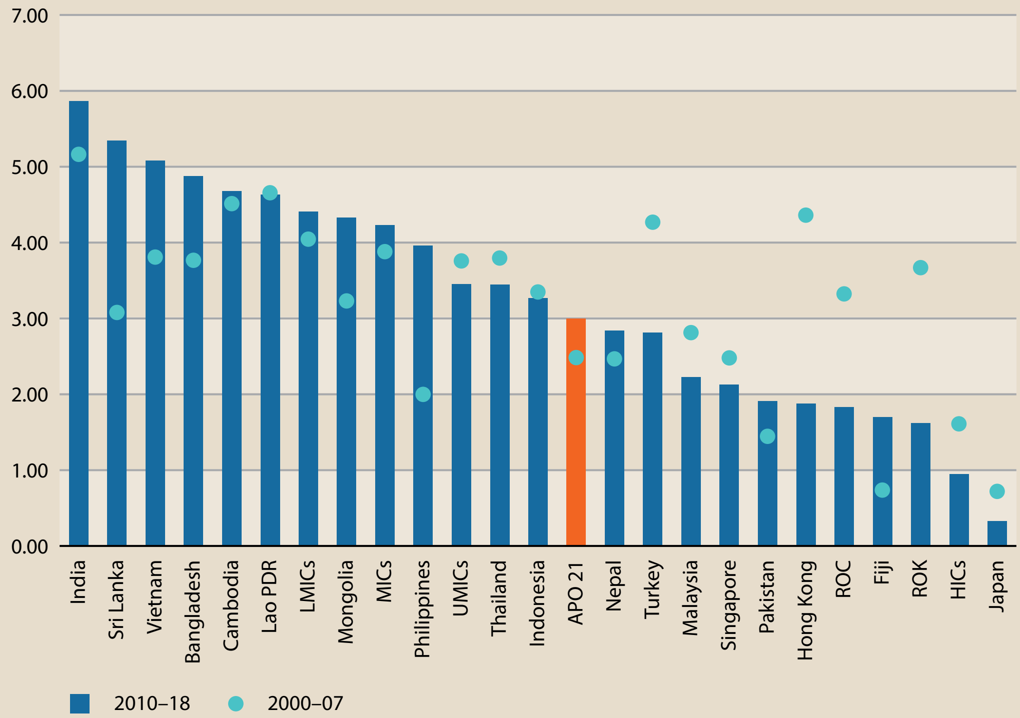
Source: Authors' calculations based on APO Productivity Database.
Notes: 1. GDP by industry is at constant prices per worker, using 2017 PPPs.
2. The coefficient of variation in sectoral labor productivity within countries (vertical axis) is graphed against the log of APO member countries' labor productivity (horizontal axis).

Sectoral Labor Productivity Growth

We start by looking into the annualized productivity growth during the period 2000–18. Productivity growth in APO average accelerated even after the GFC, but its overall pattern seems to have varied according to an economy's stage of development. Productivity growth in HICs and UMICs slowed post crisis (2010–18) versus pre crisis (2000–07), with growth rates of 0.94% and 3.45%, respectively, while that in LMICs accelerated further to 5.21%. Specifically, in about half of APO member countries, productivity has grown at a faster pace in the last decade (2010–18) than it did in the eight years (2000–07) that preceded the GFC, with India, Sri Lanka, and Vietnam being major examples among LMICs (see Figure 6). The opposite is true for most HICs such as Japan, the ROK, the Republic of China (ROC), and Hong Kong.

FIGURE 6

PRODUCTIVITY GROWTH IN APO MEMBER COUNTRIES (%).



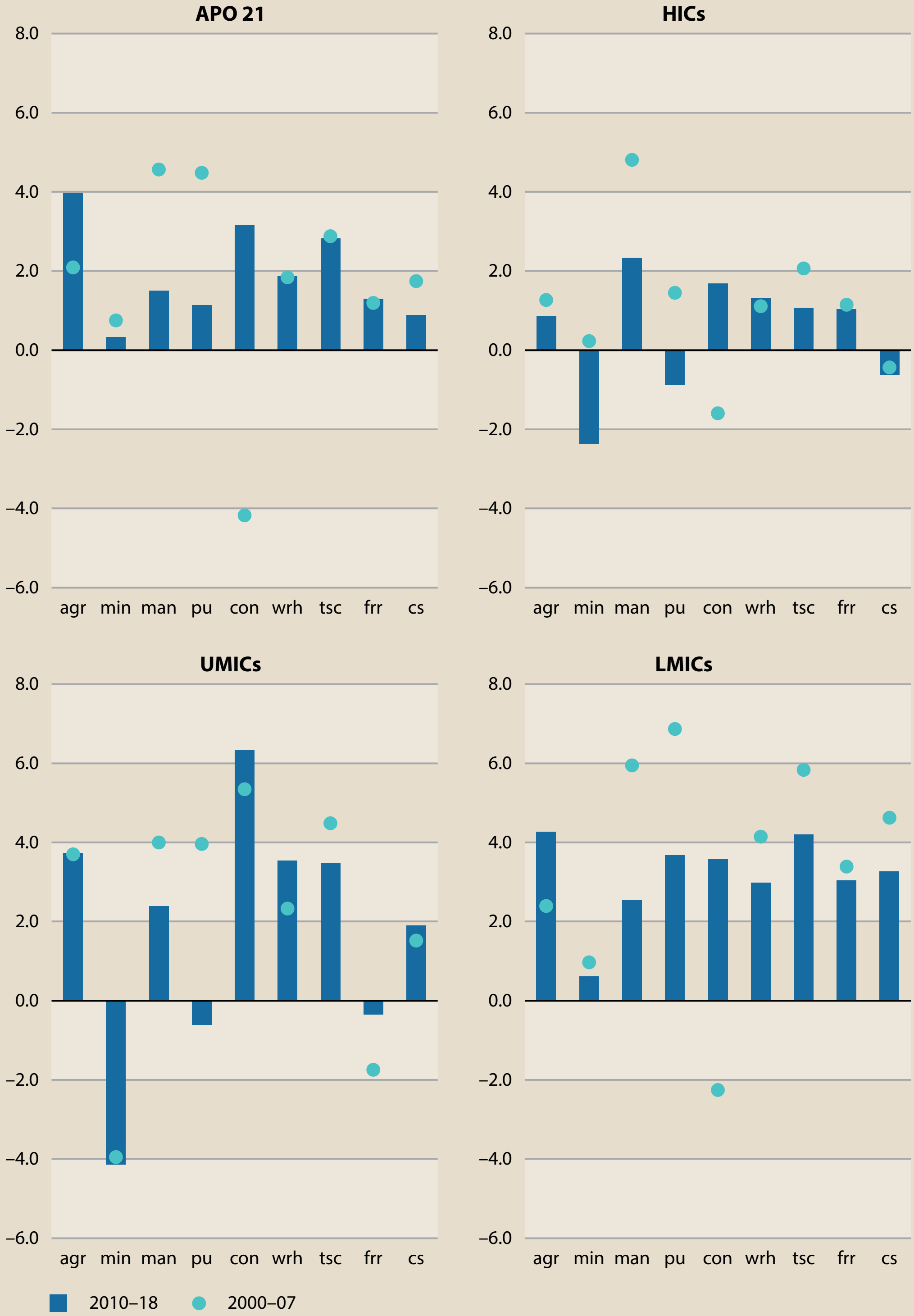
Source: Authors' calculations based on APO Productivity Database.
Note: GDP by industry is at constant prices per worker, using 2017 PPPs.

Looking at the sector level, heterogeneous productivity growth can be found (see Figure 7). In the post-crisis period, sectors with fastest growing productivity versus APO 21 average were agriculture (agr); construction (con); and transport, storage, and communications (tsc), with annual growth rates between 2.8% and 4.0%. This is in contrast with the period before the GFC (2000–07), when manufacturing was the sector with highest productivity growth.

In HICs and UMICs, post-2010 productivity growth was negative in mining (min), public utilities (pu), and some sub-services (frr or cs) but was positive in all sectors in LMICs. Although the sectoral productivity growth has differed largely across various country groups, a common feature shared is that the sector with the sharpest slowdown, of over 1.5% points, was manufacturing.

FIGURE 7

SECTORAL PRODUCTIVITY GROWTH IN APO MEMBER COUNTRIES.



Source: Authors' calculations based on APO Productivity Database.
Note: 1. GDP by industry is at constant prices per worker, using 2017 PPPs.
2. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; cs = community, social, and personal services.

We now turn to explore the drivers of productivity growth and how their roles have changed over time, with a special emphasis on the aftermath of the GFC. Figure 8 presents sectoral contributions to post-GFC productivity growth. In APO 21 and LMICs, which boasted a rising trend of productivity following the GFC, an acceleration in overall productivity growth was largely driven by faster growth in construction (con) and sub-services (frr) (see Figure 8A).

FIGURE 8

SECTORAL CONTRIBUTION TO PRODUCTIVITY GROWTH, IN % AND %P.

Source: Authors' calculations based on APO Productivity Database.
Notes: 1. GDP by industry is at constant prices per worker, using 2017 PPPs.
2. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications, frr = financial intermediation, real estate, renting, and business activities; cs= community, social, and personal services.

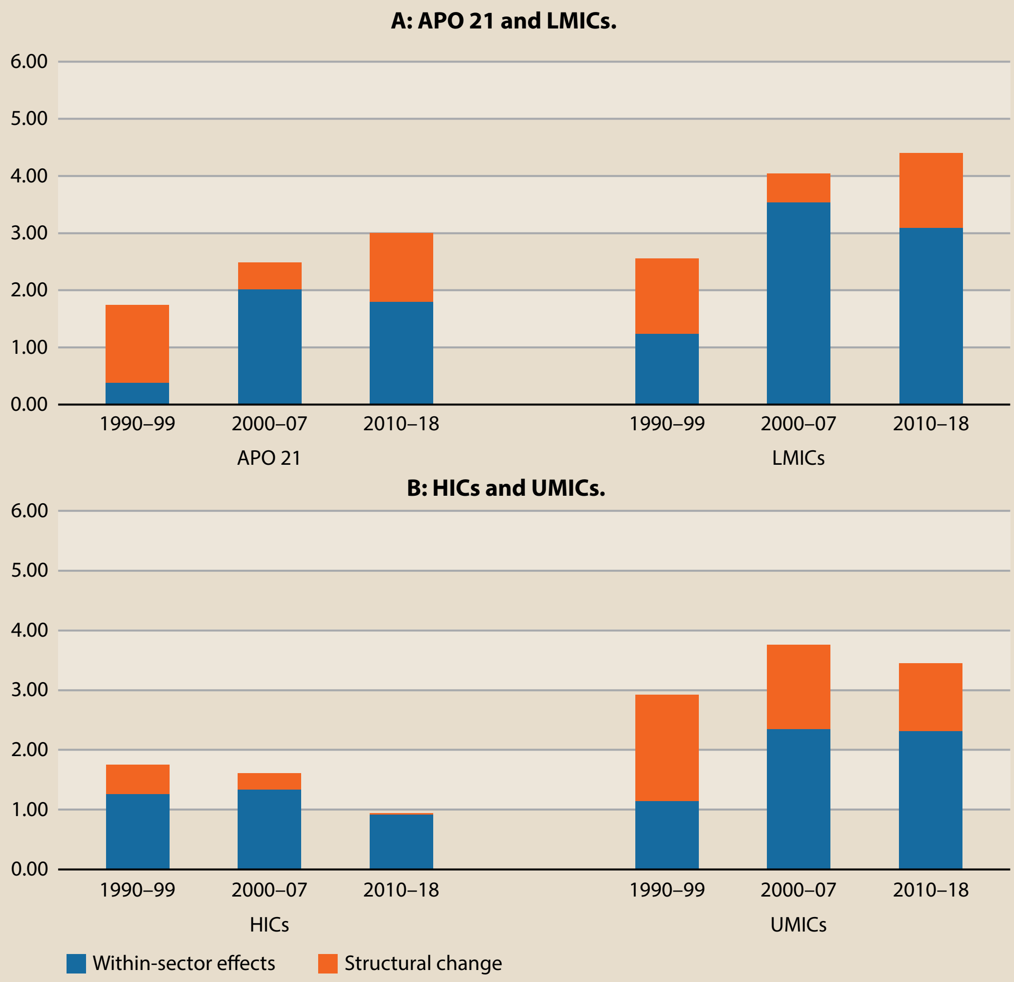
In contrast, the productivity slowdown in HICs and UMICs is accounted for, markedly, by slower growth in mining (min) in the same period (Figure 8B). Moreover, homogenous patterns, regardless of income groups, show that large contributing sectors in overall growth, e.g., mining and public utilities, were hit the hardest by the adverse event.

Figure 9 indicates the results of decomposing productivity growth into two components: (1) the 'within-sector effects' component, which measures productivity improvement within individual sectors through capital accumulation, technological innovation, etc.; and (2) the 'between-sector effects or structural change' component, which measures labor allocative efficiency across sectors.

Ever since 2000, within-sector productivity growth has been the main driver of overall growth across all groups of countries. During the post-GFC period, productivity gains from sectoral reallocation have further increased in APO 21 and LMICs with a much greater contribution of overall productivity growth, albeit that has faded in HICs and UMICs.

FIGURE 9

SECTORAL DECOMPOSITION OF PRODUCTIVITY GROWTH.



Source: Authors' calculations based on APO Productivity Database.
Note: GDP by industry is at constant prices per worker, using 2017 PPPs.

This evidence indicates that the process of development for APO member countries is on track as per their development status. For instance, as discussed earlier (see Figure 5), gradual disappearance of intersectoral productivity gaps is a notable feature in the process of development. In that regard, productivity enhancement within each individual sector, via the creation, transfer, and adoption of new technologies is, by and large, more crucial in fostering economy-wide performance for HICs and/or some UMICs. On the other hand, structural change or labor-allocative efficiency, which contributes to reducing sectoral differentials prevalent in LICs, needs to be prioritized for countries with lagged productivity, with a view to hasten convergence in productivity.

Yet, there have been concerns that the post-GFC slowdown in within-sector growth for both HICs and UMICs was greater than that in the structural change, primarily driven by a drastic drop in manufacturing productivity (see Figure 10). In addition, notwithstanding the fact that the contribution from the sectoral reallocation to the post-GFC productivity growth increased in LMICs, most of the productivity gains can primarily be attributed to a shift toward services sectors with relatively low productivity in general. This degraded ample growth potential for productivity due to an absence of intersectoral reallocation of labor toward the manufacturing sector.

We further look at the sectoral details for selected APO member countries to gain insights by investigating the patterns of the structural change. Figures 11, 12, and 13 exhibit the linkages between sectoral productivity relative to economy-wide productivity and changes in the employment share in the post-GFC period (2010–18), with the size of a circle depicting the corresponding sector's initial share of employment. Figure 11 shows cases for selected LMICs, namely, Indonesia, India, the Philippines, and Vietnam.

These countries show a typical case of productivity-enhancing reallocation, sharing the common feature that the sector with the largest loss in employment is agriculture, which is the largest sector, but with the lowest productivity. The sector with the greatest employment gain however differs by country. Vietnam underwent notable employment gains in manufacturing, whereas Indonesia, India, and the Philippines experienced a sharp rise of employment in services like wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants (wrh) and community, social, and personal services (cs), both of which are relatively unproductive nontradable sectors with high levels of informality.

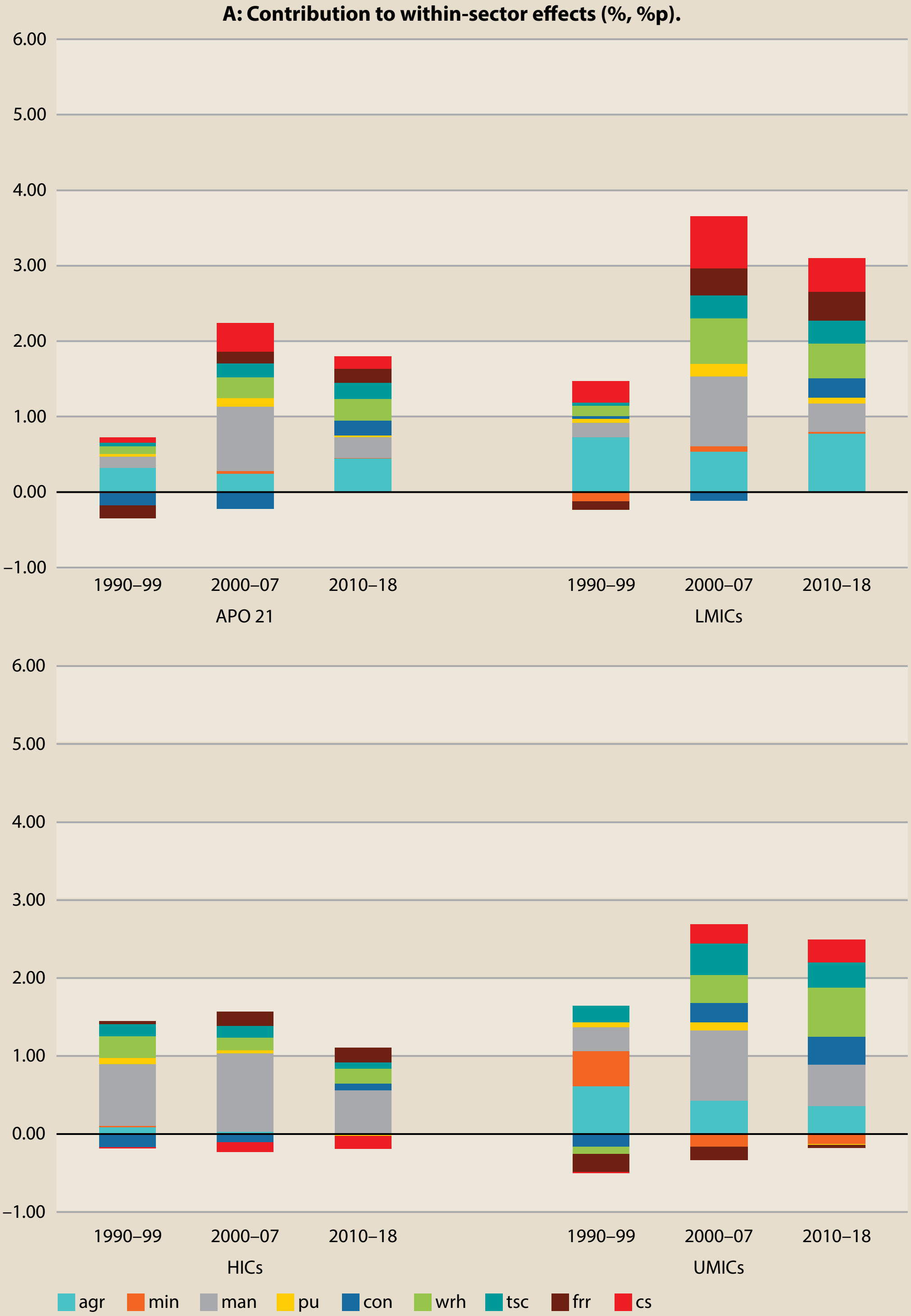
Thailand shows a somewhat more progressive form of structural change (see Figure 12), accompanied by a contraction of employment in agriculture, which is a significantly below-average productivity sector. The most rapidly expanding sector in Thailand was manufacturing among those with above-average productivity. Thailand has further proceeded with the process of industrialization in the aftermath of the GFC by grasping the opportunities for a growth-enhancing structural change, i.e., moving labor from low-productivity agriculture to a more productive manufacturing.

The picture of the structural change following the GFC in the ROK and Japan is differentiated from that in the middle-income country groups (see Figure 13).

It is worth noting that Japan is a pioneer in that it was the first non-European/North American economy to achieve industrialization in the early 1990s, and the ROK is a country touted as an Asian Tiger that has boasted a story of dazzling national transformation from poverty to wealth, largely driven by rapid industrialization since the 1960s [9]. In this regard, those industrialized countries that have already experienced intersectoral productivity growth during the course of

FIGURE 10A

WITHIN-SECTOR EFFECTS AND STRUCTURAL CHANGES.



Source: Authors' calculations based on APO Productivity Database.
Note: 1. GDP by industry is at constant prices per worker, using 2017 PPPs.
2. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; and cs = community, social, and personal services.

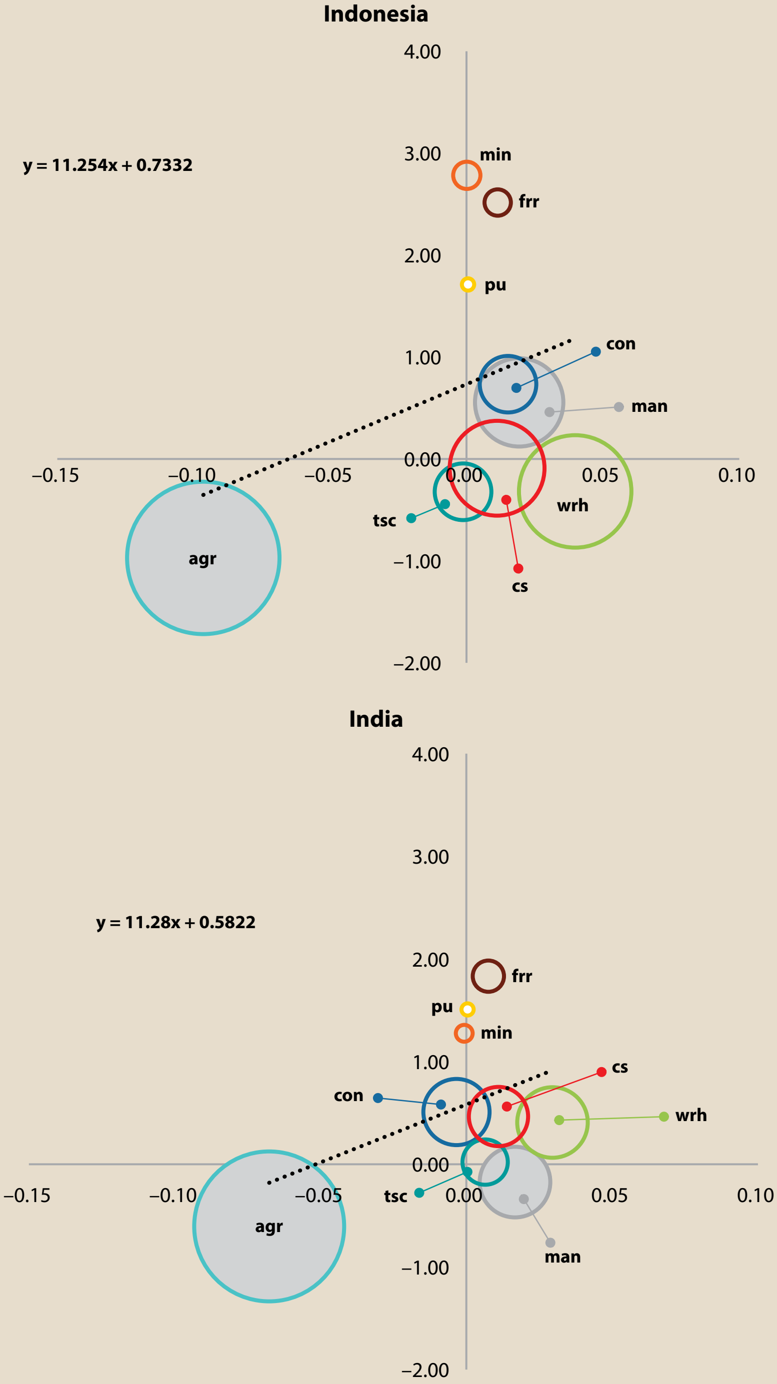
FIGURE 10B

WITHIN-SECTOR EFFECTS AND STRUCTURAL CHANGES.

Source: Authors' calculations based on APO Productivity Database.
Note: 1. GDP by industry is at constant prices per worker, using 2017 PPPs.
2. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; and cs = community, social, and personal services.

FIGURE 11A

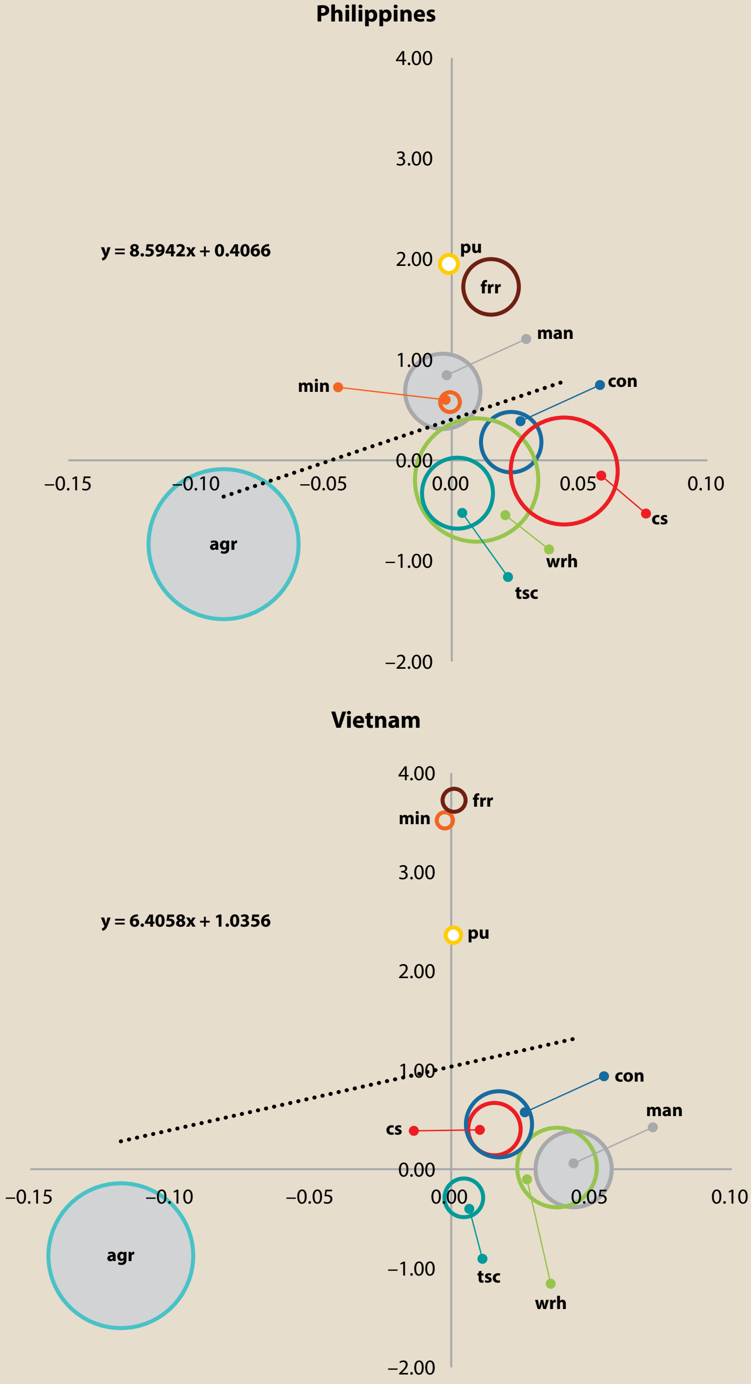
CORRELATION BETWEEN SECTORAL PRODUCTIVITY AND CHANGES IN EMPLOYMENT SHARES IN SELECTED LMICS.



Source: Authors' calculations based on APO Productivity Database.
Note: 1. y-axis: log of sectoral productivity/economy-wide productivity in 2010; x-axis: changes in employment share during 2010–18.
2. A circle's size indicates the corresponding sector's share of total employment in 2010.
3. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; cs = community, social, and personal services.

FIGURE 11B

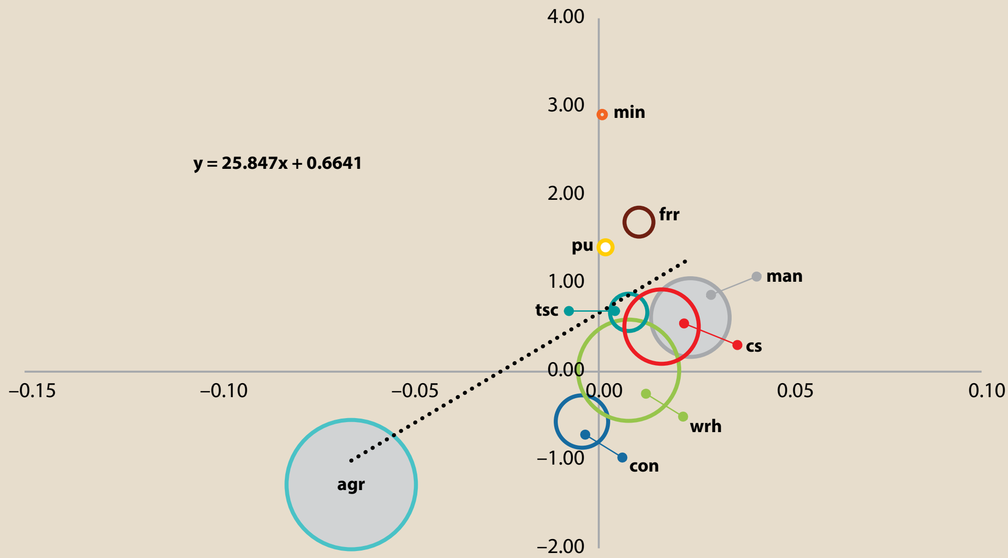
CORRELATION BETWEEN SECTORAL PRODUCTIVITY AND CHANGES IN EMPLOYMENT SHARES IN SELECTED LMICS.



Source: Authors' calculations based on APO Productivity Database.
Note: 1. y-axis: log of sectoral productivity/economy-wide productivity in 2010; x-axis: changes in employment share during 2010–18.
2. A circle's size indicates the corresponding sector's share of total employment in 2010.
3. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; cs = community, social, and personal services.

FIGURE 12

CORRELATION BETWEEN SECTORAL PRODUCTIVITY AND CHANGES IN EMPLOYMENT SHARES IN SELECTED UMICS.



Source: Authors' calculations based on APO Productivity Database.
Note: 1. y-axis: log of sectoral productivity/economy-wide productivity in 2010; x-axis: changes in employment share between 2010–18.
2. A circle's size indicates the corresponding sector's share of total employment in 2010.
3. agr = agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; and cs = community, social, and personal services.

development, exhibit that manufacturing employment has shrunk in favor of some relatively lower-productivity service activities (e.g., community, social, and personal services) in recent years (see Figure 13). Even though it may not be the case of a growth-reducing structural change, it can be seen as undesirable for long-term productivity growth because of the progression toward lower-productivity services rather than the higher-productive, knowledge-intensive sectors.

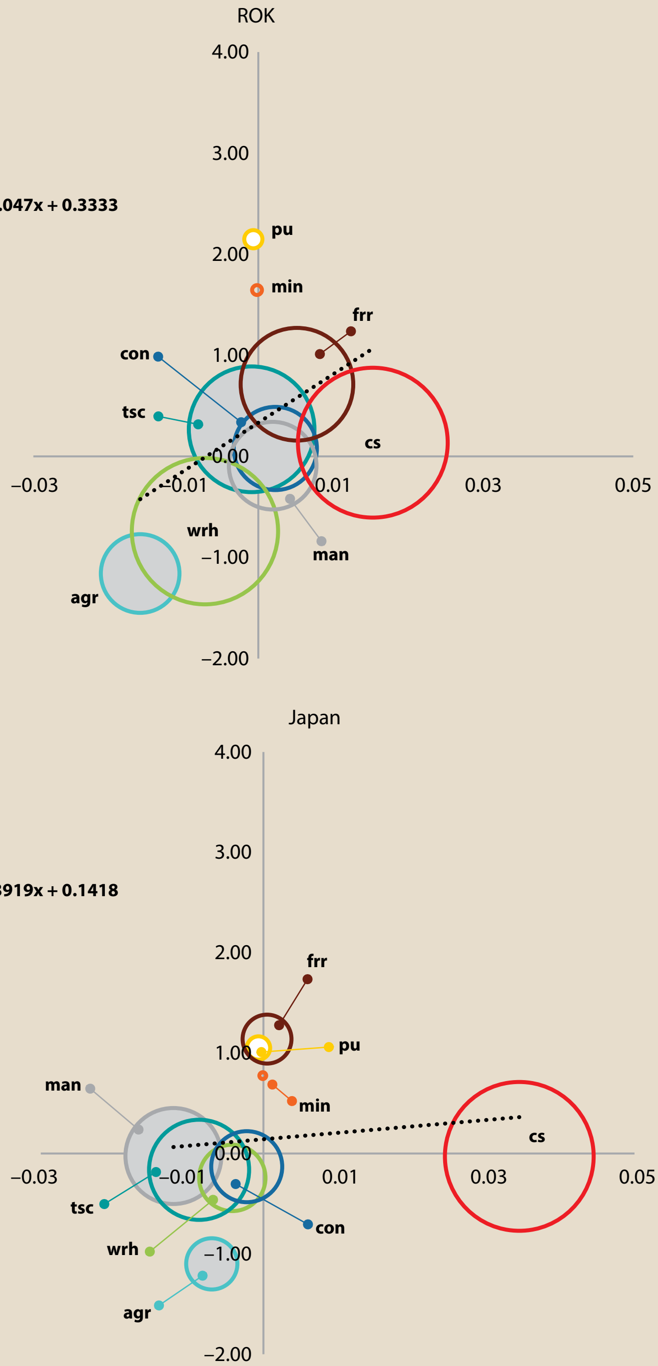
Also notable is the fact that they have, meanwhile, moved to a more advanced stage of structural change, dubbed 'industrial upgrading,' i.e., moved from labor-intensive, low-tech industries toward more technology-intensive industries within manufacturing. As seen in Figure 13B, a sharp increase of employment was found in the medium-high and high-technology industries such as transportation equipment (te) and electric machinery or medical, precision, and optical instruments (emp), with a shrinking share of employment in labor-intensive, low-tech industries such as food products, beverages, and tobacco products (fbt) and textiles and wearing apparel, and leather products (twl). In fact, high-tech industries do not usually create as many jobs as labor-intensive ones, but demand a small fraction of workers who are more educated, better trained, higher skilled, and thus are better able to complement technological advancements [10]. In industrialized countries, therefore, technology and knowledge-based structural changes within and across sectors play a more pivotal role in boosting productivity growth.

Five MICs saw an expansion of the manufacturing sector that had absorbed workers mostly from a relatively low-productive agriculture even in the pre-pandemic period, notwithstanding large

FIGURE 13A

CORRELATION BETWEEN SECTORAL PRODUCTIVITY AND CHANGES IN EMPLOYMENT SHARES IN SELECTED HICS.

A: Structural changes across sectors.

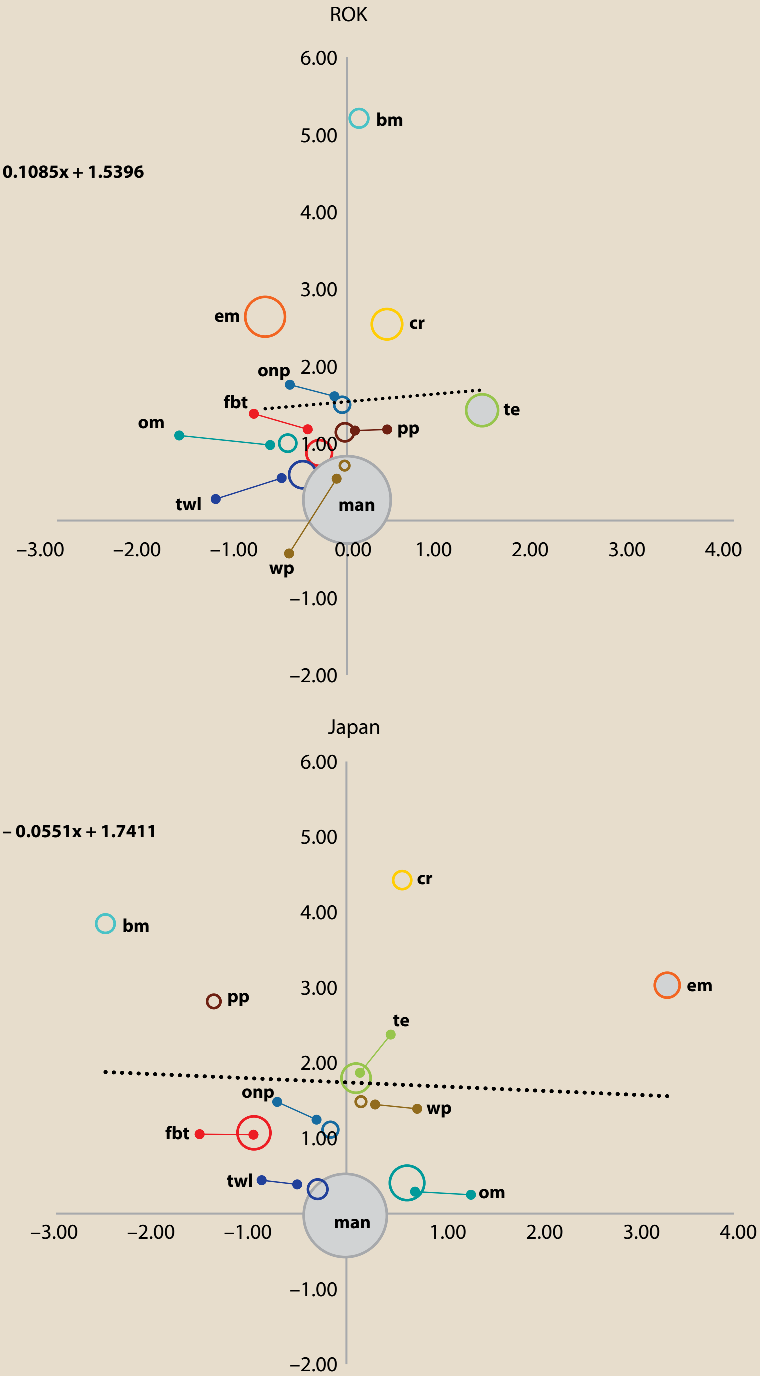


Source: Authors' calculations based on APO Productivity Database.
Note: *te = transportation equipment; em = electric machinery, medical, precision and optical instruments; cr = coke, refined petroleum products, nuclear fuel, chemicals, rubber, and plastic products; bm = basic metals; fbt = food products, beverages, and tobacco products; om = other manufacturing; pp = paper, paper products, printing, and publishing; onp = other non-metallic products; wp = wood and products of wood and cork; twl = textiles and wearing apparel, and leather products.

FIGURE 13B

CORRELATION BETWEEN SECTORAL PRODUCTIVITY AND CHANGES IN EMPLOYMENT SHARES IN SELECTED HICS.

B: Structural change within manufacturing or industrial upgrading. *



Source: Authors' calculations based on APO Productivity Database.
Note: *te = transportation equipment; em = electric machinery, medical, precision and optical instruments; cr = coke, refined petroleum products, nuclear fuel, chemicals, rubber, and plastic products; bm = basic metals; fbt = food products, beverages, and tobacco products; om = other manufacturing; pp = paper, paper products, printing, and publishing; onp = other non-metallic products; wp = wood and products of wood and cork; twl = textiles and wearing apparel, and leather products.

disparities in the magnitude of such changes across those countries. That is, they have taken a step toward convergence to the productivity frontier, indicating that productivity gains from sectoral reallocation could be sustainable if manufacturing development continues to move in the right direction. However, a caution is required regarding a large expansion of nontradable services observed recently, given that such services cannot absorb as much labor force in the development process. This may be a signal of premature deindustrialization, because if the service sector is overdeveloped for its stage of development, it may lead to loss of potential opportunities for further growth in productivity.

As for two HICs, the ROK and Japan, which had already undergone industrialization in the 1990s, the process of industrial upgrading within manufacturing had been facilitated before COVID-19. There was a notable rise in employment in high-tech sectors, while the transfer of workforce to nontradable, low-productivity services (from manufacturing) was also done. Such sectors that are more capital- and technology-intensive, have high growth potential to create a fraction of value added and jobs in labor-intensive manufacturing and manufacturing-related services. Thus, even in industrialized countries, manufacturing can make a bigger contribution to productivity growth through intraindustry shifts to a higher value-added, technology-intensive structure that demands highly educated and skilled workers.

All things considered, regardless of a country's stage of development, productivity gains in the manufacturing sector are thus far essential in driving sustained productivity growth. However, a targeted approach at each stage of development can be far more effective in promoting manufacturing productivity growth. Accordingly, we first take a closer look at what was going on for manufacturing-productivity growth in the seven selected countries before the outbreak of COVID-19 in more detail. Then, we attempt to discern the unfolding impact of COVID-19 that ushered in the arrival of an uncertain future for enhancing manufacturing productivity.

Labor Productivity in Manufacturing

Preexisting Status of Labor Productivity in Manufacturing

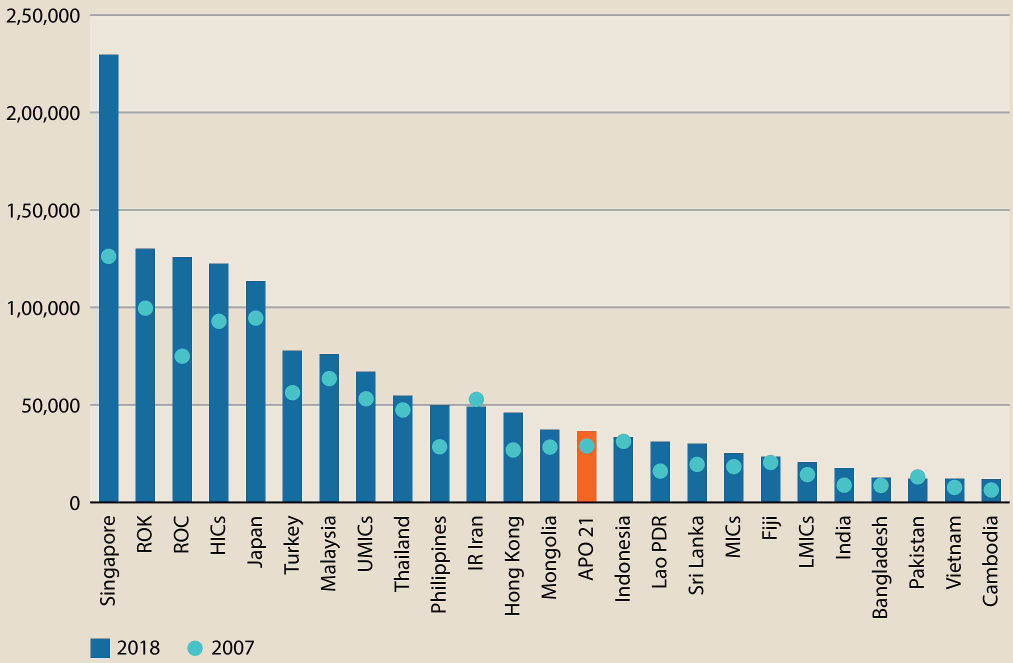
Among the selected APO countries, the manufacturing productivity level in 2018 was found to be the highest in the ROK (USD130,260) and Japan (USD113,408), while it was the lowest in Vietnam (USD12,258) and India (USD17,634), possibly reflecting their stages of industrial development (see Figure 14). Notably, the Philippines with a manufacturing productivity level below APO average and UMIC average in 2007 has seen a substantial contraction of this gap and has outpaced its LMIC peers, thus pointing to a process of convergence in productivity levels across APO member countries.

In the post-GFC period examined, APO member countries, with the exception of Thailand, experienced positive growth in manufacturing productivity. This was most pronounced for Vietnam (5.8%) and the Philippines (5.2%), both of which are fast-growing latecomers among LMICs (see Figure 15). In the post-GFC period, compared with the pre-GFC period, slowdown in manufacturing productivity growth was revealed across all APO member countries. It was particularly steep in the ROK (–5.7%) and to a lesser degree in Thailand (–4.6%), The exceptions were countries such as Vietnam and the Philippines, which boasted of robust growth in the period following the GFC.

As illustrated in Figure 16, the initial impact of GFC on manufacturing productivity tended to be long-lasting for all APO countries. The short-term growth gaps in manufacturing productivity

FIGURE 14

MANUFACTURING PRODUCTIVITY LEVELS IN APO MEMBER COUNTRIES.



Source: Authors' calculations based on APO Productivity Database.
Note: GDP by industry is at constant prices per worker, using 2017 PPPs.

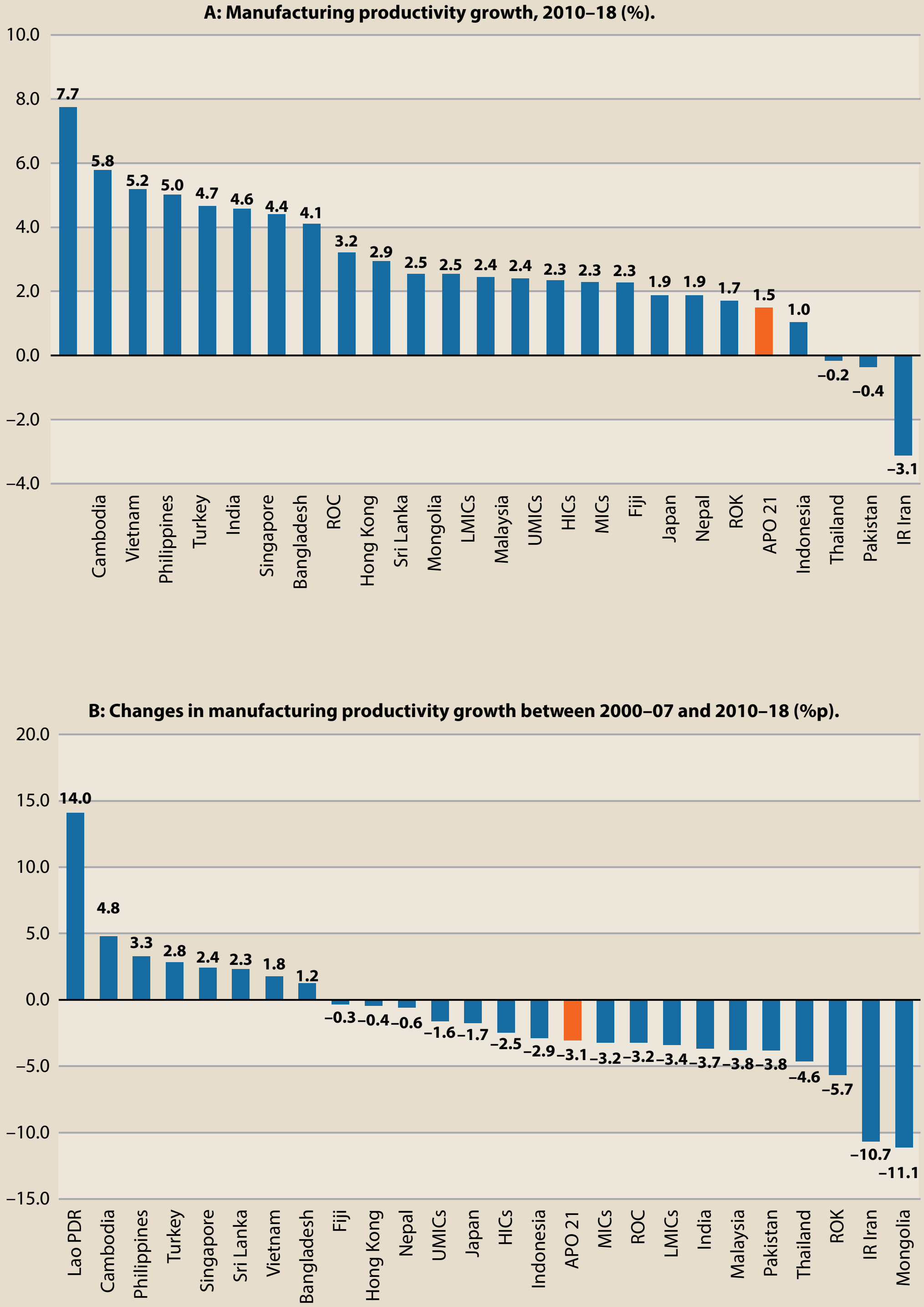
before and after the GFC were highly and positively associated with the long-term ones, indicating that the larger the impact of the GFC, the longer the negative shocks. The ROK and Thailand are prime examples (quadrant 3). Those countries that were hit the hardest by the initial crisis-induced shocks have not fared well in the long term, with slowing productivity growth in manufacturing. The opposite has been true for Vietnam and the Philippines (quadrant 1).

To better understand the dynamics of productivity growth in manufacturing in the pre- and post-GFC periods, we further investigate how they vary according to an observed rate of change in the volume of output (e.g., value added) relative to the rate of change in the volume of labor input (e.g., the number of employees). When measured on this basis, we can depict a typology of growth patterns in productivity, which can generally be divided into six groups (see Table 1).

In Group 1 that shows positive growth in productivity, there are three different subgroups. Group 1-1 is the most desirable case when growth in both output and labor input is positive, but the output growth outpaces input growth. Group 1-2 presents an increase in productivity due to a decrease in labor input, while Group 1-3 depicts a case of decline in both output and input, notably when the input declines relatively faster. Despite positive productivity growth for countries in Group 1-2 and Group 1-3, the mid- and long-term growth prospects may remain brittle without further improvement and expansion of existing manufacturing sectors. Group 2 also includes three different groups that exhibit negative productivity growth or a contraction of manufacturing activities. Group 2-1 exhibits the case when a drop in output is faster than that in labor input. In contrast, Group 2-2 is the case when labor input grows at a faster pace with output being diminished. Group 2-3 is an indication of decreasing productivity because of a relatively higher rise in labor input compared

FIGURE 15

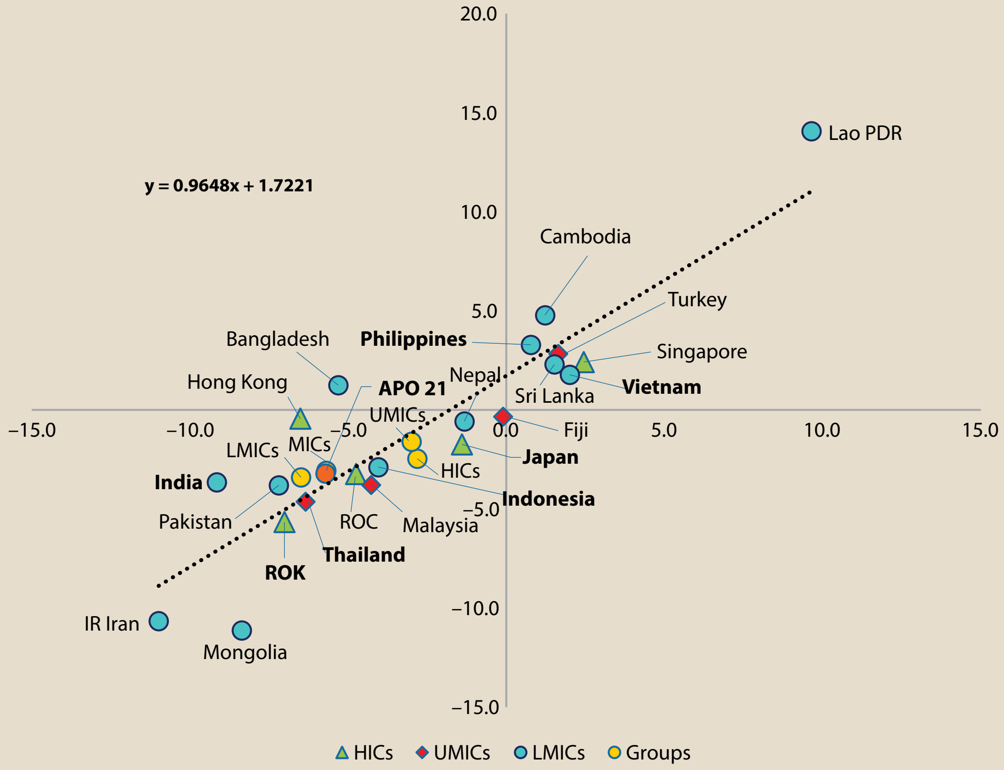
MANUFACTURING PRODUCTIVITY GROWTH IN APO MEMBER COUNTRIES.



Source: Authors' calculations based on APO Productivity Database.
Note: GDP by industry is at constant prices per worker, using 2017 PPPs.

FIGURE 16

THE LONG-LASTING IMPACT OF THE GFC ON MANUFACTURING PRODUCTIVITY GROWTH (%P).



Source: Authors' calculations based on APO Productivity Database.
Note: x-axis: difference in growth rates between 2005–07 and 2010–12, y-axis: difference in growth rates between 2000–07 and 2010–18.

with output. Particularly, unless countries in the last two groups fall short of extensive and/or intensive growth of value added in manufacturing in the short run, a reduction of labor input would be inevitable through industrial restructuring of employment.

We employ this typology to explain the experiences of the seven example countries. Vietnam, the Philippines, and India show the most ideal way of productivity growth, maintaining higher output created in the given period of 2000–18 (see G1-1, Table 1). Yet, Thailand, which used to be in the same group (G1-1) with the other three economies, did not experience that kind of growth, and moved to G2-2 because of a sharp drop in outputs. Notably, the ROK and Indonesia moved from G1-2 to G1-1, with greatly improved outputs after the GFC (2000–07), but no changes took place for Japan (G1-2). In this way, a positive relationship between the two factors became more significant for the seven APO countries in the post-GFC period, implying that growth in output accompanied by that in labor input or vice versa, i.e., the co-movement of the two variables, resulted in raising manufacturing productivity.

However, productivity growth that either accelerated or slowed in the post-GFC period, compared with the pre-GFC period, stemmed from the varying degrees and directions of the observed growth patterns of the two factors, thereby showing less synchronized relationship between them. This can simply be categorized into two groups. First, the accelerated group of productivity (G1) includes

TABLE 1

A TYPOLOGY OF PATTERNS OF PRODUCTIVITY GROWTH FOR PRE- AND POST-GFC PERIODS.

Group			2000–07		2010–18		Difference (% p)	
			APO 21	APO 7	APO 21	APO 7	APO 21	APO 7
Correlation between VA and EMP			**0.68**	**0.73**	**0.51**	**0.77**	**0.23**	**–0.05**
G1 (+)	1 Jan	VA↑> EMP↑	Bangladesh, Cambodia, India, IR Iran, Pakistan, the Philippines, Republic of China, Singapore, Sri Lanka, Thailand, Turkey, Vietnam, APO21, UMICs, LMICs		Bangladesh, Cambodia, Fiji, Indonesia, India, Malaysia, Mongolia, Nepal, the Philippines, the ROC, the ROK, Sri Lanka, Turkey, Vietnam, APO21, HICs, UMICs, LMICs		Bangladesh	
	1 Feb	VA↑, EMP↓	Fiji, Indonesia, Japan, Malaysia, Mongolia, Nepal, the ROK, HICs		Japan, Lao PDR, Singapore		The Philippines, Turkey	
	1 Mar	VA↓< EMP↓	Hong Kong		Hong Kong		Cambodia, Lao PDR, Singapore, Sri Lanka, Vietnam	
G2 (–)	2 Jan	VA↓> EMP↓	–		–		Pakistan, the ROC, Thailand	
	2 Feb	VA↓, EMP↑	–		IR Iran, Pakistan, Thailand		Indonesia, India, IR Iran, Japan, Mongolia, the ROK, APO21, HICs, UMICs, LMICs	
	2 Mar	VA↑< EMP↑	Lao PDR		–		Fiji, Hong Kong, Malaysia, Nepal	

Note: VA = value added (output); EMP = number of employees (labor input).

the Philippines and Vietnam whose further acceleration of productivity over the post-crisis period (2010–18) can largely be attributed to a relatively sharp drop in workforce, recorded at –0.4%p and –2.8%p, respectively, compared with the value added in production. Second, the other five countries fall in the slowdown group (G2) that demonstrates a more dramatic reduction in output generated, ranging from –0.1%p to –4.8%p, over the same time period. The details are presented in Figure 17 and Table 2.

TABLE 2

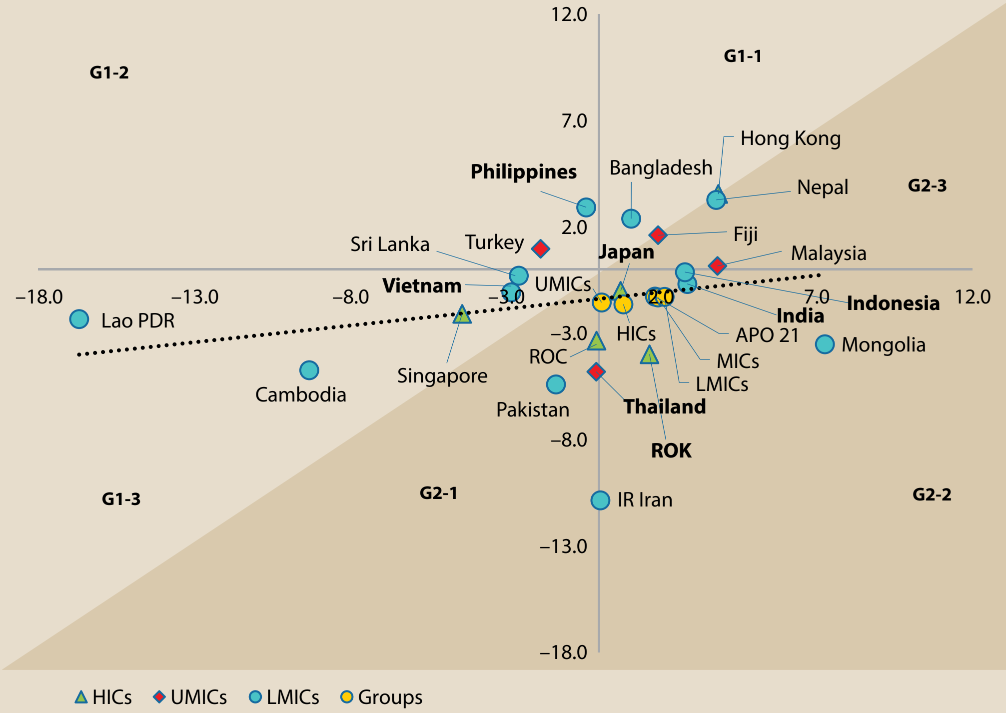
DIFFERENCES IN GROWTH RATES FOR LABOR INPUTS AND OUTPUTS FOR SEVEN APO MEMBER COUNTRIES.

	G1(+)		G2(–)				
	G1-2	G1-3	G2-1	G2-2			
	Philippines	Vietnam	Thailand	ROK	India	Indonesia	Japan
Productivity	3.29	1.77	–4.63	–5.66	–3.65	–2.89	–1.74
Output	2.92	–1.07	–4.81	–3.99	–0.68	–0.12	–1.01
Labor input	–0.41	–2.82	–0.09	1.62	2.83	2.76	0.70

Although the underlying factors of productivity growth in these two broad categories may depend to a large degree on country-specific conditions in manufacturing sectors, there would be common attributes across and within the two groups in explaining the distinct features of productivity

FIGURE 17

DIFFERENCES IN GROWTH RATES OF LABOR INPUTS AND OUTPUTS.



Notes: 1. The shaded area indicates slowdown of productivity growth after the GFC.
2. x-axis plots differences in growth rate of labor inputs between 2000–07 and 2010–18; y-axis plots differences in growth rate of outputs between 2000–07 and 2010–18.

growth. Hence, we try to shed light on the driving forces behind the complex dynamics of productivity growth in the following section.

Factors Behind Labor Productivity Changes after the GFC

Two major drivers can explain the post-GFC growth patterns of manufacturing productivity in the seven example countries, while acknowledging the fact that it is difficult to untangle the individual influences associated with the unobserved factors of each country's productivity.

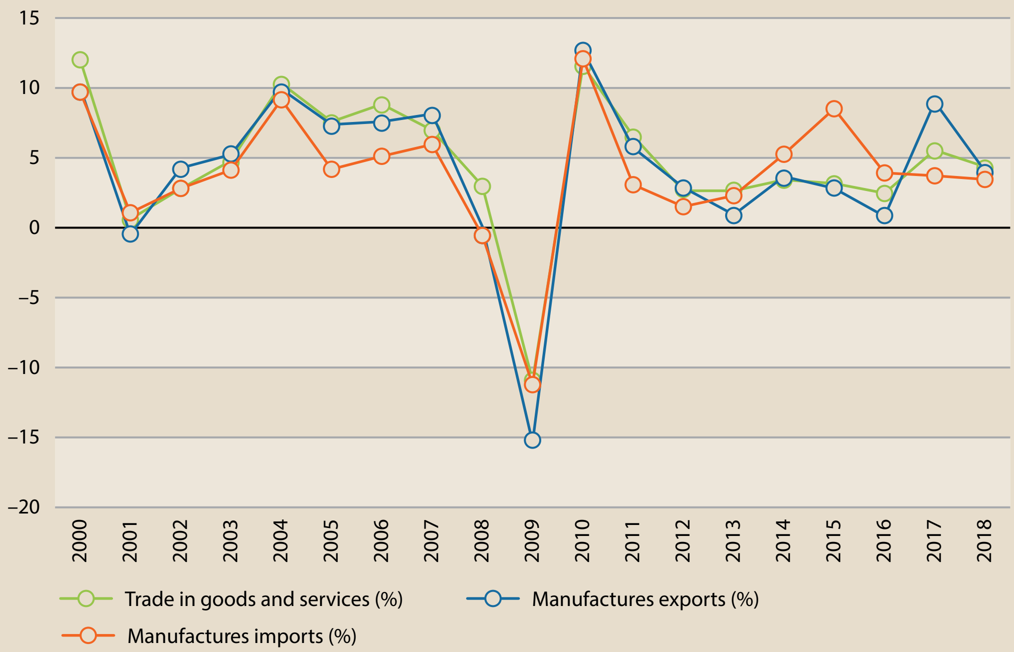
Trade and Investment

First of all, the changing landscape of global trade and investment after the GFC played a large role in driving the observed trends of manufacturing productivity. As seen in Figure 18, global exports and imports in manufacturing goods during 2000–07 grew in real terms at annual rates of 4.5% and 5.9%, respectively. Except for a rebound in 2010 since the crisis, growth in export and import volumes during 2011–18 had slowed down to 3.6% and 3.0% annually, respectively, broadly in line with the slowing trends in trade of goods and services.

In this same vein, Japan and the ROK (G2), which are major players among world's leading exporting nations, underwent a broadbased slowdown of manufacturing exports because of weak global demand for manufacturing goods, which was largely associated with a declining pattern of productivity in the pre-pandemic period, with correlation coefficient of 0.78 (Japan) and 0.61 (ROK), respectively (Figure 19).

FIGURE 18

TRENDS IN GLOBAL TRADE (%).



Source: Authors' calculations, based on APO Productivity Database and WITS Database.

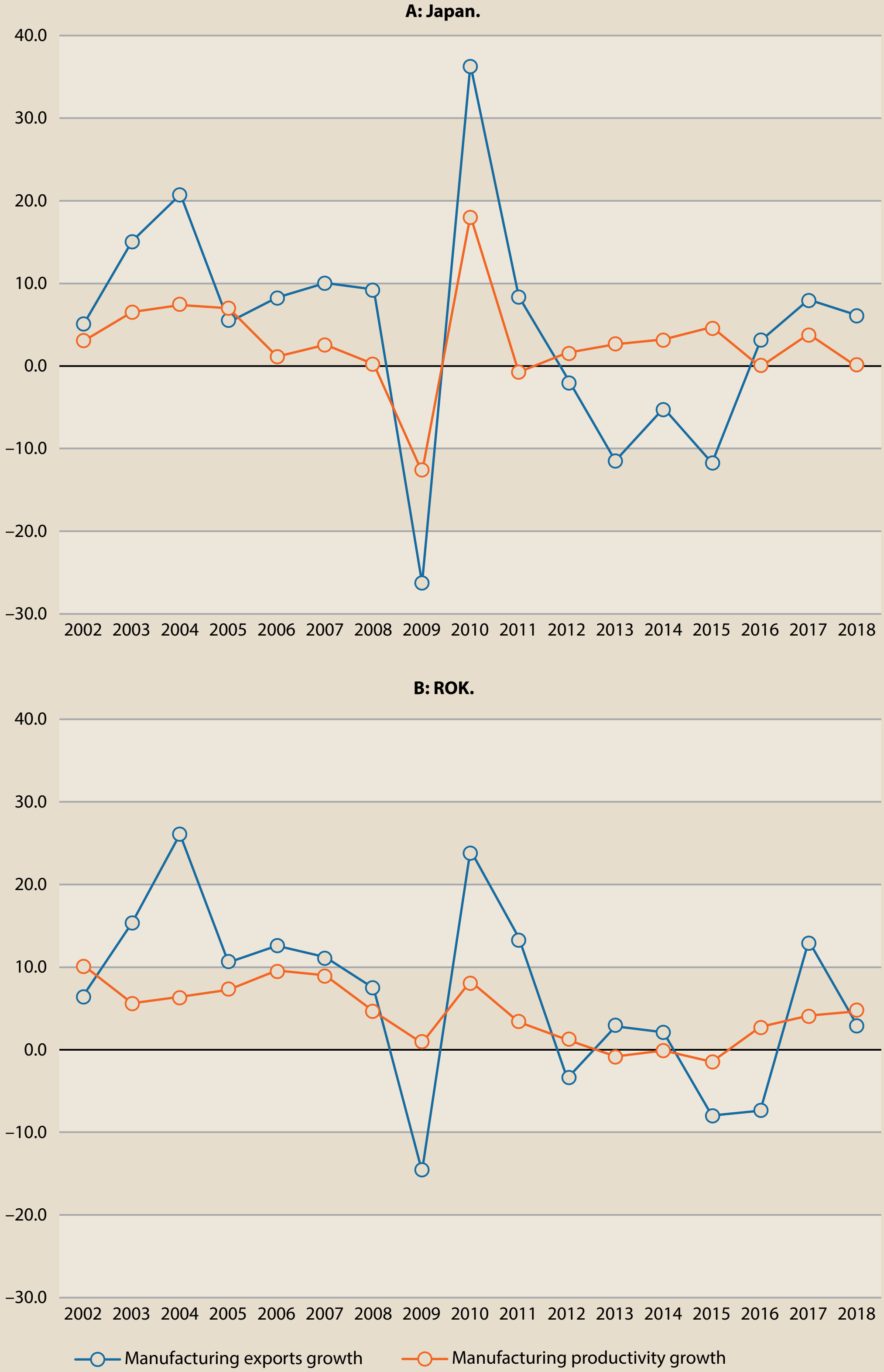
Such sluggish exports sparked by deficient global demand negatively affect productivity through two channels. First, exporting firms that tend to have higher productivity in general would inevitably lower factor utilization (e.g., labor and capital), followed by a drop in productivity, as they are exposed to exports slowdown [11]. Second, either simultaneously or consecutively, allocative efficiency, i.e., resource allocation toward more productive exporting firms and/or industries could fade, which in turn hampers productivity growth [12].

The MICs, on the other hand, became global hubs for manufacturing production in the post-GFC period (2012–19), driven by significant foreign direct investment (FDI) inflows (see Figure 20). Notably, the increased FDI has been a key driver of further growth in manufacturing, particularly for the Philippines and Vietnam (G1), accounting for 23% and 9.2% of gross fixed capital formation in 2019, respectively. These are higher than Thailand (2.5%), India (6.3%), and Indonesia (6.6%) (G2).

The arrival of manufacturing FDI firms that execute simple assembly or processing of light industry products for exports has translated into a rise in imports of intermediate goods, i.e., key industrial materials, parts, and components that are essentially utilized in production processes. In this manner, manufacturing exports, combined with intermediate goods imports in the Philippines and Vietnam (G1), display strong upward trends, leading to notable productivity gains in manufacturing (see Figure 21). By comparison, Thailand, Indonesia, and India (G2) show volatility in the post-crisis period (see Figure 22). Nevertheless, for developing countries, integrating into the global economy through trade and FDI is a key channel to increase the exposure of firms (e.g., local suppliers) to foreign knowledge and advanced technologies. Ultimately, their adoption could support productivity growth, as has been the case with the Philippines and Vietnam.

FIGURE 19

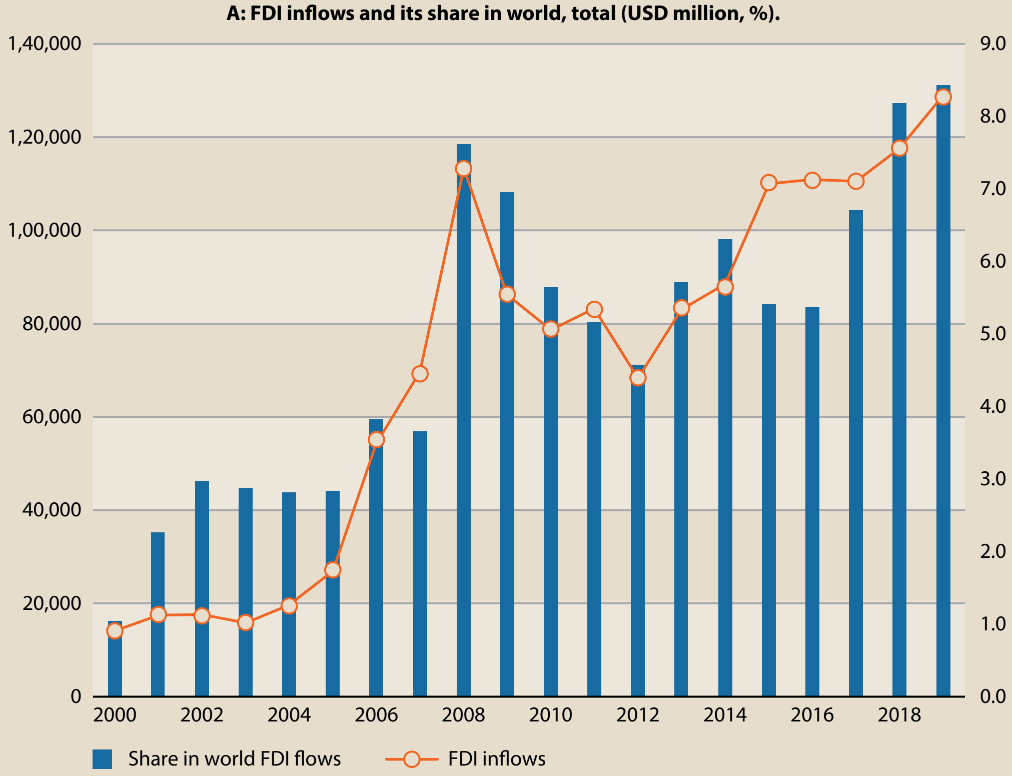
TRENDS OF MANUFACTURING EXPORTS AND PRODUCTIVITY GROWTH (%).

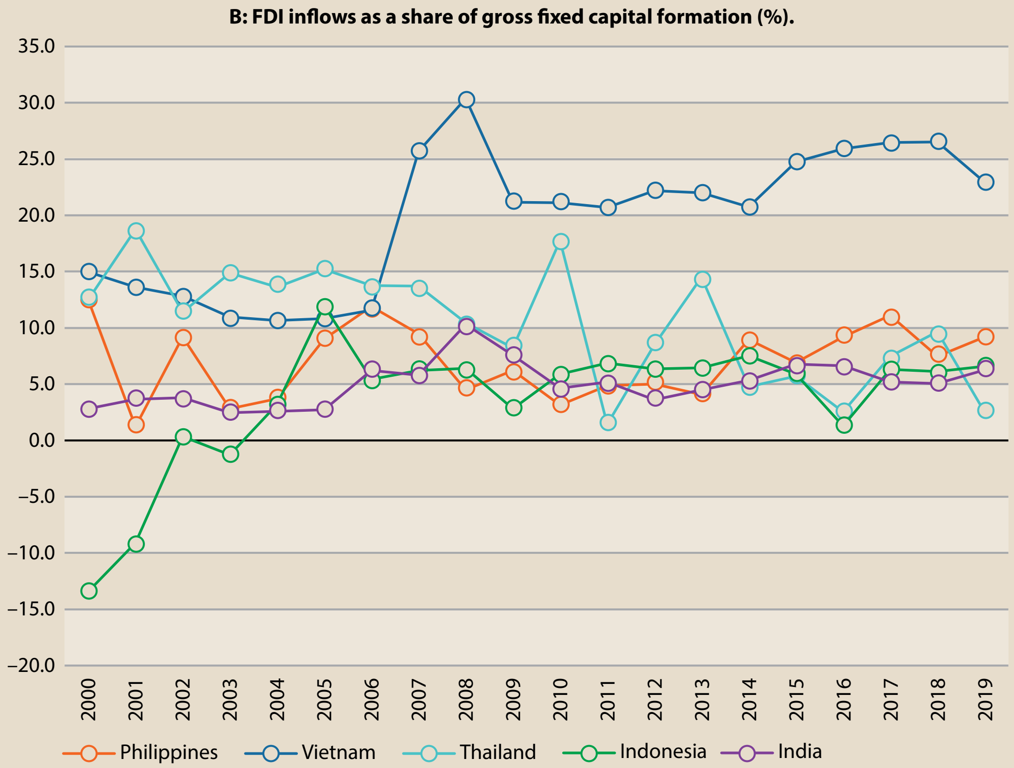


Source: Authors' calculations based on APO Productivity Database and WITS Database.

FIGURE 20

FDI INFLOW IN SELECTED APO MEMBER COUNTRIES.

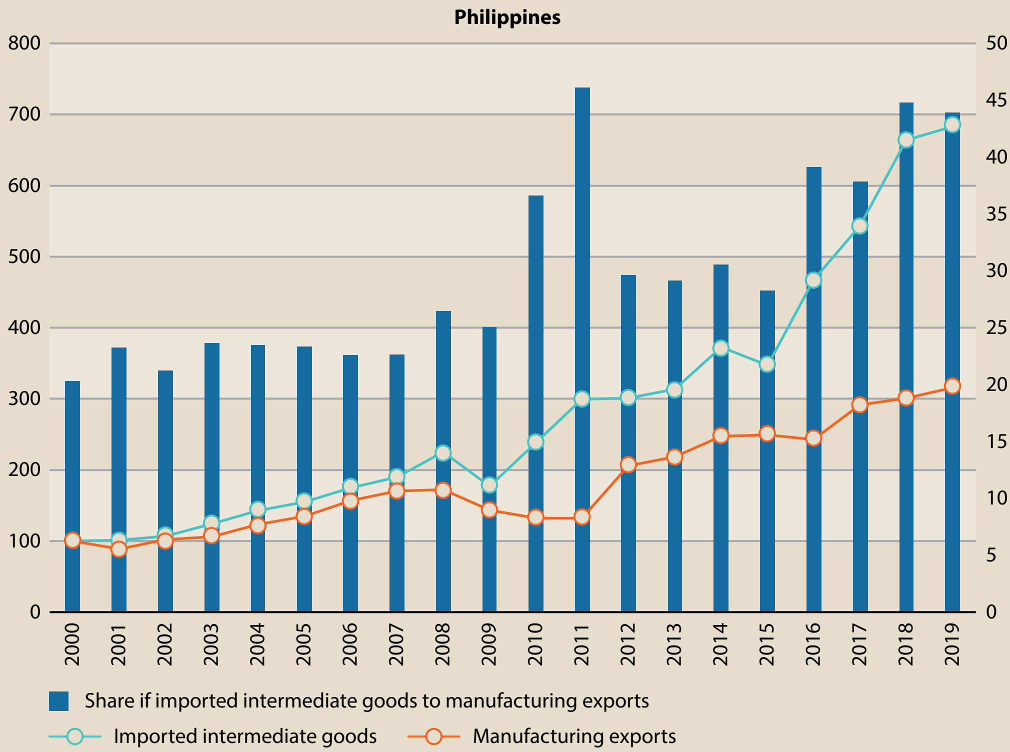


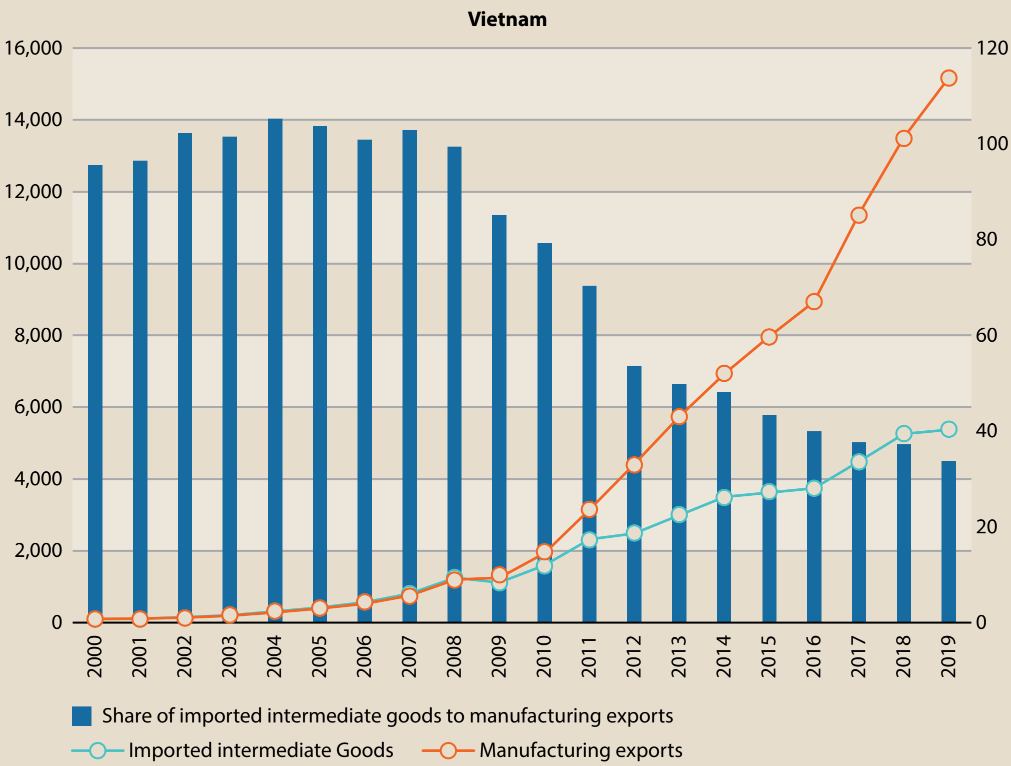


Source: Authors' calculation based on UNCTAD Database.

FIGURE 21

TRENDS OF MANUFACTURING EXPORTS AND IMPORTED INTERMEDIATE GOODS FOR G1 COUNTRIES.
(UNIT: 2000=100, %)



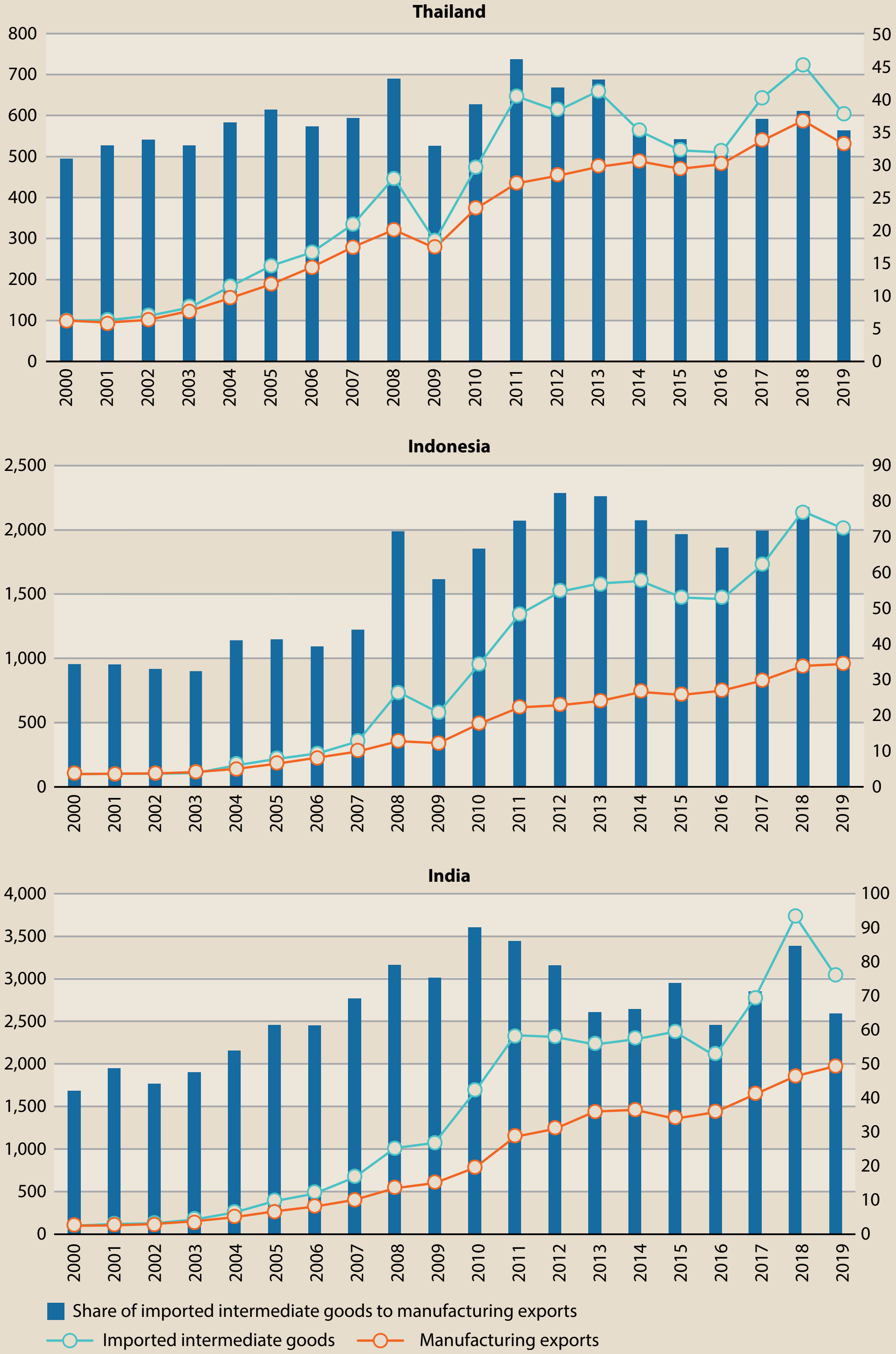


Source: Authors' calculation based on UNCTAD Database.

FIGURE 22

TRENDS OF MANUFACTURING EXPORTS AND IMPORTED INTERMEDIATE GOODS FOR G2 COUNTRIES.

(UNIT: 2000=100, %)

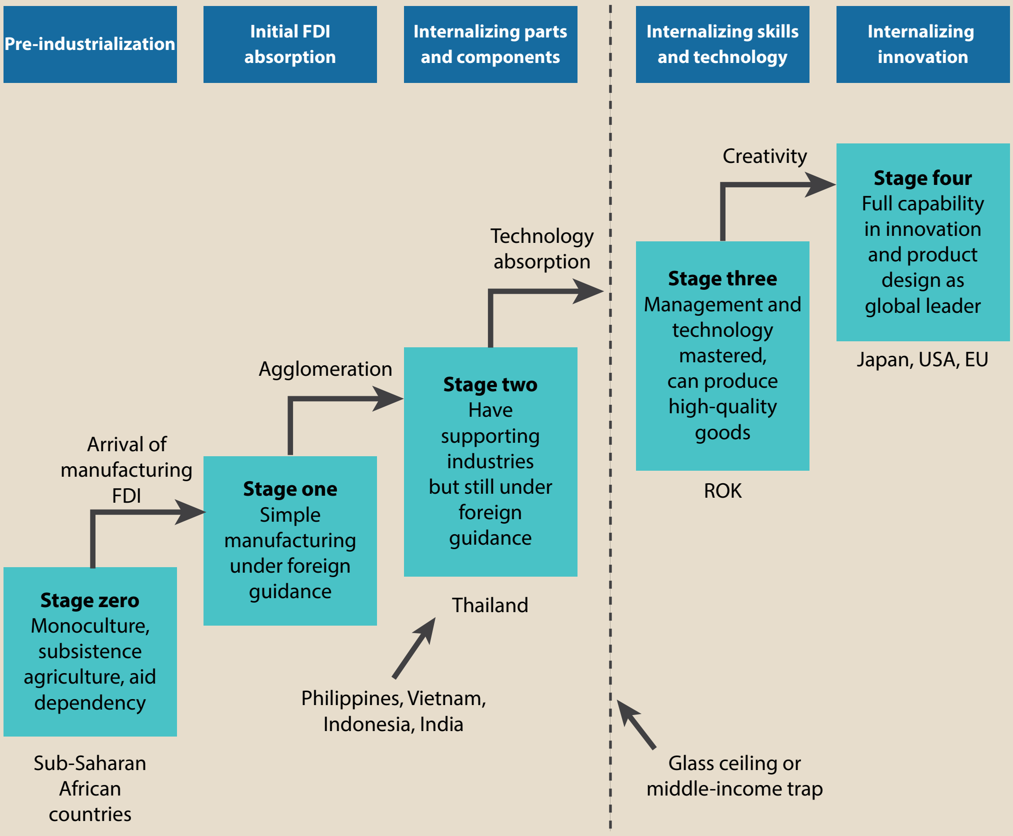


Source: Authors' calculation based on UNCTAD Database.

This evidence can also be confirmed from the fact that the ratio of intermediate goods imports to manufactured goods, which represents a rough proxy for GVC trade, increased from 31% to 72% between 2000 and 2019 for the MICs, indicating a deeper integration into global trade. On the contrary, Vietnam showed a fall in the ratio from 96% to 34% for the same time period due to the reason that its export volume of manufactured goods outstripped its import volume of intermediates goods after the year 2010. Yet, it can be inferred that as production expanded with the inflow of FDI suppliers, and the domestic supply of parts and components that contain higher value addition than assembling products began to rise, Vietnam gradually expanded export of intermediate goods to other countries to support their final goods exports to the global market by greatly benefiting from technology spillovers through participation in GVCs (see Box).

BOX

STAGES OF CATCH-UP INDUSTRIALIZATION.



Source: Authors' compilation based on Ohno [13].

Technological Change

Another compelling factor underlying the post-crisis growth in manufacturing can be revealed through differences in technological levels and speeds of technological changes across countries. To investigate the development details of countries' manufacturing sectors with different technology levels, we look at the manufacturing subsector level using value-added data available from UNIDO database for the post-GFC period, as it could not be identified from APO database. It can provide insights for understanding the factors behind the pre-pandemic growth trends, notwithstanding that the patterns of value added from two different sources may be heterogeneous.

As described in Table 3, declining growth patterns of medium-tech and high-tech industries that account for more than half of total value added were particularly pronounced in Japan and the ROK (G2) at more advanced stages of industrialization, meaning that the slowdown in productivity growth could be spurred by severe contractions in their core industries within manufacturing. This is in stark contrast with the Philippines and Vietnam (G1), which boasted notable value-added growths in medium-high and high-tech industries even in the post-crisis periods.

TABLE 3

MANUFACTURING VALUE ADDED BY TECHNOLOGICAL INTENSITY.

		G2(−)						G1(+)
		HICs		MICs				
		Japan	ROK	Thailand	Indonesia	India	Philippines	Vietnam
Low technology	Growth rates (%)	0.24	0.43	4.54	24.44	−0.13	2.12	1.47
	Proportion in total value added (%)	27.80	22.82	41.05	60.39	38.70	43.69	43.89
Medium technology	Growth rates (%)	−7.16	−1.22	0.92	14.27	−1.50	1.45	4.58
	Proportion in total value added (%)	19.69	14.49	19.43	13.38	20.05	9.76	15.85
Medium–high and high technology	Growth rates (%)	−5.22	−1.09	2.29	14.39	1.01	5.19	16.28
	Proportion in total value added (%)	52.51	62.69	39.51	26.24	41.25	46.55	40.26
Total	Growth rates (%)	−4.31	−0.78	2.89	18.48	0.00	3.39	6.30
	Proportion in total value added (%)	100	100	100	100	100	100	100

Source: Authors' calculation based on UNIDO Database.
Note: Manufacturing industries are at the two-digit level of International Standard Industrial Classification (ISIC) Revision 4. Due to varying data availability, annual growth rates are calculated based on different time periods for G1 (2011–17) and G2 (2011–16) for comparison; and value in the last year is utilized for their proportion in total value added.

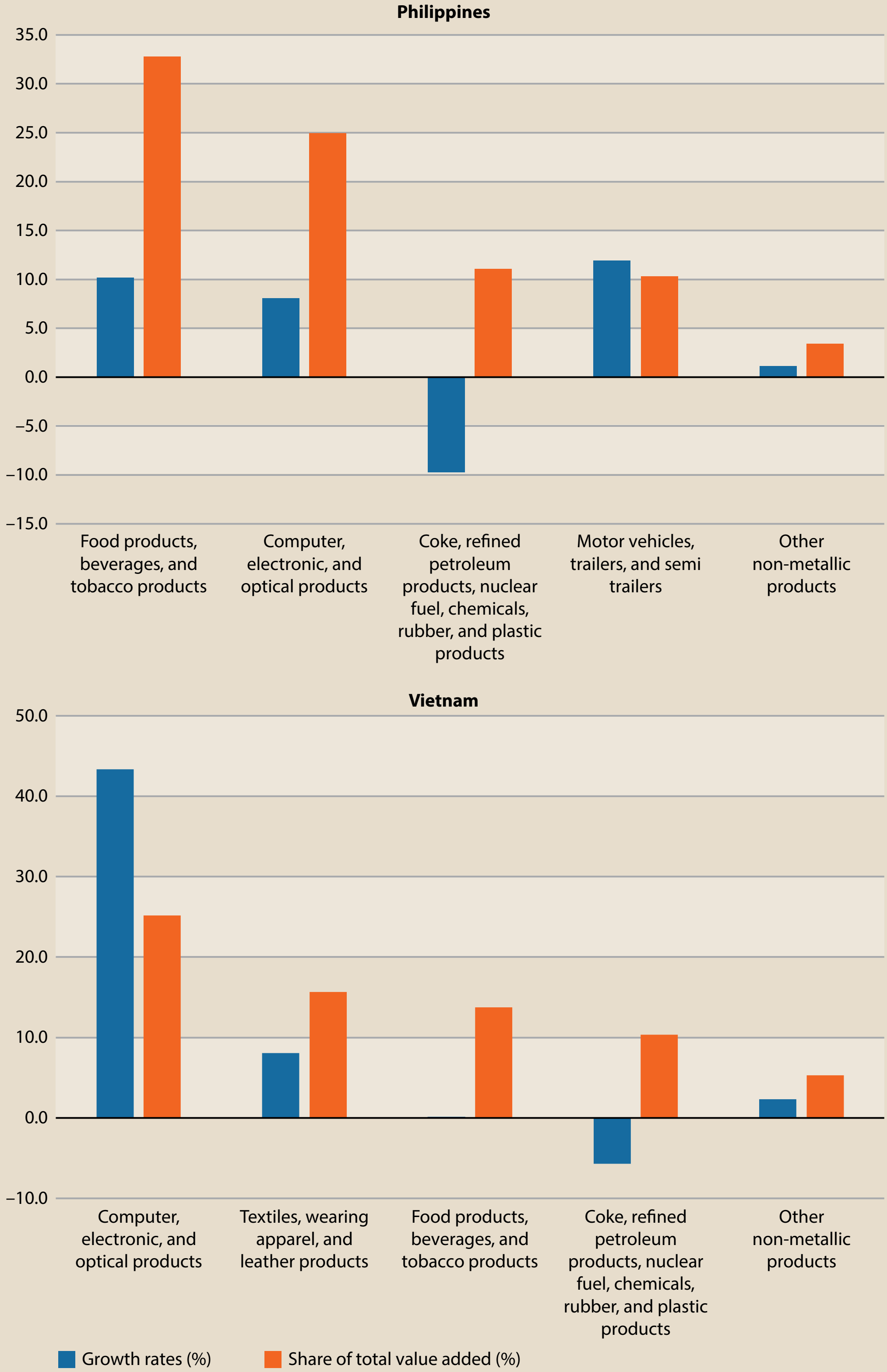
What can be inferred is that as discussed above, their manufacturing growth has been able to benefit from technology transfer and investment financing through high FDI inflows, accompanied by positive spillovers results in productivity gains for both the countries. The other three MICs, Thailand, Indonesia, and India (G2), on the other hand, either increased or decreased low- and medium-tech activities with lower productivity, possibly reflecting weak productivity growth during the post-GFC period.

To further dig into why manufacturing growth is particularly distinguished in the Philippines and Vietnam (G1), a deeper examination of which industries are experiencing fast rates of value-added growth was carried out to better bring out the subsectoral characteristics (see Figure 23). Interestingly, a common feature shared by the two countries is a marked growth of information and communication technology (ICT) manufacturing industries pertaining to computer, electronic, and optical products, which are covered under International Standard Industrial Classification (ISIC) Revision 4, code 26.

Alongside this recent development in ICT production, the Philippines and Vietnam have also achieved a leapfrog growth in terms of ICT goods exports, showing 6.2% and 16% rates of growth, respectively, at a record higher than other five APO member countries being discussed. Toward this

FIGURE 23

MANUFACTURING INDUSTRIES AT THE TWO-DIGIT LEVEL IN G1.

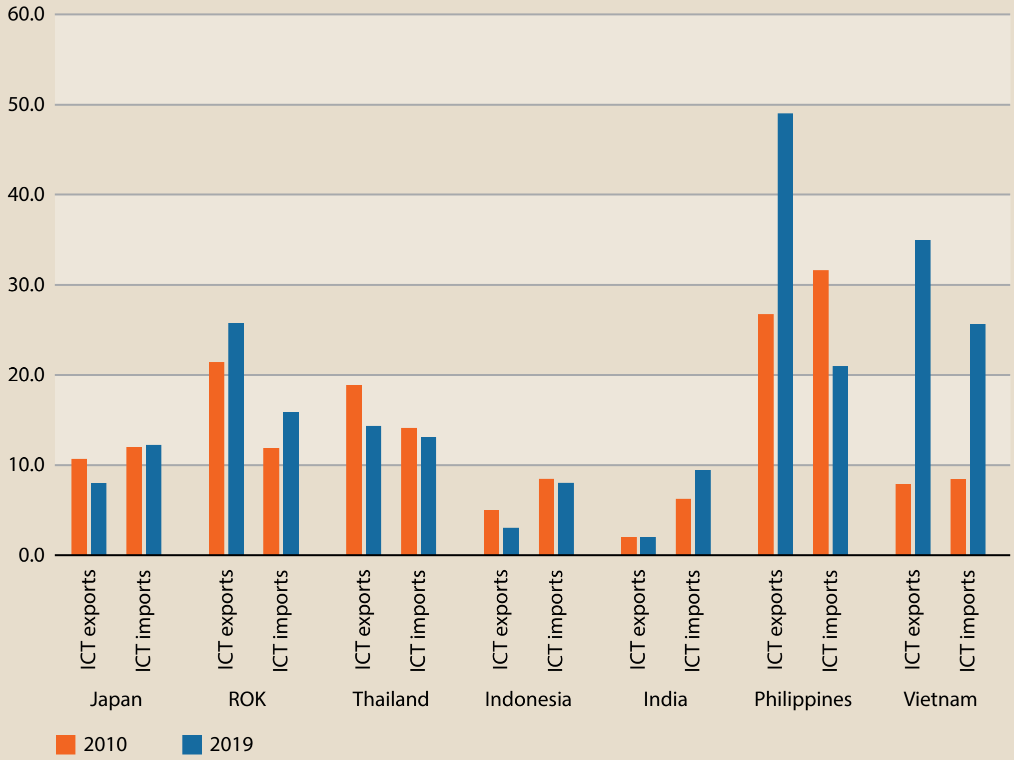


Source: Authors' calculation based on UNIDO Database.

end, producing a large range of high-value-added ICT goods has enabled these countries to bolster further productivity growth even during the post-GFC period (see Figure 24).

FIGURE 24

ICT GOODS EXPORT AS % OF TOTAL MERCHANDISE TRADE.



Source: Authors' calculations based on UNCTAD Database.

Then, how would the preexisting trends change with the onset of the COVID-19 crisis? In the following section, we seek to answer this question, starting with a brief synopsis of how COVID-19 has spread across selected APO member countries and through which channels have adverse events affected manufacturing productivity.

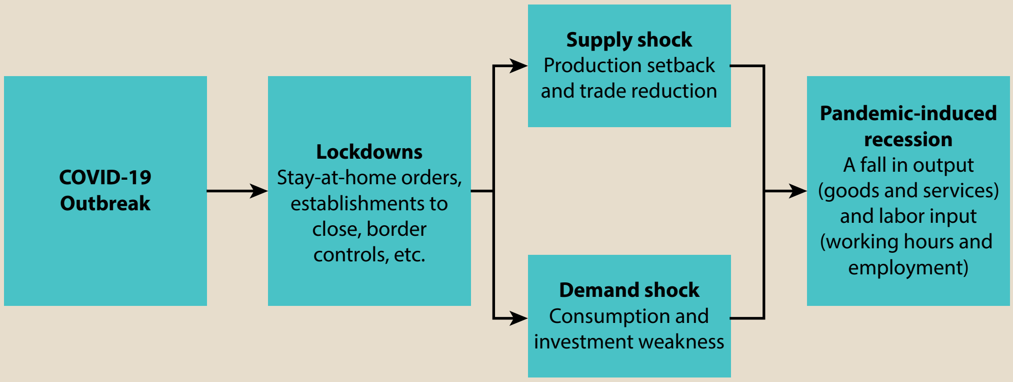
Potential Impact of COVID-19 on Labor Productivity in Manufacturing

Evolution of the Pandemic-induced Crisis

Ever since it was first reported in December 2019, a novel coronavirus disease, COVID-19, has spread across the globe. In the seven APO countries under discussion, the virus started diffusing widely from early 2020, and immediately forced the governments to shut down almost all spheres of human activity, through implementation of stringent border controls, lockdowns, and quarantines to restrain the spread of the virus. As such, people's daily mobility, along with economic activities, was hampered, ultimately followed by negative economic shocks. A supply shock was first manifested as workers were quarantined and refrained from daily commuting and thus firms were forced to suspend operations for production of goods and services. The shock soon extended to the demand side in that the consequential reduction in income and growing uncertainty weakened consumption and investment (see Figure 25).

FIGURE 25

CHANNELS THROUGH WHICH COVID-19 AFFECTED ECONOMIC ACTIVITIES (LABOR PRODUCTIVITY).



Figures 26 and 27 shows how mobility could be affected by COVID-19. In the period following the outbreak of the virus in the seven countries, the Oxford Government Response Stringency Index (for government response to the pandemic) soared from around 13 index points on average in February to a high of 74 in April, then fell to 56 index points in November, and again rose to 61 index points by the end of December, as seen in Figure 26-B. As expected, the fluctuating patterns of implementation of government measures in response to COVID-19 are largely consistent with the time spent in places of residence, particularly during March–April 2020, clocking a sharp increase from 3.2% to 16.8% in the given period (see Figure 26-C).

Figure 27 depicts such association with the size of circle for level of manufacturing productivity by illustrating a relatively moderate but positive relation between the confirmed cases of the virus and the stringency level from the first quarter of 2020 to that of 2021. This is largely because despite the risk of further waves of contagion, a gradual relaxation in restrictions was executed over the course of the year 2020. There was an early optimism for reopening economies until the end of 2020 when new variants were discovered across the world. Yet, more strong relation confirms that the stringency of government interventions for COVID-19 limited the mobility in those countries, as depicted in Figure 27-B. In particular, LMICs like the Philippines, India, Vietnam, and Indonesia, with relatively lower levels of manufacturing productivity and incomes are typical cases of the devastating impact of the restriction measures on mobility.

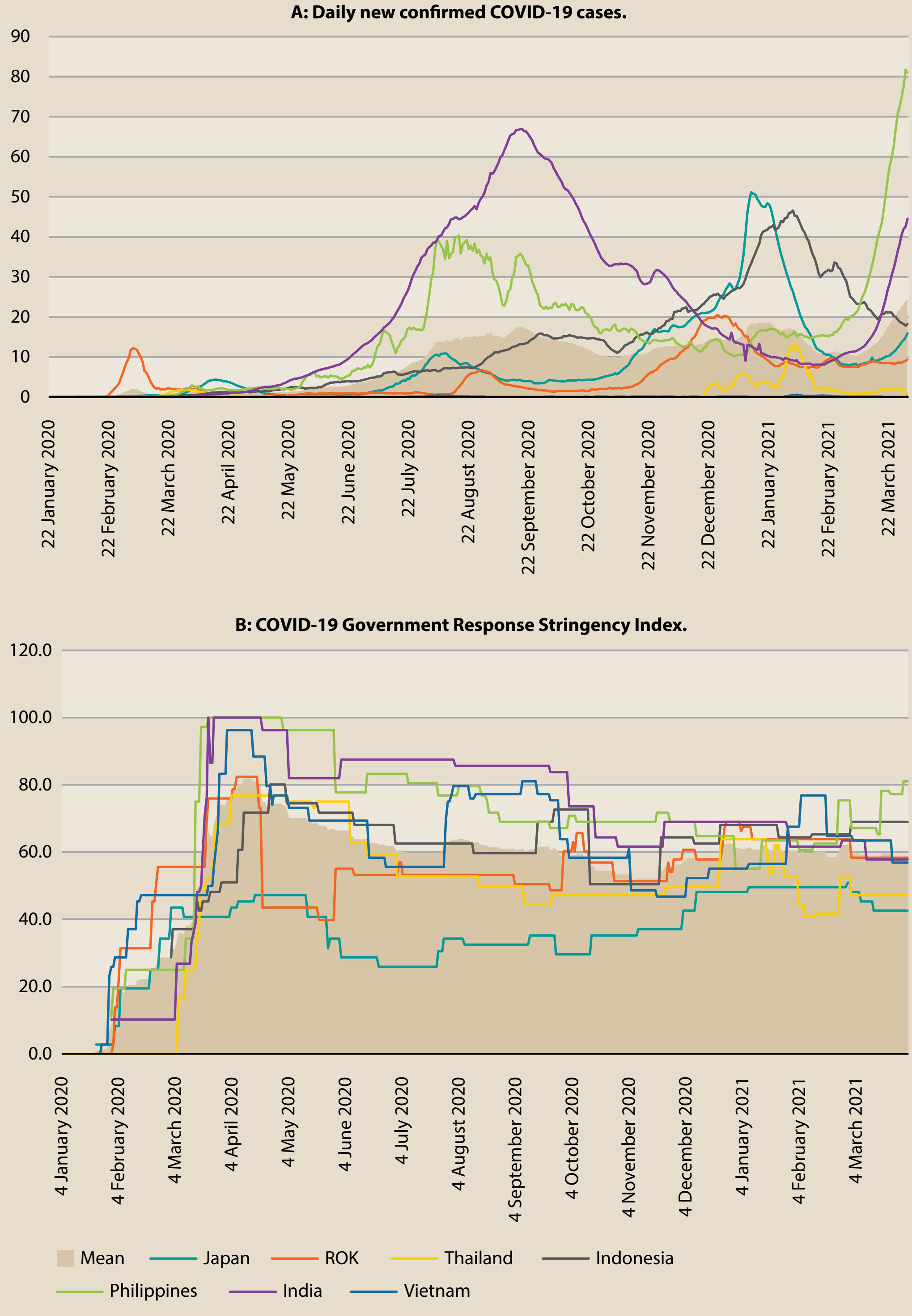
The Evolving Impact on Manufacturing Activities

Unsurprisingly, the impact of the COVID-19 crisis on manufacturing activities across APO member countries has been profound (see Figure 28).

According to the Purchasing Managers' Index (PMI), a measure of whether the market conditions in the manufacturing sector are expanding or contracting, manufacturing activities of selected APO countries plunged significantly in the second quarter of 2020, consistent with the patterns of mobility restrictions driven by containment measures. This is supported by the fact that a decline in manufacturing activities was most pronounced in all MICs, with a notable halt in mobility in the given period. The contraction was relatively moderate in two HICs, namely, Japan and the ROK. Fortunately, however, since the third quarter of 2020, a broadbased recovery in manufacturing has materialized, with most countries remaining above the 50-point threshold that separates expansion

FIGURE 26A

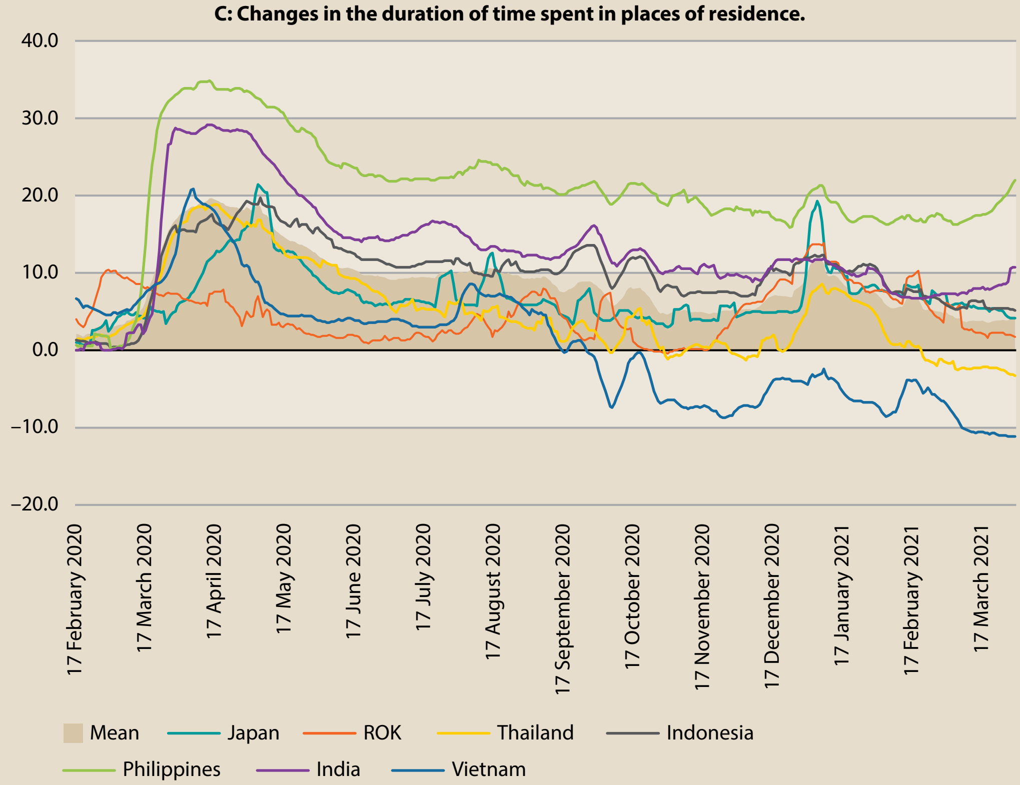
COVID-19 CONFIRMED CASES AND STRINGENCY OF CONTAINMENT MEASURES.



Source: Authors' calculations based on ourworldindata.org data.
Note: The Oxford COVID-19 Government Response Stringency Index is a composite indicator, with a range of 0 to 100 (most restrictive), that captures policy decisions on (1) school closures; (2) workplace closures; (3) cancellation of public events; (4) restrictions on gathering size; (5) public transport closures; (6) home confinement orders; (7) restrictions on internal movement; (8) international travel controls; and (9) public information on COVID-19.

FIGURE 26B

COVID-19 CONFIRMED CASES AND STRINGENCY OF CONTAINMENT MEASURES.



Source: Authors' calculations based on ourworldindata.org data.
Note: The Oxford COVID-19 Government Response Stringency Index is a composite indicator, with a range of 0 to 100 (most restrictive), that captures policy decisions on (1) school closures; (2) workplace closures; (3) cancellation of public events; (4) restrictions on gathering size; (5) public transport closures; (6) home confinement orders; (7) restrictions on internal movement; (8) international travel controls; and (9) public information on COVID-19.

from contraction, and the upturn continuing in the first quarter of 2021. Even with the recovery phase now underway, along with the vaccination rollout and the gradual lifting of restrictions, returning to pre-pandemic levels in the full range of manufacturing activities remains uncertain largely due to potential risks of rapid contagion.

Initial Impact of COVID-19 on Labor Productivity in Manufacturing

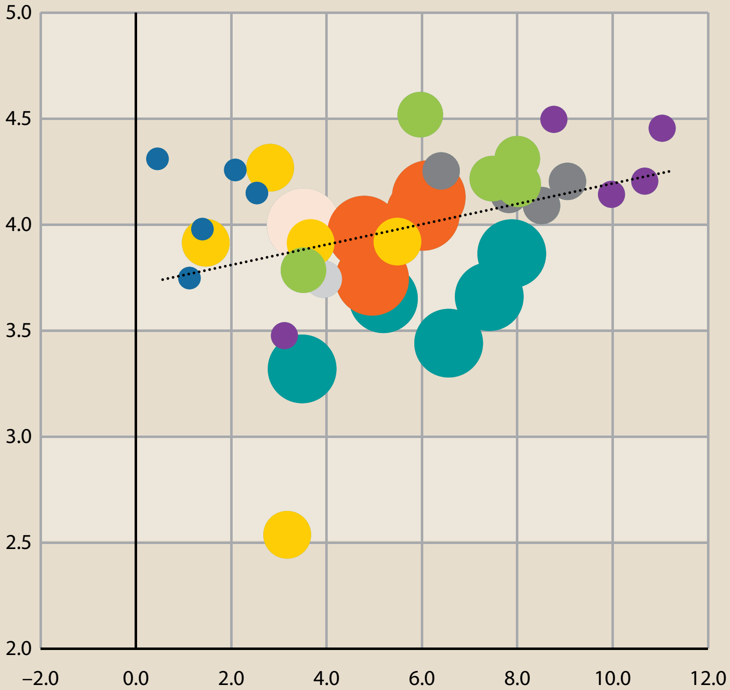
Building upon the discussion above, we attempt to explore the initial impact of the COVID-19 crisis on manufacturing productivity. Yet, with the consideration of data limitations, we focus on capturing fluctuations in deterministic components of productivity, i.e., output and labor input, at the very initial stage of the pandemic's spread and the associated quarantine measures.

Japan and the ROK (HICs): To assess the initial adverse impact on productivity for HICs, we utilized datasets from national productivity organizations (NPOs) in Japan and the ROK, which are the only sources publicly available among selected APO member countries. As expected, manufacturing productivity in Japan fell 14.2% in the second quarter of 2020 from the previous year due to a sharp drop in output (down 20.4%, year-on-year) and to a lesser degree in labor input (down 7.1%, year-on-year), as given in Figure 29-A. Compared with the first quarter of 2020

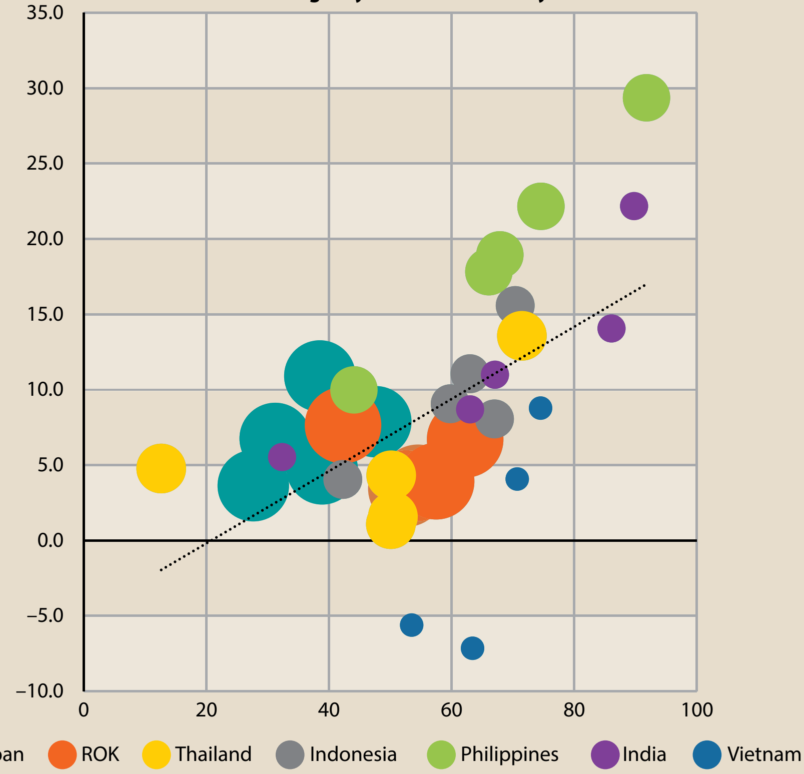
FIGURE 27

COVID-19 AND MOBILITY RESTRICTIONS.

A: Confirmed cases of COVID-19 and Government Stringency Index.



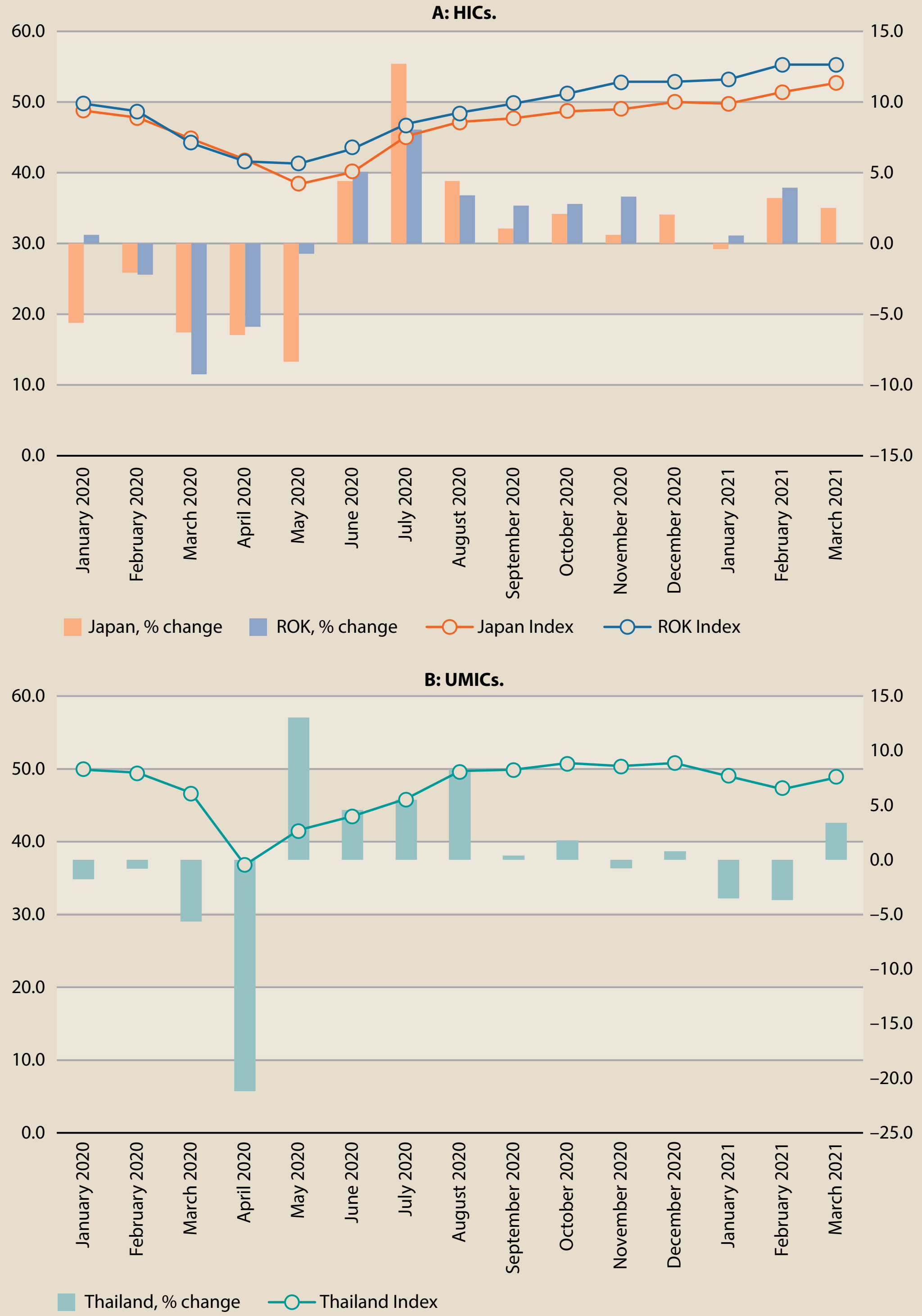
B: Government Stringency Index and mobility restrictions.



Source: Authors' calculations based on ourworldindata.org data.
Notes: 1. Data is from Q1 of 2020 to Q1 of 2021.

FIGURE 28A

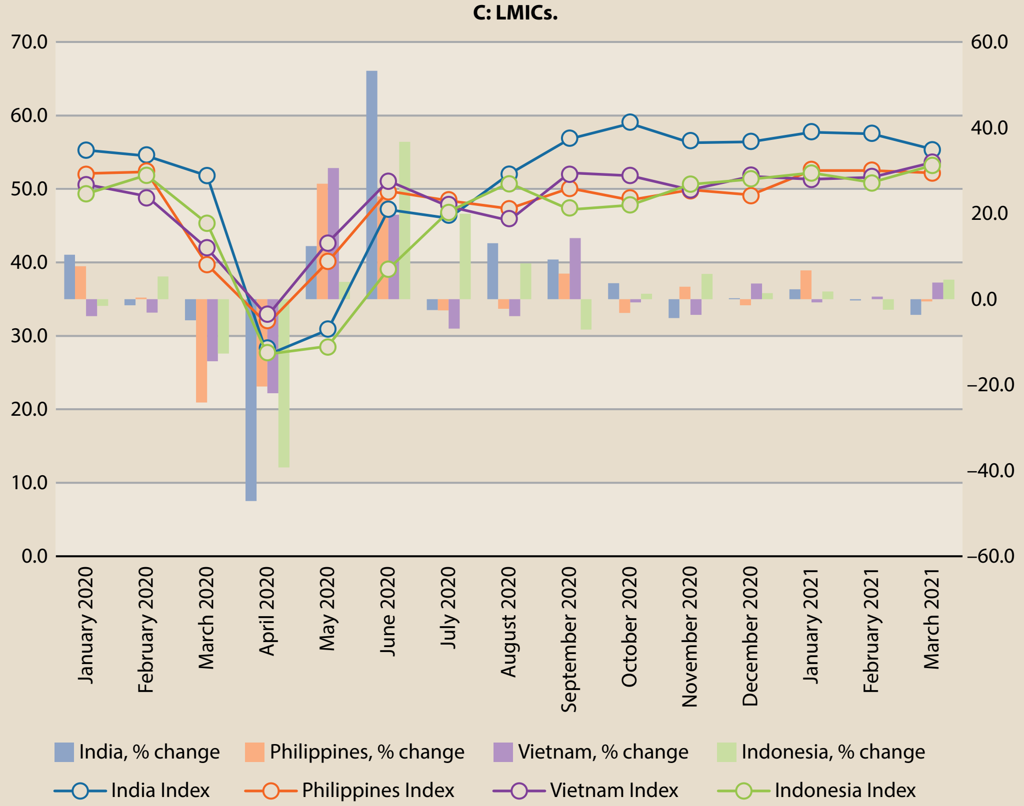
EVOLUTION OF THE IMPACT OF THE CRISIS ON MANUFACTURING THROUGH PURCHASING MANAGERS' INDEX.



Source: CEIC Data Database.
Notes: 1. The Purchasing Managers' Index is based on monthly surveys of supply chain managers, where less than 50 = deterioration (contraction) and higher than 50 = improvement (expansion).

FIGURE 28B

EVOLUTION OF THE IMPACT OF THE CRISIS ON MANUFACTURING THROUGH PURCHASING MANAGERS' INDEX.



Source: CEIC Data Database.
Notes: 1. The Purchasing Managers' Index is based on monthly surveys of supply chain managers, where less than 50 = deterioration (contraction) and higher than 50 = improvement (expansion).

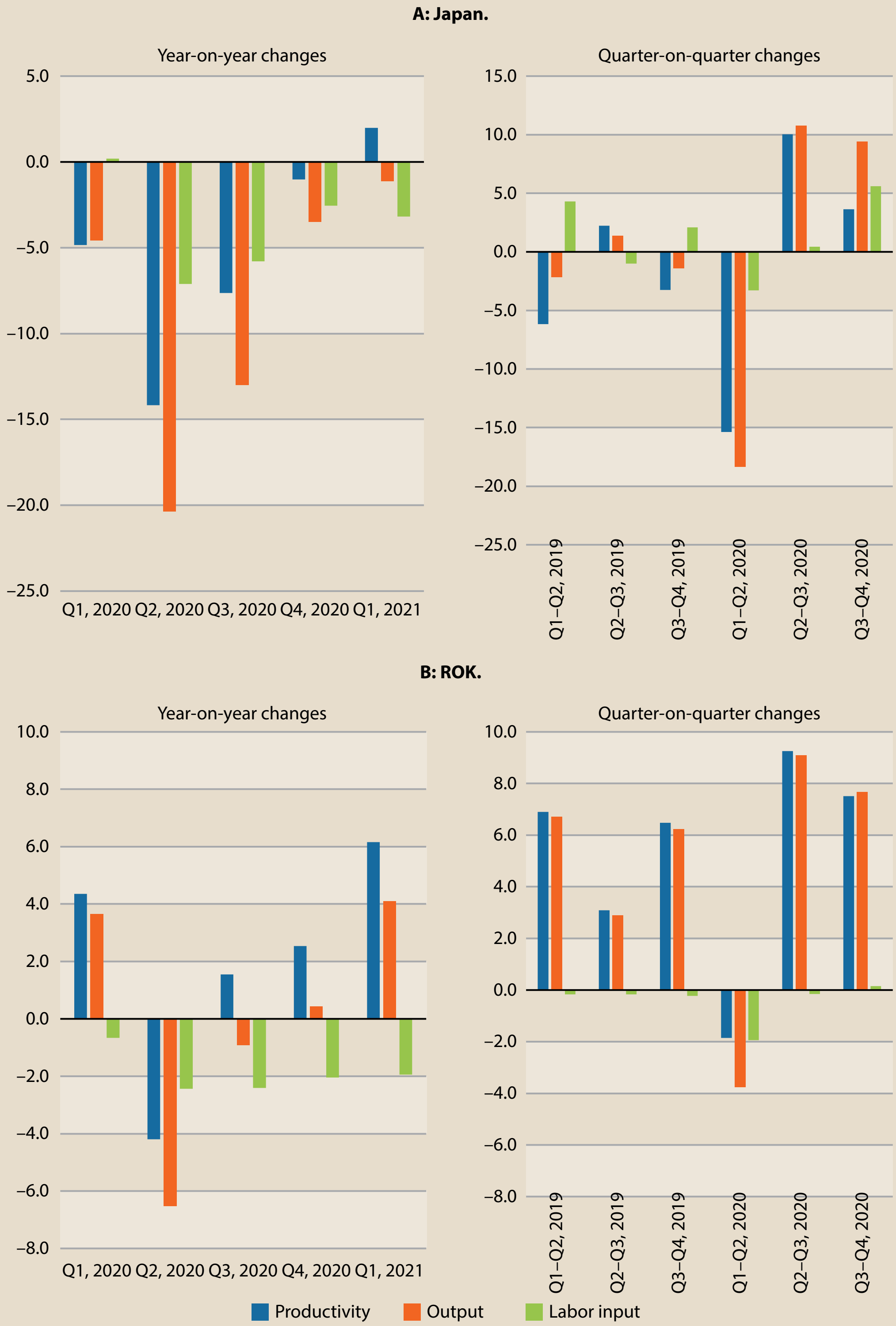
before the outbreak of COVID-19, in particular, productivity dropped 15.4% quarter-on-quarter, as both manufacturing output (down 18.3%) and labor input (down 3.3%) fell sharply.

These trends indicate that the pandemic-induced initial shock on manufacturing productivity was formidable. Despite the unexpected upheavals, fortunately, Japan seems to have experienced a steady recovery over the year 2020, recording 2% year-on-year growth and 3.6% quarter-on-quarter growth in the first quarter of 2021. In the ROK (see Figure 29-B), where productivity in the manufacturing sector fell 4.2% in Q2 2020 year-on-year and 1.9% quarter-on-quarter, appreciable difference can be found in the pace of recovery following an adverse event. Manufacturing output in the ROK recovered at a faster pace, with productivity rebounding at a growth rate of 6.2% year-on-year and 7.5% quarter-on-quarter in Q1 2021.

Thailand, Indonesia, India, the Philippines, and Vietnam (MICs): Because of non-availability of data for MICs to gauge the initial impact of the COVID-19 crisis on productivity, we complied datasets from two major sources, ADB and the World Bank surveys of firms in order to estimate potential adverse shocks on manufacturing output and labor input. According to ADB Enterprise Survey on COVID-19, firms in Thailand (UMIC) were hit hard by the pandemic, with dramatic and widespread falls in sales and employment (see Figure 30).

FIGURE 29

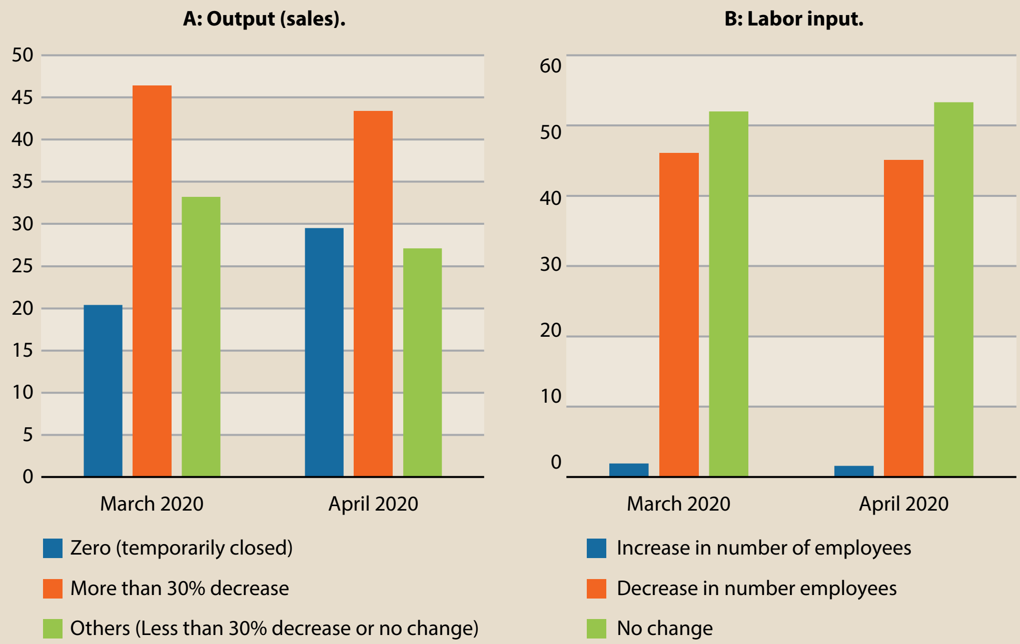
THE INITIAL IMPACT OF COVID-19 ON MANUFACTURING PRODUCTIVITY IN HICS.



Source: Authors' calculations based on Korea Productivity Center (KPC) and Japan Productivity Center (JPC) databases.
Note: Productivity = output divided by labor input; output = value added; and labor input =number of employees x total working hours.

FIGURE 30

THE INITIAL IMPACT OF COVID-19 ON LABOR PRODUCTIVITY IN MANUFACTURING IN UMICS.



Source: ADB MSME survey in Thailand during April–May 2020.
Note: Total respondents in the manufacturing sector were 272.

Specifically, more than 40% of manufacturing firms surveyed reported that monthly sales volumes fell over 30% in March 2020 and even more in April, while around 25% of the firms posted no sales during March 2020 and May 2020 due to temporary business closures. In terms of employment, around 45% of firms reduced their workforce, albeit the majority of them made no changes after the outbreak. Additionally, with regards to changes in work arrangements, firms surveyed reported that temporary layoffs were widespread and reduction in employee working hours was the second choice.

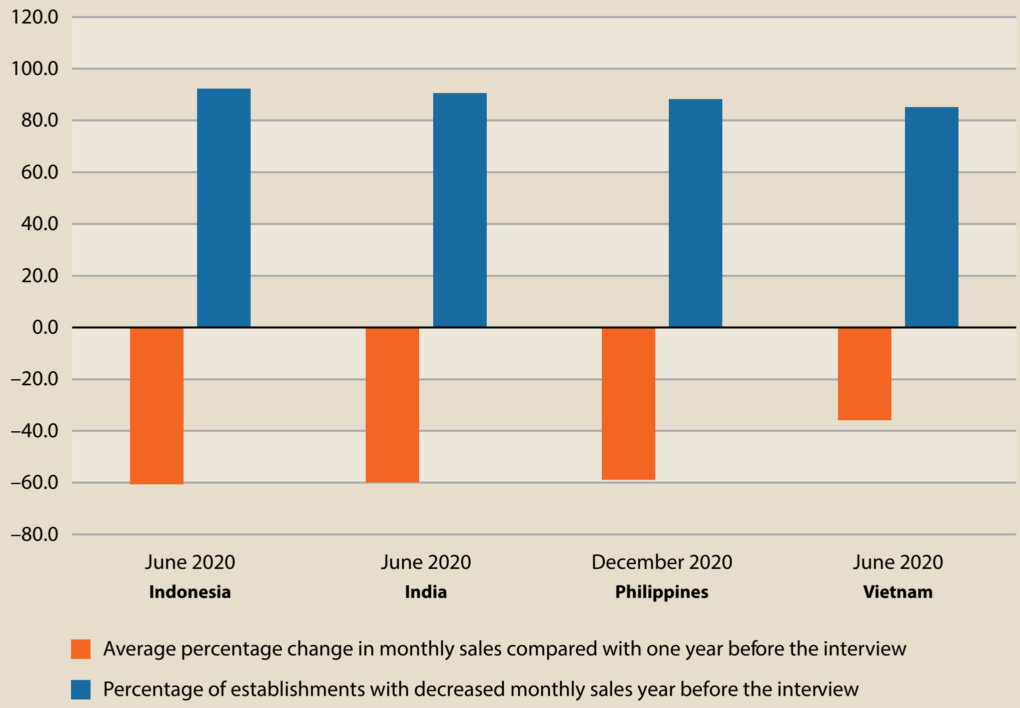
Four LMICs, i.e., Indonesia, India, the Philippines, and Vietnam also followed a trend similar to Thailand. Using data from the World Bank COVID-19 Business Pulse Survey, we found that sales and employment of manufacturing firms surveyed in those countries had fallen significantly because of strict lockdown and quarantine measures (see Figure 31). Firm sales in the LMICs were 35.9% to 60.6% lower in June and December 2020, compared with the same months in the previous year. Besides, in response to very sharp fall in sales, employment adjustment by firms was inevitably made by either cutting staff strength or adjusting employee working hours. In particular, among LMICs, the Philippines had the sharpest reduction in staff strength as well as in working hours in December 2020, largely due to the most significant mobility restrictions associated with anti-contagion measures (see Figure 27).

In short, the spread of COVID-19 has disrupted firms' operations. Particularly, in the manufacturing sector, firms had to reduce their operational activities, and some had to either halt production or even go out of business. Even if some firms continued operating, most of them were adjusting employments to lower labor costs, by firing workers, granting temporarily leaves, or reducing

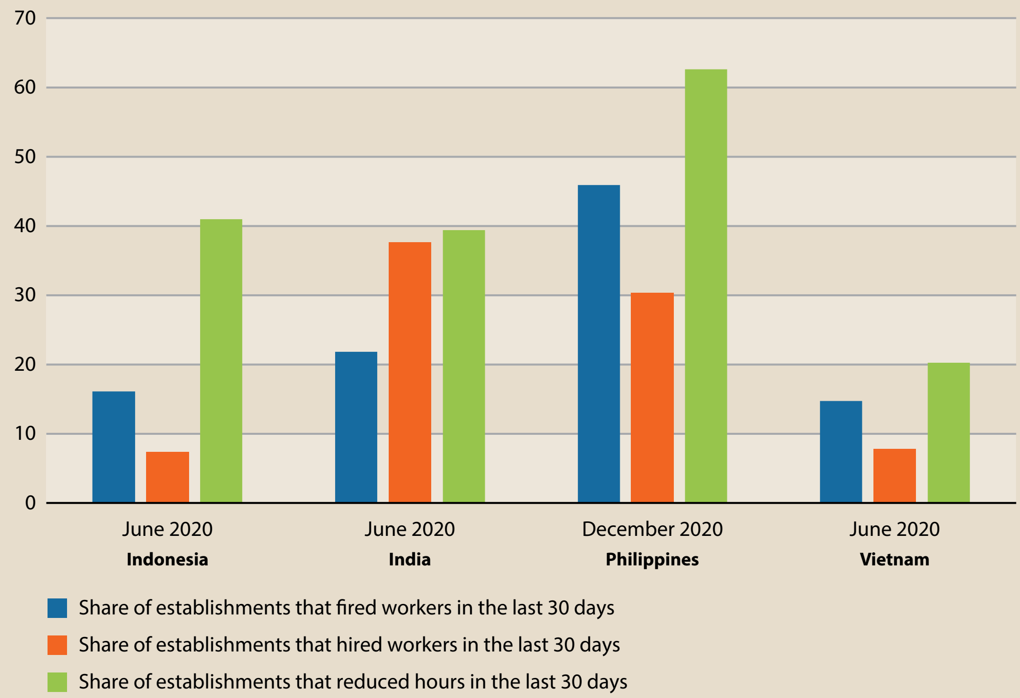
FIGURE 31

THE INITIAL IMPACT OF COVID-19 ON LABOR PRODUCTIVITY IN MANUFACTURING IN LMICS.

A: Output (sales).



B: Labor input.



Source: Authors' calculation based on WB COVID-19 Business Pulse Survey.
Note: The total respondents in the manufacturing sector: Indonesia, India, the Philippines, and Vietnam.

number of hours worked. The accompanying unintended, negative consequences would have a lasting impact on manufacturing productivity growth.

Conclusion

A thriving manufacturing sector has long been recognized as the key to raised productivity, and thereby to economic growth. As the COVID-19 pandemic swept across the globe, however, manufacturing faced significant operational challenges. Most factories had been temporarily or completely shuttered in response to imposed government restrictions or falling demand. The pandemic threatened to further aggravate the prolonged slowdown in manufacturing productivity, which ushered in the arrival of an uncertain future for productivity growth. Against this backdrop, this chapter carried out a comprehensive examination of preexisting trends and explored the initial negative shocks to sketch the outlook for manufacturing productivity growth, with a focus on seven APO member countries. Specifically, the chapter documented the following results.

Preexisting Status of Industrial Structural Change and Economy-wide Productivity

First, sizable productivity gaps between different sectors in APO member countries have remained since the mid-2000s. The redistribution of labor across sectors, especially toward modern manufacturing in MICs can alleviate such gaps in the process of industrialization, and thus promote the convergence to productivity frontiers (e.g., advanced, industrialized countries). For industrialized HICs that tend to have sectoral productivity gaps of a relatively small scale, either or both of industrial upgrading from basic, low-tech industries to high-tech ones (within manufacturing) and factor reallocation (from manufacturing to high-value services) is even more vital for further productivity gains. In this chapter, we documented clear evidence to support this argument for selected APO countries.

In the post-GFC period, however, a broadbased, long-lasting slowdown in productivity growth was found across all sectors in APO member countries, and was particularly pronounced in the manufacturing sector across all income groups. Specifically, the seven example countries at varying stages of development demonstrate that the undesirable structural change from high-value manufacturing (tradable) to low-value services (non-tradable) was observed in HICs, i.e., Japan and the ROK. Moreover, industrial upgrading in those countries proceeded toward higher-value-added industries, but the overall patterns were either moderate growth or growth-reducing. Five MICs, namely, Thailand, Indonesia, India, the Philippines, and Vietnam, on the other hand, performed reasonably well by boasting of a productivity-enhancing structural change before the outbreak of the pandemic. However, it was an unfavorable structural change, i.e., a shift from high-value manufacturing to low-value services even prior to absorbing the manufacturing productivity premium, with the exceptions of Thailand and Vietnam.

Preexisting Status of Manufacturing Productivity

Second, while delving into the pre-existing trends of manufacturing productivity, muted growth was discovered in five of the seven countries, including the HICs of Japan and the ROK and the MICs of Thailand, Indonesia, and India. The larger the adverse impact of the GFC, the longer were the negative shocks. In contrast, Vietnam and the Philippines were found out to be notable exceptions to the slowdown, boasting of robust growth even in the period after the GFC. Among other reasons, their post-GFC productivity growth could be attributed to two major forces: (1) the changing landscape of global trade and investments; and (2) the associated adverse impact on core manufacturing industries. The major findings are summarized in Table 4.

TABLE 4

MAJOR FACTORS BEHIND EXISTING TRENDS OF MANUFACTURING PRODUCTIVITY.

Income group	Country	Growth trends	Underlying factors	
			Macro level: Trade and investment	Industry level: Technological change
HICs	Japan, the ROK	Slowdown G1 (+)	Weak global demand of manufacturing goods	Significant negative shocks on medium-tech and high-tech industries with high productivity
MICs	Thailand, Indonesia, India	Slowdown G2 (–)	Further integration into the global economy through rising inward investment and manufacturing trade, particularly, in the Philippines and Vietnam	Either increased or decreased low-and medium-tech activities with lower productivity
	The Philippines, Vietnam	Acceleration G1 (+)		Notable growth in medium- and high-tech industries with high productivity, especially ICT producing ones (e.g., computer, electronic, and optical products), which in turn boosted ICT goods exports

Initial Impact of the COVID-19 Crisis and Prospects

Third, we sought to explore the initial adverse impact on manufacturing productivity based on datasets from varied sources to tackle limited data availability for comparison of the seven example countries. It was revealed that regardless of the country's stage of development, the spread of COVID-19 had severely disrupted manufacturing activities, particularly in the second quarter of the pandemic-scarred year (2020), mainly due to the strict lockdowns and quarantine measures. This in turn negatively affected productivity by shirking manufacturing output associated with unavoidable adjustment in employment, e.g., shortened working hours and layoffs. Even though a gradual, but uneven recovery to prepandemic level was identified in the first quarter of 2021, the full range of recovery remained uncertain largely due to the potential risk of further large-scale contagion as well as the outbreak of a new variant.

At the current phase of the COVID-19 crisis, views might be divided on the long-term prospects in manufacturing productivity. However, it can be expected from past experiences of the 2008–09 global recessions that the ongoing pandemic will likely deepen the prolonged growth slowdown with preexisting underlying factors of productivity, which could be further aggravated by unexpected shocks. Concretely, investment and supply chain linkages will be weakened by the shutdowns of manufacturing facilities in APO member countries. Their leading manufacturing industries, which depend on country-specific conditions will be most affected, and this will reduce trade volumes greatly. Accompanying and inevitably unpleasant consequences will be more likely to be longer lasting in countries with weak fundamentals such as poor social security system and restricted fiscal space to ramp up spending to mitigate an imminent damage.

Nonetheless, there will be potential opportunities to raise manufacturing productivity. In response to COVID-19, the adoption of new digital technologies termed as "digitalization of industry" has been at the forefront of industrial transition, with their adoption accelerating in a way that has never been seen before. Greater automation and digitalization in both MICs and HICs will offer new opportunities to rebound the slowing productivity growth. Yet, without the necessary preconditions to complement new technologies, i.e., highly skilled workers and basic digital infrastructure (e.g., fixed and mobile networks, data centers, etc.), COVID-19-induced technology adoption would even exacerbate existing inequalities between MICs and HICs. The challenges pertaining to disrupted global supply chains and adoption of digital technologies are addressed in more detail in the following chapters.

Policy Implications

Taken together, secular trends seen in APO economies as a shift of emphasis from manufacturing to services may make manufacturing-led productivity enhancement challenging. Although high-value-added services sectors such as finance and ICT offer opportunities for rapid productivity growth [14], the importance of manufacturing with multiple economic benefits such as larger scale of employment creation, improvement in income and living standards, and thus sustained productivity growth remains unaltered. The implication is that concerted efforts through a comprehensive set of policies are more crucial than ever before to tackle the aforementioned challenges to manufacturing productivity in order to counter the pandemic fallout and bolster growth. Based on lessons learned from the previous economic crisis, this is among the considerations that point to the need for the following two policy measures.

First, policy measures that support the most affected industries with deeper GVC integrations will be imperative to alleviate the adverse shock and reboot slowing productivity growth. Since the extent and degree of participation in the global economy may differ for countries, well-targeted instruments are needed to reinforce the disrupted production activities in the light of country-specific conditions. Moreover, building resilient institutions and growth-friendly business climate will become more important for joining GVCs. A reconfiguration of GVCs involving relocation and reshoring of productive activities may be accelerated in a way that mitigates risks in the event of a pandemic. For developing economies in particular, reshoring of multinational companies (MNCs) could be lethal, leading to large-scale job losses in manufacturing, which would not only undermine manufacturing development but accelerate the so-called 'premature deindustrialization.' Yet, in some countries with sound institutional environments, this could be a new opportunity for stronger integration of GVCs, which facilitate diffusion of new production technologies through trade and FDI and thus boost productivity growth.

Second, improving policy setting to adopt new digital technologies, regardless of a country's development status, can support productivity growth. In particular, education and technical training that equip workforce with digital-related skills will be crucial to better complement the introduction of new ICT and manufacturing technologies [1]. Combined with social protection programs (e.g., unemployment insurance benefits) for displaced or transiting workers, the potential for productivity enhancement could be amplified in the COVID-19 era. At the same time, it is advisable to support investment in upgrading digital infrastructure (e.g., high quality of broadband network) and provide better targeted R&D support. Such steps would facilitate digitalization in countries that are currently lagging.

These two thematic issues will be discussed in the subsequent chapters in more detail, where we will explore the linkages of manufacturing labor productivity with GVCs and ICT, respectively.

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Appendix

TABLE A

KEY STATISTICS.

Country	Code	Region	Economy-wide labor productivity (USD) (2018)	Coefficient of variation of log of sectoral productivity (2018)	Sector with highest labor productivity (USD)		Sector with lowest labor productivity (USD)	
					Sector	Labor productivity	Sector	Labor productivity
High income countries	**HICs**		**84,837**	**0.051**	**pu**	**236,658**	**agr**	**28,210**
Singapore	SGP	East Asia and Pacific	148,840	0.128	pu	845,958	agr	8,689
Hong Kong	HKG	East Asia and Pacific	117,320	0.072	pu	406,193	agr	31,684
ROC	ROC	East Asia and Pacific	100,442	0.062	frr	216,652	con	29,894
Japan	JPN	East Asia and Pacific	81,263	0.062	frr	296,664	agr	25,213
ROK	ROK	East Asia and Pacific	73,888	0.083	pu	676,327	agr	29,568
Upper-middle-income countries	**UMICs**		**51,928**	**0.081**	**min**	**362,422**	**agr**	**17,223**
Turkey	TUR	Europe and Central Asia	73,436	0.055	pu	216,812	agr	27,008
Malaysia	MLY	East Asia and Pacific	57,493	0.091	min	697,932	con	30,922
Thailand	THA	East Asia and Pacific	33,660	0.110	min	397,274	agr	9,008
Fiji	FJI	East Asia and Pacific	27,890	0.095	frr	169,160	pu	5,441
Lower-middle-income countries	**LMICs**		**18,098**	**0.098**	**min**	**128,045**	**agr**	**6,829**
IR Iran	IRN	Middle East and North Africa	57,020	0.110	min	922,652	con	18,122
Sri Lanka	SLK	South Asia	32,368	0.079	frr	145,677	agr	11,174
Mongolia	MGL	East Asia and Pacific	27,822	0.095	frr	180,807	agr	11,571
Indonesia	IDN	East Asia and Pacific	24,160	0.091	min	155,341	agr	11,172
Philippines	PHL	East Asia and Pacific	20,870	0.096	pu	190,642	agr	7,754
India	IND	South Asia	16,653	0.093	pu	104,179	agr	6,060
Pakistan	PAK	South Asia	15,282	0.123	frr	209,000	con	4,592
Lao PDR	LAO	East Asia and Pacific	13,294	0.133	min	367,112	agr	4,249
Vietnam	VNM	East Asia and Pacific	12,202	0.138	min	274,348	agr	5,350
Bangladesh	BGD	South Asia	11,140	0.107	min	119,272	agr	3,895
Nepal	NPL	South Asia	8,189	0.109	frr	149,953	agr	3,342
Cambodia	CAM	East Asia and Pacific	6,716	0.097	frr	60,048	agr	4,074
APO 21			**27,323**	**0.093**	**min**	**142,205**	**agr**	**7,579**

Source: Authors' calculations based on the APO Productivity Database.
Note: (1) GDP by industry at constant prices per worker, using 2017 PPPs (as of 2018) (2) Agr = Agriculture, hunting, forestry, and fishing; min = mining and quarrying; man = manufacturing; pu (public utilities) = electricity, gas, and water supply; con = construction; wrh = wholesale and retail trade, repair of vehicles and household goods, and hotels and restaurants; tsc = transport, storage, and communications; frr = financial intermediation, real estate, renting, and business activities; and cs = community, social, and personal services.

TABLE B

DATA SOURCES.

	Variable/description	Source
Labor productivity	GDP by industry at constant prices per worker, using 2017 PPPs (USD)	APO database
Output (manufacturing)	Value added at the two-digit level (constant 2018 USD)	UNIDO database
	Value added at the one-digit level (2015=100)	Korea Productivity Center (KPC) Japan Productivity Center (JPC)
	Sales (response rate, %)	ADB Enterprise Survey on COVID-19 WB COVID-19 Business Pulse Survey
Labor input (manufacturing)	Value added at the two-digit level	UNIDO database
	The number of employees x total working hours (2015=100)	Korea Productivity Center (KPC) Japan Productivity Center (JPC)
	The number of employees (response rate, %)	ADB Enterprise Survey on COVID-19
	The number of employees, and reduced working hours (response rate, %)	WB COVID-19 Business Pulse Survey
Trade	Trade in goods and services (constant 2010 USD) Manufactures exports and imports (constant 2010 USD)	WITS database
	ICT goods export (% of total merchandise trade) Manufacturing exports and imported intermediate goods (constant 2015 USD)	UNCTAD database
Investment	FDI inflow (constant 2015 USD) FDI inflows as a share of gross fixed capital formation (%)	UNCTAD database
COVID-19	Daily new confirmed COVID-19 cases	Our World in Data
	COVID-19 government response stringency index (0–100) Duration of time spent in places of residence	Oxford COVID-19 Government Response Tracker
	Purchasing Managers' Index	CEIC database

THEMATIC ISSUE 1: GVCs AND PRODUCTIVITY

Introduction

Global value chains (GVCs) are generally regarded as a decisive factor in not only shaping trade and FDI patterns for an economy but also stimulating its industrial transformation and growth opportunities. GVCs refer to a phenomenon where the different stages of a production process, such as R&D, design, component production, assembly, marketing, distribution, and aftercare service, are located across different countries. The accelerated pace of globalization, the ongoing trade and investment liberalization, and the rapid development of ICT and transport technologies all motivate firms to restructure their operations globally through foreign outsourcing of some parts of their production process. Although the pace of GVC expansion has been stagnated due to recent disruptions such as prolonged global recession, trade protectionism, and the COVID-19 pandemic, no one denies that GVCs remain an important impetus for industrial restructuring and economic growth in future. For developing countries, in particular, GVCs provide opportunities to increase their participation in global trade and to diversify their export portfolio toward manufacturing goods.

GVC participation could contribute to productivity enhancement not only at individual firms but also for the economy as a whole through multilayered channels. For instance, as Grossman and Rossi-Hansberg [1] suggest, the specialization in core tasks that an economy most efficiently provides, along with offshoring of less efficient parts of the production process, would generate productivity gains. On top of that, increased access to the available variety of foreign inputs and intermediate goods improves overall production efficiency. Furthermore, since GVC participation often involves foreign direct investment (FDI) and multinational corporation (MNC) activities, it could also serve as an important vehicle for technological knowledge spillovers across borders.

This chapter focuses on investigating the relationship between GVC participation and manufacturing productivity, with a special attention to the case of APO member countries over the period 2006–18. We start with reviewing the basic concepts of GVCs and the theoretical arguments on potential channels through which GVC participation contributes to productivity enhancement. Then, the current status and main characteristics of GVC participation of APO member countries are extensively examined and described. GVC participation indicates how much an economy is connected with GVCs for its foreign trade. It consists of two different patterns of participation, i.e., whether a country imports foreign intermediates to produce its exports (backward GVC participation) or it exports domestically produced inputs to trade partners and then those inputs are embodied in the exports of those trade partners (forward GVC participation). We further investigate the current structure of foreign contents of gross exports for APO member countries.

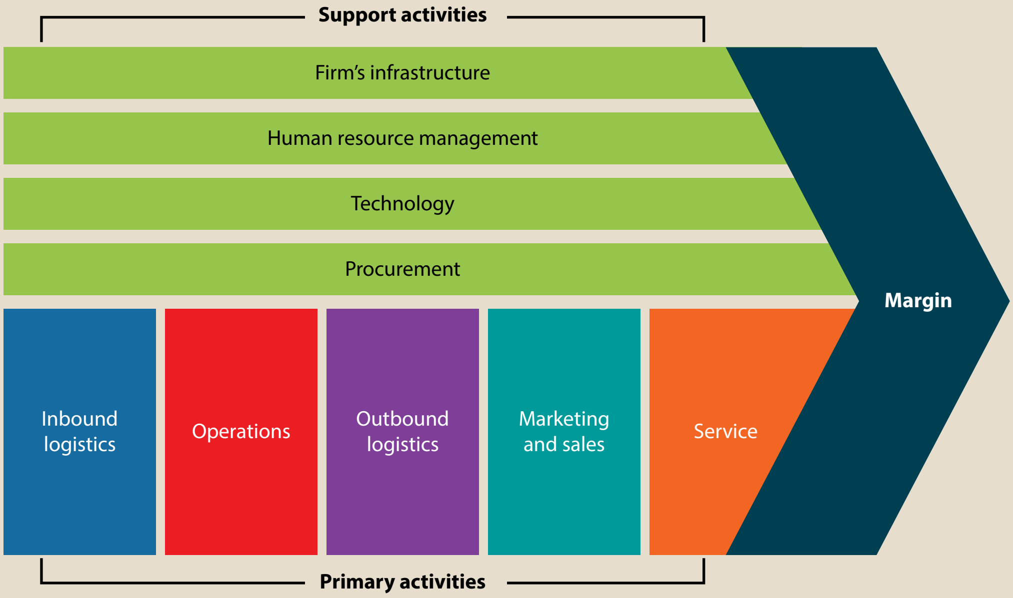
Next, we explore the linkage between GVCs and productivity in detail. We examine the relationship between GVC participation and manufacturing productivity for the countries included in APO Productivity Database. Then the empirical investigation of the GVCs' impact on manufacturing productivity is done. Finally, some policy implications and concluding remarks are provided.

GVCs and Productivity: A Conceptual Review

The term value chain was first coined by Porter [2]. Since then it has been used as the basic conceptual framework for analyzing various activities that a firm performs and their interactions. In order for a firm to deliver goods and services to the market, it needs to carry out several different stages of the value chain, as depicted in Figure 2, including technology, logistics, procurement, operations, marketing, sales, and aftercare services. Depending on cost considerations involved in each activity, firms decide to perform each activity internally or simply outsource it to the domestic market or abroad.

FIGURE 1

FLOWCHART OF VALUE CHAIN.



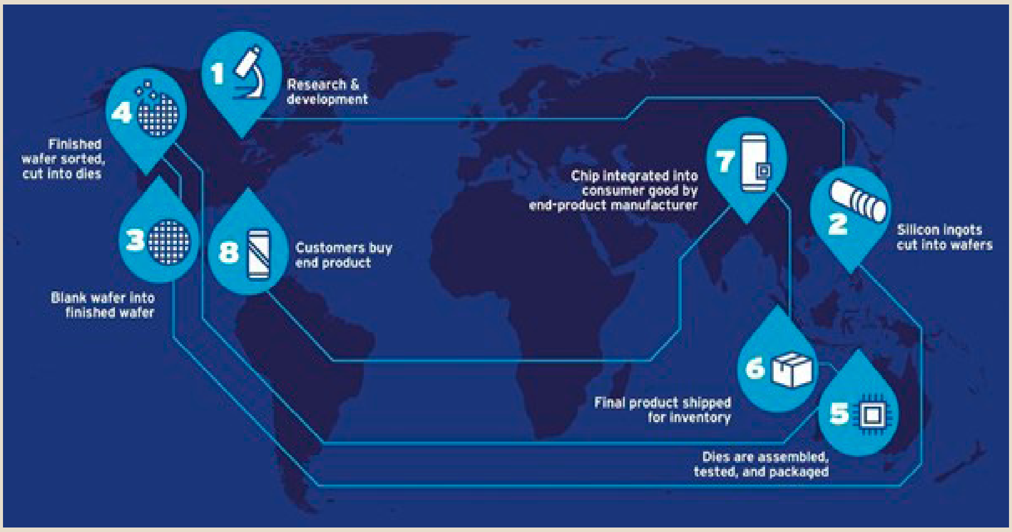
Source: Porter [2].

Although some forms of global outsourcing or offshoring have existed since long in human history, GVCs have expanded at an unprecedented pace since the second half the 20th century and significantly transformed the patterns of global production and trade thereafter. Countries have been increasingly involved in GVCs and the production processes have become more and more fragmented until recently.

As an example, Figure 2 illustrates the GVC map for semiconductors. As shown in the figure, each stage of the value chain is supported by an extensive array of suppliers that provide research and development (R&D), wafer fabrication, testing, packaging, distribution, and so on. The USA engages in the most R&D-intensive activities, including chip design, advanced manufacturing equipment, and electronic design automation (EDA), while a number of East Asian countries such as the Republic of Korea (ROK) and the Republic of China (ROC) specialize in wafer fabrication [3]. PR China leads dies assembly, testing, packaging, and chip integration into final consumer products. Given such a complex and interdependent network of production processes, it is virtually impossible for an economy or a region to achieve self-sufficiency or technological autonomy in the semiconductor market [4].

FIGURE 2

SEMICONDUCTOR'S GVC MAP.



Source: Semiconductor Industry Association.

Recently, a series of changes in international economic environments, such as the emergence of trade protectionism and the occurrence of COVID-19, have cast doubts on the stability and sustainability of GVCs. As a result, many governments are pursuing various policies to improve the resilience and stability of GVCs, particularly by supporting reshoring of domestic companies located overseas, which might cause GVCs to shrink. However, the economic case for policy-driven reshoring of GVCs is weak and there exists little evidence for supporting the success of reshoring policies [5, 6]. For instance, Zhu, *et al.* [7] show that, after the Great East Earthquake and tsunami in Japan, Japanese firms actively engaged in supplier diversification and kept on expanding offshoring. Such recent experiences indicates that GVCs could remain strong in future despite various disruptions and challenges.

Many countries are participating in GVCs nowadays, but their extent and roles are heterogeneous. A number of advanced countries like the USA, Germany, France, Japan, and the ROK, engage in innovative GVC activities and exhibit a high level of backward integration into GVCs. Meantime, PR China, India, Mexico, and some east and central European economies are where GVCs for advanced manufacturing and services take place. On the other hand, countries with a small share of manufacturing exports tend to exhibit a limited extent of GVC participation.

According to the World Bank [8], a country's extent of GVC participation is determined by various factors, notably factor endowments, market size, geography, and institutional quality, among many others. Large pools of low-skilled labor and foreign capital are factors for backward participation in GVCs, while abundance of natural resources stimulates forward GVC participation. FDI is an important stimulus for GVC participation, by offering financial resources as well as technical and managerial knowhows. Also, other things being equal, a country with a relatively large domestic market tends to reveal a low extent of backward GVC integration, by utilizing domestically produced inputs more intensively. Geographical proximity to large countries, institutional quality, and political stability also matter for GVC integration.

As aforementioned, GVCs not only shape trade and FDI patterns for an economy but also stimulate its industrial transformation and growth opportunities. GVC integration could contribute to inclusive growth, poverty reduction, employment creation, and most importantly, productivity improvement.

Productivity is arguably the most decisive indicator for long-term sustained growth, and GVC participation could potentially lead to productivity enhancement through multiple channels. First of all, as Grossman and Rossi-Hansberg [1] suggest, the expansion of GVCs implies reduction in costs involved in trading tasks along value chains, and thus, specialization in core tasks in which an economy has comparative advantages. This would leap up productivity gains. Second, increased access to the available variety of foreign inputs and intermediate goods also contributes to overall production efficiency through cost savings and access to better-quality inputs.

Third, imported inputs often embody a higher R&D knowledge content and thus GVCs could be an important conduit for technological knowledge spillovers [9]. Fourth, GVCs offer not only better access to foreign markets but also increase competitive pressure on domestic producers. Higher competitive pressure encourages firms to reduce product inefficiencies and invest more in technology-intensive activities. Heightened competition also results in domestic market restructuring and resource reallocation toward the most productive firm.

GVC Participation for APO Member Countries

Overall Trend of GVC Participation

Figure 3 shows the overall trend of GVC participation for APO member countries during the period 1990–2018. GVC participation is defined as the share of GVC-related exports in total exports. As illustrated in the figure, GVC participation of APO countries as a group had steadily expanded until the global financial crisis in 2008, but it slowed down afterward. During the 1990–2008 period, APO countries' participation in GVCs increased by about 14.7% points, larger than the global increase of 13.4% points. However, after the global financial crisis, APO countries' GVC participation rate declined by 4.7% points, which was similar to that of the world as a whole (–4.4% points).

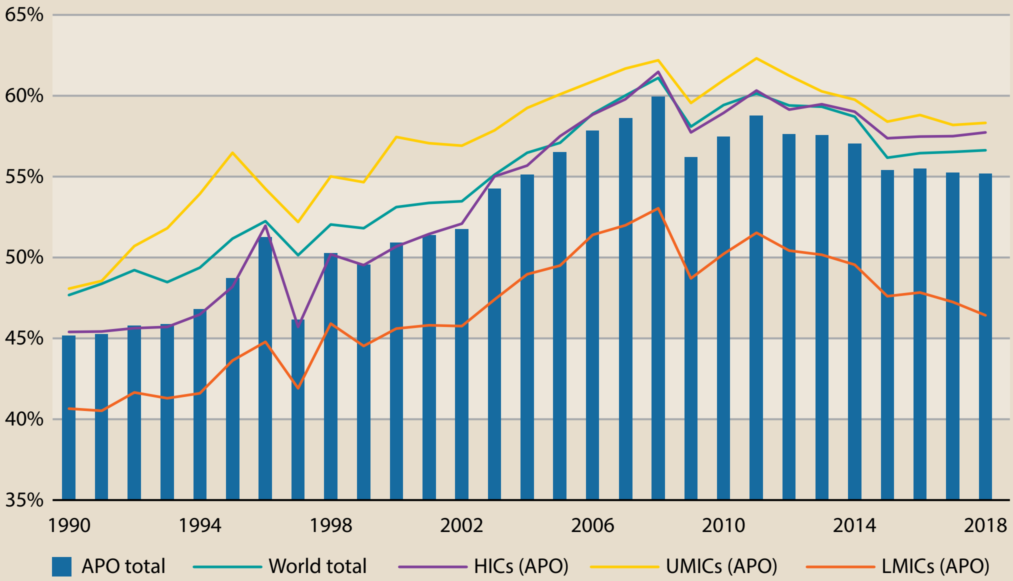
Figure 3 also compares the degrees of GVC participation among APO countries by categorizing them into high-income countries (HIC), upper-middle-income countries (UMICs) and lower-middle-income countries (LMICs). We follow the income group classification proposed by the World Bank as of 2021. For the country list by income group, please refer to Table A1 in Appendix.

While the LMIC APO group maintains lower GVC participation than other groups during the entire period, the HIC and LMIC groups reveal similar levels of participation. On the other hand, when GVC participation is categorized by forward and backward participation, we observe quite different dynamics across income groups (see Figure 4). In case of forward participation, the LMIC group shows the highest level of GVC participation throughout the entire period.

After the global crisis, the HIC group experienced the largest decline in forward GVC participation (–4.1% points), followed by the LMIC group (–2.5% points). Meanwhile, the HIC group has been rapidly increasing its backward GVC participation since the early 2000s and maintained a similar level till 2008 and even after the global crisis. Compared with the HIC group, the UMIC and LMIC groups had shown decrease in forward participation by 1.4% points and 3.0% points, respectively, during the 2008–18 period.

FIGURE 3

GVC PARTICIPATION TRENDS FOR WORLD VERSUS APO GROUP, 1990–2018.



Source: UNCTAD MRIO Database.

Figure 5 shows the degree of GVC participation by individual APO countries. The extent of GVC participation differs across countries, ranging from 62.3% (Singapore) to 30.1% (Sri Lanka) as of 2019. More than half of gross exports are GVC-related in the case of five APO countries, notably Singapore, the ROC (60.0%), Malaysia (59.4%), Vietnam (58.8%), and the ROK (50.6%). A total of nine countries among APO members experienced a decline in GVC participation during the period 2007–19. Thailand reveals the largest decline (–11.7% points), followed by Sri Lanka (–6.2% points), Mongolia (–6.2% points), the Philippines (–5.7% points), and Malaysia (–5.3% points). On the other hand, the GVC participation rate significantly increased for a number of countries including Bangladesh (15.6% points), Vietnam (12.2% points), and Turkey (8.9% points).

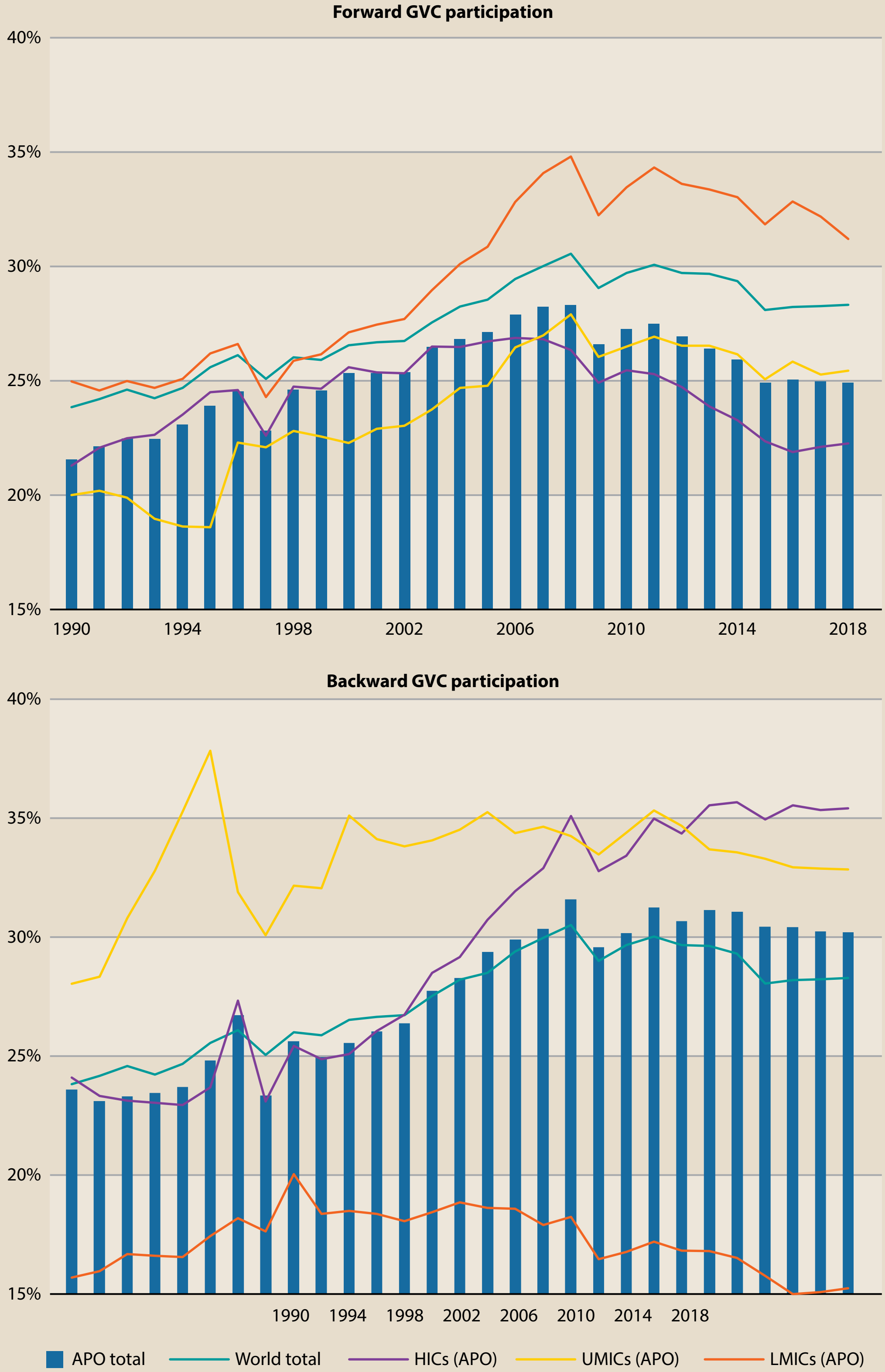
As depicted in Figure 6, the type of GVC participation differs significantly across APO members. The countries with abundant natural resources, such as petroleum, minerals, and agricultural produce, show relatively higher levels of forward GVC participation. For instance, the share of forward GVC-related exports in total exports for Lao PDR in 2019 was 27.4%, substantially higher than its share of backward GVC-related exports (12.2%).

On the other hand, Singapore (48.6%), Vietnam (47.0%), and the ROC (40.6%) tend to have a large proportion of backward GVC involvement. By definition, a high share of backward GVC participation directly implies a high foreign value-added share embodied in gross exports. That is, with a higher backward GVC participation, a country imports relatively more of foreign intermediate goods and services and uses them to produce its exporting items.

In fact, countries' sectoral specialization shapes the degree of backward and forward GVC involvement. Backward integration is relatively lower for countries that specialize in primary commodities. On the other hand, countries that have comparative advantage in advanced manufacturing and services tend

FIGURE 4

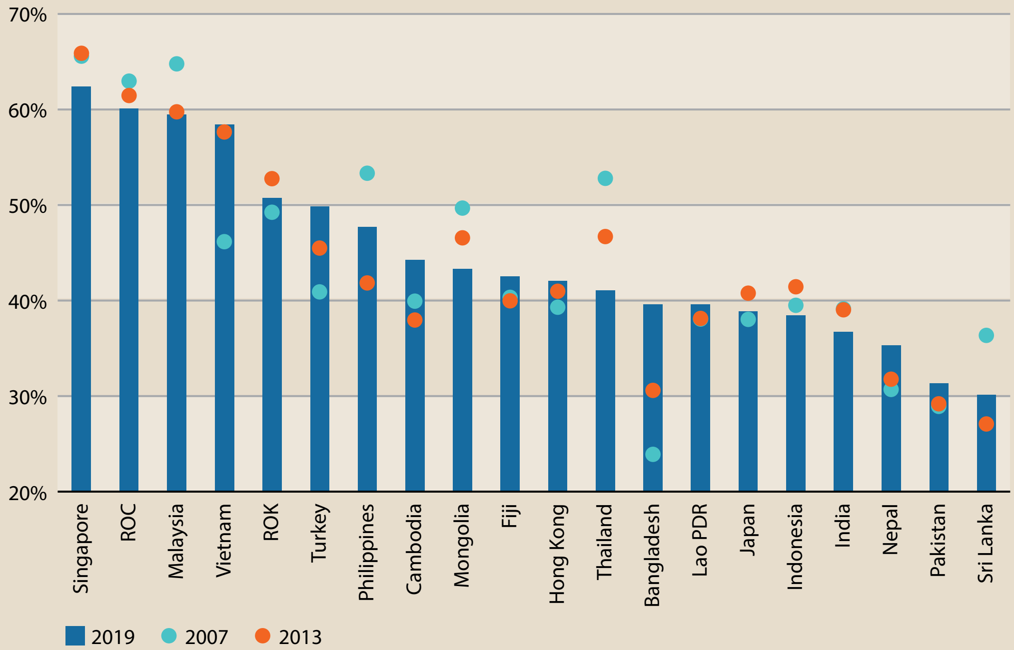
FORWARD/BACKWARD GVC PARTICIPATION TREND, 1990–2018.



Source: UNCTAD MRIO Database.

FIGURE 5

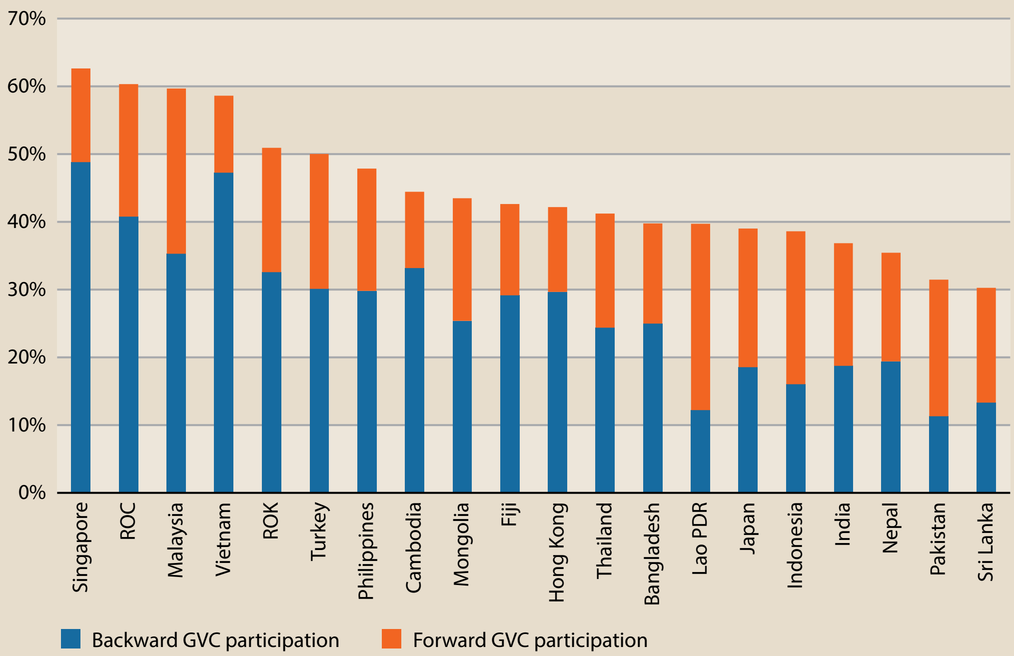
GVC PARTICIPATION FOR INDIVIDUAL APO MEMBER COUNTRIES.



Source: ADB MRIO Database.
Note: The ADB MRIO database contains information on GVC participation for all APO countries except IR Iran.

FIGURE 6

FORWARD/BACKWARD GVC PARTICIPATION FOR APO MEMBER COUNTRIES, 2019.



Source: ADB MRIO Database.

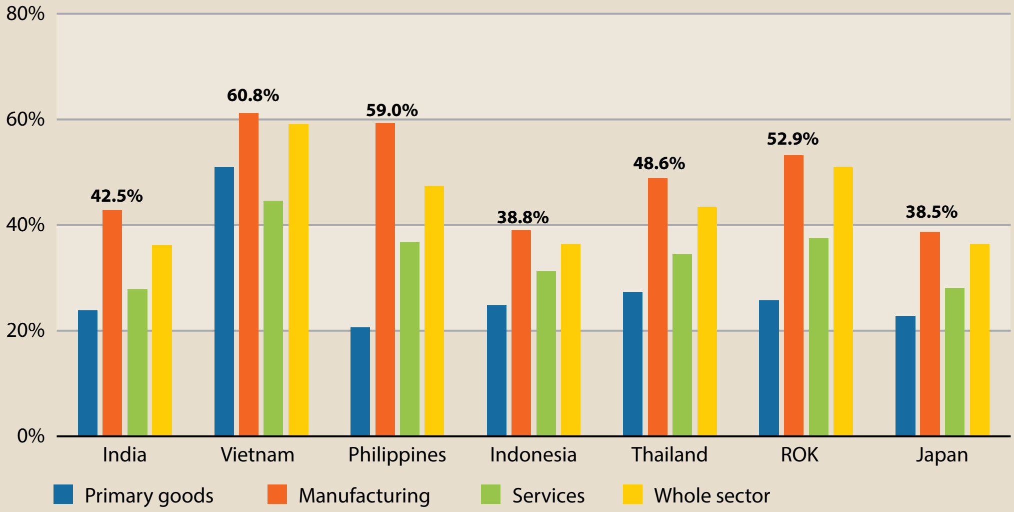
to be more dependent on imported inputs for exports and thus show active backward GVC involvement. Finally, large economies specializing in advanced manufacturing, notably Japan, reveal relatively lower backward integration because they are less reliant on imported inputs.

GVCs and Trade in Value Added in Seven APO Members

As aforementioned, the extent and pattern of GVC participation are highly correlated with the value-added structure of gross exports. In this subsection, we explore this linkage in detail, focusing on the manufacturing sector of seven APO member countries, namely, India, the Philippines, Vietnam, Indonesia, Thailand, the ROK, and Japan. First of all, Figure 7 illustrates the status of GVC participation for these countries in 2019.

FIGURE 7

GVC PARTICIPATION BY SECTOR FOR SEVEN APO COUNTRIES, 2019.



Source: ADB MRIO Database.

Overall, Vietnam shows the highest level of GVC participation, followed by the ROK, the Philippines, and Thailand. Since GVCs are mostly related to manufacturing activities, such differences between countries are similar when looking at GVC participation only in the manufacturing sector. As depicted in Figure 7, Vietnam (60.8%), the Philippines (59.0%), the ROK (52.9%), and Thailand (48.6%) have relatively high GVC participation rates in the manufacturing sector. Another notable point is that, although the gap is not significant compared with the manufacturing sector, these countries' GVC participation in the service sector is also relatively higher than that of other countries. In case of primary goods sector, GVC participation (50.7% for Vietnam and 20–27% for other countries) is relatively lower than that of other sectors.

Table 1 presents the status of GVC participation by manufacturing subsectors of these seven APO countries. (Forward and backward integration by manufacturing subsectors for these countries is also provided in Table A2 and Table A3 in Appendix.)

India, Indonesia, and Japan show a relatively low proportion of GVC-related trade across the manufacturing subsectors. Of course, these countries also reveal different levels of GVC participation for individual subsectors depending on their resource abundance, industrial characteristics, and export composition. For instance, GVC participation of the coke and petroleum sector in India (60.7%) and Japan (66.3%) is higher than other industries within these countries. Also, Indonesia (49.3%) maintains the lowest share of GVC-related trade in this sector among the seven countries, due to its abundance of crude oil. Other countries like Thailand (82.5%) and the Philippines (78.2%) show a very high proportion of GVC-related trade in the sector.

In case of Vietnam, its GVC participation in almost all manufacturing subsectors appears to be very high compared with other countries. In its subsectors of metal products, electrical/optical equipment, and rubber/plastics products, in particular, GVC-related trade accounts for more than 70% of total exports. In the Philippines, the proportions of GVC-related trade in coke and petroleum and metal industries exceed 70%, while those of textiles, chemicals, and manufacturing are relatively lower when compared with other countries.

Overall, sectors such as coke and petroleum, metal products, rubber and plastics, and electrical/optical equipment are involved more actively in GVC-related trade. As shown in Table A2 and Table A3 in Appendix, the high levels of GVC participation in these sectors are closely related with their backward GVC linkages.

TABLE 1

GVC PARTICIPATION BY MANUFACTURING SUBSECTORS, 2019.

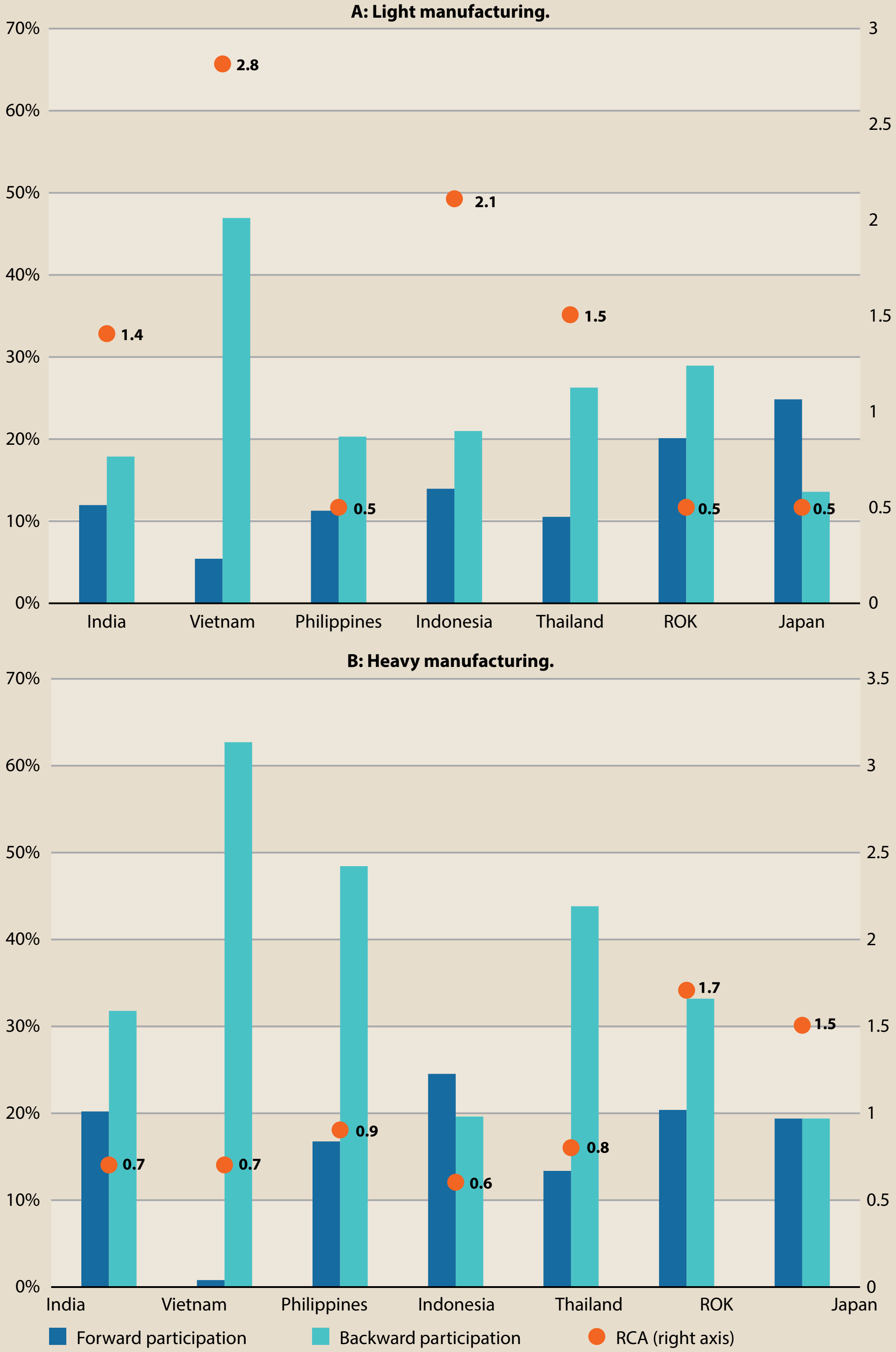
	India	Philippines	Vietnam	Indonesia	Thailand	ROK	Japan
Food and beverages	19.2%	28.3%	55.1%	24.3%	26.8%	26.9%	20.8%
Textiles	27.6%	28.0%	52.1%	50.5%	41.0%	62.7%	47.3%
Leather and footwear	28.9%	31.8%	45.6%	47.1%	45.0%	59.0%	35.4%
Wood products	22.9%	23.1%	53.6%	29.3%	39.8%	41.3%	26.3%
Pulp and paper	39.2%	49.4%	66.3%	44.9%	40.0%	42.5%	36.4%
Coke and petroleum	60.7%	78.2%	55.6%	41.4%	82.5%	70.2%	66.3%
Chemicals	46.5%	37.6%	66.4%	49.3%	61.1%	54.0%	48.8%
Rubber and plastics	48.9%	55.2%	73.9%	48.2%	46.3%	55.2%	44.6%
Nonmetallic	35.7%	47.1%	42.8%	30.5%	69.4%	46.4%	40.1%
Metal products	67.1%	71.4%	77.5%	51.4%	69.5%	63.1%	55.5%
General machinery	43.3%	51.7%	70.2%	46.0%	47.6%	35.9%	26.8%
Electrical/optical equipment	44.0%	67.7%	74.1%	46.7%	53.0%	53.4%	42.3%
Transport equipment	39.2%	46.4%	64.7%	23.7%	45.5%	46.9%	29.7%
Manufacturing, nec	34.0%	28.7%	47.7%	20.8%	39.3%	39.5%	28.9%

Source: Authors' calculations based on ADB MRIO Database.

In Figure 8, by dividing the manufacturing industry into light and heavy industries, we present the comparisons of forward/backward GVC participation and export competitiveness in these sectors. Here, export competitiveness is proxied by the Revealed Comparative Advantage (RCA) Index proposed by Balassa [10]. As depicted in Figure 8, Vietnam, Indonesia, and Thailand have a comparative advantage in light manufacturing exports, while the ROK and Japan have competitiveness in heavy manufacturing exports. Importantly, we cannot find any clear linkage

FIGURE 8

GVC PARTICIPATION AND EXPORT COMPETITIVENESS.



Source: ADB MRIO Database.
Note: Light manufacturing includes food and beverages, textiles, leather and footwear, wood products, pulp and paper, rubber and plastics, nonmetallic products, and manufacturing. Heavy manufacturing refers to coke and petroleum, chemicals, metal products, general machinery, electrical/optical equipment, and transport equipment.

between GVC participation and export competitiveness, implying that GVC participation does not automatically improve export competitiveness of an economy. Therefore, we need to further examine how GVC participation could contribute toward promoting manufacturing exports and improving competitiveness.

By construction, a high share of backward GVC participation implies a high foreign value-added content of gross exports. In this subsection, we look at the foreign value-added composition of gross exports in further detail. First of all, Table 2 illustrates the value-added structure of gross manufacturing exports for these member countries as of 2019. As depicted in the table, the foreign value-added share of gross manufacturing exports is the highest in Vietnam (48.7%), followed by the Philippines (45.1%), the ROK (35.5%), and Thailand (33.2%). On the other hand, Indonesia reveals the lowest share of foreign value added in its gross exports, being less dependent on foreign sourcing mainly due to its abundant natural resources and exports structure.

TABLE 2

VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS, 2019.

	India	Philippines	Vietnam	Indonesia	Thailand	ROK	Japan
A. Domestic value added.							
Primary goods	9.5%	8.2%	8.5%	20.1%	5.2%	0.8%	0.4%
Manufacturing	36.1%	33.7%	28.9%	45.9%	37.95	46.6%	54.7%
Services	26.0%	11.2%	11.45	14.0%	21.4%	16.9%	22.0%
Others	2.5%	1.9%	2.55	1.6%	2.2%	1.6%	2.6%
Subtotal	74.1%	54.9%	51.3%	81.6%	66.8%	65.9%	79.8%
B. Foreign value added.							
Primary goods	9.0%	8.4%	11.4%	3.8%	8.7%	9.1%	6.2%
Manufacturing	6.6%	21.2%	19.4%	6.4%	10.9%	11.3%	5.9%
Services	8.9%	13.8%	15.8%	7.3%	12.0%	12.3%	7.2%
Others	1.4%	1.7%	2.0%	0.8%	1.6%	1.5%	0.9%
Subtotal	25.9%	45.1%	48.7%	18.4%	33.2%	34.1%	20.2%

Source: Author's calculations based on ADB MRIO Database.

Vietnam and the Philippines apparently engage in foreign outsourcing for manufacturing and service inputs more intensively than other countries. The ROK and Japan are resource-scarce countries and thus reveal a relatively lower share of domestic primary inputs in their manufacturing value added. Japan, the ROK, and Indonesia contain relatively larger content of domestically produced manufacturing and services inputs compared with other countries. All this indicates that the value-added composition for gross exports depends on countries' resource endowment, domestic industrial competitiveness, and exports composition.

In Table 3, the foreign value-added shares for gross exports by manufacturing subsectors are presented. The extent of foreign value-added share varies across sectors as well as countries. For instance, the coke and petroleum industry and the metal industry reveal a relatively high foreign value-added share in gross exports, given that they rely heavily on import of crude oil and minerals. Gross exports in machinery industries, including electrical and optimal equipment, transport equipment and machinery, also contain relatively high content of foreign imports.

TABLE 3

FOREIGN VALUE-ADDED SHARE FOR GROSS EXPORTS BY SECTOR, 2019.

	India	Philippines	Vietnam	Indonesia	Thailand	ROK	Japan
Food and beverages	10.7%	17.3%	42.2%	9.0%	17.5%	23.9%	10.4%
Textiles	13.2%	32.9%	48.4%	49.5%	21.8%	25.7%	12.0%
Leather and footwear	14.9%	38.2%	40.6%	45.7%	19.0%	31.4%	16.9%
Wood products	7.2%	22.2%	38.3%	10.2%	15.4%	29.2%	14.4%
Pulp and paper	19.9%	28.3%	51.7%	15.8%	10.3%	30.1%	9.7%
Coke and petroleum	39.9%	46.6%	47.7%	8.7%	57.7%	57.6%	50.1%
Chemicals	21.1%	49.0%	49.8%	19.7%	34.5%	36.7%	23.7%
Rubber and plastics	21.2%	41.7%	56.1%	25.6%	18.8%	29.6%	16.7%
Nonmetallic	20.4%	44.3%	29.6%	16.2%	47.9%	31.4%	20.4%
Metal products	41.0%	65.8%	57.0%	19.8%	39.3%	34.5%	27.6%
General machinery	24.6%	52.6%	53.9%	36.7%	28.0%	26.0%	14.9%
Electrical/optical equipment	23.5%	63.7%	59.7%	34.7%	28.3%	28.5%	17.6%
Transport equipment	26.0%	40.9%	60.0%	16.1%	27.8%	30.3%	17.0%
Manufacturing, nec	21.3%	33.9%	41.5%	19.2%	25.3%	28.7%	14.4%

Source: Authors' calculations based on ADB MRIO Database.

Impact of GVC Participation on Productivity

In this section, we empirically examine the impact of GVC participation on manufacturing productivity. Due to data availability, our analysis confines to a sample of 21 countries contained in APO Productivity Database. These countries are: Australia, Bangladesh, Brunei, Bhutan, Cambodia, Fiji, India, Indonesia, Japan, the ROK, Lao PDR, Malaysia, Mongolia, Nepal, the Philippines, Singapore, Sri Lanka, Thailand, Turkey, and Vietnam. The time period is 2006–18. Our estimation specification is as follows:

$$\Delta ln(LP)_{c,t} = \beta_0 + \beta_1 ln(LP)_{c,t-1} + \beta_2 \Delta GVC_{c,t}^{Back} + \beta_3 \Delta GVC_{c,t}^{For} + \beta_3 UPSTREAM_{c,t-1}$$
$$+ X_{c,t-1}^{'}\Theta + D_c^{'}\Omega + T^{'}\Psi + \varepsilon_{c,t}$$

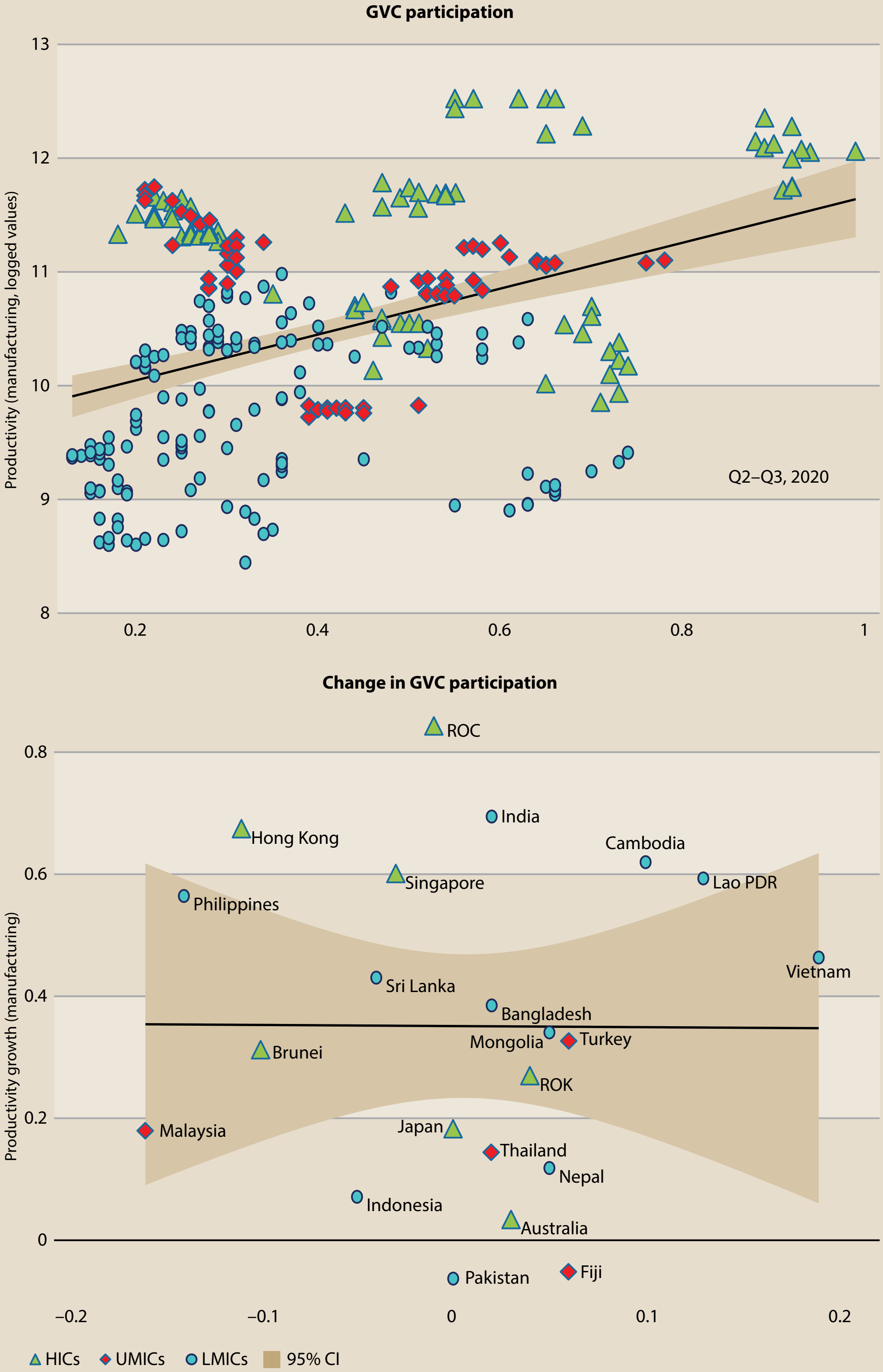
where c represents the country, t is the time period, and Δ denotes year-to-year change. LP is the labor productivity in manufacturing, measured as GDP (at constant USD, using 2017 PPP) per employed person. GVC^{Back} and GVC^{For} refer to the extents of backward and forward GVC participation, respectively.

Upstream, developed by Antràs, *et al.* [11], represents the extent to which a country exports goods that are sold directly to final consumers or that are sold to other sectors as intermediates rather than directly to final consumers. X is the vector of other control variables, including export intensity, FDI intensity, the level of human capital, inflation, and financial depth proxied by the share of domestic credit to private sector relative to GDP. D and T are the vectors of country dummies and year dummies, respectively. Hence, we employ the Least Squared Dummy Variables (LSDV) estimation for analysis to control for country-level unobserved heterogeneity. The variable descriptions and data sources are presented in Table A4 in Appendix.

In Figure 9, we depict the relationship between GVC participation and manufacturing productivity. The figure on the left shows that there exists a positive relationship between productivity and the

FIGURE 9

RELATIONSHIP BETWEEN GVC PARTICIPATION AND PRODUCTIVITY.



Source: Author's constructions based on APO and ADB MRIO databases.

extent of GVC integration for the sample years. The productivity levels of the majority of high-income APO countries lie above the fitted line, while those of the lower-middle-income countries largely lie below it and reveal a relatively lower degree of GVC participation. On the other hand, the figure on the right represents the correlation between productivity growth and change in GVC participation over the period 2007–18. Surprisingly, there exists no clear relationship between them.

It turns out that such ambiguous relationship between productivity growth and change in GVC participation stems from the fact that forward participation and backward participation have different effects on productivity growth. Panels A and B in Figure 10A depict the relationship between the manufacturing productivity level and the extent of forward/backward GVC participation. As far as such level-to-level comparison is concerned, forward integration seems to have a more positive and significant correlation with productivity level, compared with backward participation.

At the same time, however, when we look at the relationship between these variables in terms of rate of change, an increase in forward participation is in fact negatively correlated with productivity growth, while backward integration turns out to be positively correlated. Such opposite effects of these different types of GVC participation lead to the ambiguous nexus between productivity growth and change in GVC participation.

Before presenting our estimation results, we explore the relationship between upstreamness and manufacturing productivity. As aforementioned, upstreamness represents average distance from final use. A relatively upstream sector is one that sells disproportionately to other sectors, while those sectors in turn sell relatively little to final consumers.

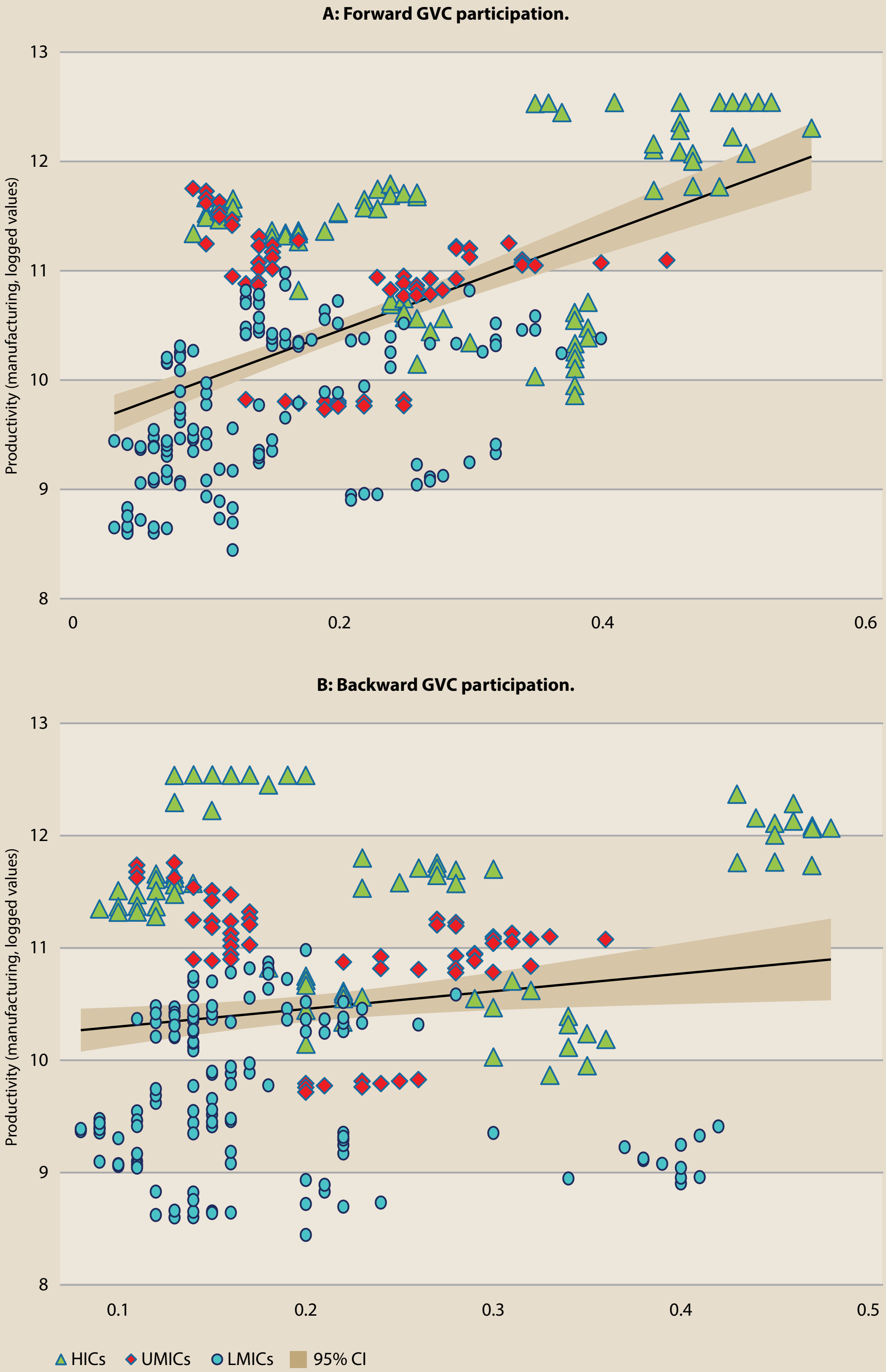
As illustrated in Figure 11, upstreamness is strongly correlated with productivity level, which implies that what countries export matters for labor productivity in the manufacturing sector. As of 2018, Malaysia, Mongolia, Singapore, and the ROC were those with a high degree of upstreamness, while Sri Lanka, Nepal, and Bangladesh tended to export more products destined for final consumers. We use the measure of upstreamness as a control variable for our regression analysis.

Results of our analyses are presented in Table 4. Estimation results in column 4 are the most preferred ones since these specifications control both for country fixed effects and time fixed effects. First of all, our results indicate the positive and significant role of backward GVC participation for labor productivity growth in manufacturing. An increase by 1% in the level of backward participation tends to increase productivity by 0.7%. On the other hand, we could not find any statistically meaningful impact of forward integration on manufacturing productivity growth.

As a matter of fact, such results are consistent with empirical evidence in existing literature. For instance, Constantinescu, *et al.* [12] examined the impact of GVC participation on productivity by using a panel dataset for 13 sectors and 40 countries over the period 2003–16. They confirmed that backward integration was a particularly important channel for productivity growth. Urata and Baek [13] conducted a similar analysis for a panel estimation comprising 47 countries and 13 manufacturing sectors for the period 1995–2011. They found that the impact on productivity was particularly larger where developing countries imported intermediate goods from developed countries. As we discussed in an earlier section, increased access to the available variety of foreign intermediate goods may improve overall production efficiency through cost savings, access to better quality inputs, and technological knowledge spillovers.

FIGURE 10A

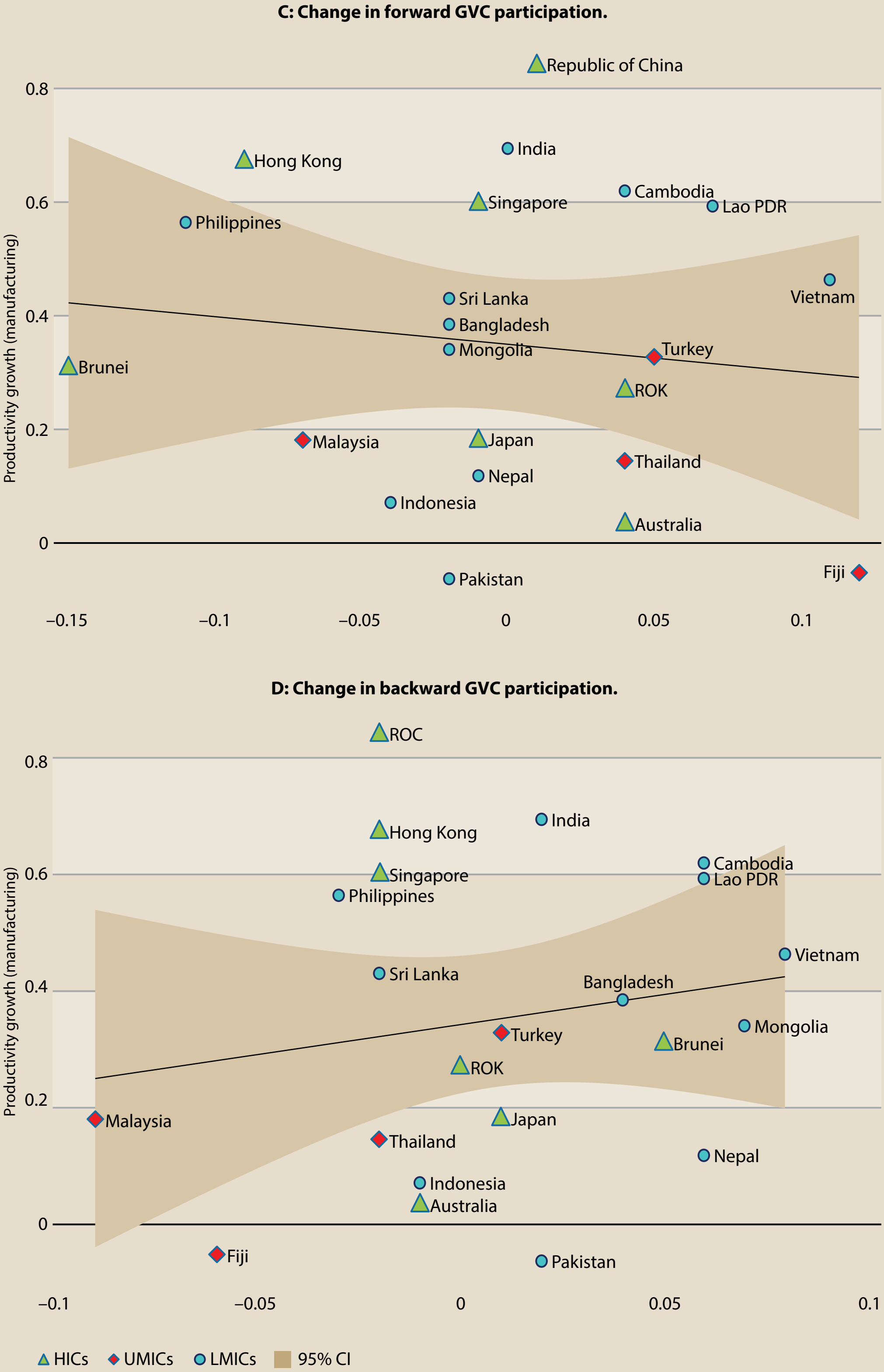
FORWARD/BACKWARD GVC PARTICIPATION VERSUS MANUFACTURING PRODUCTIVITY, 2018.



Source: Author's constructions based on APO and ADB MRIO databases.

FIGURE 10B

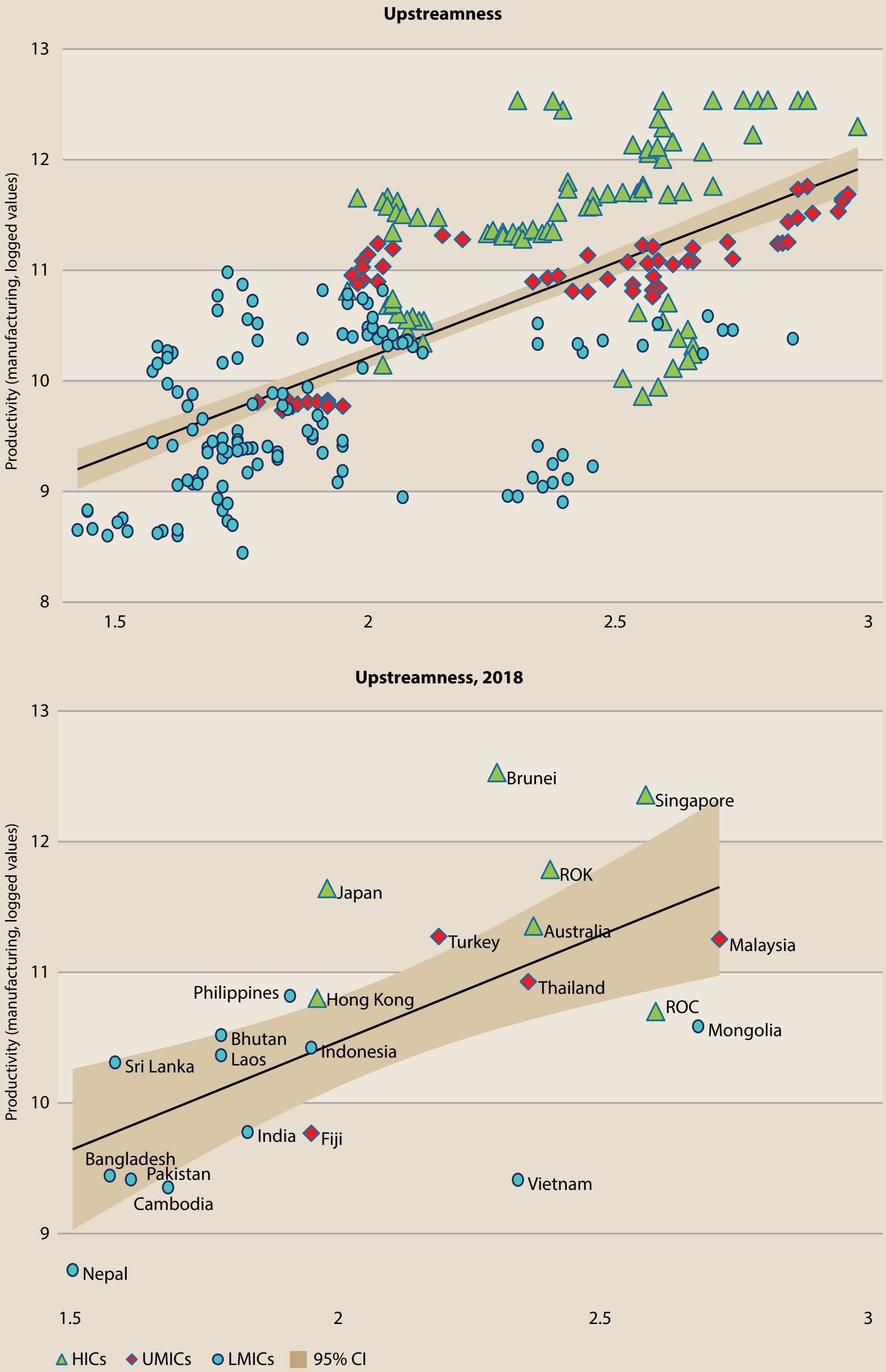
FORWARD/BACKWARD GVC PARTICIPATION VERSUS MANUFACTURING PRODUCTIVITY, 2018.



Source: Author's constructions based on APO and ADB MRIO databases.

FIGURE 11

RELATIONSHIP BETWEEN UPSTREAMNESS AND MANUFACTURING PRODUCTIVITY.



Source: Author's constructions based on APO and ADB MRIO databases.

TABLE 4

REGRESSION RESULTS 1 (DETERMINANTS OF MANUFACTURING PRODUCTIVITY GROWTH).

	(1)	(2)	(3)	(4)
Initial productivity level	−0.018***	−0.019*	−0.018*	−0.414***
	(0.006)	(0.010)	(0.010)	(0.079)
Change in backward participation	0.448*	0.502*	0.558*	0.711***
	(0.237)	(0.259)	(0.288)	(0.257)
Change in forward participation	−0.021	−0.061	−0.106	0.141
	(0.187)	(0.259)	(0.265)	(0.187)
Upstreamness	0.050***	0.038*	0.036*	0.151**
	(0.014)	(0.021)	(0.021)	(0.071)
Export intensity		−0.000	−0.000	0.000
		(0.000)	(0.000)	(0.001)
FDI intensity		0.002	0.001	0.003***
		(0.001)	(0.001)	(0.001)
Human capital level		0.011	0.011	0.093
		(0.015)	(0.015)	(0.071)
Inflation		−0.003	−0.003	−0.003
		(0.002)	(0.002)	(0.003)
Financial depth		−0.000	−0.000	0.001**
		(0.000)	(0.000)	(0.001)
Constant	0.104*	0.151*	0.124	3.839***
	(0.060)	(0.082)	(0.080)	(0.799)
Observations	260	221	221	221
R-squared	0.051	0.080	0.118	0.386
Country FE	No	No	No	Yes
Year FE	No	No	Yes	Yes

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; standard errors are in parentheses.

Another interesting finding from our estimation is that upstreamness is also a decisive factor for productivity growth, which implies that what countries export indeed matters for manufacturing productivity. Among other control variables, FDI intensity and financial depth have positive and statistically significant impacts on manufacturing productivity for APO countries.

Finally, we run another regression by replacing manufacturing productivity growth with that of the overall sector as the dependent variable and report the results in Table A5 in Appendix. The estimation results indicate that backward GVC participation still matters for productivity growth of the overall sector, but like the case of manufacturing productivity, upstreamness is not an important determinant for productivity growth of the overall sector.

Conclusion

Over the past several decades, we have witnessed an accelerated pace of globalization. Countries do not have to rely on domestic producers only for goods and services they consume. The GVC networks have been expanding rapidly and the different stages of the production process are located across different countries. GVCs are nowadays shaping trade and FDI patterns for economies and also stimulating their industrial transformation and growth opportunities. Although the ascending trend of globalization suddenly stopped after the global financial crisis in the mid-2000s, GVC-related trade still accounts for 60~70% of global trade.

Empirical evidence so far, including this chapter, suggests that there is a positive contribution of GVCs on productivity enhancement. Specifically, our analyses results confirm the significant role of backward GVC participation in labor productivity growth in manufacturing. Increased access to the available variety of foreign intermediate goods may improve overall production efficiency through cost savings, access to better-quality inputs, and technological knowledge spillovers. With the recent widespread protectionism in the global economy, protectionist measures to limit imports from abroad tend to increase. These measures may have some effects on improving trade balance in the short term, but in the mid-to-long term, they rather increase production costs for exporters, resulting in a decline in export competitiveness and industrial productivity.

Given that countries possess different levels of absorptive capacities and have different characteristics of GVC engagement, the extent of GVC effects could be different across these countries. In any case, it seems apparent that countries could significantly improve potential benefits from participating in GVCs. These benefits would include economic growth, job creation, and poverty reduction, if countries undertake deeper reforms and maintain policy consistency and transparency.

At the same time, one should note that there may be a two-way causal relationship between productivity and GVCs. Not only GVC participation positively affects productivity, but productivity itself could be a decisive determinant of the extent of GVC involvement. Low wages are often perceived to be a key factor for enabling developing countries to participate in GVC trade, but empirical evidence often does not support such perception. Countries with high labor productivity would generally have higher wages and still be low unit labor cost producers [14]. (Unit labor cost is measured as the ratio of average wages to per capita GDP.) These countries tend to be more actively involved in GVCs, implying that unit labor costs, and thus productivity, are more important factors for GVC participation than low wages.

Trade costs are another determinant of the propensity and intensity of GVC involvement. Trade costs stem not only from tariff barriers, but also from other factors such as restrictive trade regulations, inefficient customs clearance, weak infrastructure, bureaucracy, and red tape. GVC-related trade tends to be more dependent on trade costs than traditional trade, and consequently countries with high trade costs face tremendous difficulties in active GVC participation. Therefore, special policy attention should be drawn toward reduction of trade costs and improvement of trade facilitation in order to increase GVC participation.

Some argue that the recent economic disruptors, notably the ongoing trade protectionism and the outbreak of COVID-19, represent an unprecedented threat to globalization in general as well as to the viability and stability of GVCs in particular. Many countries are nowadays providing supporting measures for reshoring of domestic companies located overseas, which might cause GVCs to shrink. However, there exists little evidence supporting the success of reshoring policy, and GVCs are expected to remain strong despite recent disruptions and challenges. Instead, Bonadio, *et al.* [15] suggest that reshoring expands economic volatility and hinders GDP growth.

At the same time, others suggest that globalization is not declining but transforming. This new wave of globalization is rooted in digital transformation, which will change the nature and scope of international trade. While the impact of digital transformation on GVCs is uncertain, digital transformation will provide new opportunities for small- and medium-sized enterprises (SMEs) to play an active role in GVCs as it reduces coordination and matching costs between producers and consumers.

Recently, there have been several studies on the impact of COVID-19 on GVCs. The prevailing view is that GVCs will shrink due to heightened uncertainty from COVID-19 and the ongoing digital transformation, but the empirical evidence for this is still lacking. Some scholars present the view that companies are reconsidering the international value chain and just-in-time production methods that have been maintained so far and are starting to seek transition to a new production method. On the other hand, others argue that companies are expected to cope with new risks by fully utilizing their own capabilities regarding agility, flexibility, and supply chain visibility rather than readjusting the entire value chain to avoid risks. As aforementioned, Zhu, *et al.* [7] suggest that, after the Great East Earthquake and tsunami in Japan, Japanese firms actively engaged in supplier diversification rather than shrinking their GVCs.

In conclusion, despite various uncertainties and economic disruptors in the global market, the importance of GVCs in international trade and growth is not expected to diminish in future. For developing countries in particular, GVCs offer them important opportunities to integrate into the global economy, create new jobs, and enhance productivity. Our analytic results indicate that import-reducing policies targeted at raising the share of domestic value added in exports can act as a factor that undermines the potential for GVC-led growth. Instead, more open and transparent policies will be imperative to promote high GVC participation and GVC-led productivity growth.

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Appendix

TABLE A

LIST OF APO MEMBER COUNTRIES BY INCOME GROUP.

Group	Country list
High-income group	Hong Kong, Japan, ROC, ROK, Singapore
Upper-middle-income group	Fiji, Malaysia, Thailand, Turkey
Lower-middle-income group	Bangladesh, Cambodia, India, Indonesia, IR Iran, Lao PDR, Mongolia, Nepal, Pakistan, Philippines, Sri Lanka, Vietnam

TABLE B

FORWARD GVC PARTICIPATION BY MANUFACTURING SUBSECTOR, 2019.

	India	Philippines	Vietnam	Indonesia	Thailand	ROK	Japan
Food and beverages	7.2%	12.6%	9.4%	12.9%	9.5%	3.4%	12.2%
Textiles	13.5%	8.6%	5.9%	5.5%	25.1%	24.4%	29.6%
Leather and footwear	15.2%	6.3%	2.8%	2.7%	6.2%	9.6%	17.6%
Wood products	11.8%	12.1%	20.0%	19.8%	21.4%	27.0%	20.3%
Pulp and paper	20.9%	20.5%	16.5%	26.4%	25.7%	19.1%	20.6%
Coke and petroleum	15.3%	16.2%	5.1%	27.5%	12.4%	12.3%	19.3%
Chemicals	27.3%	16.5%	17.0%	28.6%	22.5%	22.7%	30.6%
Rubber and plastics	28.8%	18.5%	22.2%	25.1%	35.1%	22.2%	29.3%
Nonmetallic	13.8%	10.7%	11.8%	15.8%	10.2%	12.7%	19.9%
Metal products	20.8%	11.1%	18.0%	33.2%	18.2%	25.3%	27.0%
General machinery	18.0%	4.4%	7.2%	25.9%	8.7%	11.1%	16.2%
Electrical/optical equipment	16.7%	16.4%	14.8%	21.1%	21.0%	22.6%	25.7%
Transport equipment	13.7%	13.3%	11.6%	20.6%	10.1%	8.7%	8.9%
Manufacturing, nec	10.9%	8.5%	6.9%	4.7%	5.0%	8.6%	12.8%

Source: Authors' calculations based on ADB MRIO Database.

TABLE C

BACKWARD GVC PARTICIPATION BY MANUFACTURING SUBSECTOR, 2019.

	India	Philippines	Vietnam	Indonesia	Thailand	ROK	Japan
Food and beverages	10.8%	17.4%	42.5%	9.1%	17.6%	24.1%	10.5%
Textiles	13.3%	32.9%	48.7%	49.7%	21.9%	26.0%	12.2%
Leather and footwear	15.0%	38.3%	40.9%	45.9%	19.1%	31.8%	17.1%
Wood products	7.2%	22.2%	38.5%	10.3%	15.5%	29.4%	14.6%
Pulp and paper	20.0%	28.4	51.9%	15.9%	10.4%	30.4%	9.9%
Coke and petroleum	40.2%	46.7%	47.8%	8.7%	57.8%	57.9%	50.4%
Chemicals	21.3%	49.0%	50.0%	19.8%	34.6%	37.1%	24.0%
Rubber and plastics	21.3%	41.8%	56.3%	25.8%	18.9%	30.0%	17.0%
Nonmetallic	20.5%	44.4%	29.6%	16.3%	48.0%	31.7%	20.6%
Metal products	41.3%	65.9%	57.2%	19.9%	39.55	34.9%	28.0%
General machinery	24.8%	52.6%	54.2%	36.8%	28.2%	26.3%	15.2%
Electrical/optical equipment	23.7%	64.1%	60.2%	34.8%	28.4%	29.3%	18.1%
Transport equipment	26.2%	41.0%	60.3%	16.1%	28.0%	30.8%	17.3%
Manufacturing, nec	21.5%	33.9%	41.7%	19.3%	25.4%	29.0%	14.7%

Source: Authors' calculations based on ADB MRIO Database.

TABLE D

VARIABLES AND DATA SOURCES.

Variable list	Data sources
Manufacturing productivity	APO
GVC Participation Index • Forward GVC Participation Index • Backward GVC Participation Index Upstreamness Index	ADB-MRIO
Export intensity (% of GDP) FDI intensity (Inward, % of GDP) Inflation rate Credit	WDI (The World Bank)
Human Capital Index	Penn-World Tables 10.0

TABLE E

REGRESSION RESULTS II (DETERMINANTS OF PRODUCTIVITY GROWTH FOR ALL SECTORS).

	(1)	(2)	(3)	(4)
Initial productivity level	−0.015***	−0.018***	−0.016***	−0.152***
	(0.003)	(0.004)	(0.004)	(0.033)
Change in backward participation	0.214*	0.262**	0.229**	0.231**
	(0.112)	(0.106)	(0.101)	(0.093)
Change in forward participation	0.083	0.071	0.038	0.079
	(0.111)	(0.109)	(0.103)	(0.107)
Upstreamness	0.017**	0.009	0.010	-0.021
	(0.007)	(0.008)	(0.008)	(0.028)
Export intensity		−0.000	−0.000	0.000
		(0.000)	(0.000)	(0.000)
FDI intensity		0.001**	0.001**	0.001***
		(0.000)	(0.000)	(0.000)
Human capital level		0.014**	0.013**	0.035
		(0.006)	(0.006)	(0.034)
Inflation		−0.001	0.000	−0.002***
		(0.001)	(0.001)	(0.001)
Credit access		−0.000	−0.000	0.000
		(0.000)	(0.000)	(0.000)
Constant	0.149***	0.163***	0.114***	1.629***
	(0.023)	(0.028)	(0.029)	(0.366)
Observations	264	221	221	221
R-squared	0.106	0.196	0.321	0.544
Country FE	No	No	No	Yes
Year FE	No	No	Yes	Yes

Note: * significant at 10%; ** significant at 5%; *** significant at 1%; standard errors are in parentheses.

FIGURE A1A

TREND OF FORWARD/BACKWARD GVC PARTICIPATION FOR INDIVIDUAL APO MEMBERS.

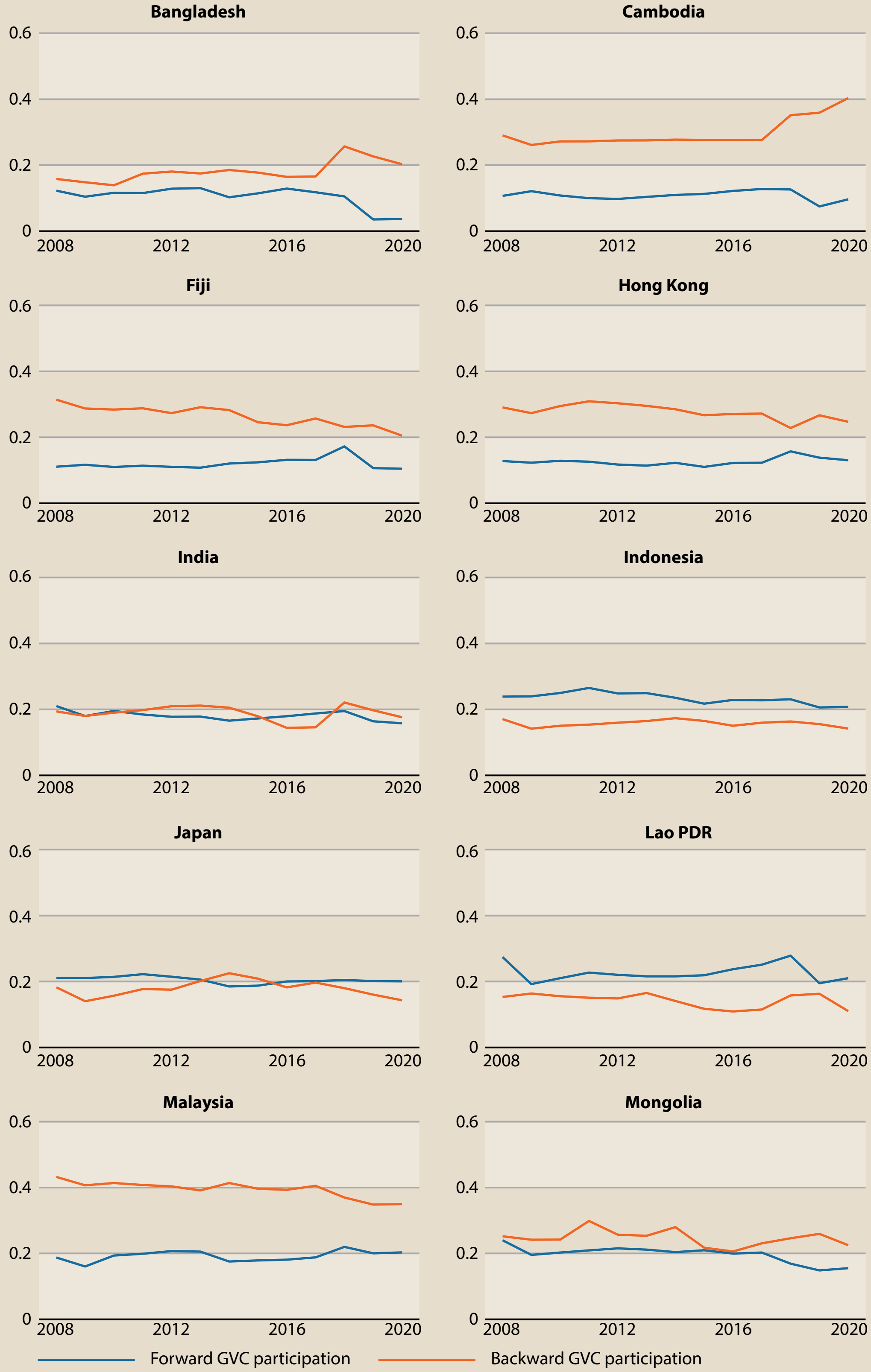
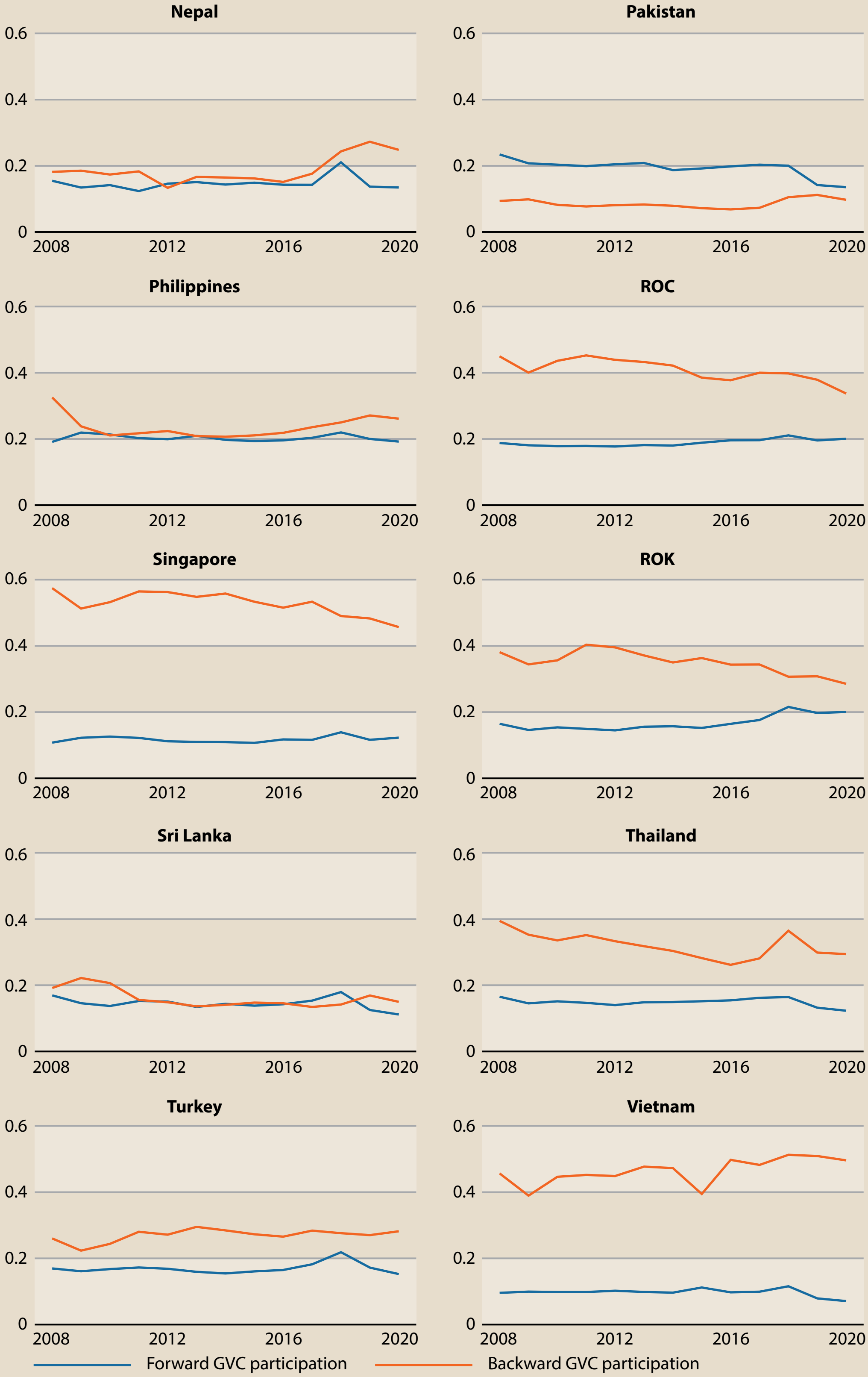


FIGURE A1B

TREND OF FORWARD/BACKWARD GVC PARTICIPATION FOR INDIVIDUAL APO MEMBERS.



THEMATIC ISSUE 2: ICT AND PRODUCTIVITY

Introduction

Information and communication technology (ICT) is considered a crucial driver of productivity growth. Technological progress in the ICT sector has lowered costs of processing information and communicating between economic agents, thus improving the economy's productivity in various ways. First, the ICT-producing industries themselves have superior productivity. As ICT's share increases, the overall economy's productivity improves due to the composition effect. Second, the ICT-using sectors improve production efficiency by using less inputs and replacing repetitive human tasks with ICT devices. Third, ICT lowers the fixed costs of product innovation and increases product variety [1]. Fourth, it increases match efficiency and minimizes idle resources [2]. Finally, as the economies of scale dictates, ICT intensifies competition between firms, thus improving allocative efficiency through reallocation [3].

However, the existing literature shows that not all economies can reap the benefits of ICT investment. Researchers have found that ICT investment accounts for a tiny portion of productivity growth in advanced countries, and the empirical relationship between the two is far from positive. Several hypotheses have been suggested to explain the 'productivity paradox,' or the 'Solow paradox.' They range from the mismeasurement hypothesis, which argues that official estimates underestimate output effects and overestimate price changes due to ICT; to the learning lag hypothesis, which claims that complementary investment is necessary to take advantage of ICT's full potential. Policymakers often focus on the role of regulations as they hamper the introduction of new business models and business practices.

This chapter explores the relationship between ICT and productivity in APO member countries. The upcoming section examines the role of ICT in productivity growth. By examining data from the APO and the Conference Board, this chapter shows how much ICT investment accounts for overall productivity growth and how it spills over to total factor productivity (TFP). The section highlights that not all APO member countries gain from ICT investment, which may be explained by complementary factors, such as management practices and skills. The subsequent section focuses on digitalization, which is the most important challenge of the time. It overviews the status and challenges of digitalization in APO member countries. It stresses that digitalization may widen productivity gap between firms and sectors and calls for effective government policy to close the gap. Finally, the last section concludes the chapter.

Role of ICT in Productivity Growth

This section examines the role of ICT in productivity growth. Although the introduction suggested various channels that contribute to productivity, we focus on the productivity potential of ICT, which is realized as technology permeates most areas of the economy. This also puts emphasis on the role of ICT capital, such as ICT hardware, communication equipment, and computer software. Firms purchase ICT capital and employ it in their production lines, for improving the production efficiency. Therefore, as more investment is made in ICT capital, we expect productivity to grow faster.

For the analysis, we use data from two reliable sources, the APO and the Conference Board, as these two datasets have different advantages. APO dataset has a full coverage of its member countries and provides sectoral information for manufacturing and services. However, it lacks some important information, such as the share of ICT capital in total investment. It only provides annual growth rates of ICT capital and non-ICT capital. This makes it difficult to evaluate the role of ICT in the medium and long run. By contrast, the Conference Board dataset includes the share of ICT capital in capital service. In addition, it provides key information for most of the countries across the world, though it misses some APO member countries. This allows researchers to compare the performance of APO member countries on a global scale.

Contribution of ICT Capital to Productivity Growth

We first quantify the importance of ICT capital investment in productivity growth through growth accounting. As it takes some time for ICT to have its effect on productivity, we conduct analyses for two subperiods, 2010–15 and 2015–18.

Figure 1 shows the decomposition result of labor productivity growth by four components: ICT capital investment, non-ICT capital investment, labor quality, and TFP. Panel A illustrates the result for the period 2010–15 and panel B for the period 2015–18. Both panels show that ICT capital investment contributed relatively less to labor productivity growth. Few countries saw that ICT capital deepening contributed more than 1% point.

What explains the small contribution of ICT capital? Is it due to ICT's smaller share in total capital or slow investment increase? Table 1 shows that ICT investment increased much faster than non-ICT investment since 2010. Low-income countries were more active in ICT investment. Within eight years, Bangladesh's ICT capital service increased more than five times, and those of Indonesia and Nepal more than three times. In contrast, most high-income countries saw less than 30% increase during the same period. Also, the increase in ICT capital was not much faster than non-ICT capital. The analysis suggests that the low contribution of ICT capital in low-income countries can be explained with their low share of ICT in total capital service. High-income countries, on the other hand, have small contribution because their investments in ICT capital have slowed.

Figure 2 corroborates this observation. Low-income countries exhibit higher labor productivity growth rates, but ICT capital makes small contribution. High-income countries show lower labor productivity growth as their economies mature, but their labor productivity growth draws more on ICT capital service than low-income countries.

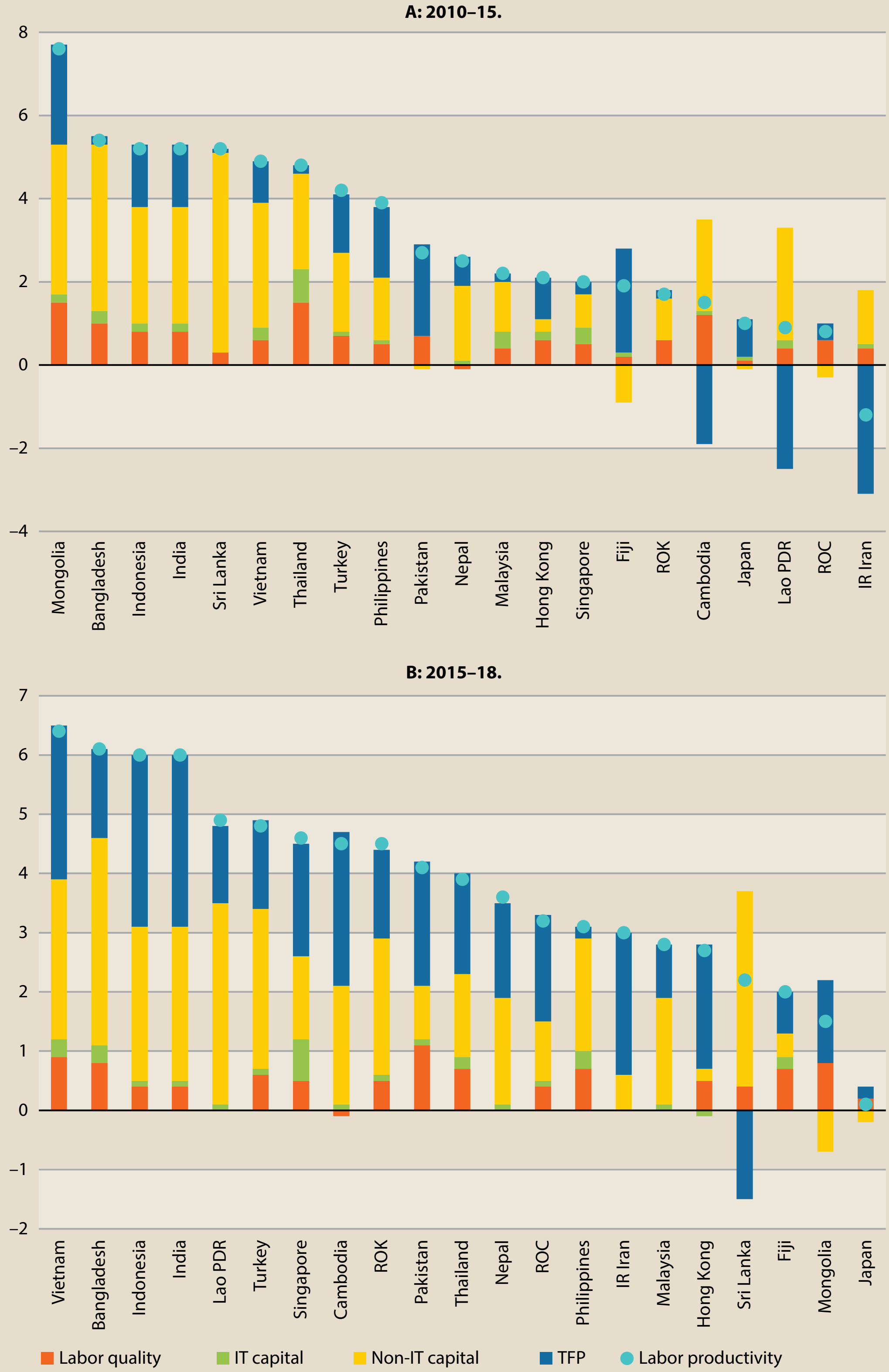
This observation suggests different policy implications for different groups. Low-income countries are required to maintain the current momentum in ICT investment, whereas high-income countries need policies to revive ICT investment.

Who Benefits from ICT Capital in Manufacturing?

The findings of the previous subsection imply heterogeneity in the capability of countries to reap benefits from ICT investments. Now we analyze this aspect in more depth. Considering that manufacturing is the sector that benefits the most from ICT investment, we test how capital services of different types affect labor productivity in the manufacturing sector.

FIGURE 1

ROLE OF ICT INVESTMENT IN LABOR PRODUCTIVITY GROWTH.



Source: APO Productivity Database.

TABLE 1

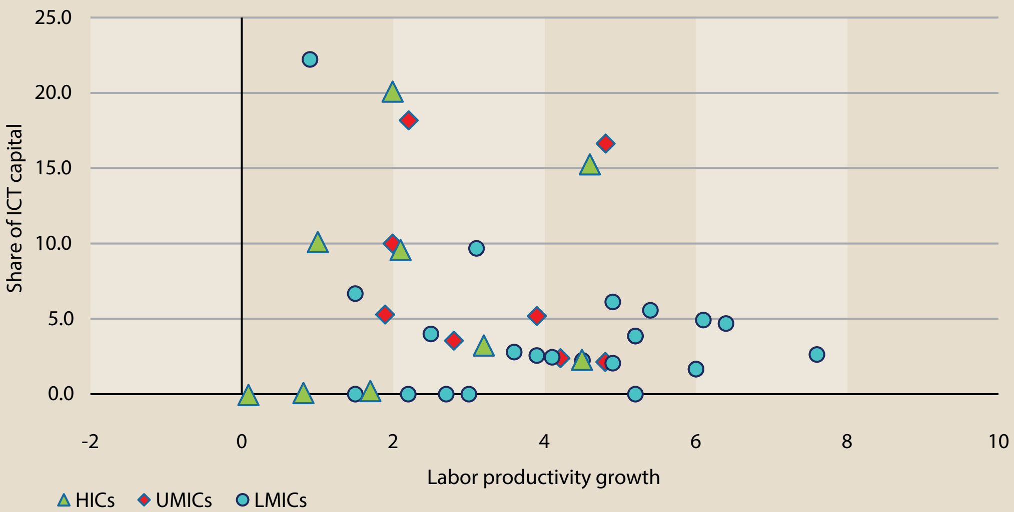
ICT AND NON-ICT CAPITAL INPUT, 2018 (2010=1).

Group	Country	ICT capital	Non-ICT capital
LMIC	Bangladesh	5.5	1.8
	Cambodia	2.5	1.7
	Indonesia	3.3	1.7
	India	2.8	1.8
	IR Iran	2.0	1.2
	Lao PDR	2.1	1.9
	Mongolia	1.8	1.5
	Nepal	3.3	1.6
	Pakistan	1.7	1.1
	Philippines	2.5	1.5
	Sri Lanka	1.3	1.7
	Vietnam	3.2	1.7
UMIC	Fiji	1.9	1.1
	Malaysia	2.1	1.5
	Thailand	2.1	1.2
	Turkey	2.1	1.6
HIC	Hong Kong	1.3	1.1
	Japan	1.1	1.0
	ROK	1.2	1.3
	ROC	1.3	1.1
	Singapore	2.8	1.3

Source: APO Productivity Database.

FIGURE 2

LABOR PRODUCTIVITY GROWTH AND SHARE OF ICT CAPITAL.



Source: APO Productivity Database.

For the analysis, we perform panel regression with the following specification:

$$ln(LP)_{c,t} = \beta_0 + \beta_1 IT_{c,t} + \beta_2 NonIT_{c,t} + \delta_c + \eta_t + \varepsilon_{c,t}$$

where c represents country and t stands for year. We use annual data from 2000. LP is labor productivity in the manufacturing sector, defined as manufacturing output at constant price divided by employment in manufacturing. $IT_{c,t}$ and $NonIT_{c,t}$ represent capital service rather than capital stock, which is available as an index in APO data. δ_c and η_t are country and year fixed effects.

Table 2 reports the fixed model panel regression results. To consider the effect of export orientation, we added the share of net exports in GDP. Other unobserved country-specific invariant characteristics would be absorbed by countries' fixed effects. Column 1 shows that ICT capital service has negative effect on manufacturing labor productivity, whereas non-ICT capital has a positive effect. Adding the share of net exports in column 2 does not alter the results. This is a striking effect considering the promised effects of ICT on manufacturing production and product innovation.

However, the results in columns 1 and 2 mask much heterogeneity across countries. To reveal such heterogeneity, columns 3 and 4 introduce interactions in terms of the capital service and the income group dummy. The results show that lower-middle-income countries do not enjoy any positive effects from ICT capital service. In fact, an increase in ICT capital leads to a decrease in labor productivity in manufacturing. In contrast, ICT capital has a positive effect on productivity in high-income countries.

It is noteworthy that all countries benefit from an increased non-ICT capital service, though the high-income member countries show greater effects of non-ICT capital. Why do lower-income countries not have productivity gains from ICT capital, unlike traditional capital? A compelling argument is that ICT needs complementary factors to increase productivity. For example, the literature documented that better management practices and organizational capabilities enhance productivity, which is even more powerful for the ICT sector, and considerable differences in managerial abilities exist between countries [4, 5]. Management practices are again determined by competition, business environment, and human capital [5, 6]. These discussions call lower-income countries for more investment in complementary factors.

TABLE 2

REGRESSION RESULT (MANUFACTURING LABOR PRODUCTIVITY AND ICT CAPITAL).

Dependent variable	Labor productivity in manufacturing			
	(1)	(2)	(3)	(4)
ICT capital service	−0.075**	−0.073**		
	(0.023)	(0.023)		
Non-ICT capital service	0.419**	0.415**		
	(0.062)	(0.062)		
ICT capital service * LMICs			−0.073**	−0.072**
			(0.024)	(0.024)
ICT capital service * UMICs			−0.075	−0.075
			(0.059)	(0.060)

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Dependent variable	Labor productivity in manufacturing			
	(1)	(2)	(3)	(4)
ICT capital service * HICs			0.124* (0.059)	0.124* (0.059)
Non-ICT capital service * LMICs			0.508** (0.070)	0.507** (0.071)
Non-ICT capital service * UMICs			0.442** (0.148)	0.444** (0.151)
Non-ICT capital service * HICs			0.734** (0.164)	0.732** (0.166)
Share of net exports in GDP		0.001 (0.002)		0.000 (0.001)
Constant	4.320** (0.046)	4.322** (0.046)	4.198** (0.051)	4.198** (0.052)
Observations	378	378	378	378
R-squared	0.746	0.746	0.783	0.783

Note: Standard errors are in parentheses. Country and year fixed effects are included in the regression but not reported in the table.
* significant at 5%. ** significant at 1%.

Productivity Paradox?

The question of how ICT affects labor productivity via capital investment was investigated. This subsection explores whether ICT can boost overall efficiency, commonly measured by TFP, via spillover effect. This question is important because if ICT boosts the overall efficiency of production, one should find a positive relationship between the share of ICT in capital service in the starting year and the subsequent TFP growth. However, researchers often found that the empirical relationship was either ambiguous or neutral, which is called the productivity paradox or the productivity puzzle.

The hypothesis applied to APO member countries using the Conference Board data is then tested. As explained in the beginning of the section, the dataset has an advantage as it includes many countries outside Asia and provides the share of ICT in capital service. The dataset suits the research goal as it allows comparing APO member countries with other countries in the world.

A simple fixed panel regression analysis using the data for 1990, 2000, 2010, and 2018 is performed. By regressing TFP growth on the previous period's ICT share in capital service and controlling for country and year fixed effects, it is possible to obtain a near-causal relationship between ICT share and TFP.

Table 3 presents the results for the period since 2000. Column 1 finds a negative relationship between ICT share and TFP, suggesting a possibility of productivity paradox. However, columns 2 and 3 show that it is due to non-APO member countries. Figure 3 graphically illustrates the relationship for APO member countries. Both panels show that there is a positive relationship between the share of ICT in capital service and TFP, though Table 3 indicates that ICT is not statistically significant.

TABLE 3

REGRESSION RESULT (TFP GROWTH AND ICT'S SHARE IN CAPITAL SERVICE).

Dependent variable	TFP growth		
	(1)	(2)	(3)
	World	APO	World
ICT's share in capital service (t-1)	−1.058* (0.520)	−0.292 (0.826)	
ICT's share in capital service (t-1) * Non-APO			−1.157* (0.559)
ICT's share in capital service (t-1) * LMIC			−0.517 (1.680)
ICT's share in capital service (t-1) * UMIC			0.683 (3.082)
ICT's share in capital service (t-1) * HIC			−4.693 (8.083)
Constant	0.053 (0.039)	0.072 (0.079)	0.061 (0.045)
Observations	390	48	390
R-squared	0.068	0.005	0.070

Note: Standard errors are in parentheses. Country and year fixed effects are included in the regression but not reported in the table.
* Significant at 5%. ** Significant at 1%.

Figure 3 also presents interesting patterns for low-income countries. First, the share of ICT in capital service has decreased significantly in these countries. Bangladesh saw the biggest decrease in the share of ICT capital, from about 15% to below 5%. However, it was not because ICT investment decreased. Table 3 shows that ICT stock growth in these countries accelerated rather than slowed down. The decline in the ICT share was therefore driven by even faster increase in non-ICT capital.

Another encouraging fact is that low-income countries took more from ICT investment in the 2010s. Although the fitted line became flatter overall, the slope for low-income countries became even greater. This suggests that these countries were more able to leverage the ICT investment. While there would be several explanations, the learning effect may be one of the most crucial factors behind this phenomenon; i.e., as low-income countries accumulate experiences in utilizing ICT capital, they learn more about where and how to apply them.

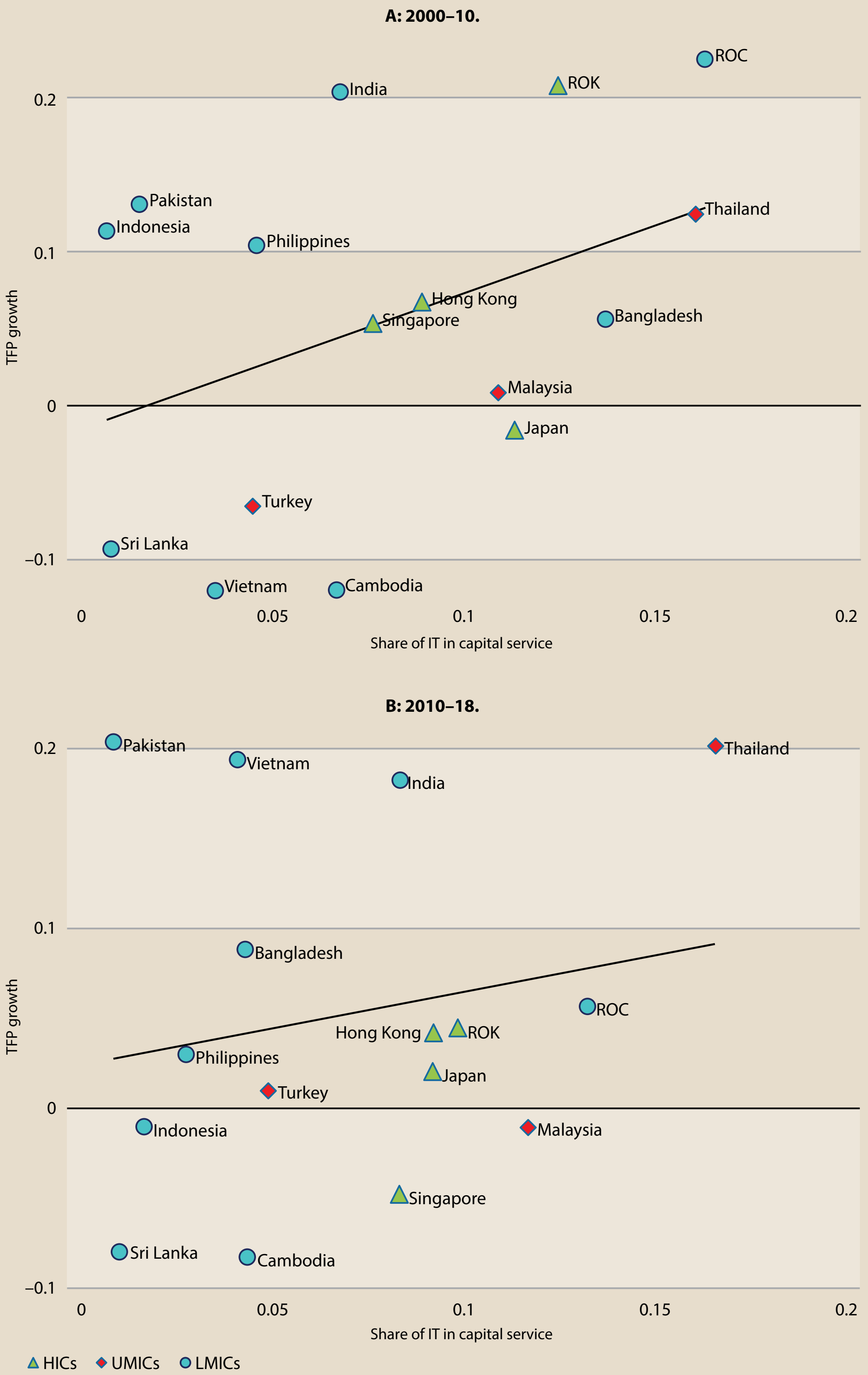
New Challenge: Digital Transformation

This section explores a new challenge, the wave of digitalization that is driven by artificial intelligence (AI), big data, and cloud computing. These new digital technologies have transformative effects. The combination of AI and big data changes the way firms operate since it enables constant experimentation and feedback of real-time data into production and innovation [7]. Cloud computing shifts the way firms employ ICT, from purchase to service. As digitalization lowers the fixed costs for ICT investment, small and young firms are expected to benefit more than the large and old ones.

Due to these promised benefits of new digital technologies, many countries set up plans for digital transformation, which envisions the application of digital technologies to all areas of business, from

FIGURE 3

TFP GROWTH AND ICT'S SHARE IN CAPITAL SERVICE FOR APO MEMBER COUNTRIES.



production to business processes and organizations. However, researchers argue that physical investment in ICT is only a part of digitalization. Policymakers need to think how to provide organizations better access to digital technologies and facilitate them in various areas to leverage technology for improving productivity. This section overviews the current state of digitalization of APO member countries.

Digital Technology Adoption

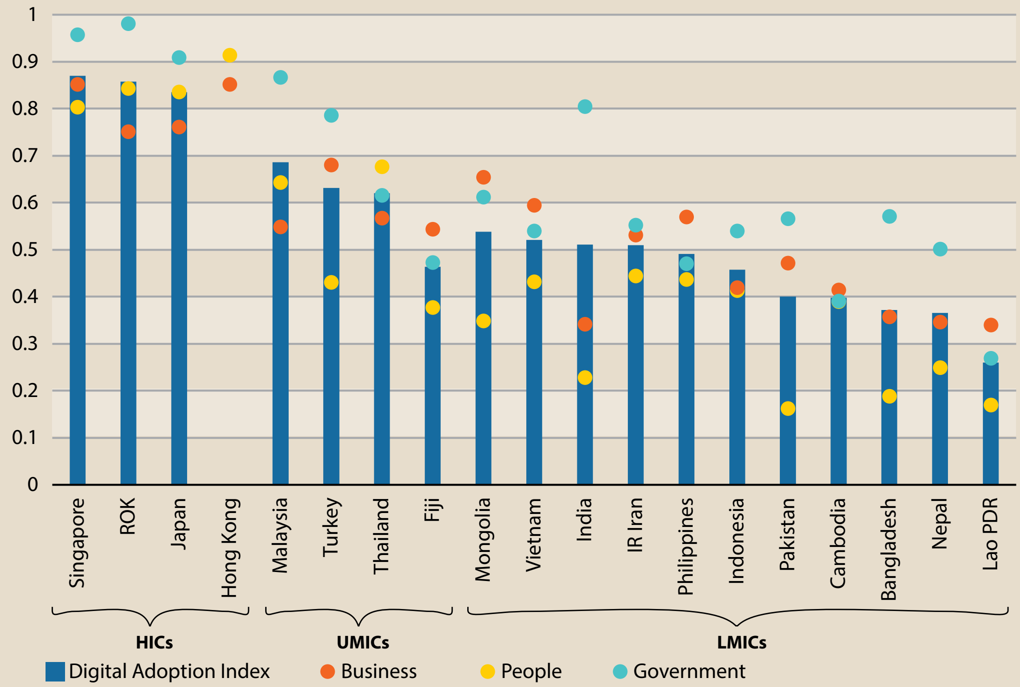
The World Bank Digital Adoption Index (DAI) offers an opportunity to measure a country's digital transformation level on a 0–1 scale. The DAI dataset has advantages in that it covers most APO member countries and has subindices for businesses, people, and governments. Figure 4 shows the DAI of APO member countries for 2016. The figure shows that there are significant gaps in digital readiness between countries. While Singapore, the ROK, and Japan score above 0.8, the bottom-five countries score below 0.4. This digital divide mirrors the gap in ICT investment, suggesting that the ICT divide is likely to widen further between nations. Low-income countries will need to make policy efforts to encourage digital technology adoption.

The DAI provides an additional advantage for analysis as it measures digital adoption by different subsectors. These include increasing productivity and accelerating broadbased growth for businesses, expanding opportunities and improving welfare for people, and increasing the efficiency and accountability of service delivery for governments [8].

Figure 4 also presents the status of member countries in each subsector. Notable is that the government sector leads overall digitalization. In almost every country, the government score exceeds the overall DAI. Although a few lower-middle-income countries show much greater role of the government's digital leadership, it is never small in high-income countries.

FIGURE 4

DIGITAL ADOPTION INDEX FOR APO MEMBER COUNTRIES, 2016.



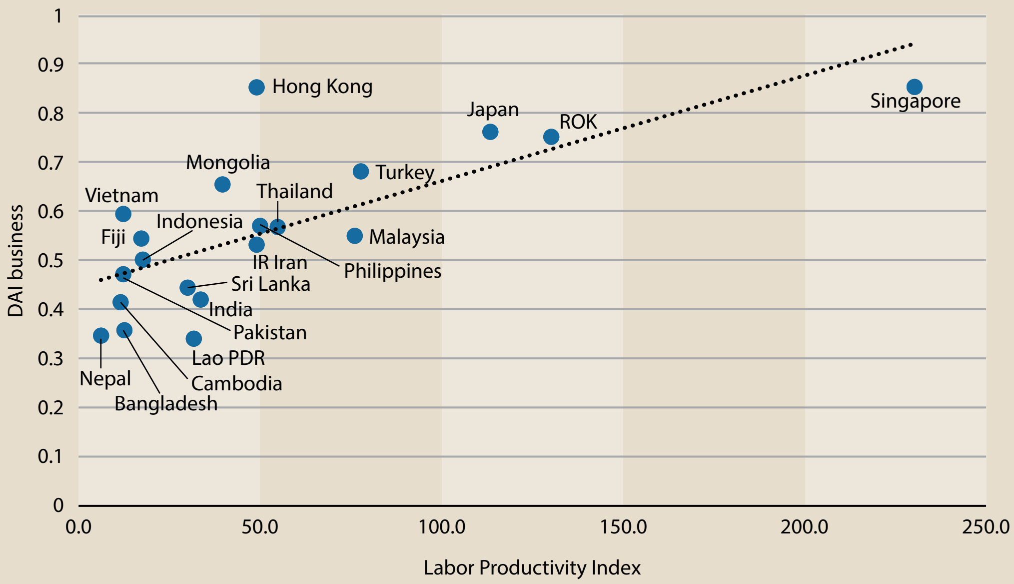
Source: The World Bank Digital Adoption Index.

Of the three subsectors, the people section shows the greatest dispersion as the standard deviation is 0.231, compared with 0.161 and 0.184 for businesses and governments, respectively. This indicates that the use of digital technology in everyday life is weak in low-income countries, which negatively affects the demand for digital technology. In these countries, the government is required to create public demand.

Figure 5 illustrates the relationship between manufacturing labor productivity and business DAI. To calculate the manufacturing labor productivity, we divided the manufacturing output of 2018 in constant prices (million USD, 2017 PPP), by manufacturing employment, with all data provided by APO Productivity Database. The figure shows that firms in high-productivity countries are better prepared for digitalization. Considering that the manufacturing sector will utilize digital technologies the most, one can predict that low-productivity countries may find it even more difficult to close the gap in the digital era.

FIGURE 5

MANUFACTURING LABOR PRODUCTIVITY AND DIGITAL ADOPTION INDEX FOR BUSINESSES.



Widening Gaps between Firms can Slow Productivity Growth

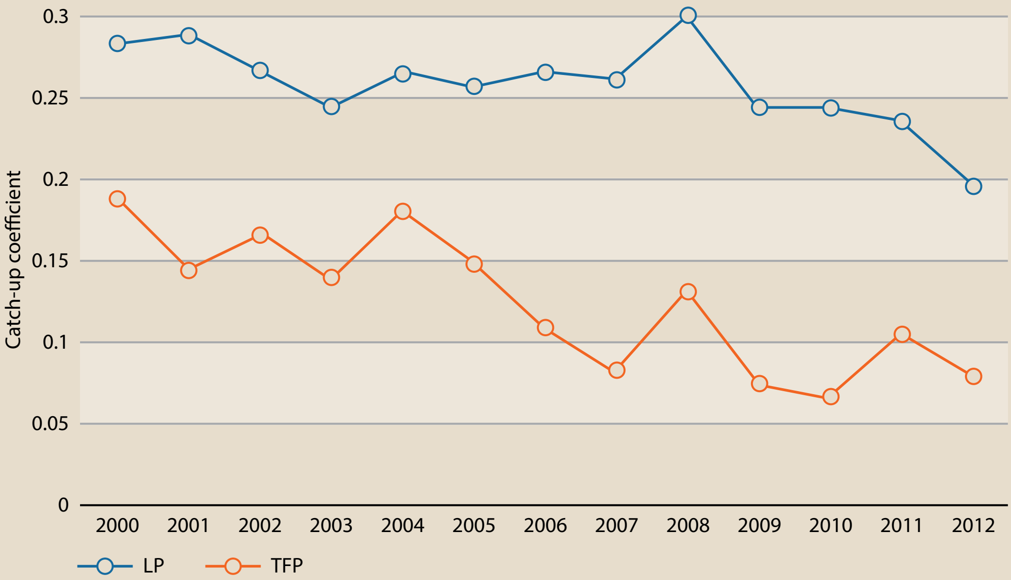
ICT not only improves overall productivity, but is also a disrupting force. While some sectors and firms adopt and leverage ICT, there exist those who are left behind. This creates productivity gaps and causes the aggregate productivity growth to slow down. This digital divide poses a significant challenge to policymakers. It is considered to serve as a general-purpose technology, with wide-ranging effects on the economy. Such effects would be materialized when technology penetrates the lower end of productivity distribution. This requires policy efforts to encourage small and medium firms to invest more in ICT.

However, with focus on developed countries, existing literature has shown that productivity gap between firms has been widening since 2000. While such a gap is natural in market economies, well-functioning markets have enabled low-productivity firms to observe, learn, and adopt the best technologies and practices of frontier firms. Facing the competitive pressure, low-performance firms could also choose to shut down or exit, which contributes toward improving the industry's productivity.

However, recent evidence indicates that such a convergence mechanism does not function well as before. Figure 6 shows that the speed of catchup of lagging firms has been slowing, in terms of both labor productivity and TFP in European countries.

FIGURE 6

DECLINING CATCH-UP SPEED IN EUROPEAN COUNTRIES.



Source: Berlingieri, *et al.* [9].

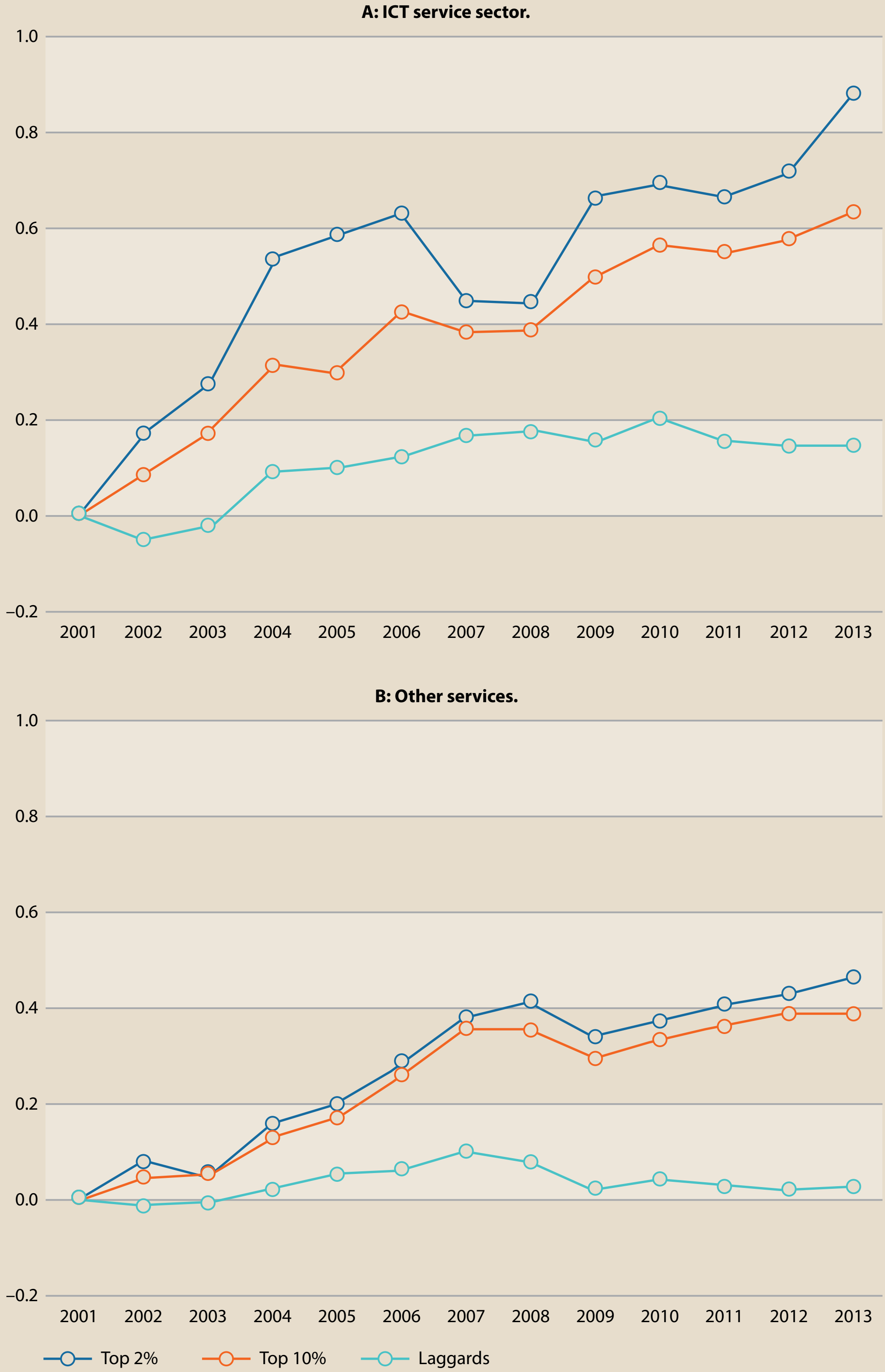
While there are several suggested factors behind this phenomenon, the differential degree of ICT adoption and usage is considered a major factor. Figure 7 shows that the winner-takes-all dynamics intensifies among OECD countries. When only the leading firms take advantage of ICT, the aggregate productivity may not improve at a fast pace, and the productivity gaps between firms may widen. The pace of widening gap is even faster in the ICT service sector (see panel A in Figure 7) than in other service sectors. For this reason, the related literature calls for policies to facilitate technology adoption by small- and medium-sized enterprises (SMEs) and more intense selection of lagging firms and reallocation toward more productive firms.

Although we need more evidence for APO member countries to tell whether digitalization serves as a diverging force, it is advisable for policymakers to pay attention to the fact that some firms are not left behind in the digital race and ICT does not limit the effect of digitalization on productivity.

Although it addresses the case of the ROK, Figure 8 demonstrates that there is considerable sectoral and firm heterogeneity. It is built on Statistics Korea's official survey of firms' universe, the annual Survey of Business Activities (SBA). The first column indicates the share of firms using at least one Industry 4.0 technology. The second to fifth columns indicate the adoption rates of AI, big data analytics, cloud computing, and IoT.

FIGURE 7

EVOLUTION OF FIRM-LEVEL TFP IN OECD COUNTRIES.



Source: Andrews, *et al.* [10].

Figure 8 shows that Industry 4.0 technologies were not widely used as of 2018. In only five industries, information technology (IT) manufacturing, ICT service, finance and insurance, utilities (i.e., electricity, gas, steam, and air conditioning), and education, more than 10% of firms used at least one Industry 4.0 technology. It also shows the adoption rates of SMEs with less than 250 employees (panel A) and those of large firms with 250 employees and more (panel B). Comparing the two panels reveals that the use of Industry 4.0 technologies was concentrated among large firms, though the difference was relatively small in the ICT manufacturing and ICT service sectors. Limiting the scope to large firms, we find that in 2008, Industry 4.0 was widely used in the construction and wholesale and retail trade industries. Another interesting fact is that SMEs did not use cloud computing much, though they were expected to benefit more from it than large firms.

The figure suggests that SMEs will need policy support to adopt digital technologies. This will help close the digital gaps between firms, thus promoting both growth and inclusiveness. Such efforts can be seen in several countries, by way of subsidizing the purchase of ICT hardware and software and promoting the supply sector to bring affordable digital services to the market. However, policy studies also highlight the often-neglected roles of governments. For example, OECD [6] suggests that enhancing worker skills through training is crucial because "less productive firms suffer relatively more from skill shortages." Pew Research Center's survey [11] shows that governments need to improve public awareness of digital technologies. According to the survey, there were notable differences in the perception of AI and automation. While 72% of Singaporeans, 69% of Koreans, and 67% of Indians saw the development of AI as a good thing, only 53% of Malaysians had such a positive view and 44% of them saw ICT as a bad thing. Likewise, 61% of Singaporeans and 62% of Koreans considered using robots for automation as a good thing, but only 47% of Indians and 45% of Malaysians held the positive view.

In-depth Diagnosis for Income Groups

Based on the general findings of previous sections, this section offers in-depth diagnosis for seven member countries: India, Indonesia, Japan, the ROK, the Philippines, Thailand, and Vietnam. The focus of diagnosis is twofold: (1) how the target country has performed in terms of ICT capital input since 2010; and (2) how ICT investment is associated with TFP.

Lower-middle-income Countries

Figure 9 shows the trend in ICT capital input of four lower-middle-income countries (LMICs), namely, India, Indonesia, the Philippines, and Vietnam. It also compares the changes in ICT capital and non-ICT capital for each country.

The figure shows that India, Indonesia, and Vietnam have performed well in ICT investment since 2010. The increase in ICT capital input in these three countries is far above the average change for other LMICs, though it shows a sign of slowdown since the mid-2010s in Vietnam. In these countries, ICT capital has increased much faster than non-ICT capital, which seems to reflect continued government efforts on the ICT investment front.

In contrast, the Philippines has been below the average in capital input increase. However, the country shows a positive sign as ICT investment has accelerated since 2015. Policy efforts, such as the establishment of Department of Information and Communications Technology in 2016 and infrastructure modernization initiative, would have made significant contributions toward the outstanding change.

FIGURE 8

DIGITAL TECHNOLOGY ADOPTION BY SECTOR AND FIRM SIZE IN THE ROK, 2018.

A. Small and medium-sized firms with less than 250 employees

	4.0	AI	BD	Cloud	IoT
18 Manufacturing	5.4	1.2	1.7	2.1	3.0
17 ICT manufacturing	13.8	3.8	3.4	3.3	10.1
16 non-ICT manufacturing	4.5	0.8	1.5	2.0	2.1
15 Electricity, gas, steam, and airconditioning	5.1	0.0	5.1	0.0	0.0
14 Water supply	3.2	0.0	0.8	3.2	0.8
13 Construction	5.3	0.8	1.2	2.9	2.3
12 Wholesale and retail trade	6.1	1.7	2.7	3.2	2.3
11 Transportation and storage	2.7	0.2	1.2	1.7	0.3
10 Accommodation and food service activities	1.5	0.7	0.4	0.7	1.1
09 Information and communication	30.5	10.6	14.6	17.4	10.9
08 Financial and insurance activities	9.5	2.3	5.4	5.4	0.9
07 Real estate activities	1.6	0.0	0.0	0.5	1.1
06 Professional, scientific, and technical activities	9.9	2.8	5.8	4.5	3.9
05 Business facilities management/services	4.9	1.1	3.5	2.1	0.7
04 Education	12.3	6.2	3.1	4.6	4.6
03 Human health and social work activities	0.0	0.0	0.0	0.0	0.0
02 Arts, sports, and recreation-related services	2.8	0.0	1.0	1.0	1.0
01 Membership org./other personal services	1.5	0.0	0.0	1.5	0.0

Rate: 30–30.5; 27.5–30; 25–27.5; 22.5–25; 20–22.5; 17.5–20; 15–17.5; 12.5–15; 10–12.5; 7.5–10; 5–7.5; 2.5–5; 0–2.5

B. Large firms with 250 employees and more

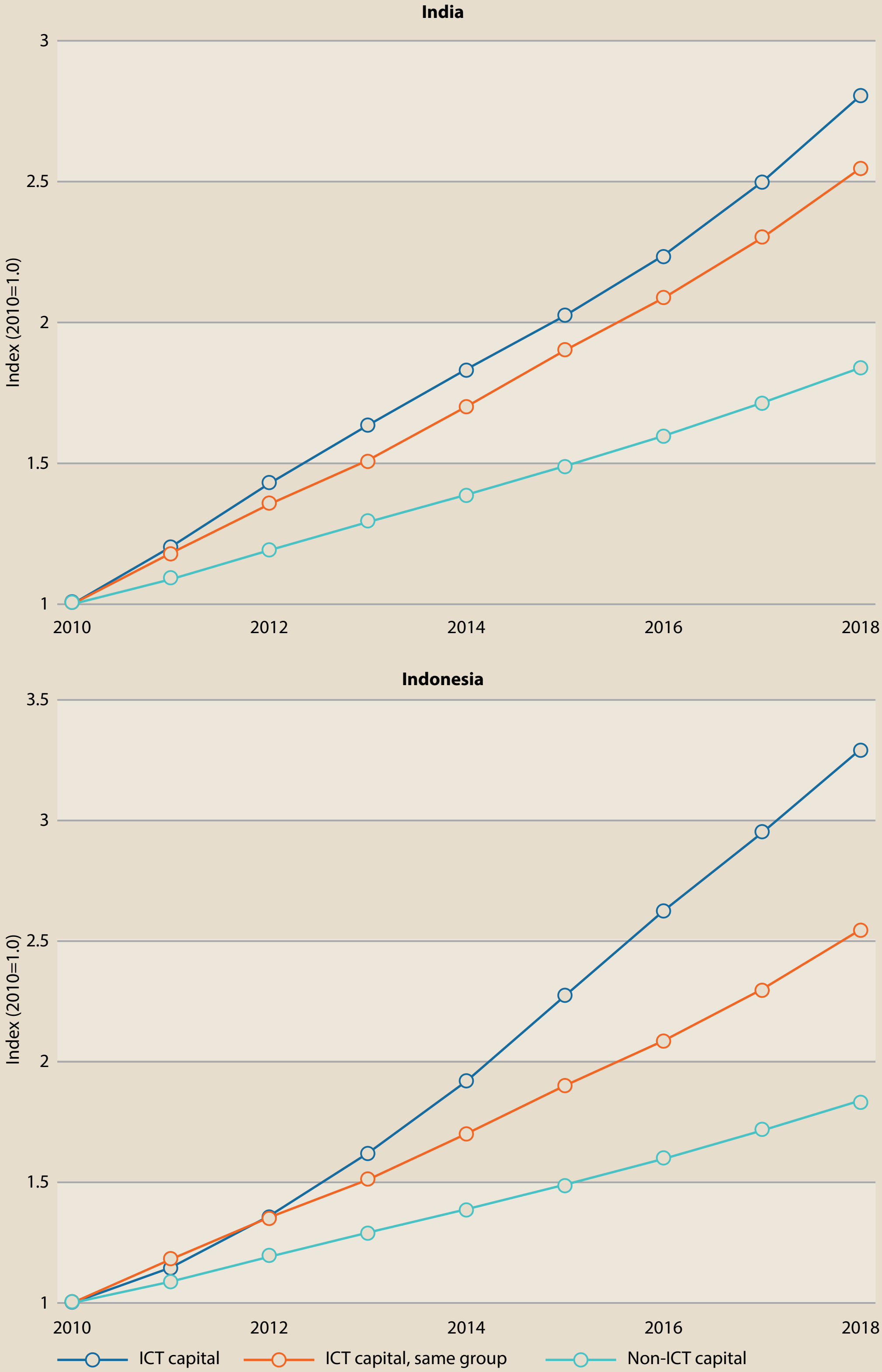
	4.0	AI	BD	Cloud	IoT
18 Manufacturing	13.0	4.2	6.7	5.2	6.4
17 ICT manufacturing	27.5	9.8	5.9	5.9	18.6
16 non-ICT manufacturing	13.9	4.9	8.3	6.3	6.4
15 Electricity, gas, steam, and airconditioning	50.0	14.3	28.6	50.0	35.7
14 Water supply	0.0	0.0	0.0	0.0	0.0
13 Construction	21.6	6.8	8.1	14.9	14.9
12 Wholesale and retail trade	17.7	6.6	11.6	8.3	8.8
11 Transportation and storage	3.4	1.4	2.1	2.1	2.1
10 Accommodation and food service activities	10.1	0.0	5.8	7.2	4.3
09 Information and communication	52.8	24.5	38.0	36.8	18.4
08 Financial and insurance activities	36.9	21.3	32.0	16.4	8.2
07 Real estate activities	4.8	0.0	1.6	3.2	3.2
06 Professional, scientific, and technical activities	6.4	1.1	5.3	4.3	2.1
05 Business facilities management/services	4.3	1.2	2.4	0.9	2.1
04 Education	13.3	0.0	6.7	6.7	0.0
03 Human health and social work activities	0.0	0.0	0.0	0.0	0.0
02 Arts, sports, and recreation-related services	0.0	0.0	0.0	0.0	0.0
01 Membership organization/other personal services	25.0	12.5	12.5	12.5	12.5

Rate: 52.5–52.8; 50–52.5; 47.5–50; 45–47.5; 42.5–45; 40–42.5; 37.5–40; 35–37.5; 32.5–35; 30–32.5; 27.5–30; 25–27.5; 22.5–25; 20–22.5; 17.5–20; 15–17.5; 12.5–15; 10–12.5; 7.5–10; 5–7.5; 2.5–5; 0–2.5

Source: Lee, *et al.* [12].

FIGURE 9A

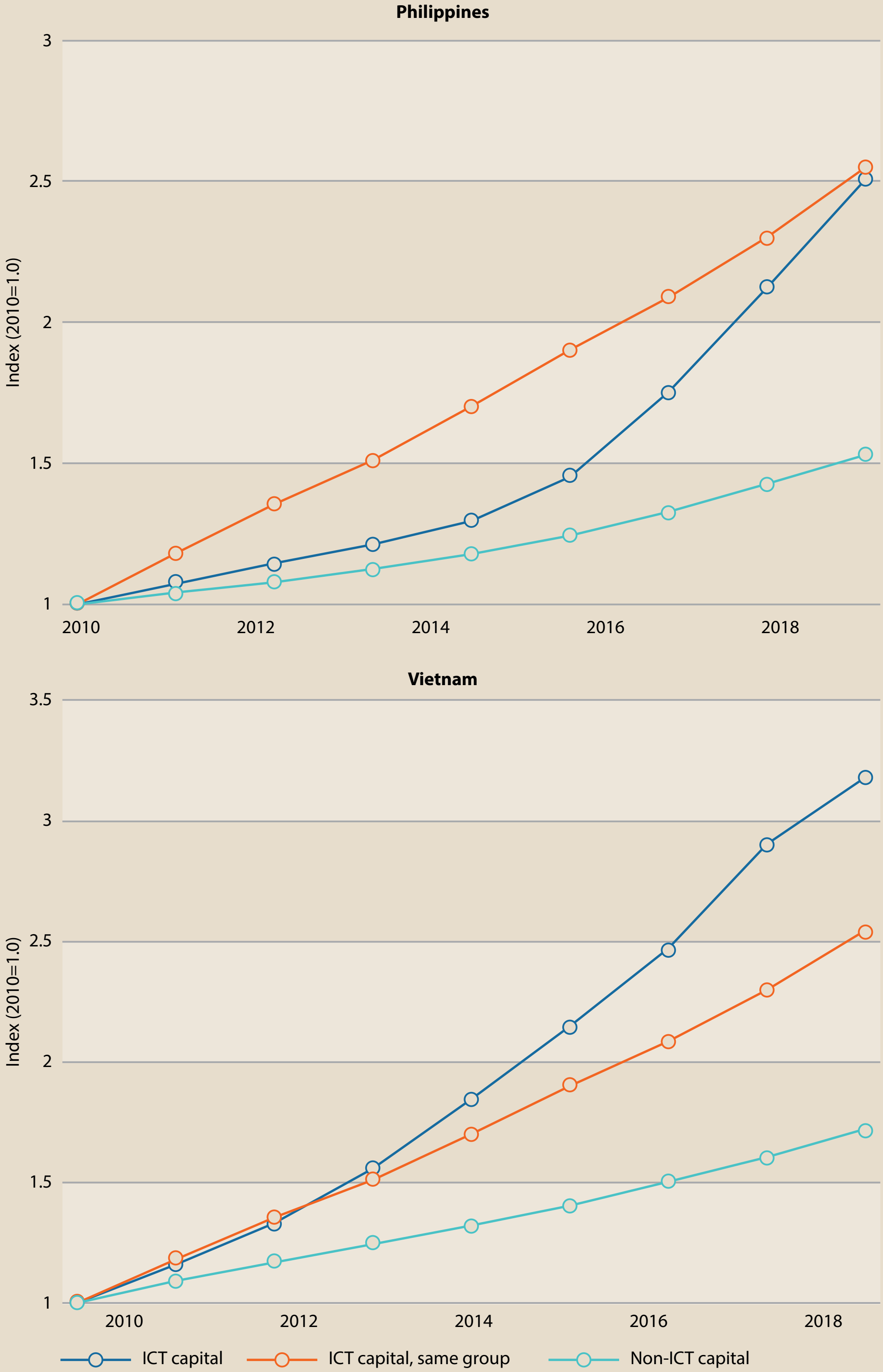
ICT AND NON-ICT CAPITAL INPUT TRENDS IN LMICS.



Source: APO Productivity Database.

FIGURE 9B

ICT AND NON-ICT CAPITAL INPUT TRENDS IN LMICS.



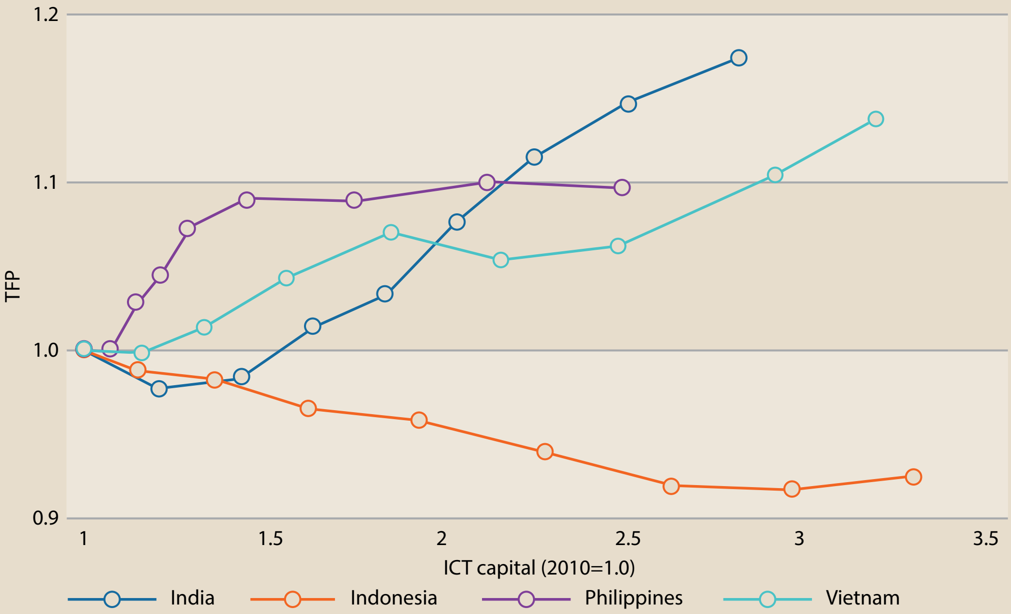
Source: APO Productivity Database.

While all four LMICs exhibit a steady increase in ICT capital input, which needs to be sustained, the degree of how ICT capital affects TFP differs by country. Figure 10 shows the trajectory of the four countries in the ICT capital and TFP space since 2010. The correlation between ICT capital and TFP increases in India and Indonesia. This indicates that these countries have learned how to leverage ICT to improve productivity by investing in and utilizing the complementarities such as training and management practices.

The other two countries show a worrying sign. The correlation between ICT capital and TFP has stagnated in the Philippines since the mid-2010s and decreased in Vietnam over time. This means that the countries got less out of the same ICT capital input, or in other words, the productivity of ICT capital diminished. To change the trend, these countries will need to match the fast increase in ICT capital, shown in Figure 9, with complementary investments.

FIGURE 10

ICT CAPITAL INPUT AND TFP IN LMICs SINCE 2010.



Source: APO Productivity Database.

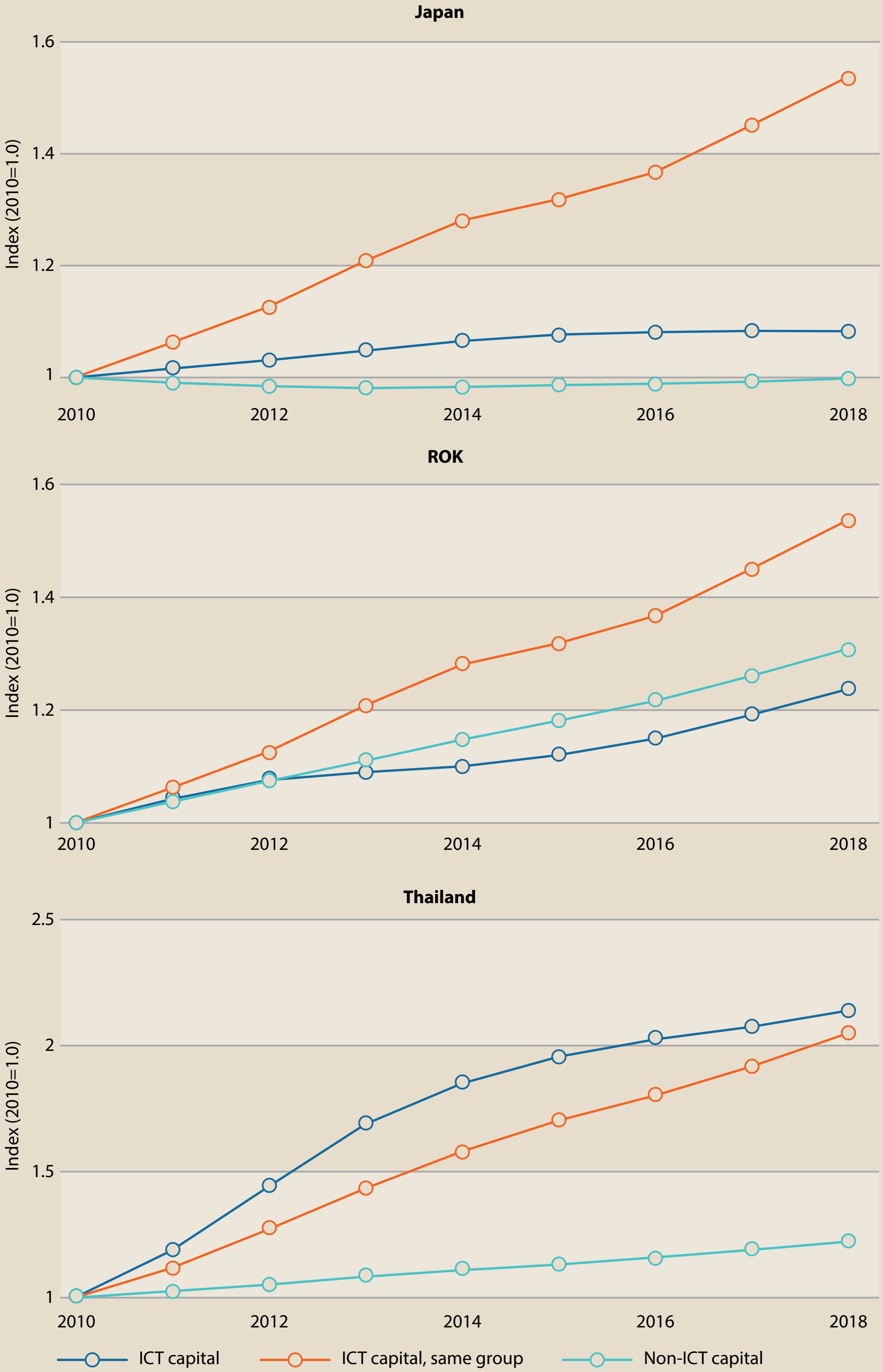
Upper-middle and High-income Countries

Unlike LMICs, upper-middle and high-income countries show relatively slow increasing trend in ICT capital. As Figure 11 shows, ICT capital investment in high-income countries is either stagnating (Japan) or even slower than non-ICT capital (ROK). ICT investment in these two countries is low even compared with other high-income countries. This recalls the policy suggestion drawn in the previous section that high-income countries need to revive ICT investment to continue productivity growth. This is particularly true because Figure 12 shows that they can still benefit much from ICT capital.

Thailand, an upper-middle-income country, still shows a robust increasing trend in ICT capital investment, even compared with other UMICs. However, the investment has slowed down and it does not lead to gain in productivity from ICT as much as is the case for HICs and well-performing LMICs. This indicates that the country faces dual challenges of keeping the investment momentum and boosting the ICT capital's productivity by improving complementary factors.

FIGURE 11

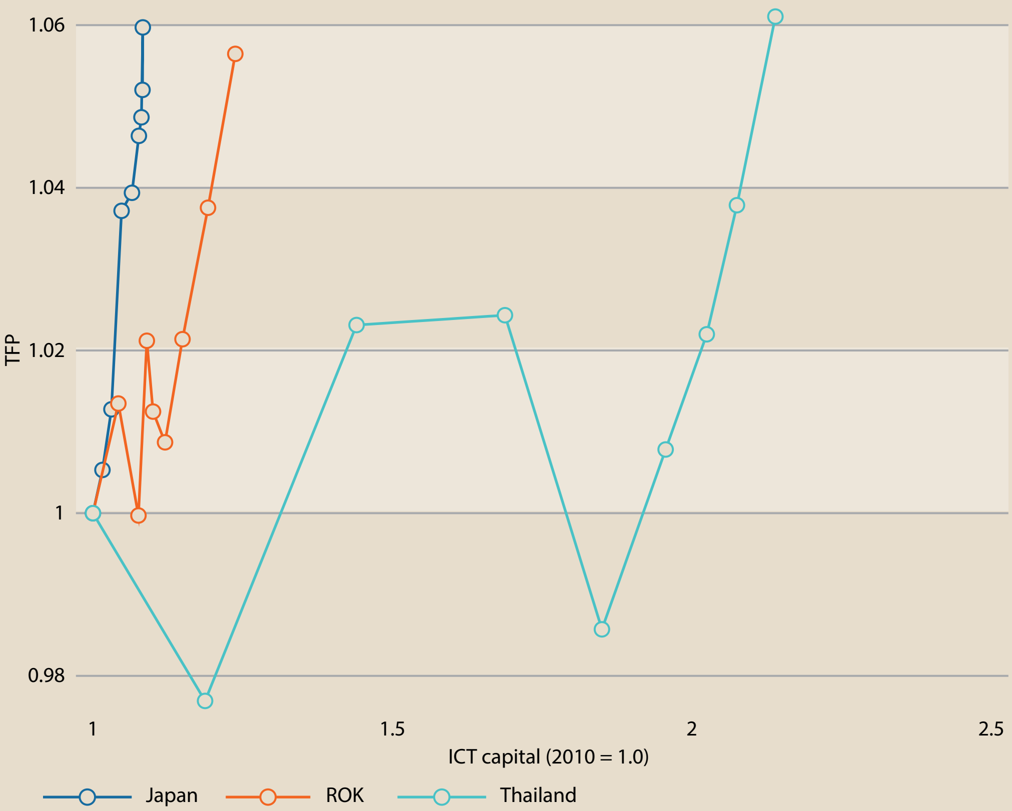
TRENDS IN ICT AND NON-ICT CAPITAL INPUT IN UMICS AND HICS.



Source: APO Productivity Database.

FIGURE 12

ICT CAPITAL INPUT AND TFP IN UMICS AND HICS SINCE 2010.



Source: APO Productivity Database.

Policy Implications

This chapter examined the relationship between ICT and productivity in APO member countries. Although the decomposition analysis showed that ICT capital investment accounts for relatively small shares in overall labor productivity growth, the cross-country analysis demonstrated that ICT investment can enhance manufacturing labor productivity and economy-wide TFP. However, it also unveiled considerable heterogeneity in that not all countries benefit from ICT investment. While high-income countries enjoyed spillover effects of ICT on TFP, low-income countries did not. The related literature suggests that they need complementary investment, such as worker training and management practices. This chapter suggests that policymakers need to encourage the adoption of high-performance practices and training mechanisms.

Digitalization is another important challenge ahead for APO member countries. This chapter showed that low-productivity countries also scored low on the digital adoption index, indicating that the digital gap between countries is likely to widen rather than narrow. The underlying mechanism is that only a small share of firms is coping well with digitalization while others are behind. This generates the dual challenge of low productivity growth and growing disparity between firms. Policymakers need to nudge SMEs to adopt digital technologies, but the policy option should not be limited to providing subsidy. They need to strive to improve the effectiveness of existing policies as well as promote public awareness and utilize the market competition forces.

Based on the findings of this chapter, we make different policy suggestions for low- and high-income countries. Low-income countries need to maintain the momentum in ICT capital investment and improve complementary factors, such as worker skills and management practices to reap more of the promised benefits of ICT. High-income countries need to focus on revitalizing ICT investments to get still more out of ICT capital by leveraging better human capital and management practices.

This chapter also revealed limitations of existing data and research and opened a new avenue for future research. The third and fifth sections demonstrated the importance of complementary factors. The fourth section documented that micro-level dynamics and aggregate performance are closely related. Yet, the relevant information for member countries was rarely obtained and investigated. More information for complementarity, micro-level evidence, and policy evaluation is required to craft policies to utilize ICT as a lever of growth.

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Appendix

TABLE A

VARIABLES AND DATA SOURCES.

List of variables	Data sources
Labor quality IT/ICT capital Non-IT/ICT capital Total factor productivity (TFP) Labor productivity	APO Productivity Database
IT/ICT's share in capital service	Conference Board Database
Digital Adoption Index	The World Bank

CONCLUSION

This report covered the trends and challenges of productivity growth for several APO member countries with a special focus on three thematic issues: the COVID-19 pandemic, global value chains (GVCs), and information communication technology (ICT). The research was conducted during the pandemic situation related to COVID-19. This unprecedented situation is affecting daily lives across the world. As the first chapter of this report revealed, COVID-19 has caused recessions in global and national economies by affecting every sector. At the same time, countries have taken preventive measures such as lockdown, quarantine, and border restriction. Due to these measures taken to stop the spread of the infection, the flow of labor, products, and services across and within the borders has shrunken and the growth of world GDP has stagnated.

However, since this crisis is comparatively new and its impact is quite unpredictable, instead of rushing to the subject, this year, we decided to focus on issues that are more traditional but closely related to COVID-19, i.e., GVCs and ICTs. Since the pandemic situation is a shock to both the supply and demand sides, both export and import have been negatively affected, and the growth rate of world trade has been moderated. Does this mean a decrease in productivity? If so, is there a difference between an open economy (more integrated with GVCs) and a closed economy (less participating in GVCs)? Since we are living in a world connected by GVCs, it would be meaningful to investigate the relationship between productivity and GVC participation.

As aforementioned, GVCs have been regarded as a decisive factor for not only shaping trade and FDI patterns of an economy but also stimulating its industrial transformation and growth opportunities. Although the pace of GVC expansion has been stagnated due to recent disruptions such as prolonged global recession, trade protectionism, and the COVID-19 pandemic, no one denies that GVCs remain an important impetus for industrial restructuring and economic growth if developing countries, by providing opportunities to increase their participation in global trade and to diversify their export portfolio toward manufacturing goods.

In addition, several research papers have insisted that the emergence of COVID-19 has accelerated digital transformation, which has been enabled by the development of ICTs. In the private sector, businesses have already been transforming themselves into smart firms, smart farms, smart factories, etc. using ICT. Also, the emergence of the era of virtual communication caused by COVID-19 facilitates digital transformation by restricting human activities and replacing labor with robots and machines. Since COVID-19 affects the labor market as well, on both the supply and demand sides, many companies, either voluntarily or intentionally, have started to introduce automation in their businesses. Intuitively, this movement will cause productivity growth since it requires less human labor. On the other hand, many scholars have pointed to the Solow Paradox, i.e., decreased or stagnated productivity despite a rapid development of ICT. From this point, we conducted data analysis to find the relationship between ICT development and productivity. The findings can be summarized as follows.

In the first chapter, we conducted data analysis to figure out the productivity trend in APO member countries before COVID-19 and how it was impacted by the pandemic situation. For this, we analyzed various datasets between 2000 and 2018. Even though COVID-19 hit the world economy, it is a well-known fact that the general trend of productivity growth in APO member countries had 'moderated' after the global financial crisis (GFC) of 2008. Partly, it could be due to the reshoring policy and protectionism caused by the global economic recession. However, in this report, we figured out that its overall patterns are diverse. For example, while productivity growth slowed down in high-income and upper-middle-income countries after the GFC, the productivity level in low-middle-income countries showed an uptrend during the same period. By analyzing sectoral contributions to productivity growth, we concluded that the manufacturing sector plays a vital role in productivity enhancement as we predicted. For example, while high-income countries such as Japan and the ROK have shown a slowdown in productivity growth while they transform their economies from manufacturing-based to service-based, other middle-income countries (India, Indonesia, Philippines, Thailand, and Vietnam) show rapid productivity growth because they are upgrading/transforming their economies from traditional agriculture based to manufacturing based.

However, COVID-19 affects productivity growth in the manufacturing sector negatively. Regardless of a country's stage of development, due to the measures taken to contain the spread of the virus, manufacturing output has shrunk. Factories have shut down their businesses temporally or permanently. The trade volume has also contracted. A decrease in export and import may imply weaker GVCs participation and a decrease in productivity growth. On the other hand, as many reports published by international organizations such as the World Bank and Organisation for Economic Co-operation and Development (OECD) reveal, the pandemic situation related to COVID-19 has accelerated the digital transformation based on ICT.

In the second chapter, we focused on the relation between GVCs and productivity. As is widely known, participating in GVCs facilitates industrial restructuring and economic growth of developing countries with the inflow of foreign capital and technology transfer. This is also proved in the field of political economics. The countries that chose export-led industrialization policy have shown better economic performance than the countries that chose import-substitution policy. Using APO and UNIDO datasets, we figured out that there is a positive relationship between GVC participation and productivity growth. Empirical evidence suggests that participating in GVCs generally contributes to productivity improvement and there is a bilateral causal relation between them. However, we found out that the direction is important: while backward participation (importing intermediates to produce exports) is positively correlated with productivity growth, forward participation (sending domestically produced inputs to third economies for further processing) is negatively correlated to productivity growth. Therefore, these opposite effects of GVC participation cause ambiguous effects. This finding would be meaningful for countries in propelling their GVCs participation in the right direction.

Then what about the relationship between ICT and productivity? We are living in the era of the 'new normal' and it is undeniable that we are also living in the era of digital transformation. Digitalization and ICT are inseparable since digital transformation has been enabled by the development of ICT. Considering that digital transformation is expected to contribute to economic growth and enable sustainable socioeconomic development, intuitively, it will enhance productivity. However, it would be worthwhile to analyze the relationship between ICT and productivity through rigorous data analysis.

ICT enables firms to work more smartly. In this context, since the 1980s, the IT industry that uses the ICT technology the most has gained attention due to its high productivity level and performance. However, much literature has also dealt with the Solow Paradox, the term describing the fact that investment in IT accounts for a small portion of productivity growth in advanced economies. To address this paradox, we analyzed APO data and Conference Board data. As a result, in the third chapter, we could find that there is a positive relationship between the two of them. However, we also figured out that to increase productivity by investing more in ICT, complementary measures such as introducing management practices and strengthening the absorptive capacities of a firm or a nation, need to be taken. These complementary measures/interventions will shorten the productivity gaps between nations, industries, and enterprises. At the same time, due to the investment capability determined by the size of the firm, the gap between firms could widen and slow the productivity growth, especially in developing countries. Therefore, developing countries should actively take complementary measures to enhance productivity and support small- and medium-sized enterprises.

COUNTRY PROFILE: JAPAN

LABOR PRODUCTIVITY

- Japan has experienced a modest rate of manufacturing productivity growth since 2000, with a significant fluctuation during the Global Financial Crisis of 2008–09.
- In the meantime, there have been some increases in productivity levels, with a record of USD113,408 in 2018, around 1.5 times higher than USD73,720 in 2000.
- The overall growth trends in manufacturing productivity were led by the synchronized nature of growth in value added and employment over the last two decades.
- The pre-pandemic productivity slowdown (–1.74%p) was mainly attributed to a notable sluggish growth in value added (–1.01%p) with a modest acceleration in employment growth (0.7%p).

PRODUCTIVITY AND GVC PARTICIPATION

- The GVC participation rate of the manufacturing sector is at a modest level, among the seven selected countries, in comparison.
- Backward participation is particularly high in the sector comprising coke, refined petroleum, and nuclear fuel (52.8%).
- The share of foreign value added in gross manufacturing exports as of 2019 was 20.2%, with a low reliance on foreign manufacturing and service inputs.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.

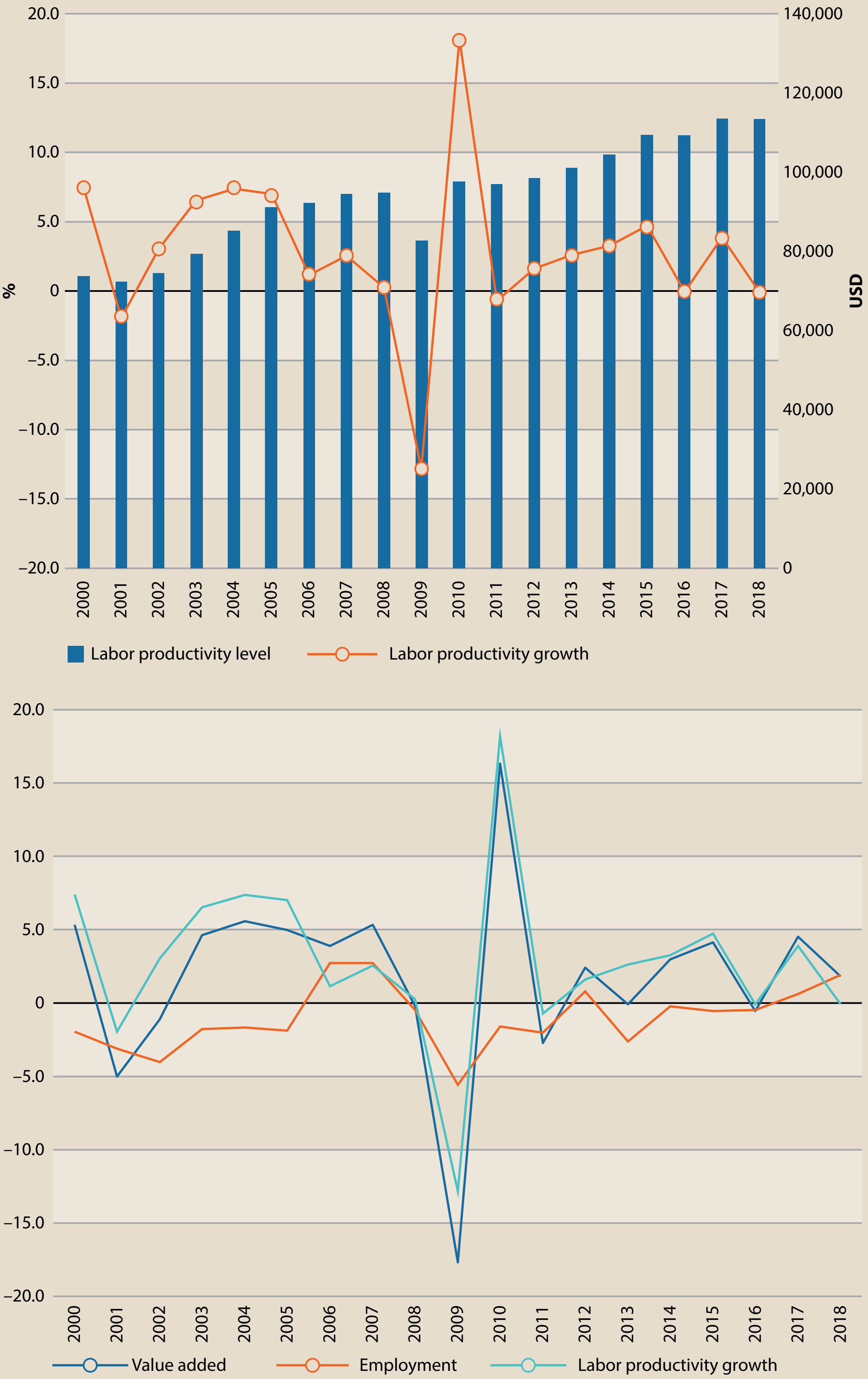

FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

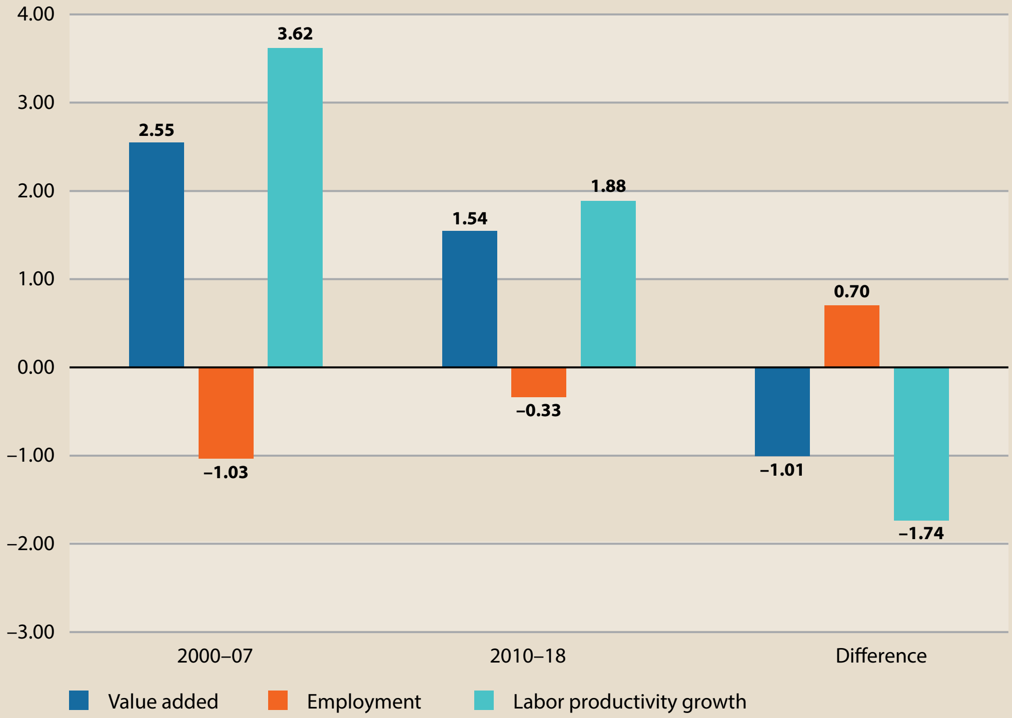

TABLE 1

THE TREND OF GVC PARTICIPATION IN JAPAN

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	30.5	37.1	39.6	38.3	39.8	38.5	36.2
	Backward	7.1	11.2	15.2	13.2	14.1	13.3	12.0
	Forward	21.2	21.4	18.8	20.0	20.1	20.5	20.1
Primary goods	GVC participation (%)	17.2	24.9	31.5	39.2	37.1	25.1	22.7
	Backward	4.9	8.5	9.5	7.3	8.3	11.9	11.7
	Forward	11.6	14.7	19.4	28.5	25.5	11.4	9.6
Manufacturing	GVC participation (%)	30.7	39.2	42.3	40.5	42.1	40.1	38.5
	Backward	7.5	12.6	17.2	14.9	15.9	15.5	13.9
	Forward	20.8	21.4	18.7	20.0	19.9	19.4	19.8
Services	GVC participation (%)	29.6	30.0	27.0	27.2	28.9	31.8	27.9
	Backward	5.1	6.2	5.7	5.0	5.2	5.1	4.8
	Forward	22.9	21.4	19.1	20.2	21.3	24.6	21.5

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN JAPAN, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	8.5%	12.2%	20.8%
Textiles and textile products	36.2%	11.1%	47.3%
Leather, leather products, and footwear	21.8%	13.6%	35.4%
Wood and products of wood and cork	12.1%	14.1%	26.3%
Pulp, paper, paper products, printing, and publishing	25.3%	11.1%	36.4%
Coke, refined petroleum, and nuclear fuel	13.6%	52.8%	66.3%
Chemicals and chemical products	28.9%	19.9%	48.8%
Rubber and plastics	32.2%	12.4%	44.6%
Other nonmetallic minerals	21.2%	18.9%	40.1%
Basic metals and fabricated metals	29.4%	26.1%	55.5%
General machinery and equipment	12.3%	14.5%	26.8%
Electrical and optical equipment	25.6%	16.7%	42.3%
Transport equipment	10.3%	19.3%	29.7%
Manufacturing, nec; recycling	14.4%	14.5%	28.9%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN JAPAN, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	10.0	59.1	18.7	1.8	89.5
Textiles	0.7	62.6	22.4	2.2	87.9
Leather and footwear	1.3	58.7	21.4	1.7	83.1
Wood products	15.0	51.2	17.7	1.7	85.5
Pulp and paper	0.5	62.6	24.4	2.9	90.2
Coke and petroleum	0.8	39.6	8.3	1.2	49.8
Chemicals	0.6	47.2	24.9	3.5	76.1
Rubber and plastics	1.1	54.0	24.8	3.3	83.2
Nonmetallic products	0.3	54.4	21.6	3.2	79.5
Metal products	0.2	47.4	21.1	3.5	72.2
General machinery	0.2	61.4	21.4	2.0	85.0
Electrical/optical equipment	0.2	56.1	23.2	2.5	82.1
Transport equipment	0.2	58.6	21.7	2.4	82.9
Manufacturing, nec	1.6	53.8	28.0	2.0	85.5
Manufacturing (total)	0.4	54.7	22.0	2.6	79.8

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	4.2	2.1	3.8	0.4	10.5
Textiles	3.1	4.1	4.5	0.5	12.1
Leather and footwear	3.5	6.1	6.6	0.6	16.9
Wood products	5.8	3.4	4.7	0.5	14.5
Pulp and paper	2.7	2.6	4.1	0.4	9.8
Coke and petroleum	28.9	3.9	14.4	2.9	50.1
Chemicals	8.4	6.0	8.3	1.1	23.8
Rubber and plastics	4.6	5.3	6.2	0.7	16.8
Nonmetallic products	8.1	3.2	8.1	1.0	20.5
Metal products	11.5	5.4	9.3	1.5	27.7
General machinery	3.5	5.3	5.6	0.6	15.0
Electrical/optical equipment	3.4	7.1	6.5	0.7	17.7
Transport equipment	3.7	6.2	6.5	0.7	17.0
Manufacturing, nec	3.9	4.5	5.5	0.6	14.5
Manufacturing (total)	6.2	5.9	7.2	0.9	20.2

Source: Authors' calculations based on ADB MRIO Database.

COUNTRY PROFILE: THE REPUBLIC OF KOREA

LABOR PRODUCTIVITY

- Ever since 2000, a downward trend of manufacturing productivity growth was found in the Republic of Korea (ROK) largely driven by adverse shocks of the Global Financial Crisis (GFC) until 2015, when a sharp rebound was on track.
- Notwithstanding the GFC, the ROK experienced a productivity growth of over 4% between 2000 and 2018, thereby showing a marked increase in the level of productivity from USD60,589 in 2000 to USD130,260 in 2018.
- The long downturn observed in employment growth seems to have played a large role in slowing the overall growth in productivity over that period.
- In contrast, a dramatic slowdown in value-added growth but a rising employment contributed to a significant deceleration of the manufacturing productivity growth before the COVID-19 crisis.

PRODUCTIVITY AND GVC PARTICIPATION

- The GVC participation rate of the manufacturing sector is relatively high, mainly due to high backward participation. However, recently the differences between forward and backward GVC participation have become small.
- Backward participation is particularly high in the sector of coke, refined petroleum, and nuclear fuel (59.6%).
- The share of foreign value added in gross manufacturing exports as of 2019 was 34.1%, with a modest reliance on foreign manufacturing and service inputs.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.

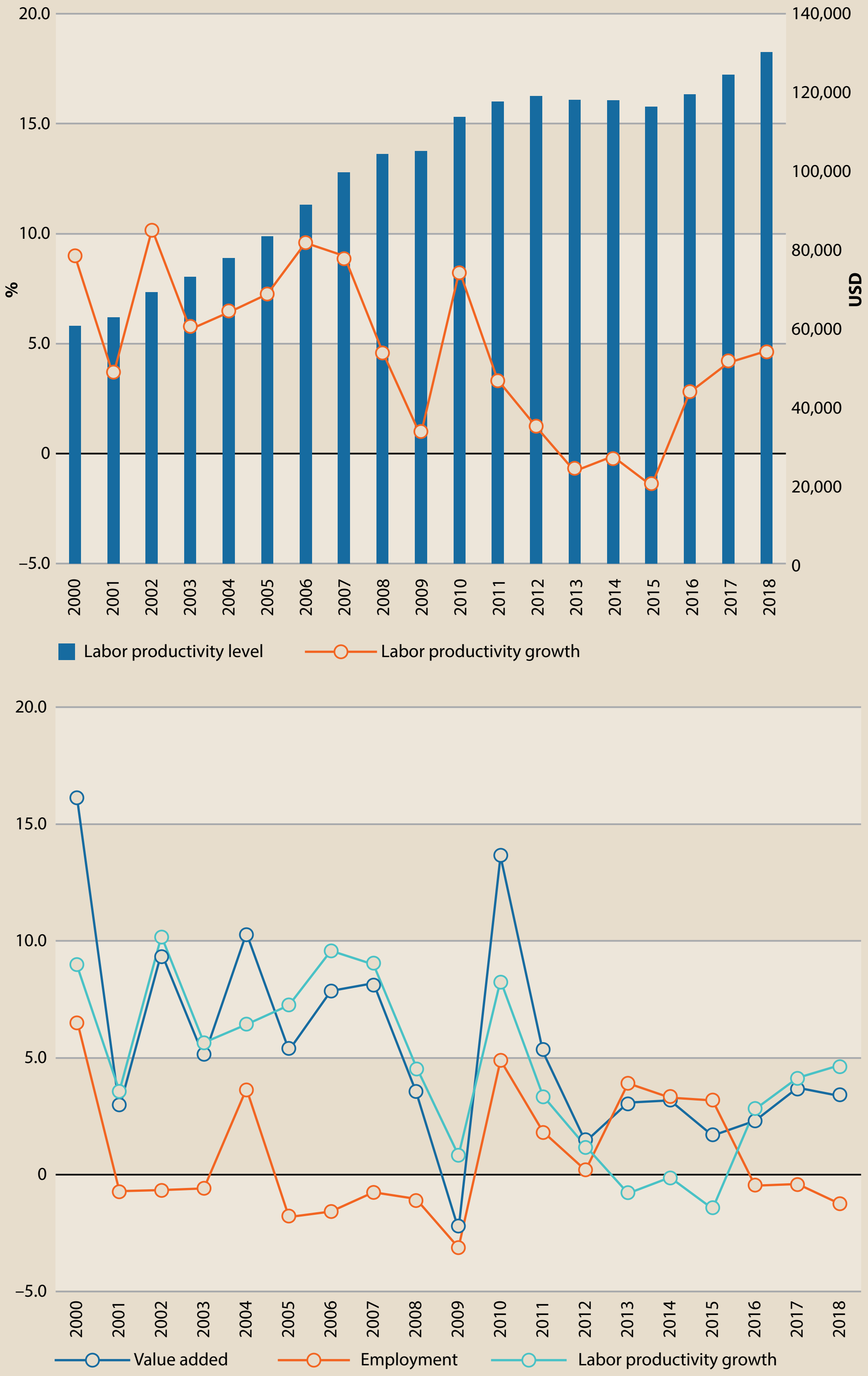

FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

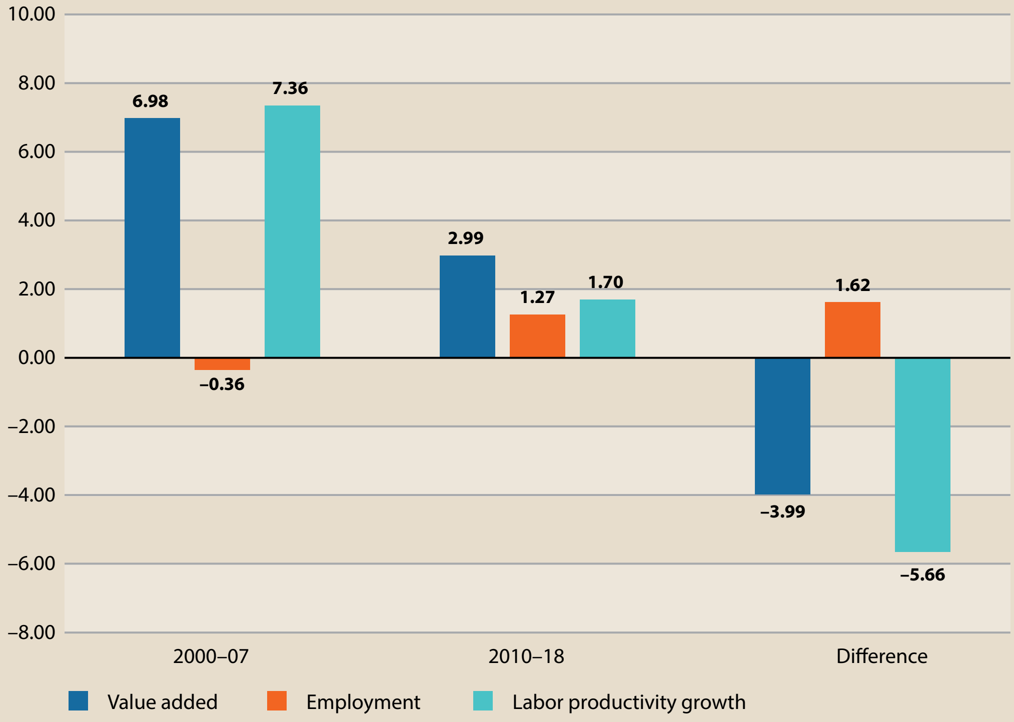

TABLE 1

THE TREND OF GVC PARTICIPATION IN THE ROK

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	45.8	51.0	51.6	50.8	52.0	52.3	50.6
	Backward	22.1	26.6	27.0	25.2	24.7	21.4	22.1
	Forward	16.5	15.4	15.2	16.5	17.6	21.6	19.7
Primary goods	GVC participation (%)	14.5	24.2	28.1	28.0	29.7	24.1	25.6
	Backward	10.0	15.5	14.6	14.1	14.2	14.3	14.1
	Forward	4.0	7.2	11.2	11.6	12.9	8.2	9.7
Manufacturing	GVC participation (%)	47.9	52.4	54.0	53.1	54.0	53.4	52.9
	Backward	23.7	28.1	29.2	27.3	26.4	22.3	23.1
	Forward	16.4	14.9	14.5	15.8	17.1	21.5	20.2
Services	GVC participation (%)	30.0	39.5	37.2	37.0	38.3	44.2	37.2
	Backward	10.2	14.5	13.5	12.3	12.5	15.3	15.4
	Forward	17.2	20.0	19.4	20.5	21.3	22.2	17.2

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN THE ROK, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	3.5%	23.5%	26.9%
Textiles and textile products	31.0%	31.7%	62.7%
Leather, leather products, and footwear	21.3%	37.6%	59.0%
Wood and products of wood and cork	13.5%	27.8%	41.3%
Pulp, paper, paper products, printing, and publishing	19.8%	22.7%	42.5%
Coke, refined petroleum, and nuclear fuel	10.7%	59.6%	70.2%
Chemicals and chemical products	20.9%	33.2%	54.0%
Rubber and plastics	26.3%	29.0%	55.2%
Other nonmetallic minerals	12.5%	33.8%	46.4%
Basic metals and fabricated metals	23.3%	39.9%	63.1%
General machinery and equipment	8.6%	27.4%	35.9%
Electrical and optical equipment	29.3%	24.1%	53.4%
Transport equipment	10.1%	36.7%	46.9%
Manufacturing, nec; recycling	11.4%	28.0%	39.5%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN THE ROK, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	19.8	33.9	21.2	1.2	76.0
Textiles	0.9	52.4	19.0	1.8	74.2
Leather and footwear	2.4	45.3	19.6	1.1	68.5
Wood products	9.8	43.8	15.7	1.5	70.8
Pulp and paper	0.3	50.2	18.2	1.2	69.8
Coke and petroleum	1.1	19.9	18.6	2.6	42.3
Chemicals	0.9	42.9	17.4	1.9	63.1
Rubber and plastics	1.3	52.1	15.5	1.4	70.3
Nonmetallic products	0.4	44.2	21.7	2.2	68.5
Metal products	0.3	45.4	17.0	2.6	65.3
General machinery	0.3	55.3	17.1	1.3	73.9
Electrical/optical equipment	0.3	53.9	15.5	1.3	70.9
Transport equipment	0.3	51.1	16.9	1.2	69.6
Manufacturing, nec	0.9	48.8	20.2	1.2	71.2
Manufacturing (total)	0.8	46.6	16.9	1.6	65.9

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	8.7	5.7	8.8	0.8	24.0
Textiles	5.1	9.9	9.8	1.0	25.8
Leather and footwear	5.7	12.8	11.9	1.1	31.5
Wood products	8.2	8.6	11.5	1.0	29.2
Pulp and paper	4.5	11.1	13.5	1.1	30.2
Coke and petroleum	27.7	7.4	19.2	3.3	57.6
Chemicals	10.8	11.3	13.0	1.7	36.8
Rubber and plastics	6.8	10.9	10.8	1.3	29.7
Nonmetallic products	9.4	9.0	11.5	1.5	31.5
Metal products	11.4	9.7	11.8	1.8	34.6
General machinery	4.9	10.3	9.8	1.1	26.1
Electrical/optical equipment	4.2	12.8	10.6	1.0	28.6
Transport equipment	4.9	12.7	11.6	1.2	30.4
Manufacturing, nec	5.7	10.7	11.2	1.1	28.8
Manufacturing (total)	9.1	11.3	12.4	1.5	34.1

Source: Authors' calculations based on ADB MRIO Database.

COUNTRY PROFILE: THAILAND

LABOR PRODUCTIVITY

- Thailand has recorded 2.53% annual growth in manufacturing productivity over the last two decades, though it has undergone two crises, namely the Global Financial Crisis (GFC) in the late 2000s and political turbulence (military coup) in the mid-2010s.

- In the aftermath of the political turmoil, its productivity levels that had reached over USD56,000 in 2012 had not yet recovered to the precrisis level and stood at USD54,783 in 2018.

- An observed slowing trend of the overall growth during the period 2010–18 can be attributed to a drop in manufacturing value added that was much faster than that in employment.

PRODUCTIVITY AND GVC PARTICIPATION

- The GVC participation rate of the manufacturing sector is relatively high, mainly due to high backward participation.

- Backward participation is particularly high in the sectors of coke, refined petroleum, and nuclear fuel (75.1%); non-metallic products (63.3%) and metal products (51.6%).

- The share of foreign value added in gross manufacturing exports was 33.2% in 2019, with a modest reliance on foreign manufacturing and service inputs.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.

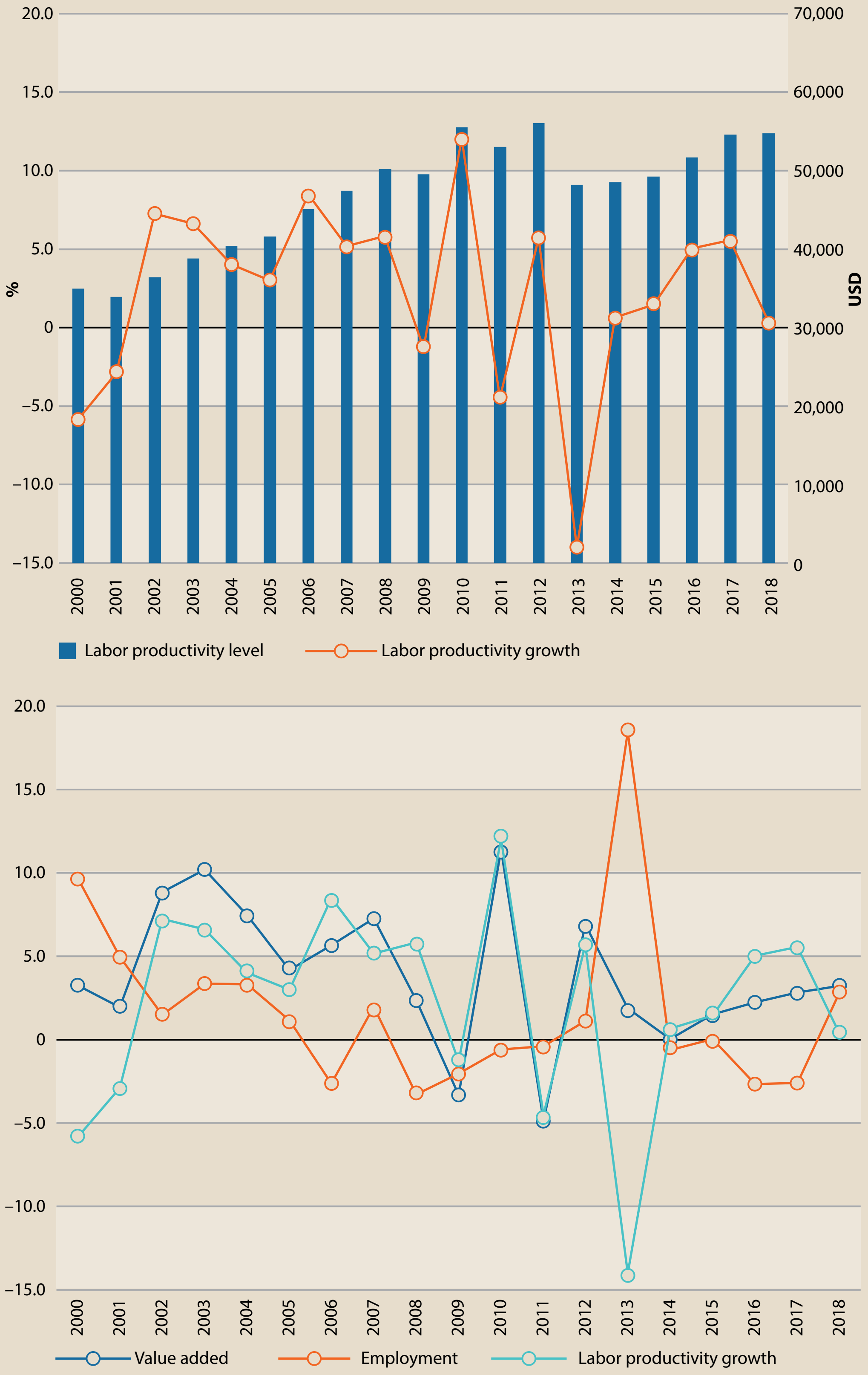

FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

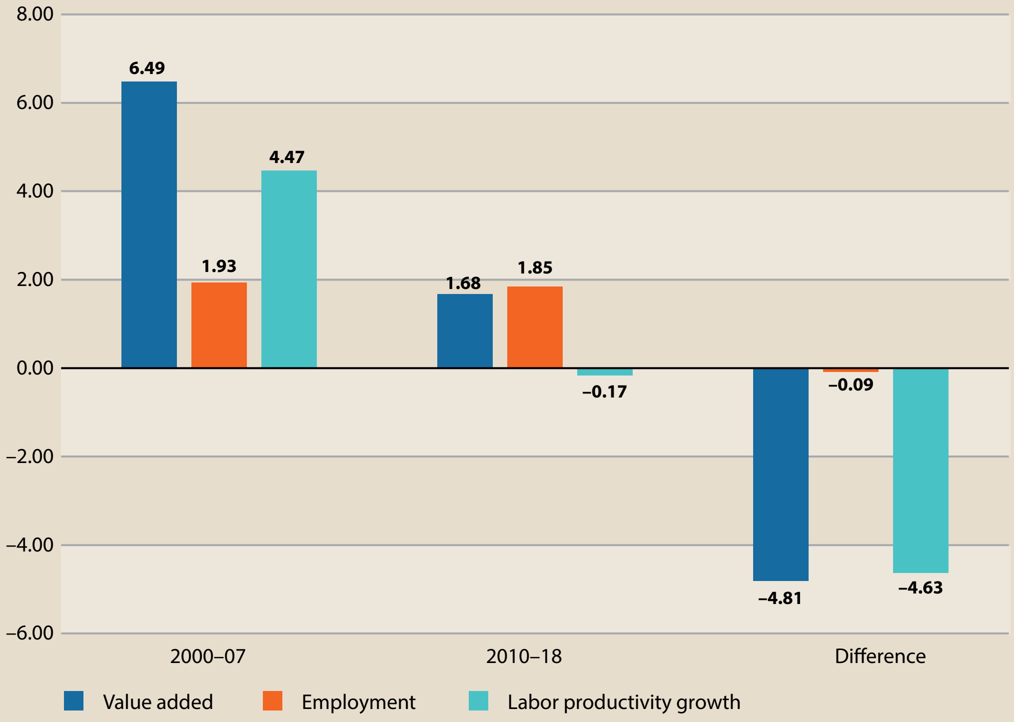

TABLE 1

THE TREND OF GVC PARTICIPATION IN THAILAND.

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	43.7	48.7	43.4	41.6	44.3	52.9	43.1
	Backward	22.9	25.3	21.5	20.0	20.8	25.9	23.3
	Forward	14.3	15.2	15.2	15.4	16.2	16.4	13.2
Primary goods	GVC participation (%)	37.0	36.0	28.8	28.7	32.5	29.2	27.2
	Backward	10.6	9.1	8.3	8.1	8.3	10.1	9.8
	Forward	22.7	23.6	18.4	18.5	21.5	16.8	15.3
Manufacturing	GVC participation (%)	47.5	53.6	50.8	49.7	53.4	59.7	48.6
	Backward	26.0	29.2	27.3	25.7	27.2	31.6	28.3
	Forward	13.9	14.5	14.5	15.3	15.8	14.9	12.1
Services	GVC participation (%)	34.3	35.1	31.0	29.4	30.7	37.1	34.2
	Backward	16.1	15.3	12.2	11.1	11.7	12.3	14.9
	Forward	14.6	16.0	16.0	15.8	16.2	20.8	15.2

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN THAILAND, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	4.0%	22.8%	26.8%
Textiles and textile products	13.2%	27.7%	41.0%
Leather, leather products, and footwear	20.5%	24.5%	45.0%
Wood and products of wood and cork	18.4%	21.4%	39.8%
Pulp, paper, paper products, printing, and publishing	26.3%	13.7%	40.0%
Coke, refined petroleum, and nuclear fuel	7.4%	75.1%	82.5%
Chemicals and chemical products	18.1%	43.0%	61.1%
Rubber and plastics	23.8%	22.5%	46.3%
Other nonmetallic minerals	6.1%	63.3%	69.4%
Basic metals and fabricated metals	18.0%	51.6%	69.5%
General machinery and equipment	10.7%	36.9%	47.6%
Electrical and optical equipment	15.9%	37.1%	53.0%
Transport equipment	8.7%	36.8%	45.5%
Manufacturing, nec; recycling	5.7%	33.7%	39.3%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN THAILAND, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	24.9	27.7	27.4	2.5	82.4
Textiles	1.4	46.4	25.9	4.4	78.1
Leather and footwear	1.4	51.2	26.7	1.7	81.0
Wood products	4.5	66.2	12.1	1.8	84.6
Pulp and paper	1.0	68.2	18.6	1.9	89.7
Coke and petroleum	5.4	19.5	16.4	1.0	42.3
Chemicals	3.0	33.9	25.1	3.5	65.5
Rubber and plastics	6.3	52.5	19.1	3.3	81.2
Nonmetallic products	3.6	22.1	23.3	3.1	52.1
Metal products	0.8	36.8	21.0	1.9	60.5
General machinery	1.0	43.0	25.5	2.4	71.9
Electrical/optical equipment	1.0	36.2	31.6	3.0	71.7
Transport equipment	0.6	54.8	15.2	1.6	72.1
Manufacturing, nec	2.4	45.8	24.6	1.9	74.7
Manufacturing (total)	5.2	37.9	21.4	2.2	66.8

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	3.8	5.1	8.0	0.6	17.5
Textiles	4.0	7.7	9.3	0.9	21.8
Leather and footwear	2.9	6.7	8.7	0.7	19.0
Wood products	2.9	5.5	6.4	0.6	15.4
Pulp and paper	1.6	3.4	4.9	0.4	10.3
Coke and petroleum	31.2	8.6	14.5	3.5	57.7
Chemicals	11.0	9.5	12.3	1.6	34.5
Rubber and plastics	3.8	7.0	7.2	0.8	18.8
Nonmetallic products	23.1	7.3	14.8	2.8	47.9
Metal products	6.2	16.4	14.8	1.9	39.3
General machinery	4.7	10.3	11.9	1.2	28.1
Electrical/optical equipment	4.7	11.0	11.5	1.1	28.3
Transport equipment	3.8	11.7	11.1	1.2	27.8
Manufacturing, nec	5.4	8.5	10.3	1.0	25.3
Manufacturing (total)	8.7	10.9	12.0	1.6	33.2

Source: Authors' calculations based on ADB MRIO Database.

COUNTRY PROFILE: INDONESIA

LABOR PRODUCTIVITY

- In the long term (2000–18), Indonesia shows a positive but relatively sluggish growth in manufacturing productivity (1.91%) as compared with its peers (e.g., Philippines, India, and Vietnam), largely due to several rapid declines in 2005, 2010–11 and 2017, driven by varying factors in terms of the rate of change in value added relative to that in employment.
- A marked slowing down of manufacturing productivity was observed before the pandemic-induced crisis because of accelerated growth in employment with value added conversely being decelerated.

PRODUCTIVITY AND GVC PARTICIPATION

- The GVC participation rate of the manufacturing sector was at a modest level, among the seven selected countries in comparison.
- Backward GVC participation is relatively high in the sectors of leather products and footwear (45.6%) and textile products (45.5%).
- The share of foreign value added in gross manufacturing exports as of 2019 was relatively low (18.4%), mainly due to its natural resource abundance and the related industrial structure.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.

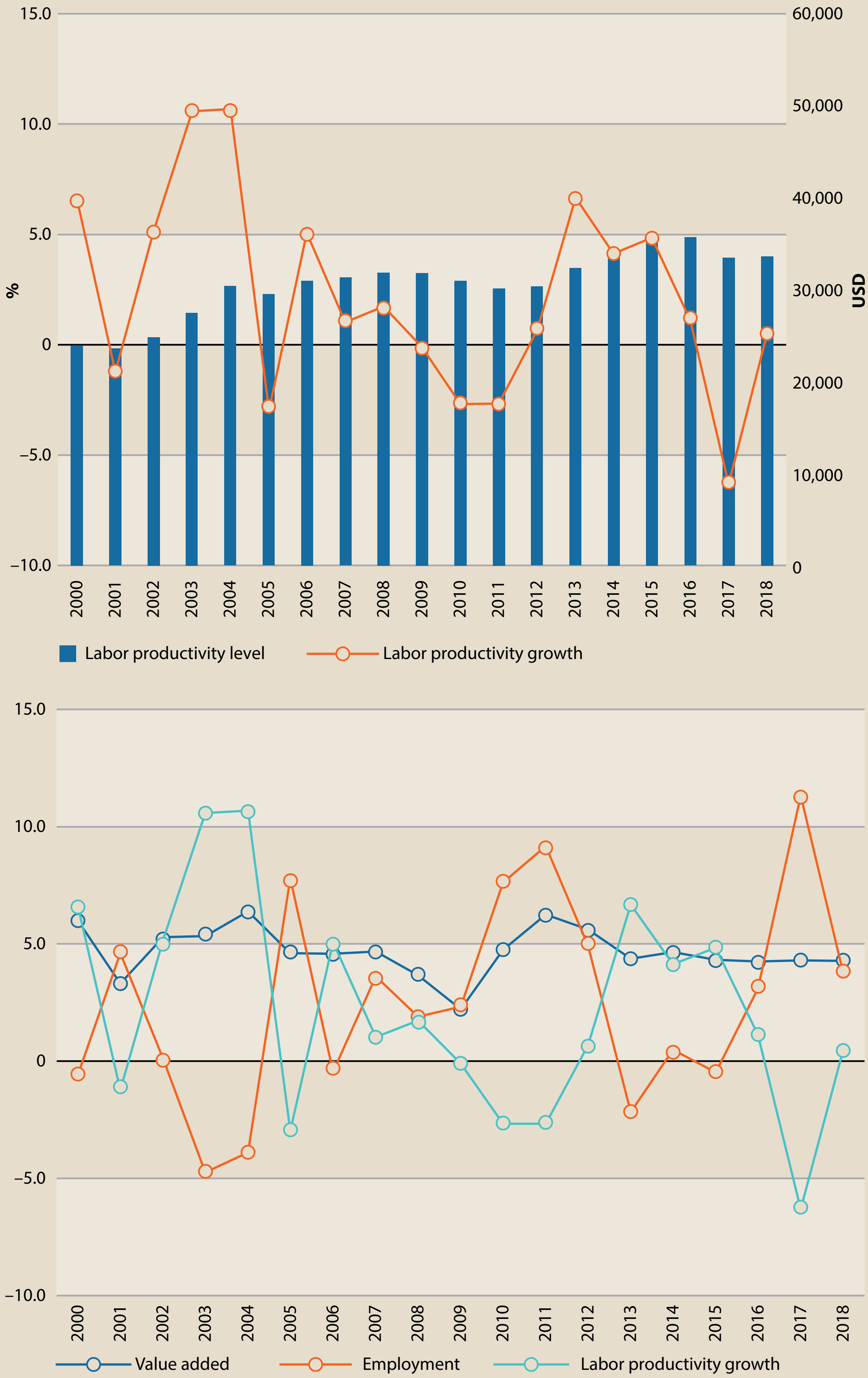

FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

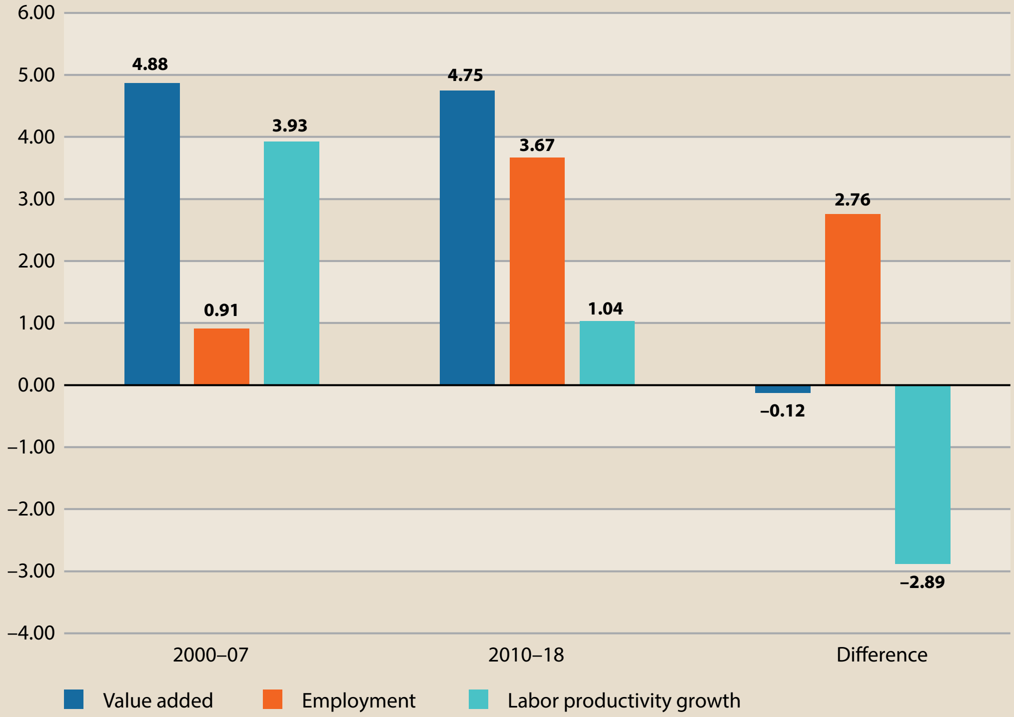

TABLE 1

THE TREND OF GVC PARTICIPATION IN INDONESIA.

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	37.1	40.0	38.3	37.9	38.8	39.4	36.2
	Backward	14.4	11.1	12.9	11.6	12.1	12.3	12.3
	Forward	18.7	25.0	21.8	22.9	22.8	23.1	20.6
Primary goods	GVC participation (%)	19.5	26.9	25.5	24.5	26.0	24.3	24.8
	Backward	4.9	2.6	2.5	2.6	2.1	2.3	2.0
	Forward	13.8	23.5	22.2	21.2	23.3	21.4	22.3
Manufacturing	GVC participation (%)	38.4	39.1	38.1	38.0	39.0	42.2	38.8
	Backward	17.0	14.4	15.0	13.4	14.3	15.0	16.3
	Forward	16.7	20.1	19.1	20.7	20.4	22.3	18.5
Services	GVC participation (%)	31.2	28.9	26.8	27.8	30.0	36.4	31.1
	Backward	11.3	8.5	7.6	8.8	8.2	8.4	8.2
	Forward	17.0	18.0	17.4	16.8	19.3	24.8	20.5

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN INDONESIA, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	4.0%	16.0%	8.3%
Textiles and textile products	13.2%	5.1%	45.5%
Leather, leather products, and footwear	20.5%	1.4%	45.6%
Wood and products of wood and cork	18.4%	20.0%	9.3%
Pulp, paper, paper products, printing, and publishing	26.3%	29.7%	15.2%
Coke, refined petroleum, and nuclear fuel	7.4%	32.9%	8.5%
Chemicals and chemical products	18.1%	31.2%	18.1%
Rubber and plastics	23.8%	25.3%	22.8%
Other nonmetallic minerals	6.1%	15.3%	15.2%
Basic metals and fabricated metals	18.0%	34.5%	16.9%
General machinery and equipment	10.7%	14.5%	31.5%
Electrical and optical equipment	15.9%	17.3%	29.4%
Transport equipment	8.7%	8.4%	15.4%
Manufacturing, nec; recycling	5.7%	3.8%	17.1%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN INDONESIA, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	34.1	41.7	13.8	1.3	91.0
Textiles	1.7	44.4	3.9	0.4	50.5
Leather and footwear	1.3	47.1	5.5	0.3	54.2
Wood products	19.0	50.7	18.6	1.5	89.8
Pulp and paper	4.2	53.3	24.5	2.2	84.1
Coke and petroleum	31.0	49.5	9.2	1.6	91.3
Chemicals	17.4	45.8	15.6	1.5	80.3
Rubber and plastics	21.2	36.9	14.8	1.5	74.3
Nonmetallic products	20.0	42.7	16.2	4.9	83.8
Metal products	18.2	41.8	17.3	2.8	80.2
General machinery	1.4	37.7	22.6	1.6	63.3
Electrical/optical equipment	2.3	40.4	20.7	1.9	65.3
Transport equipment	1.4	61.4	20.1	1.0	83.9
Manufacturing, nec	5.5	50.1	23.0	2.2	80.8
Manufacturing (total)	20.1	45.9	14.0	1.6	81.6

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	3.3	2.2	3.2	0.3	9.0
Textiles	8.9	17.2	20.7	2.7	49.5
Leather and footwear	6.8	16.5	20.9	1.6	45.8
Wood products	2.0	3.9	3.8	0.4	10.2
Pulp and paper	2.7	6.1	6.3	0.8	15.9
Coke and petroleum	2.9	2.2	3.2	0.4	8.7
Chemicals	4.4	6.6	7.6	1.0	19.7
Rubber and plastics	5.0	9.6	10.1	1.1	25.7
Nonmetallic products	3.6	5.5	6.3	0.8	16.2
Metal products	3.9	7.2	7.7	1.0	19.8
General machinery	3.7	16.3	14.9	1.7	36.7
Electrical/optical equipment	3.8	14.9	14.4	1.5	34.7
Transport equipment	1.9	7.0	6.6	0.7	16.1
Manufacturing, nec	3.1	7.5	7.7	0.9	19.2
Manufacturing (total)	3.8	6.4	7.3	0.8	18.4

Source: Authors' calculations based on ADB MRIO Database.

COUNTRY PROFILE: THE PHILIPPINES

LABOR PRODUCTIVITY

- Manufacturing productivity in the Philippines grew by 3.92% per annum between 2000 and 2018, thereby reporting an increase in productivity levels by around two times during the period (e.g., USD24,974 in 2000 and USD49,905 in 2018).

- During 2010–18, even after the Global Financial Crisis (GFC), the Philippines experienced accelerated productivity growth in manufacturing, which was mainly boosted by a notable rise in value added with employment being diminished.

PRODUCTIVITY AND GVC PARTICIPATION

- The GVC participation rate of the manufacturing sector is relatively high, with an ascending trend.

- Backward participation is particularly high in the sectors of coke, refined petroleum, and nuclear fuel (60.9%); metals products (52.7%); and electrical and optical equipment (50.4%).

- The share of foreign value added in gross manufacturing exports as of 2019 was 45.1%, with a relatively high reliance on foreign manufacturing and service inputs.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.

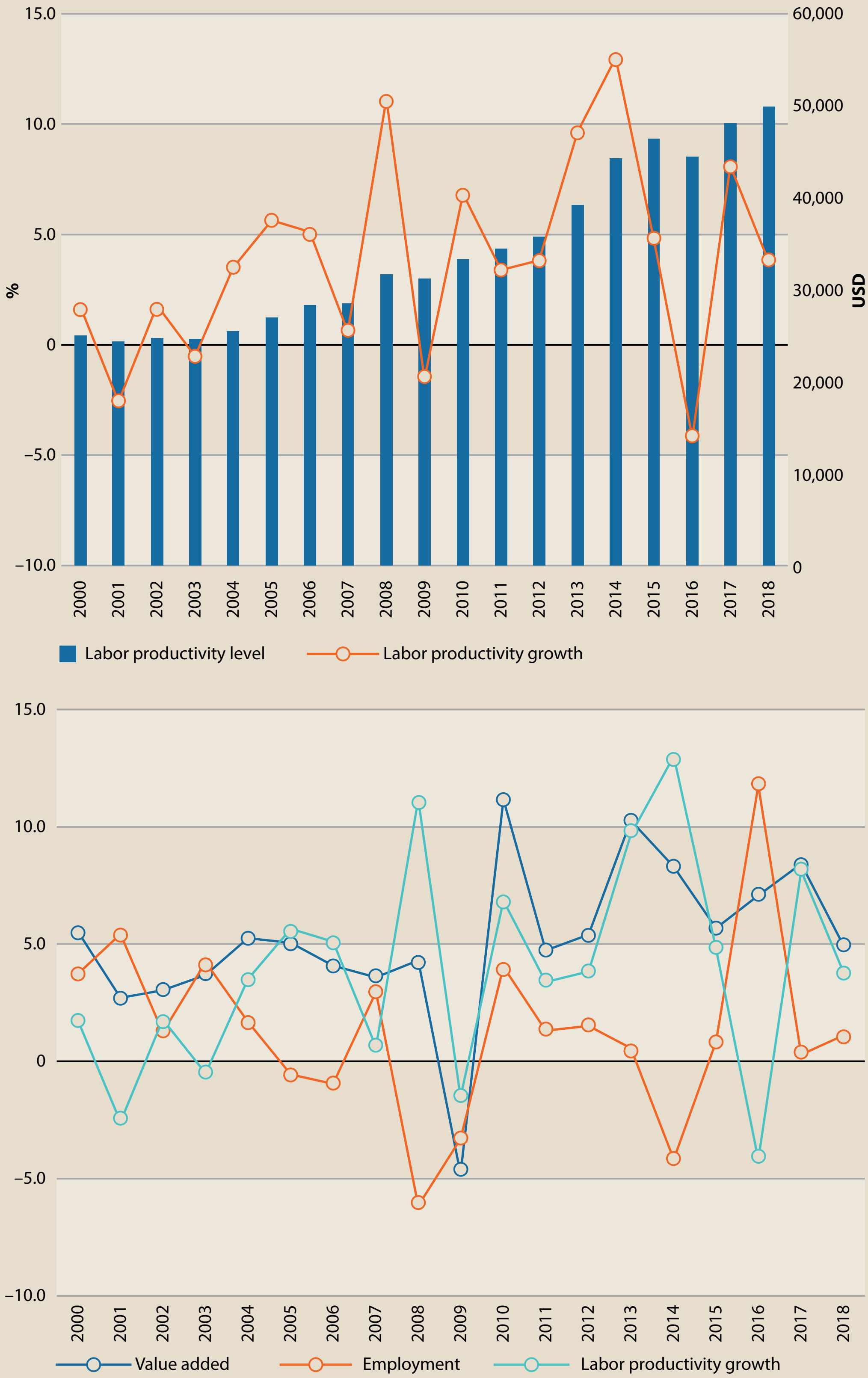

FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

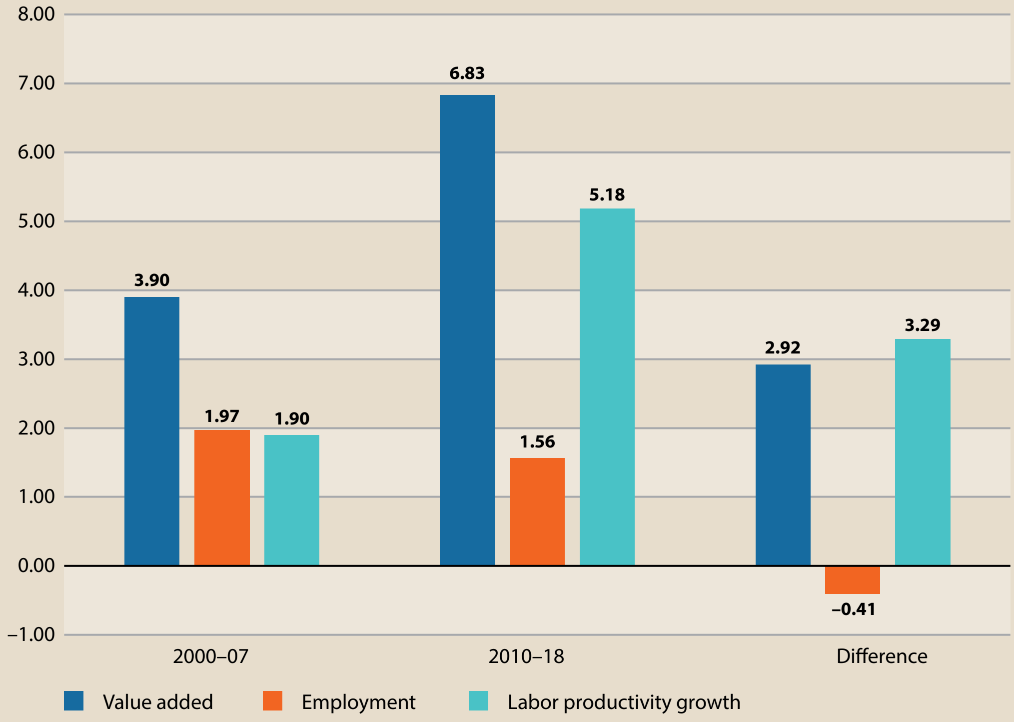

TABLE 1

THE TREND OF GVC PARTICIPATION IN THE PHILIPPINES.

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	43.1	42.4	40.5	41.5	43.9	47.0	47.1
	Backward	13.5	13.9	14.5	15.0	15.8	17.2	18.8
	Forward	23.1	21.4	19.4	19.6	20.4	22.0	20.0
Primary goods	GVC participation (%)	19.3	28.1	22.1	22.9	25.4	21.0	20.5
	Backward	5.7	5.7	5.2	5.7	6.0	6.7	6.6
	Forward	12.7	20.7	15.8	15.9	17.9	13.1	12.8
Manufacturing	GVC participation (%)	46.6	50.3	48.5	49.9	52.6	54.6	59.0
	Backward	14.2	18.9	21.4	22.5	23.5	26.1	29.4
	Forward	25.1	20.9	16.6	16.2	16.7	16.2	15.8
Services	GVC participation (%)	27.4	29.9	30.9	32.1	33.9	39.0	36.5
	Backward	11.4	6.1	6.1	6.4	6.7	6.7	8.5
	Forward	13.9	22.1	23.0	23.7	24.9	29.4	24.9

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN THE PHILIPPINES, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	4.0%	15.9%	12.4%
Textiles and textile products	13.2%	3.1%	24.9%
Leather, leather products, and footwear	20.5%	3.0%	28.8%
Wood and products of wood and cork	18.4%	7.3%	15.8%
Pulp, paper, paper products, printing, and publishing	26.3%	29.4%	19.9%
Coke, refined petroleum, and nuclear fuel	7.4%	17.3%	60.9%
Chemicals and chemical products	18.1%	13.1%	24.5%
Rubber and plastics	23.8%	23.4%	31.9%
Other nonmetallic minerals	6.1%	11.6%	35.5%
Basic metals and fabricated metals	18.0%	18.7%	52.7%
General machinery and equipment	10.7%	9.3%	42.4%
Electrical and optical equipment	15.9%	17.3%	50.4%
Transport equipment	8.7%	15.9%	30.6%
Manufacturing, nec; recycling	5.7%	4.0%	24.7%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN PHILIPPINES, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	23.5	44.0	13.4	1.7	82.7
Textiles	2.0	51.0	12.5	1.6	67.1
Leather and footwear	2.6	47.3	9.1	2.7	61.8
Wood products	6.5	38.1	31.2	1.9	77.8
Pulp and paper	2.9	39.8	25.0	4.0	71.6
Coke and petroleum	16.5	29.7	6.5	0.6	53.4
Chemicals	1.6	42.7	5.7	1.0	51.0
Rubber and plastics	4.9	38.8	11.6	3.0	58.3
Nonmetallic products	3.6	36.1	10.7	5.3	55.7
Metal products	2.8	22.9	6.3	2.2	34.2
General machinery	1.4	31.1	12.6	2.3	47.4
Electrical/optical equipment	0.4	25.9	8.1	1.6	36.0
Transport equipment	1.0	26.6	30.3	1.3	59.1
Manufacturing, nec	7.4	44.7	12.1	1.9	66.1
Manufacturing (total)	8.2	33.7	11.2	1.9	54.9

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	6.1	5.2	5.5	0.6	17.3
Textiles	6.8	14.5	10.4	1.1	32.9
Leather and footwear	6.1	19.2	11.7	1.2	38.2
Wood products	6.6	6.9	7.8	0.9	22.2
Pulp and paper	6.5	11.3	9.5	1.1	28.4
Coke and petroleum	26.3	6.8	10.8	2.7	46.6
Chemicals	15.6	16.5	14.6	2.3	49.0
Rubber and plastics	12.3	14.9	12.7	1.9	41.7
Nonmetallic products	18.5	11.4	12.1	2.3	44.3
Metal products	24.8	19.5	18.2	3.3	65.8
General machinery	13.7	20.4	16.0	2.5	52.6
Electrical/optical equipment	5.2	36.7	19.9	2.0	63.7
Transport equipment	6.6	18.6	14.0	1.6	40.9
Manufacturing, nec	8.6	13.7	10.3	1.3	33.9
Manufacturing (total)	8.4	21.2	13.8	1.7	45.1

Source: Authors' calculations based on ADB MRIO Database.

COUNTRY PROFILE: INDIA

LABOR PRODUCTIVITY

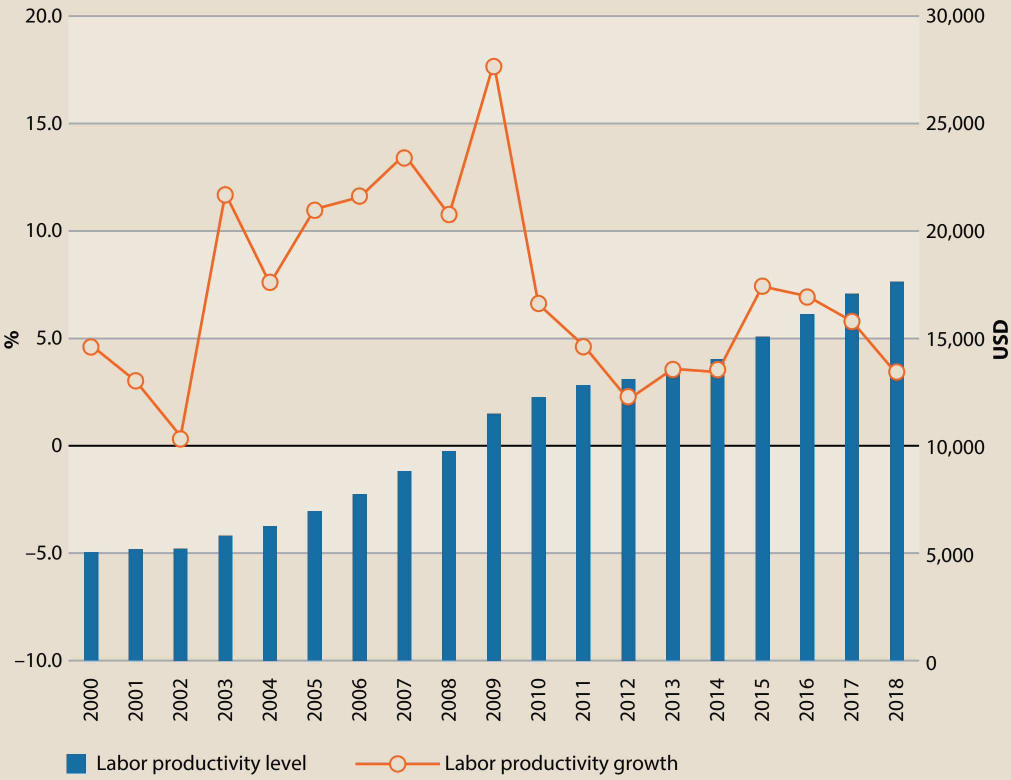
- India has recorded a manufacturing productivity growth rate of 7.21% on an average since 2000, notwithstanding a substantial slowdown after the 2008–09 recession.
- Accordingly, its productivity rose by around 3.5 times in the given time period, jumping from USD5,039 in 2010 to USD17,634 in 2018.
- The rapid growth was mainly driven by faster growth in manufacturing value added (7.8%) rather than the employment (0.6%) over a 19-year period.
- A slowdown in value-added growth along with accelerated employment growth shaped the slowing trends of manufacturing productivity during the pre-pandemic period (2010–18).

PRODUCTIVITY AND GVC PARTICIPATION

- The GVC participation rate of the manufacturing sector is at a modest level, among the seven selected countries, in comparison.
- The differences between forward and backward GVC participations are also relatively modest in most of the manufacturing subsectors, with the notable exceptions of coke, refined petroleum, and nuclear fuel (15.3% versus 45.5%) and metals products (20.8% versus 46.3%).
- The share of foreign value added in gross manufacturing exports as of 2019 was 25.9%, with a low reliance on foreign manufacturing inputs.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.



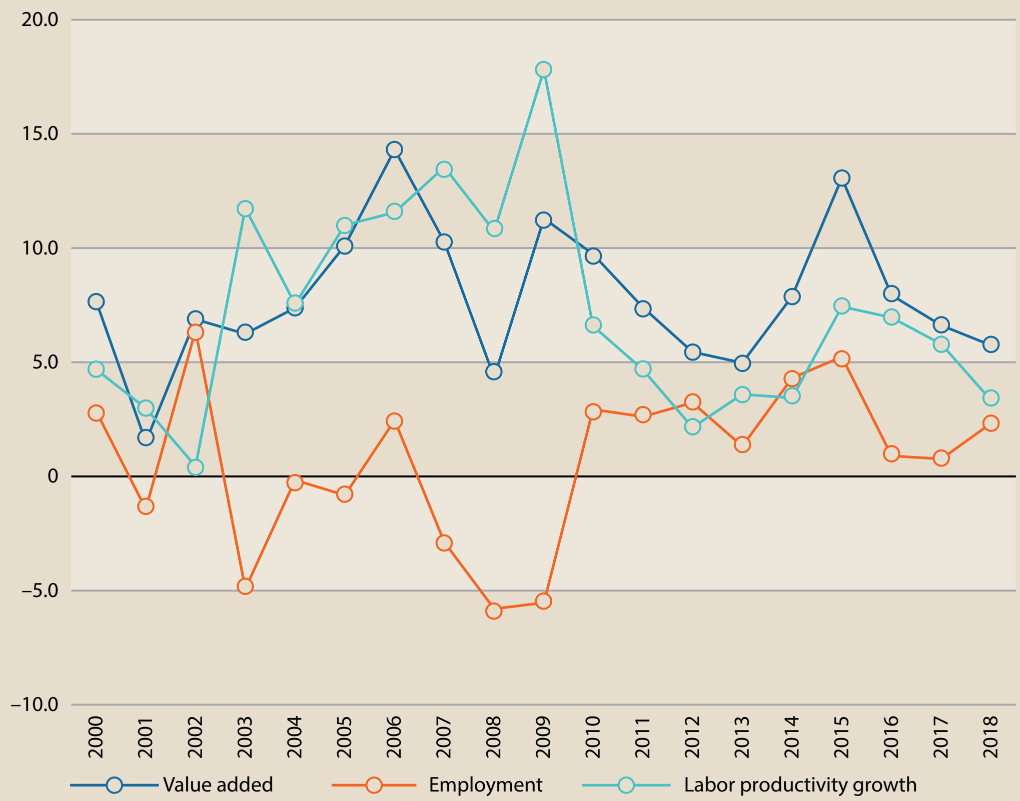


FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

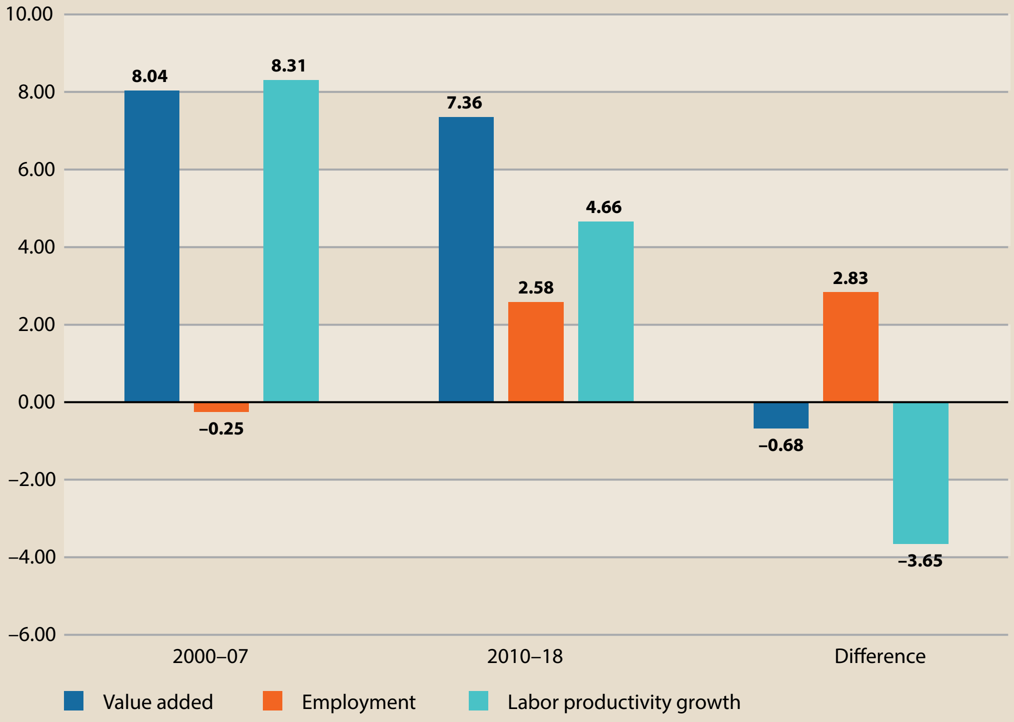


TABLE 1

THE TREND OF GVC PARTICIPATION IN INDIA, 2000–19.

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	30.9	38.6	35.2	32.4	33.4	41.6	36.1
	Backward	10.0	13.8	12.6	10.8	10.7	15.7	15.0
	Forward	18.0	19.6	17.3	18.0	18.8	19.5	16.4
Primary goods	GVC participation (%)	12.7	19.4	19.2	19.6	20.7	30.3	23.7
	Backward	2.3	2.4	2.2	2.0	1.8	2.2	2.2
	Forward	10.1	16.6	16.5	17.2	18.5	27.2	20.8
Manufacturing	GVC participation (%)	32.0	46.7	42.2	37.5	38.8	47.6	42.5
	Backward	12.4	21.0	17.7	14.6	14.9	20.9	19.1
	Forward	16.0	17.3	16.8	17.9	18.5	17.8	16.7
Services	GVC participation (%)	31.4	31.7	22.1	22.8	23.6	30.9	27.8
	Backward	7.5	7.8	3.8	4.4	4.1	8.4	10.1
	Forward	21.4	21.2	17.4	17.2	18.4	19.9	15.5

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN INDIA, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	7.2%	12.0%	19.2%
Textiles and textile products	13.5%	14.1%	27.6%
Leather, leather products, and footwear	15.2%	13.7%	28.9%
Wood and products of wood and cork	11.8%	11.0%	22.9%
Pulp, paper, paper products, printing, and publishing	20.9%	18.3%	39.2%
Coke, refined petroleum, and nuclear fuel	15.3%	45.5%	60.7%
Chemicals and chemical products	27.3%	19.2%	46.5%
Rubber and plastics	28.8%	20.1%	48.9%
Other nonmetallic minerals	13.8%	22.0%	35.7%
Basic metals and fabricated metals	20.8%	46.3%	67.1%
General machinery and equipment	18.0%	25.3%	43.3%
Electrical and optical equipment	16.7%	27.2%	44.0%
Transport equipment	13.7%	25.5%	39.2%
Manufacturing, nec; recycling	8.9%	25.1%	34.0%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN INDIA, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	34.4	17.7	35.1	2.1	89.3
Textiles	10.8	36.5	36.3	3.2	86.8
Leather and footwear	10.3	35.9	37.5	1.4	85.1
Wood products	21.1	46.3	24.4	1.0	92.8
Pulp and paper	7.6	40.9	28.3	3.3	80.1
Coke and petroleum	18.4	23.0	16.3	2.3	60.0
Chemicals	5.3	42.4	28.0	3.2	78.8
Rubber and plastics	7.0	42.3	26.8	2.7	78.8
Nonmetallic products	4.0	46.3	24.5	4.7	79.6
Metal products	2.0	36.2	19.2	1.6	58.9
General machinery	1.2	49.0	23.0	2.2	75.3
Electrical/optical equipment	1.4	45.4	26.7	3.0	76.4
Transport equipment	1.2	43.5	26.9	2.4	73.9
Manufacturing, nec	3.4	43.9	29.4	1.9	78.7
Manufacturing (total)	9.5	36.1	26.0	2.5	74.1

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	3.0	3.6	3.8	0.4	10.7
Textiles	3.1	4.7	4.8	0.6	13.2
Leather and footwear	2.7	5.8	5.8	0.6	14.9
Wood products	2.3	2.1	2.5	0.3	7.2
Pulp and paper	4.7	7.1	7.3	0.9	19.9
Coke and petroleum	20.5	4.6	12.3	2.5	39.9
Chemicals	6.1	6.5	7.5	1.0	21.1
Rubber and plastics	4.8	7.5	7.8	1.0	21.2
Nonmetallic products	8.2	4.3	6.7	1.1	20.4
Metal products	15.7	9.2	13.7	2.3	41.0
General machinery	5.8	8.7	9.1	1.2	24.7
Electrical/optical equipment	5.2	8.6	8.7	1.1	23.6
Transport equipment	5.3	9.7	9.9	1.2	26.0
Manufacturing, nec	5.1	7.4	7.9	1.0	21.3
Manufacturing (total)	9.0	6.6	8.9	1.4	25.9

Source: Authors calculations based on ADB MRIO Database.

COUNTRY PROFILE: VIETNAM

LABOR PRODUCTIVITY

- Vietnam's manufacturing productivity shows an average annual growth rate of 4.21% over the period 2000–18, with its productivity levels more than doubling from USD5,832 in 2000 to USD12,258 in 2018.

- In particular, a robust growth pattern has been found in manufacturing value added, boasting of a positive growth even during the 2008–09 recession.

- Growth in manufacturing productivity has accelerated even after the Global Financial Crisis (GFC) but that is largely attributable to a faster slowdown in employment relative to that in value added.

PRODUCTIVITY AND GVC PARTICIPATION

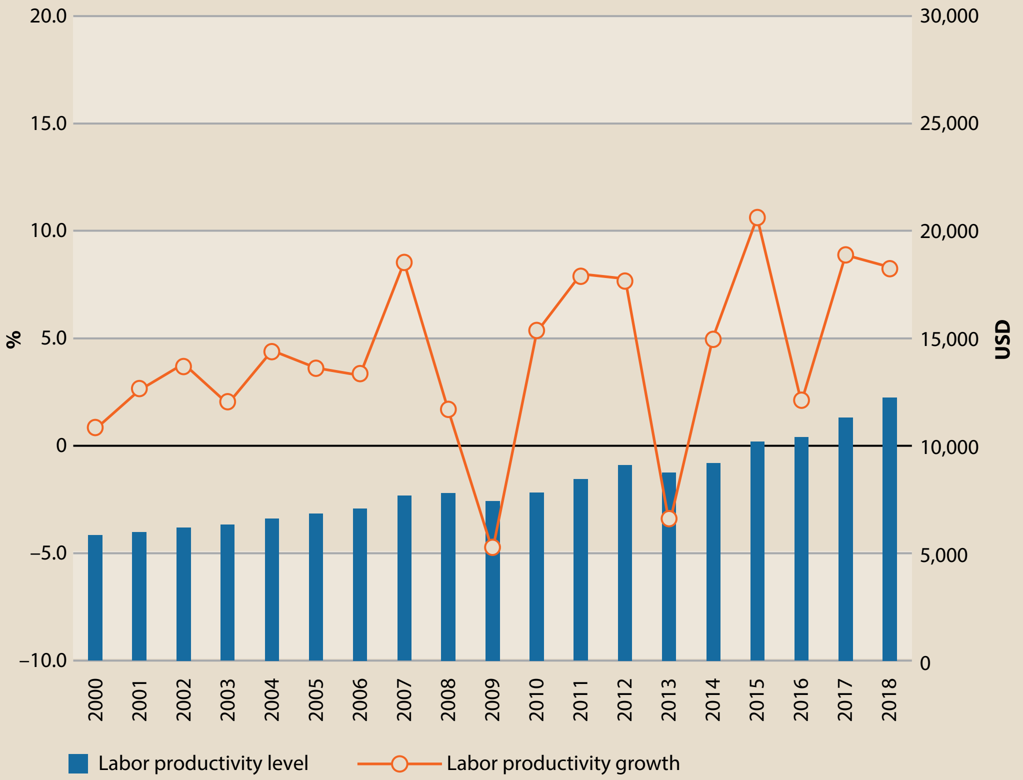
- The GVC participation rate of the manufacturing sector is relatively high, mainly due to high backward participation.

- Backward participation is particularly high in the sectors of electrical and optical equipment (66.1%); general machinery and equipment (63.8); and metals products (62.9%).

- The share of foreign value added in gross manufacturing exports as of 2019 was 48.7%, with a relatively high reliance on foreign manufacturing and service inputs.

FIGURE 1

MANUFACTURING LABOR PRODUCTIVITY SINCE 2000.



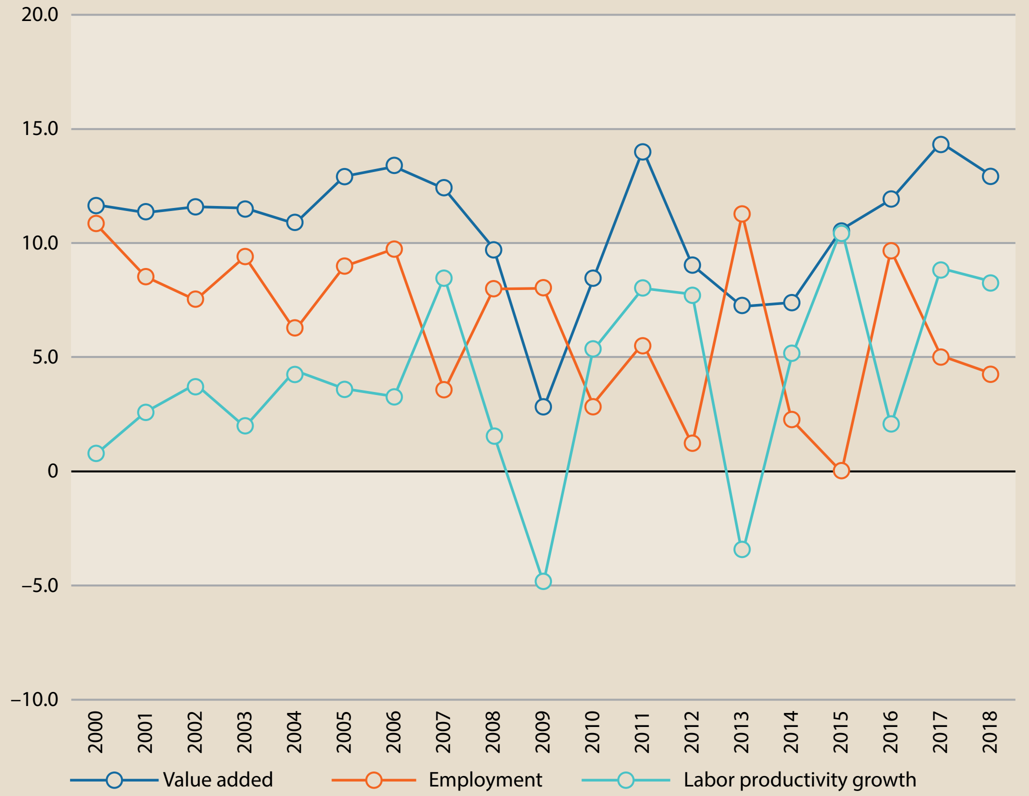


FIGURE 2

MANUFACTURING LABOR PRODUCTIVITY AND THE GLOBAL FINANCIAL CRISIS OF 2008–09.

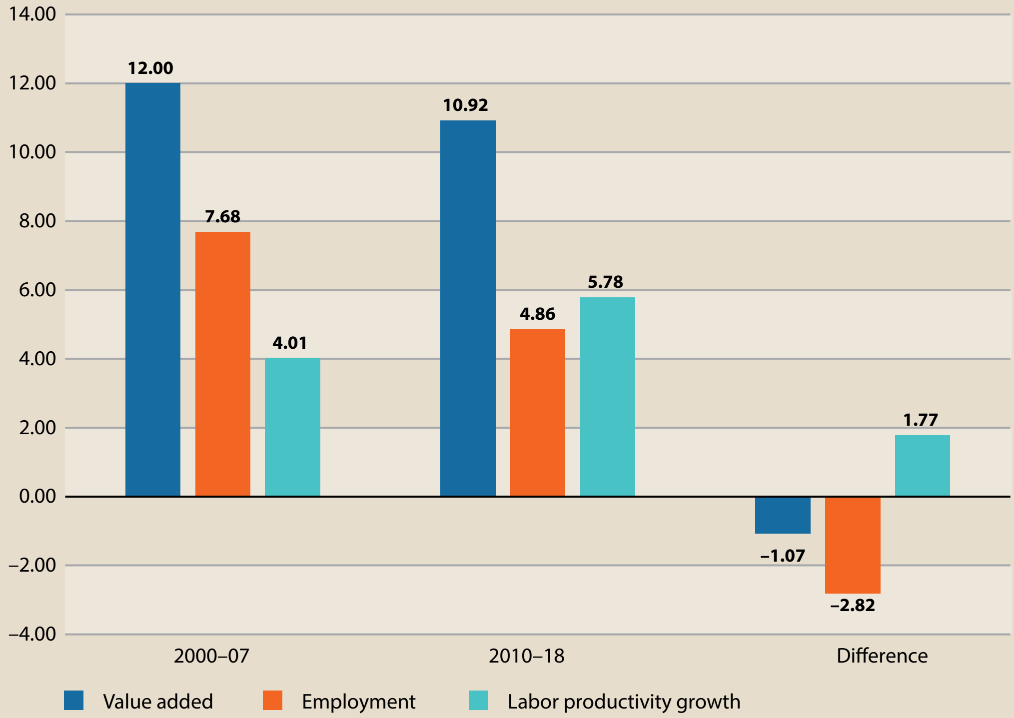


TABLE 1

THE TREND OF GVC PARTICIPATION IN VIETNAM.

Sector	Indicators	2000	2010	2015	2016	2017	2018	2019
Whole sector	GVC participation (%)	36.6	54.5	50.7	59.5	58.2	62.9	58.8
	Backward	20.7	36.5	31.4	38.6	37.0	39.5	41.7
	Forward	11.9	9.8	11.2	9.7	9.9	11.6	7.9
Primary goods	GVC participation (%)	35.4	44.2	43.1	45.5	44.6	48.2	50.7
	Backward	13.5	27.6	28.0	30.6	29.3	30.5	32.6
	Forward	18.1	11.1	10.1	9.6	10.0	11.1	10.9
Manufacturing	GVC participation (%)	36.9	57.4	53.3	61.8	59.7	64.5	60.8
	Backward	22.7	40.7	34.9	40.9	38.4	41.5	44.0
	Forward	10.2	8.0	9.4	8.9	9.4	10.7	7.1
Services	GVC participation (%)	30.2	43.5	41.0	41.9	45.0	48.9	44.3
	Backward	16.6	25.0	21.7	21.5	23.7	20.2	26.8
	Forward	11.5	13.6	14.9	15.9	15.9	21.8	12.1

Source: ADB MRIO Database.

TABLE 2

THE EXTENT OF GVC PARTICIPATION BY MANUFACTURING SUBSECTORS IN VIETNAM, 2019.

	GVC participation		
	Forward	Backward	Total
Food, beverages, and tobacco	6.2%	48.9%	55.1%
Textiles and textile products	3.3%	48.9%	52.2%
Leather, leather products, and footwear	3.3%	42.3%	45.6%
Wood and products of wood and cork	12.0%	41.6%	53.6%
Pulp, paper, paper products, printing, and publishing	12.1%	54.3%	66.3%
Coke, refined petroleum, and nuclear fuel	12.6%	42.9%	55.6%
Chemicals and chemical products	13.8%	52.6%	66.4%
Rubber and plastics	14.7%	59.2%	73.9%
Other nonmetallic minerals	12.2%	30.6%	42.8%
Basic metals and fabricated metals	14.6%	62.9%	77.5%
General machinery and equipment	6.5%	63.8%	70.2%
Electrical and optical equipment	8.0%	66.1%	74.1%
Transport equipment	6.2%	58.5%	64.7%
Manufacturing, nec; recycling	3.2%	44.5%	47.7%

Source: ADB MRIO Database.

TABLE 3

THE VALUE-ADDED STRUCTURE OF GROSS MANUFACTURING EXPORTS BY SECTOR IN VIETNAM, 2019.

	Share of domestic value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	20.8	20.2	13.6	2.9	57.6
Textiles	1.9	37.3	9.9	2.2	51.4
Leather and footwear	1.3	44.6	11.1	2.3	59.3
Wood products	20.7	20.6	17.4	3.0	61.6
Pulp and paper	2.4	32.0	11.5	2.3	48.2
Coke and petroleum	25.2	19.2	6.6	1.3	52.2
Chemicals	8.6	29.3	10.1	2.1	50.1
Rubber and plastics	3.2	29.1	9.1	2.3	43.8
Nonmetallic products	12.6	40.6	9.3	7.9	70.4
Metal products	3.8	28.6	7.1	3.3	42.8
General machinery	1.5	33.2	8.7	2.5	45.9
Electrical/optical equipment	1.1	25.8	11.5	1.5	39.9
Transport equipment	0.9	28.5	9.2	1.3	39.8
Manufacturing, nec	11.2	31.4	13.2	2.7	58.4
Manufacturing (total)	8.5	28.9	11.4	2.5	51.3

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	Share of foreign value added (%)				
	Primary goods	Manufacturing	Services	Others	Subtotal
Food and beverages	16.2	12.2	12.5	1.4	42.3
Textiles	8.3	21.0	17.3	1.9	48.5
Leather and footwear	7.3	16.8	14.8	1.7	40.7
Wood products	14.8	11.0	11.2	1.3	38.4
Pulp and paper	9.1	19.4	21.2	2.2	51.8
Coke and petroleum	17.1	14.6	14.0	2.1	47.7
Chemicals	12.7	19.0	16.1	2.0	49.9
Rubber and plastics	12.8	23.1	17.9	2.4	56.2
Nonmetallic products	8.1	10.2	9.9	1.4	29.6
Metal products	12.5	22.9	18.3	3.3	57.0
General machinery	7.8	26.0	17.9	2.4	54.1
Electrical/optical equipment	7.6	30.6	19.1	2.5	59.8
Transport equipment	10.1	23.5	23.6	2.9	60.1
Manufacturing, nec	13.3	13.9	12.7	1.7	41.6
Manufacturing (total)	11.4	19.4	15.8	2.0	48.7

Source: Authors' calculations based on ADB MRIO Database.

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PRODUCTIVITY TRENDS AND CHALLENGES

THEMATIC ISSUE 1: GVCS AND PRODUCTIVITY

LIST OF ACRONYMS

ADB	Asian Development Bank
AI	Artificial Intelligence
APO	Asian Productivity Organization
DAI	Digital Adoption Index
EDA	Electronic Design Automation
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GVC	Global Value Chain
HICs	High Income Countries
IT	Information Technology
ICT	Information Communication Technology
IoT	Internet of Things
KDI	Korea Development Institute
LMICs	Lower-Middle Income Countries
LP	Labor Productivity
LSDV	Least Squared Dummy Variables
MCs	Member Countries
MICs	Middle-Income Countries
MNCs	Multi-national Companies
NPO	National Productivity Organization
OECD	Organisation for Economic Co-operation and Development
PMI	Purchasing Manager's Index
PPP	Purchasing Power Parity
RCA	Revealed Comparative Advantage
R&D	Research and Development
SBA	Survey of Business Activities
SMEs	Small and Medium-sized Enterprises
SOEs	State-Owned Enterprises
TFP	Total Factor Productivity
UMICS	Upper-Middle Income Countries
UNIDO	United Nations Industrial Development Organization
VA	Value-Added
WB	World Bank

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