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Abstract

This paper explores the role of productivity gains in driving economic growth in Brunei Darussalam, a resource-rich economy. While Brunei's growth has traditionally relied on primary inputs such as labor and capital, boosting total factor productivity (TFP) is increasingly critical for sustaining long-term economic growth. The analysis highlights significant improvement in labor productivity following the COVID-19 pandemic, primarily driven by TFP gains in the non oil-and-gas sector. This reflects tangible gains from capital deepening through economic diversification efforts in new technologies and infrastructure. Despite progress, challenges remain. Continuing reforms are crucial to foster greater competition and flexibility in the labor market. Deliberate policies that align education and training with industry needs are essential for closing manpower gaps and enhancing human capital development. Promoting technological innovation is vital for sustaining productivity gains in non oil-and-gas sector. A "whole-of-nation" approach, aligned with the Digital Economy Masterplan 2025, will remain key to enhancing digital infrastructure, fostering innovation, and encouraging MSMEs to adopt digital technologies. Complementary policies to improve access to finance, reduce regulatory barriers, and incentivize research and development are critical for modernizing industries and creating high-value jobs. By prioritizing these strategic approaches, Brunei can address structural challenges, reduce resource dependency, and pave the way for sustainable economic growth.

JEL classification: E22, O40, Q32

Keywords: total factor productivity, labor productivity, economic growth, structural transformation, innovation and technological progress

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Acronyms and Abbreviations

AE	United Arab Emirates
AMRO	ASEAN+3 Macroeconomic Research Office
ASEAN	Association of Southeast Asia Nations
ASEAN+3	ASEAN, China, Hong Kong; China, Korea and Japan
ASEAN-5	Malaysia, Thailand, Indonesia, Philippines and Singapore
BH	Bahrain
BN	Brunei
COVID-19	Coronavirus disease 2019
FDI	Foreign direct investment
GCC	Gulf Cooperation Council economies
HRDF	Human Resources Development Fund
ICT	Information and communication technology
IMF	International Monetary Fund
KW	Kuwait
LP	Labor productivity
MPEC	Manpower Planning and Employment Council
MSME	Micro, Small and Medium-Sized Enterprises
NEP	National Employment Policy
Non-O&G	Non oil-and-gas sector
O&G	Oil and gas sector
OM	Oman
PWT	Penn World Table
RKN	National Development Plans
R&D	Research and Development
SA	Saudi Arabia
TFP	Total factor productivity
UBD	Universiti Brunei Darussalam

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I. Introduction

One of the core tenets in economics is that enhancing productivity is crucial for sustaining long-term economic growth, bolstering competitiveness, and improving overall living standards. Total factor productivity (TFP) serves as a comprehensive measure of productivity, assessing how effectively an economy achieves growth through optimal resource allocation and advancements in technology and innovation. Improvements in TFP reflect an economy's ability to increase output by utilizing inputs—labor, capital, technology, and natural resources—more efficiently in the production process. Consequently, an extensive body of literature identifies TFP as a key driver of economic growth.

While TFP offers a holistic perspective by encompassing the efficiency of all production inputs, labor productivity—defined as output per worker or output per hour worked—provides a more focused view of economic performance. This distinction is particularly important because labor productivity directly influences a nation's immediate output and income levels, making it a fundamental indicator of economic health. Typically, higher labor productivity correlates with increased wages, improved living standards, and enhanced competitiveness in the global market.

TFP measures the overall efficiency of all inputs in the production process, while labor productivity focuses specifically on the output generated per unit (or hour) of labor. Improvements in TFP, driven by innovations and better resource management, enhance labor productivity by allowing economies to generate more output per worker without a corresponding increase in input usage.

Analyzing trends in labor productivity is vital for assessing the effectiveness of labor market policies, as fluctuations in labor productivity reflect underlying TFP changes. Policymakers can determine whether existing policies are yielding the desired outcomes or if adjustments are necessary to address gaps in skills and technology adoption. Furthermore, fluctuations in labor productivity can signal shifts in economic conditions tied to TFP changes, allowing for timely interventions to support lagging industries or sectors. Thus, tracking both TFP and labor productivity trends is essential for guiding strategic decisions regarding workforce education and training, which are critical for fostering long-term human capital development and sustaining future economic growth.

For resource-rich economies such as Brunei, prioritizing productivity enhancements is especially crucial to mitigate the risks associated with the exhaustibility of non-renewable resources, while ensuring their efficient utilization (Van de Ploeg 2010; Gylfason 2005; Sachs and Warner 1995). By investing in technology diffusion and fostering innovation, resource-rich economies can maximize the benefits of their resource wealth, creating productivity spillovers across various sectors. Furthermore, in the context of Brunei's aging population, enhancing both TFP and labor productivity becomes fundamental to sustaining growth, shifting the focus from extensive growth drivers—like increasing primary inputs (labor, capital)—to intensive strategies that prioritize the adoption and spread of innovative technologies.

This paper aims to evaluate the productivity trends in Brunei since the mid-2000s and to compare these trends with those of peer economies in the Gulf Cooperation Council (GCC). Section II outlines the analytical framework for estimating productivity, incorporating both

TFP and labor productivity measures. Following this, we analyze the key drivers of productivity shifts in Brunei, with a particular emphasis on developments post-COVID-19 pandemic. Section III presents a policy discussion that focuses on the key challenges and barriers to labor productivity growth in Brunei, followed by a discussion on the key strategies and priorities for the future. Section IV concludes.

II. Literature Review

The significance of productivity in driving long-term economic growth has been widely acknowledged in the economic literature. Pioneering studies by Solow (1957) and Swan (1956) laid the foundation for understanding economic growth through the decomposition of inputs and productivity enhancements. Solow's seminal work introduced the concept of TFP as a measure of technological progress, distinct from the contributions of labor and capital. This growth accounting framework has since become a cornerstone in examining how economies achieve sustainable growth, with productivity improvements playing a critical role beyond input accumulations.

Subsequent empirical studies have explored the relationship between TFP growth and economic development across different countries and regions. In the ASEAN+3 region, AMRO (2024) highlights that the pace of growth and productivity improvements in the region—especially after the global financial crisis of 2008-09—is slowing. It is also found that productivity gaps remain substantial between many in the ASEAN+3 region and the productivity frontier (proxied by the United States), despite significant progress achieved in the past two decades. In this context, World Bank (2019) highlights the crucial role of innovation in boosting productivity growth, particularly in East Asia. Eichengreen, Park, and Shin (2012) demonstrates that TFP gains, alongside capital accumulation, are key enablers for emerging economies to escape the middle-income trap. These findings emphasize that technological progress, institutional reforms, and human capital development are essential for sustaining growth in the long run.

In the context of resource-rich economies, the literature underscores the critical need for productivity enhancements to diversify economic activity and mitigate the risks of resource dependence (or Dutch disease effects). Van der Ploeg and Poelhekke (2010) argue that resource-rich economies often experience volatility in growth due to their over-reliance on natural resources. The resource dependence could then draw capital away from other sectors, stifling growth and innovations, with significant implications on human capital. Such negative impacts have been observed in many countries with significant natural resource wealth, such as Nigeria, Venezuela and Russia (Auty 1993). Scholarly discourse often highlights factors such as sound economic policies, prudent fiscal management, and strategic investments in human capital as crucial elements in mitigating the risks associated with resource dependence (Rosser 2006; Van der Ploeg, 2010).

GCC countries, characterized by their rich natural resources, have increasingly recognized the importance of diversifying their economies and boosting productivity through innovation and efficient resource allocation (Callen et al., 2019). Several studies have highlighted the need for these nations to transition from a dependence on oil and gas (O&G) revenues to sustainable economic growth driven by non-O&G sectors. Akkas and Altiparmak (2023) argue that innovation is critical for GCC economies, as it can mitigate the risks associated

with fluctuating oil prices. By fostering a culture of innovation through investment in research and development, the study suggests that productivity improvements across various sectors tend to be associated with a more resilient economic structure. Similarly, a report by the World Bank (2018) indicates that efficient resource allocation, particularly in education and technology, is essential for promoting human capital development, which directly affects productivity levels.

Literature suggests that GCC countries are increasingly leveraging on technology to optimize resource utilization. World Economic Forum (2023) highlights the transformative impact of Industry 4.0 technologies on the Gulf's manufacturing sector. It underscores how cutting-edge advancements like artificial intelligence, data analytics, and automation are enabling countries such as Bahrain, Saudi Arabia and United Arab Emirates (UAE) to build more advanced and productive industries. These technologies are not only improving efficiency and competitiveness but also fostering sustainability by helping the sector reduce emissions and adopt greener practices.

GCC countries are also focusing on enhancing the efficiency of their public sectors. In a study by Asiri (2024), the author explores how public sector reforms aimed at improving governance and transparency can lead to better resource allocation. The findings suggest that enhanced efficiency in public administration not only improves productivity but also attracts foreign direct investment, which is vital for economic diversification.

Similarly, labor productivity plays a central role in determining economic performance. In resource-rich economies, the importance of labor productivity becomes even more pronounced, as it helps mitigate the reliance on natural resources for growth. For economies grappling with demographic challenges, such as a shrinking working-age population and rising dependency ratios, increasing labor productivity is essential to elevate the population's economic well-being Gordon (2016). This finding is corroborated in a study by Mankiw, Romer and Weil (1992), where the researchers emphasized the constraints from demographic factors in limiting economic growth, as labor force and participation rates cannot increase without bounds. Bloom, Canning, and Sevilla (2003) highlight that as labor force participation rates decline due to demographic shifts, growth in labor productivity can serve as a counterbalance, ensuring that overall economic output remains robust. This underscores the necessity for policymakers to prioritize investments in education, training, and technology that boost labor productivity. This finding is supported by Shi and Zhao (2024), where the researchers found that the accumulation of human capital and technological advancements helps mitigate negative effects from population aging in the ASEAN+3 region.

In resource-rich economies where the wealth generated from natural resources can sometimes mask underlying economic vulnerabilities, enhancing labor productivity is vital for ensuring sustainable growth. By focusing on productivity improvements, these economies can diversify their economies, reduce their dependence on volatile resource markets, and create more stable and resilient economic environments. Therefore, fostering a culture of continuous improvement in labor productivity is essential not only for addressing immediate economic challenges but also for laying the groundwork for long-term prosperity and stability

In the case of Brunei, the literature on productivity remains limited, particularly concerning detailed sectoral TFP and labor productivity trends. In a study by Razak (2012) on the population and labor market trends in Brunei, the author noted the importance of tracking labor productivity, which is a key metric that objectively measure the country's economic performance and the quality of labor force. Apong (2013) painted a picture of Brunei's declining labor productivity trend since the early 1990s, calling for integrating productivity improvements into Brunei's long-term national development agenda. Both studies argued for greater labor market flexibilities and/or human capital investment in education, training and innovation to spur economic growth through productivity enhancements

The findings by Apong (2013) of a long-term downward trend in Brunei's labor productivity are consistent with the results in Cheong (2013). In the latter study, the author found that while Brunei is the only country within ASEAN with such as trend, it is common across other oil exporter countries in the GCC. More strikingly, the author argued that the higher population growth achieved during the past 15 years coincided with a period of lower economic growth in Brunei. In other words, adding more workers to the economy, on average, resulted in lower level of productivity instead.

Koh (2014) provided a notable contribution by presenting the first comprehensive growth accounting exercise and estimates of TFP growth for Brunei, covering the period from 1981 to 2011. This study also offers a comparative analysis with other GCC countries and those in ASEAN, which is crucial for contextualizing Brunei's economic performance. The research focuses primarily on TFP and labor productivity at an aggregate level, revealing that Brunei exhibits the lowest labor productivity growth among its peers. This finding is particularly concerning as it highlights the challenges that Brunei faces in enhancing its economic competitiveness. The study attributes this low labor productivity growth primarily to two factors—limited contribution of TFP and insufficient growth in capital inputs.

Research on similar oil-dependent economies such as that by Rodrik (2013) offers valuable insights into the potential for productivity growth through diversification and structural transformation. Enhancing productivity particularly in the non-O&G sector through innovation and technology diffusion is essential for maintaining Brunei's long-term economic prospects, especially as it faces diminishing returns from its oil reserves. This underscores that the durable pathway to sustainable growth in Brunei lies in boosting both TFP and labor productivity.

III. TFP and Labor Productivity Trends in Brunei

A. Analytical Framework

A widely adopted analytical approach for capturing TFP is the growth accounting framework within the neoclassical model, most often represented by the Cobb-Douglas production function. This framework decomposes overall economic growth into the contributions of various inputs, such as labor and capital, thereby isolating the TFP component—commonly referred to as the Solow residual. TFP captures the portion of output growth that cannot be explained by the accumulation of these traditional inputs, reflecting improvements in efficiency, technology, and innovation. The Cobb-Douglas function's simplicity and flexibility make it a robust and widely used tool for analyzing economic growth, particularly in its ability

to separately identify the impact of input accumulation from productivity enhancements, thereby providing a clearer understanding of the drivers of long-term development.

In resource-rich economies such as Brunei, however, a more nuanced approach is required to fully grasp the growth dynamics. The traditional Cobb-Douglas production function, which primarily accounts for labor and capital may overlook the significant role that natural resources play in driving economic performance. Thus, the **extended Cobb-Douglas production function** incorporates natural resources as an additional factor of production. This extended model is better suited for analyzing growth in economies where natural resources—such as oil, gas, and minerals—are central to output (Barro and Sala-i-Martin 1995; Stiglitz 1974). The addition of the resource sector in the growth accounting framework is evident in studies such as Hamilton, Naikal, and Lange (2019), Brandt, Schreyer, and Zipperer (2017), Behbudi, Mamipour and Karami (2010) and Dasgupta and Heal (1974), where the authors emphasized the need to account for finite natural resources in the growth accounting models. By including natural resources alongside labor and capital, the extended model offers a more comprehensive view of how these economies operate, reflecting the unique contribution of resource extraction and use to economic performance.

This extension allows for a more detailed decomposition of economic growth by distinguishing the roles of labor, capital, and natural resources, enabling policymakers and researchers to better understand how each component contributes to overall productivity. Furthermore, the model sheds light on the importance of technological progress and innovation in driving TFP. In resource-rich economies, technological advancements are especially critical for improving the efficiency of resource extraction and utilization, lowering production costs, and reducing the environmental footprint associated with resource exploitation. For instance, innovations in oil extraction techniques, renewable energy technologies, and resource management can significantly boost the long-term sustainability of growth in resource-dependent economies.

Moreover, technological progress can serve as a catalyst for diversification. In economies heavily reliant on natural resources, innovation is essential not only for maximizing the output derived from these resources but also for promoting the development of new industries. Through this lens, the extended Cobb-Douglas model not only highlights the contributions of labor, capital, and resources but also emphasizes the transformative role of technological innovation in reshaping the economic landscape of resource-rich economies like Brunei.

However, it should be noted that even though the extended Cobb-Douglas production function is widely used for quantifying economic growth due to its analytical utility, it has several limitations. First, productivity is treated as a residual in the model, which can obscure the impact of key factors such as institutional quality, improvements in infrastructure (including networks and connectivity), and externalities or spillovers. Second, positive knowledge spillovers from technological diffusion, for instance, or negative ones like environmental degradation, may not be fully captured, leading to an incomplete understanding of the true drivers of economic growth and efficiency improvements. Third, its assumptions, such as constant returns to scale, may not capture the complexities of

technology[3] and labor market dynamics, potentially leading to oversimplified interpretations of economic performance (Mankiw, Romer, and Weil (1992); Solow (1957)).

Finally, a key limitation of the model is the susceptibility to Dutch disease conditions, since the resource dependence introduces specific challenges in the estimation of TFP. For instance, a resource boom may lead to higher apparent output growth. However, if the model attributes this to either gains in TFP or growth of the resource sector, it may potentially ignore the structural weaknesses caused by deindustrialization. This may result in lower long-term TFP growth trend, even if short-term TFP growth appears robust. Dutch disease effects could affect the stability of the elasticity estimates, making it harder to arrive at robust parameter estimates for each component in the model (Corden and Neary 1982).[4]

The mathematical representation of this extended production function is given by Equation (1), which introduces natural resources explicitly as a factor of production alongside labor and capital, thus reflecting the full complexity of production processes in resource-dependent economies. This approach enables a deeper understanding of how technological advancements and productivity improvements interact with traditional inputs, offering insights into pathways for long-term growth and economic resilience in resource-rich contexts.

$$Y_t = A_t \, K_t^{\alpha} \, L_t^{\beta} \, R_t^{\gamma} \tag{1}$$

where,

- Y is the economy's output;
- A is TFP;
- K is capital stock;
- L is labor input;
- R is the natural resource input (O&G production, in volume terms);
- α, β, γ are the output elasticities with respect to of capital, labor and resource inputs, respectively. Assuming constant returns to scale, the sum of these elasticities would equal to one, reflecting the proportional relationship between inputs and output.

To account for the quality of human capital in Equation (1), the labor input L_t is adjusted by a human capital factor H_t, where,

$$H_t = exp\,(\varphi_t S_t) \tag{2}$$

where,

- S is the learning-adjusted years of schooling;
- φ is the time-varying returns to education.

[3] The model assumes technology to be constant unless explicitly adjusted, thereby failing to account for endogenous technological changes driven by innovation, research and development, or policy interventions. By not incorporating these evolving factors, the model can overlook how shifts in technology interact with labor and capital, which are crucial to understanding productivity and long-term economic performance.

[4] A comprehensive discussion on the susceptibility of the Dutch disease conditions on the model estimation is beyond the scope of this paper. Readers are encouraged to review the following literature (Corden and Neary 1982; Ismail, Kareem 2010).

Time (in years) is denoted by the subscript, t. The data sources and key assumptions are set out in Appendix I.

This exponential form captures the compounding effect of education on labor productivity—reflecting how even small improvements in education levels (both in quantity and quality) can have significant impacts on the economy's output over time.

To assess the effects of the COVID-19 pandemic on school closures and their potential impact on learning outcomes, the estimates for the human capital factor are adjusted from 2020 onwards, based on findings from World Bank (2021), where a five-month school closure could lead to an average learning loss equivalent to 0.6 learning-adjusted years of schooling.

The adjusted production function becomes:

$$Y_t = A_t \, K_t^{\alpha} \, (L_t H_t)^{\beta} \, R_t^{\gamma} \tag{3}$$

From Equation (3), output per worker (or labor productivity)[5] can be derived which is a function of TFP, capital per worker and resource per worker. From Equation (1), the growth of output per worker can be derived by taking logs and differentiating both sides of the equation. By re-arranging terms, the growth in output per worker (commonly referred to as labor productivity growth) is given by Equation (4).

$$\underbrace{\frac{\dot{Y}}{Y} - \frac{L\dot{H}}{LH}}_{\text{Growth rate of output per worker}} = \underbrace{\frac{\dot{A}}{A}}_{\text{Growth rate of TFP}} + \underbrace{\alpha\left(\frac{\dot{K}}{K} - \frac{L\dot{H}}{LH}\right)}_{\text{Contributions of capital per worker}} + \underbrace{\gamma\left(\frac{\dot{R}}{R} - \frac{L\dot{H}}{LH}\right)}_{\text{Contributions of natural resource inputs per worker}} \tag{4}$$

where,

- $\dot{Y}/Y$ is the growth rate of output.
- $\dot{A}/A$ is the growth rate of TFP.
- $\dot{K}/K$ is the growth rate of capital.
- $L\dot{H}/LH$ is the growth rate of labor.
- $\dot{R}/R$ is the growth rate of natural resources.
- α and γ are the output elasticities with respect to of capital and resource inputs, respectively.

[5] There are various measures of labor productivity other than output per worker, such as output per hour worked, value added per worker, and value added per hour worked. These metrics offer insights into how efficiently labor contributes to production across different contexts. At the macroeconomic level, labor productivity is often measured using GDP per worker (or GDP per hour worked). However, measuring labor productivity in non-market activities, such as in public institutions, often lacks precision due to the difficulty in quantifying outputs, making it necessary to employ more complex methodologies or enhanced data collection techniques (Atkinson 2005).

The left-hand side of Equation (4) is the labor productivity growth. This growth rate can be decomposed into the contributions from TFP, capital per worker (often termed capital deepening)[6] and resource per worker (or resource deepening).[7] For sectoral analysis, Equation (4) can be split into two separate parts—one for the O&G sector, and one for the non-O&G sector—where each would have its own dynamics (Equation 5a and 5b).

Labor productivity growth in the O&G sector:

$$\frac{\dot{Y}_{OG}}{Y_{OG}} - \frac{\dot{LH}_{OG}}{LH_{OG}} = \frac{\dot{A}_{OG}}{A_{OG}} + \alpha_{OG}\left(\frac{\dot{K}_{OG}}{K_{OG}} - \frac{\dot{LH}_{OG}}{LH_{OG}}\right) + \gamma_{OG}\left(\frac{\dot{R}_{OG}}{R_{OG}} - \frac{\dot{LH}_{OG}}{LH_{OG}}\right) \quad (5a)$$

Labor productivity growth in the non-O&G sector:

$$\frac{\dot{Y}_{NOG}}{Y_{NOG}} - \frac{\dot{LH}_{NOG}}{LH_{NOG}} = \frac{\dot{A}_{NOG}}{A_{NOG}} + \alpha_{NOG}\left(\frac{\dot{K}_{NOG}}{K_{NOG}} - \frac{\dot{LH}_{NOG}}{LH_{NOG}}\right) \quad (5b)$$

where,

- $\dot{Y}_{OG}/Y_{OG}$ and $\dot{Y}_{NOG}/Y_{NOG}$ are the growth rates of output in the O&G and non-O&G sectors, respectively.
- $\dot{A}_{OG}/A_{OG}$ and $\dot{A}_{NOG}/A_{NOG}$ are the growth rates of TFP in the O&G and non-O&G sectors, respectively.
- $\dot{K}_{OG}/K_{OG}$ and $\dot{K}_{NOG}/K_{NOG}$ are the growth rates of capital stock in the O&G and non-O&G sectors, respectively.
- $\dot{LH}_{OG}/LH_{OG}$ and $\dot{LH}_{NOG}/LH_{NOG}$ are the growth rates of labor input in the O&G and non-O&G sectors, respectively.
- α_{OG} and α_{NOG} are the elasticities of output with respect to capital in the O&G and non-O&G sectors, respectively.
- γ_{OG} is the elasticity of output with respect to natural resources in the O&G sector.

The aggregate labor productivity (LP) growth is given by:

$$LP_{Total\ economy} = w_{OG} \cdot LP_{OG} + w_{NOG} \cdot LP_{NOG} \quad (6)$$

where,

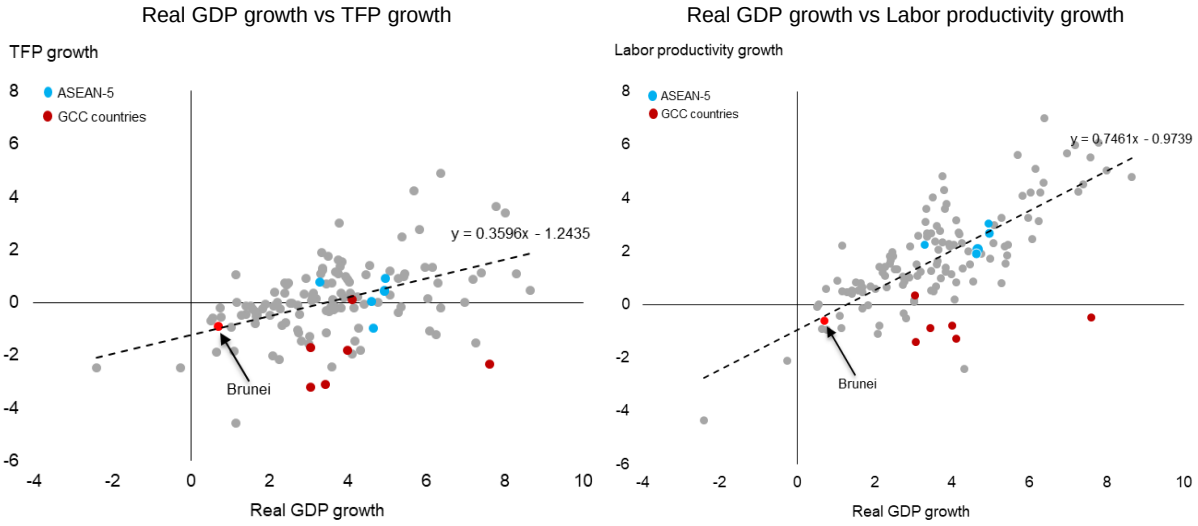
w_{OG} and w_{NOG} are the sectoral weights, i.e., proportion of labor in each sector.

[6] Capital deepening refers to the increase in the amount of capital per worker in the economy. It occurs when additional investments in capital goods (such as machinery, equipment, and technology) enhance the productivity of the existing labor force. For example, when firms invest in more or better-quality capital goods, each worker has access to more or better tools, which increases their productivity. Capital deepening generally leads to higher labor productivity because workers are able to produce more output with the same amount of effort due to improved capital.

[7] Resource deepening refers to the more efficient use of natural resources in production per worker in the economy. It reflects how effectively a country utilizes its natural resource base. For example, improvements in resource extraction technologies, better management practices, or finding new resources can lead to higher productivity from the same (or increased) resource inputs. Resource deepening enhances the productivity of labor by ensuring that resources are utilized more effectively or that there is a greater availability of resources for production.

The analytical model clearly illustrates that continuous improvements in TFP are crucial for sustaining labor productivity growth, a conclusion that is well-supported by extensive literature. Enhancements in TFP, fueled by innovation, technological advancements, and efficient resource utilization, play a crucial role in maintaining and accelerating labor productivity growth over the long term, which in turn drives total output growth. A simple correlation analysis shows that gains in productivity are positively related to economic growth (Figure 1).

Figure 1. Scatterplot of Real GDP Growth vs Measures of Productivity Growth (2000–23)



Source: Conference Board Total Economy Database; IMF; AMRO staff estimates.

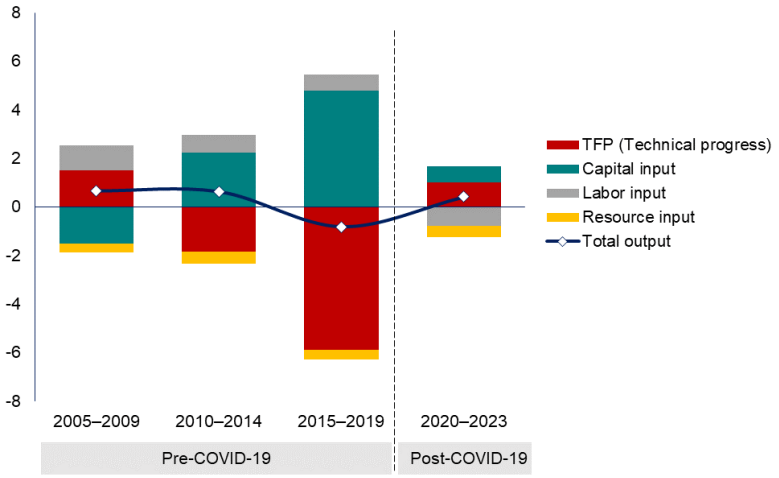
B. Key Drivers of Productivity Shifts in Brunei

(I) 2005—2019 (Pre-COVID-19 Pandemic)

From 2005 to 2019, Brunei's economic growth was primarily driven by increases in labor and capital inputs. Labor played a key role, as reflected in labor force survey data which showed peak labor force participation rates, particularly in the mid-2000s. Employment growth was also strong during this period, averaging around 3 percent annually. A significant share of migrant workers, especially in the labor-intensive service sector, further underscored the importance of labor in supporting economic output. Similarly, capital stock expanded significantly, as investment surged at an average annual rate of 8 percent. In particular, during 2015–19, gains in capital stock accelerated, fueled by large-scale investments in downstream fertilizer and petrochemical facilities. The cumulative investment in these two FDI projects reached approximately BND6.6 billion, which helped boost investment to GDP ratio of almost 40 percent during 2015–19 (2005–14: 30 percent of GDP).

However, while the volume of labor and capital inputs was increasing, TFP was a drag on overall economic growth during the pre-pandemic years. Figure 2 shows that overall TFP growth had been largely negative from 2005–19, suggesting that while the quantity of primary inputs was increasing, the productivity with which they were used was declining. The drag from TFP was significant, notably from 2015–19, which outweighed the positive contributions from capital. This led to a contraction in total output during this period.

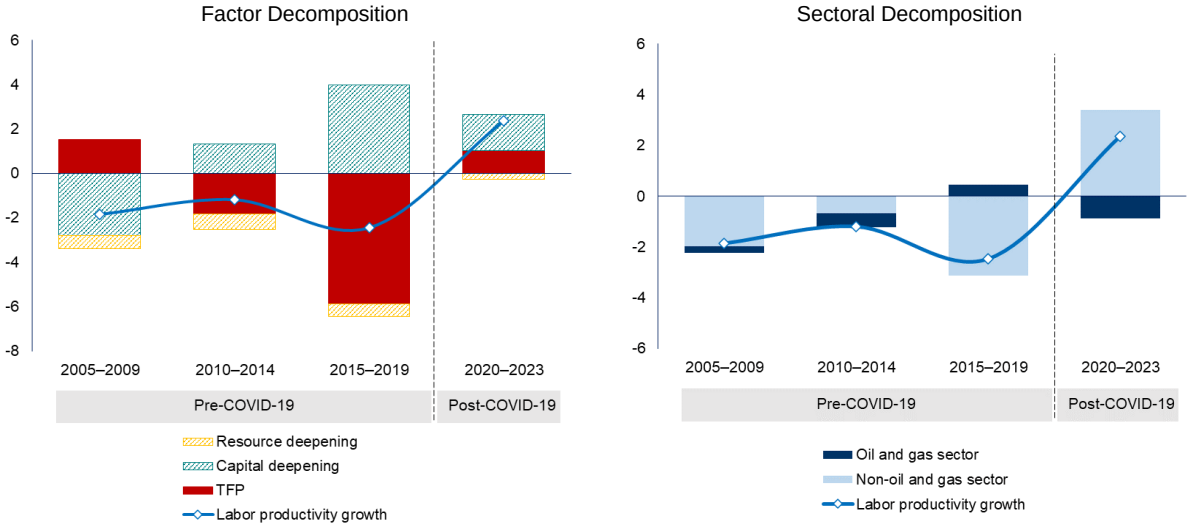
Figure 2. Decomposition of Output Growth
% Points contributions to growth



Source: National authorities; PWT; UNDP; World Bank; AMRO staff estimates.

Similarly, factor decomposition revealed that the drag from TFP was the primary factor weighing on labor productivity throughout most of 2005–19 (Figure 3, left panel). Despite the expansion in labor inputs, Brunei's labor productivity continued to decline during this period. This result is consistent with the findings in Cheong (2013) and Koh (2014). Even though increased investments in capital goods, such as machinery and equipment supported labor productivity gains, i.e., through capital deepening, notably during the 2010s, Brunei faces persistent challenges in advancing technological innovation and improving efficiency. These obstacles appear to limit the economy's ability to achieve sustained productivity improvements.

Figure 3. Decomposition of Labor Productivity Growth
% Points contributions to growth



Source: National authorities; PWT; UNDP; World Bank; AMRO staff estimates.
Note: Sectoral disaggregation, beyond the O&G and non-O&G sectors are constrained by data limitations.

Sectoral decomposition of labor productivity suggests that both the O&G and the non-O&G sectors contributed negatively to growth throughout most of 2005–19 (Figure 3, right panel). In the O&G sector, declining production levels and aging infrastructure could have significantly hindered gains in labor productivity. Similarly, in the non-O&G sector, despite ongoing diversification efforts, structural challenges, such as a small pool of skilled workforce and slower pace of adoption of advanced technologies, especially amongst micro, small and medium-size enterprises (MSMEs), may have constrained the growth in labor productivity during this period. The weak productivity growth in both sectors underscores the need for more strategic investments in innovation and capacity building across the economy (Section III).

(II) 2020—2023 (Post-COVID-19 Pandemic—A New Normal)

The COVID-19 pandemic had a profound and multifaceted impact on labor markets worldwide. Lockdowns and mobility restrictions implemented during the peak of the pandemic not only disrupted economic activities but also significantly affected both the quantity and quality of available workers. In Brunei, local employment growth post-pandemic has remained moderate, averaging below 2 percent from 2020–23. In contrast, non-local employment growth has continued to remain sluggish as migrant workers have been slow to return. As of end-2023, the number of migrant workers is still 15 percent below the 2019 level. Given Brunei's dependence on migrant workers (30 percent share of the labor force), it is not surprising that the contribution of labor inputs to total output growth was negative in 2020–23 (Figure 2).

Encouragingly however, the contribution of TFP to both output and labor productivity growth saw a marked improvement in 2020–23, a reversal from its historical trends. Even though the economy had to rely on fewer number of labor inputs, the accelerated adoption of technology and digital innovations spurred by the pandemic led to significant efficiency gains. Businesses rapidly embraced digital tools and automation to adapt to changing conditions, resulting in streamlined operations and enhanced productivity. Many sectors, particularly those that had been slower to adopt technology, started to incorporate technology into their business process, such as adopting e-commerce platforms, remote work technologies, and data analytics (Basir 2022; Noorashid and Chin 2021). This shift not only allowed firms to maintain continuity during lockdowns but also fostered a culture of innovation that will benefit future productivity.

From the sectoral viewpoint, the gains in TFP post-pandemic were contributed solely by the non-O&G sector, given the continuing strong headwinds in the O&G sector. Structural shifts in the economy, evidenced by the acceleration of several non-O&G activities, such as the downstream refinery and fertilizer production, suggest that workers are moving towards higher productivity sectors, even as labor inputs fell. Targeted government initiatives in key areas such as digitalization, exemplified by projects as such BRUHealth and the Smart City initiative, have been instrumental in driving growth in the information and communication technology (ICT) sector. These policies are starting to produce positive outcomes, demonstrating a commitment to modernizing Brunei's economy and enhancing its digital infrastructure (see further discussion in Section III). The strong emphasis on promoting digital transformation has empowered businesses to adopt advanced technologies, enhancing their operational efficiency and responsiveness to market demands. These

technologies not only streamline processes but also facilitate better decision-making and resource allocation, ultimately leading to higher productivity levels.

(III) Regional Comparison

Cross-country comparisons reveal that the trends in Brunei's TFP and labor productivity growth closely mirror those observed among its GCC peers. For close to two decades, i.e., from 2005 to 2023, Brunei's 5-year average TFP and labor productivity growth rates have remained largely around the sample averages, between the top and bottom quartiles (Figures 4 and 5).

Leading countries like Saudi Arabia and United Arab Emirates (UAE) have leveraged ambitious digitalization initiatives. In Saudi Arabia, initiatives such as the *National Transformation Program* and the *Saudi Vision 2030 Realization Program* have helped position Saudi Arabia as the regional leader in productivity growth. Their investment in sectors like technology, artificial intelligence, and renewable energy has yielded remarkable results, driving sustained TFP gains. Saudi Arabia has also undertaken significant labor market reforms under initiatives like Vision 2030, aiming to reduce unemployment and increase female workforce participation. These reforms, combined with aggressive investment in infrastructure and non-O&G sectors, have yielded improvements in productivity.

Meanwhile, other GCC countries, such as Bahrain, Kuwait, and Qatar have faced more significant challenges in boosting productivity, particularly due to the more gradual pace of transitions away from oil and gas dependency, and slower integration of advanced technologies. Brunei's performance, though not in the upper echelon such as Saudi Arabia, has outpaced these slower-growth economies. This middle-ground position suggests that Brunei's policies have shielded it from the more pronounced declines witnessed in some of its GCC peers.

Figure 4. Distribution of TPF Growth: Brunei and GCC Peers
(% yoy, 5-year averages)

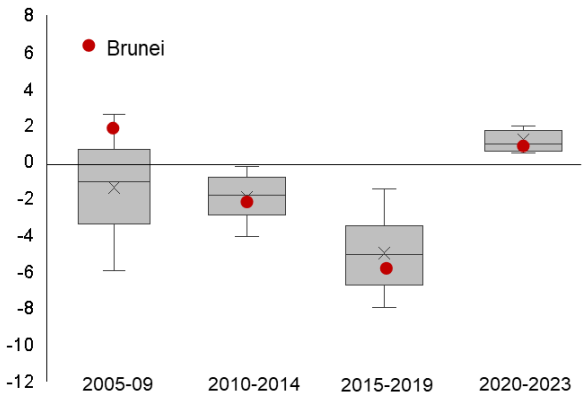
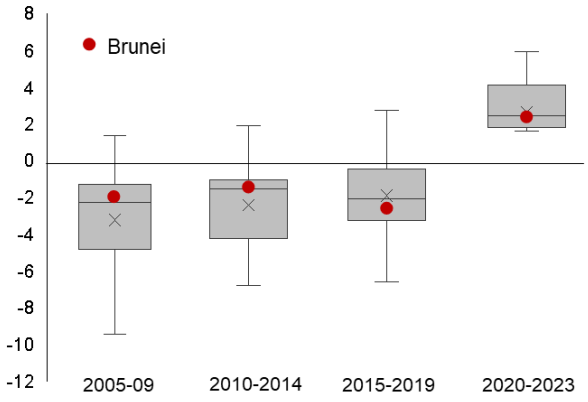


Figure 5. Distribution of Labor Productivity Growth: Brunei and GCC Peers
(% yoy, 5-year averages)



Source: National authorities; World Bank; AMRO staff estimates.
Note: The horizontal line inside each box represents the median; the upper and lower edges of each box show the top and bottom quartiles, respectively; and the top and bottom markers denote the maximum and the minimum, respectively; x is the mean.

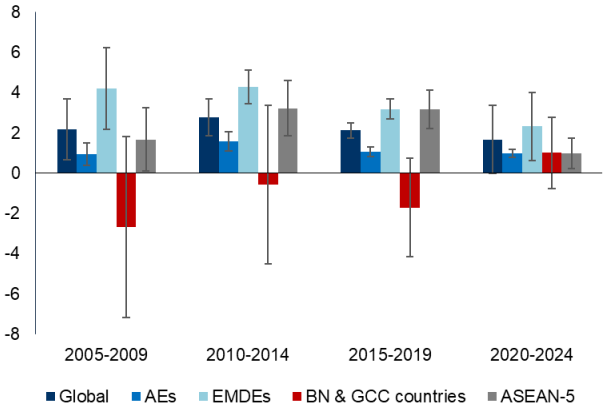
A key factor contributing to the productivity improvements in leading GCC countries has been capital deepening, or the increase in capital per worker. Saudi Arabia and the UAE, in particular, have invested heavily in advanced capital assets such as high-tech infrastructure and industrial machinery, which have bolstered their capital-to-labor ratios and enhanced labor productivity. For Brunei, capital deepening has also played an important role in mitigating productivity declines, especially through strategic investments in sectors like downstream petrochemicals and infrastructure development. However, while Brunei has made notable strides, its capital deepening efforts remain less aggressive compared to its more advanced peers (Table 1). Accelerating investments in technology and innovation-driven sectors could help Brunei close the gap and sustain higher levels of productivity growth in the long term.

Table 1. Labor Productivity Decomposition: Brunei and GCC Peers (2005–23)
(% Points contributions to growth)

Economy	Labor productivity growth	Contributions:		
		Capital deepening	Resource deepening	TFP growth
Bahrain	-3.7	1.0	-0.8	-3.9
Brunei	-1.0	1.0	-0.5	-1.5
Kuwait	-1.4	0.4	-0.9	-0.9
Oman	-0.7	2.0	-0.4	-2.3
Qatar	-1.4	0.6	-0.6	-1.4
Saudi Arabia	-0.3	1.2	-0.4	-1.1
United Arab Emirates	-0.9	1.3	-0.6	-1.6
Average	-1.3	1.1	-0.6	-1.8

Source: National authorities; World Bank; AMRO staff estimates.
Note: The horizontal line inside each box represents the median; the upper and lower edges of each box show the top and bottom quartiles, respectively; and the top and bottom markers denote the maximum and the minimum, respectively; x is the mean.

Figure 6. Global Labor Productivity Growth Trends
(% yoy, 5-year average)



Source: Conference Board Total Economy Database.
Note: The bars represent the mean values for each regional grouping, while the whiskers (error bars) indicate the volatility range. Longer whiskers reflect greater variability in the data. AEs refers to Advanced Economies; EMDEs refers to Emerging Markets and Developing Economies. ASEAN-5 refers to Malaysia, Thailand, Indonesia, Philippines and Singapore. 2024 figures are forecasts by Conference Board.

Looking at the bigger picture, developments in Brunei and GCC labor productivity growth have become more aligned with global trends recently, marking a significant departure from their historical performance (Figure 6). Prior to the pandemic, labor productivity in Brunei and many GCC countries had often lagged behind or diverged from global benchmarks, largely due to structural challenges such as slower technology adoption and relatively rigid labor markets. However, the pandemic has acted as a catalyst, accelerating digital transformation and prompting governments to implement reforms aimed at enhancing productivity and economic diversification. The increased focus on digital economy initiatives and the adoption of new technologies have helped spur productivity gains across Brunei and its GCC peers. This newfound alignment with global trends suggests that both Brunei and the GCC are adapting to a more competitive and innovation-driven global economy.

III. Policy Discussion

A. Challenges and Barriers to Enhancing Labor Productivity Growth in Brunei

Given that resource-rich economies are often vulnerable to the natural resource curse, commonly referred to as Dutch disease, it is essential to implement diversification strategies alongside proactive policies to foster growth in the non-resource sectors, such as tourism and digital services, while ensuring sustainable investments in human capital. Additionally, integrating productivity enhancement is vital for achieving broader economic goals. In Brunei, the focus on productivity enhancement aligns closely with the objectives of Wawasan Brunei 2035 (Brunei Vision 2035), which explicitly aims to position Brunei as a nation with a dynamic and sustainable economy, where productivity plays a central role in driving competitiveness and improving the standard of living. These long-term strategic frameworks recognize the importance of boosting productivity to ensure sustainable economic growth and diversification beyond the O&G sector. To achieve such aspirations, the government has launched various initiatives aimed at enhancing human capital investment, improving labor market efficiency, and fostering private sector innovation. However, despite these efforts, Brunei faces several key structural challenges and barriers which continue to impede progress in achieving sustained productivity gains.

(I) Structural rigidities in the labor market

Literature shows that structural rigidities in the labor market can hinder the efficient allocation and utilization of labor, limiting the ability of the economy to respond flexibly to changes in demand, technology, or global market conditions (Nickell 1997). In the case of Brunei, several structural constraints have contributed to the inefficiencies in the labor market, preventing the full potential for productivity gains from being realized.

One key challenge is the continuing reliance on migrant workers, particularly in low- and mid-skilled sectors such as construction, retail, and services where productivity gains have been slow. While migrant workers are essential to support these economic activities, it has inevitably led to labor market segmentation, where local and foreign workers occupy distinct roles with differing wages, job security, and working conditions. This segmentation discourages the local workforce from participating fully in certain sectors, notably in the service sector, constraining labor mobility and the reallocation of workers to higher productivity roles. Limited opportunities (or the perceived limited opportunities) by local workforce for career advancement in certain private sector industries tend to inhibit productivity gains among the locals, reducing their overall engagement and efficiency.

The subdued labor market competition in Brunei has also created inefficiencies within the economy. The dominance of two major employers in Brunei—the public sector and a major O&G player—has an unintended consequence on labor market dynamics. These major employers play a significant role in Brunei's economy, often setting wage standards that influence the private sector. As public sector wages are typically higher and more stable (IMF 2021), this has created disparities and pressure on private companies to match these wages, leading to inflexible wage dynamics. For example, because private firms are often constrained by the need to align their wages with public sector standards, they may have less room to implement variable compensation structures. Performance-based pay or merit-based increases become challenging to establish, limiting the ability of firms to incentivize

higher productivity or reward exceptional performance. Consequently, businesses may struggle to cultivate a motivated workforce that is essential for driving productivity enhancements. Such structural rigidities and unbalanced incentive structure caused by an imperfectly competitive labor market are symptomatic of the unique structure of the Brunei economy (Razak 2012).

Gender imbalances and limited female workforce participation also represent a key structural challenge in Brunei's labor market. Despite recent improvements, female labor force participation remains relatively low, especially in high-skill sectors. Addressing these barriers through policies that promote gender equality and provide flexible working conditions could unlock a significant source of untapped potential, contributing to overall productivity gains.

(II) Gaps in manpower requirements—mismatch between industry demand and talent supply

The pervasive gap between industry demand for skilled labor and the available talent supply presents another key challenge in the labor market. While such challenges are also evident in other regional economies, it is more pressing in Brunei as the country is seeking to foster critical new growth engines in emerging industries such as ICT, renewable energy, and advanced manufacturing, which require specialized skillsets. It has been documented that this mismatch between the skills required by employers and those available in the local workforce hampers productivity growth and poses risks to the country's long-term economic viability (AMRO 2023).

A primary factor contributing to this skills mismatch is the misalignment of the educational system with current industry needs (Cheong 2013). While Brunei's educational institutions have made strides in recent years, the curricula often lag behind the rapid advancements and evolving market demands, such as in the field of information and communication technology. Furthermore, research indicates that many graduates possess theoretical knowledge but lack the practical skills essential for the workplace. It is also observed that graduates with backgrounds in the field of social and biological sciences struggled to find related career paths. This trend is also reflected in relatively few successful matched apprenticeships (Fatimahwati 2022). This gap suggests that the workforce is not fully equipped to meet the demands of modern industries, leading to persistent job vacancies and reduced overall productivity.

Moreover, the rapid pace of innovation in various sectors means that the skills needed today may quickly become obsolete. Industries that rely on cutting-edge technology require workers who are not only well-versed in existing practices but also adaptable and willing to engage in lifelong learning (Brynjolfsson and McAfee 2014). Until recently, Brunei has made some progress in addressing this gap, which underscores the importance of ongoing skills enhancement.

The implications of the talent supply shortage are significant. Companies may be compelled to seek skilled labor abroad, creating dependencies on foreign expertise that hinder the development of a robust local workforce. While foreign labor can fill immediate gaps, an overreliance on it can stifle local talent development, thereby impeding the progress of innovation.

(III) Constraints to accessing and/or adopting technological innovation particularly in the non-O&G sector

The progress of technological innovation, particularly in Brunei's non-O&G sectors has yet to pick up strongly, posing a significant barrier to the country's long-term economic growth and productivity enhancement. While the O&G sector has traditionally driven Brunei's economy, slower progress in adopting advanced technologies in other sectors, such as manufacturing and services, appears to have impeded the country's efforts to accelerate economic transformation and spur productivity gains.

With more than 95 percent of all non-O&G private sector establishments in Brunei considered as MSMEs, there are constraints in accessing or adopting digital technologies, including automation, artificial intelligence, which are critical for improving operational efficiency, reducing costs, and fostering innovation. A study by Almunawar (2022) indicates that the rate of adoption of digital technologies such as for e-commerce platforms by MSMEs in Brunei remains relatively modest, potentially weighing on their competitiveness in regional and global markets.

A key factor contributing to the slower pace of technological adoption is the limited infrastructure and ecosystem to support industry-wide innovation. While Brunei has made strides in improving its digital infrastructure, there remains a lack of robust policies and initiatives to encourage private sector investment in research and development (R&D). Ongoing labor market challenges, discussed in the preceding section, further aggravate the situation. The adoption and management of advanced technologies demand specialized technical expertise and skilled human capital, which limits businesses' ability to innovate and modernize effectively.

Another challenge is the reliance on traditional resource-based sectors, which has historically dampened the urgency for innovation in the non-O&G industries. With substantial revenues from the hydrocarbon sector, there has been less pressure on these other resource-based industries, such as in the agri-food business to adopt productivity-enhancing technologies. This dependency has induced a risk-averse business culture that tend to prioritize short-term gains over long-term investments in innovation.

Moreover, the financial sector, which is critical for driving productivity and innovation in other industries, also faces challenges in adopting financial technology or fintech solutions. While regional peers have embraced digital payments, blockchain, and other fintech innovations to enhance the efficiency and reach of financial services, Brunei's financial sector remains largely traditional. This constrains the ability of businesses to leverage modern financial tools that could accelerate growth, particularly for MSMEs.

B. Strategies and Priorities for the Future

Brunei's focus on enhancing productivity has been a key priority since the 8th National Development Plan (RKN), which spanned from 2001–2005. This plan emphasized the importance of improving human capital, enhancing workforce skills, and creating a more diversified economy, all of which are closely linked to productivity growth. The subsequent 9th RKN (2007–2012) continued to reinforce these efforts. It was the 10th RKN (2012–2017)

that productivity was prominently made an explicit key theme in the national development agenda, aligning with the Wawasan Brunei 2035.

Wawasan Brunei 2035 and RKNs

The Wawasan Brunei 2035, initiated in 2007, outlines the vision for a highly productive and knowledge-based economy. The RKNs have been designed to achieve the objectives of Wawasan Brunei 2035 by carrying out various projects, programs, and activities stipulated in the 5-year plans.[8] The Ministry of Finance and Economy allocates budgets to specific projects and sectors every 5 years, to achieve the strategic development objectives of Wawasan 2035.

The RKN's focus on raising productivity is reflected in several key initiatives. These initiatives focus on enhancing human capital through education reforms, upskilling, and workforce development programs. Investments in technical and vocational education, alongside partnerships with international institutions, aim to increase the skillsets of Bruneians to better align with the needs of a modern, diversified economy. RKN also prioritizes the adoption of innovative technologies and streamlining business regulations to boost efficiency in the economy. Under the just concluded 11th RKN, the government remains steadfast in its efforts to develop the non-O&G sector through various initiatives that enhance physical infrastructure, technology, entrepreneurship, and skills. These endeavors are strongly focused on increasing productivity, while generating new revenue and employment spinoffs. In similar vein, the upcoming 12th RKN sets out the key objectives aimed at realizing the Wawasan 2035, with particular focus on local skills improvement, advancing digital transformation, boosting non-O&G exports, enhancing social development, and promoting environmental sustainability.

(I) Fostering greater labor market flexibility and competition

Addressing structural challenges in the labor market remains key to promoting labor market flexibility and competition. To foster greater labor market flexibility, policymakers are encouraged to undertake a careful sequencing of policy priorities that are complementary and market-based.

- First, encouraging greater mobility of migrant workers would help reduce labor market segmentation. Currently, local and foreign workers occupy distinct roles with differing wages, job security, and working conditions. For example, revising regulations that restrict migrant workers to working exclusively for their sponsors could allow for more equitable labor market integration, improve resource allocation while helping to promote greater efficiency. This could also enhance job matching, reduce labor shortages in some industries, and contribute to overall economic resilience.

- Second, to foster greater labor market competition and promote flexible wage dynamics, one feasible option is to target mid-skill, mid-wage jobs where more local employees can contribute significantly to the workforce. To support this, a productivity-based wage subsidy scheme, funded by migrant worker levies, would not only make

[8] An economic blueprint was also created in 2021 to assist agencies and stakeholders in achieving the goals of the Wawasan Brunei 2035. This economic plan builds upon current initiatives by defining six goals, each with specific strategic priorities and policy directions, aiming to grow the non-O&G sector by exploring new economic activities and strengthening the five priority sectors: Downstream Oil and Gas, Food, Tourism, Information and Communications Technology (ICT), and Services. The Implementation of the Vision 2035 is done through five-year RKNs, which detail projects and policies. Progress is consistently assessed, with modifications being implemented to remain aligned with the objectives of Wawasan Brunei 2035.

local hires more affordable but also incentivize employers to invest in training and upskilling (Koh 2020).

- Third, ensuring the availability and access of targeted skills training programs that would enhance local workforce competencies will continue to be vital, enabling the local workforce to compete for higher productivity roles. This priority should be accompanied by the creation of an incentive system that would encourage greater participation from the local workforce in critical occupations, notably in the hospitality and tourism, energy and construction. In this context, the introduction of the Salary Guidelines in 2023 is a strategic move by Manpower Planning and Employment Council (MPEC), [9] benefiting both businesses and workers.

- MPEC, benefiting both businesses and workers. For businesses, it provides crucial information on the potential career ladders for certain jobs-industry pairs. With such information, businesses are better guided and could use the Salary Guidelines as a form of retention and attraction strategy for the local workforce. Salary guidelines can also encourage workers to pursue skill development and training, given there is now greater clarity on career progression. When workers see a direct correlation between enhanced skills and higher wages, they are more likely to invest in their own professional growth. This, in turn, enhances the overall skill level of the workforce, contributing to productivity improvements.

The government can also consider policies that diversify the employment landscape, reducing reliance on dominant employers in the public sector and the O&G industry. Encouraging the growth of MSMEs can foster a more dynamic job market. A key strategy is to nurture the development of local MSME champions (such as in the halal and agrifood business), which should continuously be emphasized. These champions can also act as innovation drivers by adopting new technologies, improving product quality, and tapping into export markets, thereby contributing to both productivity growth and long-term economic development. Supporting MSME entrepreneurship and innovation through access to financing, mentorship, and reduced regulatory burdens will enable MSMEs to thrive, creating more diverse job opportunities, while contributing to greater labor market competition.

Other inclusive policies such as addressing gender imbalances in the labor market is also desirable for unlocking the full potential of Brunei's workforce. To promote greater female participation, policies that support flexible working conditions, such as remote work and family-friendly workplace practices, should be implemented. Additionally, providing targeted training and mentorship programs for women can help bridge the skills gap and encourage their entry into high-skill sectors. By fostering an inclusive labor market that values diversity, Brunei can enhance overall productivity and innovation, contributing to economic growth and diversification.

Enhancing labor market information systems can improve transparency and help job seekers make informed decisions about their career paths. By providing better access to information

[9] The Salary Guideline introduced by the Manpower Planning and Employment Council (MPEC) in 2023 acts as a comprehensive resource for private sector employers to create attractive salary plans. The guideline includes 22 job families, with 100 different job roles in sectors such as logistics, ICT, customer service, finance, tourism, and energy. It is an important measure to enhance transparency in compensation, match salaries to the value of labor, and tackle wage issues in the private industry. The methodology for the guideline was created after analyzing data from 114,865 employees and job descriptions from 13,371 positions on the JobCentre Brunei portal. This method based on data guarantees that the salary structures accurately represent Brunei’s labor market and industry requirements. The guideline is constructed to assist in implementing other workforce policies, like promoting local hiring.

on job opportunities, skills requirements, and market trends, the government can empower individuals to make strategic career choices that align with labor market needs. This, in turn, can facilitate labor mobility and the reallocation of workers to sectors with higher productivity potential. In this context, the JobCentre Brunei and the National Labor Management System[10] digital platform serves as strategic tools for Brunei to enhance its labor market efficiency, support economic diversification, and ensure that the workforce is equipped to meet the demands of a rapidly changing economy.

(II) Addressing gaps in manpower requirements

To address gaps in manpower requirements, Brunei has implemented several labor market policies over the years, designed to boost workforce productivity and foster economic diversification. Early policies, particularly under the RKN, focused on promoting local employment and reducing reliance on foreign workers. Vocational training programs were introduced to equip the local workforce with industry-relevant skills, while entrepreneurship initiatives aimed to create opportunities for self-employment and small business growth. However, despite these efforts, productivity growth in key sectors has lagged behind other ASEAN countries, highlighting the need for more targeted interventions. Cheong (2013) argues for a more strategic approach to improve the competitiveness of labor productivity in Brunei, one that would facilitate the transition to an innovation-driven economy.

Encouragingly, in more recent years, particularly under the 10th and 11th RKNs, policy reforms and targeted measures have been undertaken to improve the efficiency of resource allocation in the labor market and to enhance workforce productivity. As the public sector plays a disproportionately large role in the economy, policymakers from top government officials can be a crucial force of change.

- First, the establishment of the Manpower Planning and Employment Council (MPEC) in 2020 under the Prime Minister's Office is a crucial step. The council's vision is to ensure effective manpower planning aligned with employability and employment. MPEC plays a key role in aligning educational and training programs with market demands, while fostering a culture of continuous learning and adaptability within organizations.

- Second, the establishment of the Manpower Industry Steering Committee (MISC) under MPEC provides a platform for tripartite collaboration among industry players, regulators, and education/training institutes to align industry needs with the appropriate manpower supply. One of the key priorities is to identify critical occupations which are highly demanded in the particular sector and to develop the required competency framework consistent with industry needs.

- Third, through MPEC, various training programs and initiatives have been introduced to address workforce development and enhance labor market efficiency. These include competency frameworks, the implementation of a minimum wage policy, and the

[10] Brunei's National Labor Management System (NLMS) is a is a digital platform created to modernize and simplify labor services. It was progressively rolled out beginning in April 2023. The NLMS is a comprehensive framework designed to enhance the management of the labor market in the country. It aims to improve the efficiency and effectiveness of labor force utilization and address key issues related to employment, workforce development, and labor market dynamics. The NLMS facilitates better coordination among various stakeholders, including government agencies, employers, and educational institutions.

introduction of salary guidelines to promote fair compensation practices. The establishment of these infrastructures serves as important key enablers in unlocking labor productivity by ensuring workers are equipped with relevant skills, motivated by fair wages, and aligned with industry standards. These efforts collectively aim to create a sustainable pipeline of skilled local talent and foster a more competitive and adaptable workforce. The establishment of these infrastructure serves as important key enablers in unlocking labor productivity.[11]

Stronger collaboration between industry and the government (such as internships and apprenticeship program arrangements) is desirable, and will continue to be a key policy priority. Such partnerships can help to bridge the gap between academic learning and industry requirements, ensuring a more skilled and job-ready workforce. These partnerships allow students and recent graduates to gain hands-on experience in real-world environments, bridging the gap between academic knowledge and industry needs. For instance, the i-Ready Apprenticeship Program seeks to help graduates transition into the workforce in both the private and public sectors by enhancing their job opportunities and skills (Appendix II).

Such collaborations not only help address the skills mismatch in the labor market but also foster innovation and entrepreneurship, which are critical ingredients for spurring productivity gains. This synergy between public and private sectors would need to be continuously enhanced, to ensure a steady pipeline of job-ready talent, thereby boosting both individual employability and overall labor productivity. Ebil et al., (2017) argues that some degree of mismatch remains between the graduates' skill and industries' needs, emphasizing the importance of flexible curriculum revisions and stronger collaboration between learning institutions and the industry. It is also crucial to address the reform agenda of Brunei's Technical and Vocational Education and Training (TVET) system, which is essential for better aligning the curricular with the demands of the industry. This would help address skill mismatches and encourage greater workforce development. It is crucial that these policies align with efforts to enhance labor market competition, as misalignment could distort education choices and lead to skills and qualifications that do not meet industry demand.

(III) Promoting technological innovation especially in the non-O&G sector

To effectively foster technological innovation, several strategies and priorities should be implemented. First, enhancing the digital infrastructure across the country is crucial. This includes expanding high-speed internet access, promoting digital literacy, and investing in cutting-edge technologies such as cloud computing and artificial intelligence. Brunei's Digital Economy Masterplan 2025 is a key component in the country's strategy to boost productivity by leveraging technology and digitalization. The plan focuses on building a strong digital foundation to enhance economic diversification, particularly in the non-O&G sector. By

[11] There are three key pillars to address skill mismatch challenges in Brunei, in line with Goal 1 of Brunei Vision 2035; Supply, Demand, and Enablers. The Supply pillar is dedicated to enhancing education and training through initiatives that prioritize up skilling and internships. The Demand pillar aims to align workforce abilities with industry requirements through the promotion of local recruitment and job compatibility. The pillar of Enablers assists in these initiatives by implementing policies, establishing lifelong learning infrastructure, and promoting collaboration among stakeholders. Jointly, these foundations, such as important initiatives like TVET, internships and apprenticeships, enhance opportunities for young people to secure employment by offering crucial practical training.

increasing the use of technology, the strategies are aimed at modernizing industries, improving efficiency, and creating high-value job opportunities.

Improved digital infrastructure would enable businesses to adopt innovative solutions and streamline operations. For instance, the BRUHealth app has not only improved healthcare access and efficiency, but also enhances customer engagement. The Smart City initiative prioritizes high-speed internet and wireless connectivity, facilitating better communication and collaboration among businesses, residents, and government agencies. Enhanced connectivity supports remote work, e-commerce, and innovation, all of which would help spur productivity growth.

Second, promoting research and development (R&D) in key non-O&G industries is vital. The government can consider offering grants, tax incentives, and other financial support to encourage businesses to invest in R&D activities. Additionally, establishing collaborative research programs between universities and industries can facilitate knowledge sharing and drive innovation. By prioritizing R&D, Brunei can develop homegrown technologies and solutions tailored to local challenges and market demands.

Third, fostering entrepreneurship and startup culture should be a key priority. Re-calibrating or re-designing innovation hubs and incubator programs that can best target aspiring entrepreneurs with the necessary resources, mentorship, and funding can be undertaken to ensure their success. Furthermore, establishing more hackathons, competitions, and networking events in partnership with the private sectors can stimulate creative thinking and collaboration among innovators. By nurturing a vibrant startup ecosystem, Brunei can attract talent and encourage the commercialization of innovative solutions. Ultimately, fostering technological innovation in Brunei's non-O&G sector requires a comprehensive and coordinated approach that involves various stakeholders.

IV. Conclusion

Enhancing productivity is essential for long-term economic growth, competitiveness, and improved living standards. For resource-rich economies like Brunei, focusing on productivity is vital to mitigate the risks associated with non-renewable resources, such as the potential for economic stagnation. Enhancing productivity through technology and innovation enables these nations to maximize their resource wealth, creating productivity spillovers across various sectors. This approach not only supports economic diversification efforts but also helps ensure sustainable growth in the context of an aging population, emphasizing the need for strategies that prioritize innovative technology adoption over increases in labor and capital inputs. This strategic shift from extensive growth drivers to intensive strategies that prioritize innovation is critical for unlocking new growth potential.

This analysis of productivity shifts in Brunei from 2005 to 2023 reveals crucial insights into the dynamics influencing the nation’s economic performance. In the pre-pandemic period, Brunei's growth trajectory was notably supported by increases in labor and capital inputs, underpinned by a robust labor force and significant capital investments. However, the concerning trend of declining TFP raises alarms about the economy's efficiency. Despite rising input quantities, the diminishing effectiveness of these resources indicates systemic inefficiencies, particularly within the O&G sector, where aging infrastructure hampered

production levels, and in the non-O&G sector, which faced challenges like a limited skilled workforce and slow technological adoption that hindered potential productivity gains.

The post-pandemic era marks a transformative shift for Brunei, largely influenced by the challenges and adaptations necessitated by the COVID-19 pandemic. As the country navigated the pandemic's aftermath, a notable recovery in TFP emerged, reflecting a significant pivot toward technology and innovation. The pandemic acted as a catalyst for businesses to embrace digital tools and automation, enhancing operational efficiency, even amid reduced labor inputs. This shift towards digitalization has profound implications for immediate productivity and the long-term adaptability and resilience of the economy. Importantly, the gains in TFP within the non-O&G sector during this period underscore a critical structural transformation in Brunei's economic landscape. Government policies aimed at fostering digital transformation and innovation have begun to yield positive results, facilitating a smoother transition to higher productivity sectors. Enhancing the ICT landscape is vital to equipping businesses to effectively meet changing market demands.

As Brunei moves forward, it must prioritize strategic investments in innovation, workforce development, and technology adoption to sustain productivity improvements. Overcoming structural rigidities requires a multifaceted approach, including labor market reforms, adjustments to the education system, and policies that encourage greater participation of the local workforce, particularly in the private sector and high-productivity industries. These efforts would not only enhance labor market flexibility but also support Brunei’s broader goals of economic diversification and sustainable growth. By cultivating an environment that supports technological advancement and skill enhancement, Brunei can counteract the risks associated with its historical resource dependency and chart a course for sustainable economic growth.

Appendix I. Data Description and Key Assumptions

Sample period: 1995–2023 (annual)

Variables	Description	Data Source/Reference
Total output	• Real GDP (local currency)	National authorities
O&G and non-O&G output	• Sectoral value-added (local currency)	National authorities
Labor inputs, adjusted for quality of human capital	• Employment • Average years of schooling (up to 2022), extended to 2023. An average learning loss of 0.6 learning-adjusted years of schooling (combining quantity and quality of education) for every five-month-long school closure due to COVID-19 pandemic-induced lockdowns is applied to 2020–23. • Returns to education (up to 2019), extrapolated to 2023. The data are estimated based on the work of Psacharopoulos and Patrinos (2004, 2018), where the returns to education are specified using an equation that relates education levels to earnings. The Mincerian wage equation is given by: $\ln(Y) = \beta_0 + \beta_{1,t} Edu + \beta_2 Exp + \beta_3 Exp^2 + \varepsilon$ where, $\beta_{1,t}$ is the return to education that varies over time due to changing economic conditions or labor market dynamics; Edu is experience, often a continuous variable representing the years of experience an individual has.	National authorities; UNDP; World Bank (2021) Psacharopoulos and Patrinos (2004); Psacharopoulos and Patrinos (2018)
Physical capital stock (Total economy)	• Nominal capital stock, converted to constant terms using GDP deflator (in local currency, up to 2019). Data for 2020–23 are estimated by applying the growth of gross fixed capital formation in the official national account data. • Depreciation rate of capital stock (up to 2019), extended to 2023.	Penn World Table (PWT) v10.01
Physical capital stock (O&G sector)	• The share of O&G investment in total gross fixed capital formation is used as a reference, with an initial assumption that O&G physical capital accounts for 45 percent of total capital stock in 2000.	AMRO staff
Resource inputs	• O&G production, in volume terms.	National authorities; JODI world oil database
Elasticities	• Labor income share (α) of 0.40 is estimated by regression of the logarithm of the extended Cobb-Douglas production function. • Capital share (β) is estimated as 0.50, which reflects the capital-intensive O&G sector. As a cross-check, using PWT capital stock, the estimated β is 0.45. • Given the assumption of constant returns to scale, the resource input share (γ) is assumed to be 0.10 as Brunei is a relatively small O&G producing economy. For larger oil producing economies such as in the GCC, the elasticity can be larger, around 0.20.	AMRO staff Van der Ploeg and Venables (2011)
TFP	• Derived as the difference between observed output (i.e., real GDP) and the weighted sum of employment (adjusted by the quality of human capital), physical capital stock and resource inputs. Also known as the Solow residual.	AMRO staff

Source: Authors' compilation.

Appendix II. Description of Key Initiatives to Address Brunei's Manpower Needs

- **Brunei Shell Petroleum (BSP) Internship Program** is a collaboration between Brunei government and BSP, established since the Seria oil field was found in 1929. Over a period of nine decades, this partnership has established BSP as a fundamental part of Brunei's economy, playing a significant role in the economy's O&G earnings and export revenue, while also supporting the growth of the nation. While the BSP Internship Program is launched by the company, it is in line with Brunei government's goals to boost workforce skills and enhance youth employability, important aspects of national development plans such as Vision 2035. Although the government frequently collaborates with BSP to assist in these initiatives, BSP is primarily responsible for driving the program. The BSP internship program provides hands-on experience in the oil and gas sector for college students and recent graduates. The programs take long, within 6-12 weeks (about 3 months) and consist of orientation, mentorship, project participation, and training. Interns acquire important industry knowledge, enhance their professional abilities, and potentially secure future job opportunities at BSP. Currently, BSP has a varied and talented staff of approximately 4,000 employees and more than 20,000 contractors.
- **Universiti Brunei Darussalam (UBD) Discovery Year** program was introduced in 2011 as part of its Gen NEXT education framework. It mandates that students take a year off to gain hands-on experience, either locally or internationally, through one of four options: studying abroad, internships, incubation programs, or community outreach initiatives. The program emphasizes experiential and design-focused learning, enabling students to tailor their experiences to their career aspirations. Discovery Year enhances students' employability by developing critical life skills such as problem-solving, adaptability, and critical thinking, while also fostering their personal, academic, and professional growth.
- In 2013, the Ministry of Education (MOE) reformed Brunei's **Technical Vocational Education and Training (TVET) system** to align it with the economy's needs, supporting Wawasan 2035 goals of developing a skilled workforce for economic growth. Key reforms include improving education quality, establishing qualifications, accrediting institutions, and updating the curriculum. Collaboration between technical institutions and the private sector is emphasized to enhance students' skills in ICT, creative technology, and innovation. Major changes highlighted by Ebil et al., (2017) include course restructuring, expanding apprenticeships, and upgrading the learning environment. TVET is crucial for fostering lifelong learning, innovation, productivity, and employability to meet labor market demands.
- **The i-Ready Apprenticeship Program**, launched by the government in 2017, is an 18-month initiative aimed at enhancing the marketability and employability of unemployed graduates—including those with degrees, Higher National Diplomas (HND), and Technical and Vocational Education and Training (TVET) qualifications. This program facilitates their transition into the workforce by providing valuable work experience and on-the-job skills in the private sectors. In 2024, an extension of this graduate apprenticeship program, called *Skim Perantis Perkhidmatan Awam* (Civil Service Apprenticeship Programme, SkiPPA), is developed as a year-long program for first degree and above graduates to gain experience of working for the public sector. Open to Bruneian citizens and permanent residents between the ages of 17 and 40, the program offers a government-funded monthly allowance, with participants eligible for additional top-up allowances from private sector companies starting from the 11th month of their apprenticeship onwards. This program is monitored by JobCentre Brunei (JCB) whereby they facilitate the registration process of the applicants, however recruitment interviews and tests (if applicable) are conducted by the host organization or company themselves. According to the Prime Minister's Office (as reported in local news), since its inception, 37 percent of i-Ready interns have secured permanent positions, and the program has contributed to the growth of startups and promoted a culture of entrepreneurial success.

Source: Author's compilation based on various reports.

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