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Key Points

- The economic impact of cloud computing on middle- and high-income economies in Asia and the Pacific is sizable. For 2023, its contribution to the economies of Australia, India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Singapore, the Republic of Korea, Thailand, and Viet Nam ranged from 0.25% to 2.23% of gross domestic product (GDP). The marginal economic impact of cloud adoption is greater for countries with higher cloud penetration resulting from cloud-enabling government policies.
- Government policies promoting cloud adoption not only impact the level of government effectiveness but also have positive spillover effects on the rest of the economy.
- Three sets of policies, are critical for stimulating the migration of government systems to the cloud: (i) an explicit "cloud first" policy for government, combined with a competitive cloud services industry model, and an effective cloud procurement mechanism; (ii) policies that allow data storage and processing beyond a country's borders, including for the majority of government data categories; and (iii) a level of cybersecurity regulations, procedures, and capabilities, aligned with international standards. If middle-income countries in the region upgrade their cloud policy frameworks to the most advanced level that would boost their GDP growth by 0.5% to 0.7% in 2024–2028.
- These policies should be complemented by other initiatives, such as the promotion of fixed broadband access, and measures to drive digital skills development.

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Cloud Computing Policies and Their Economic Impacts in Asia and the Pacific

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1. Introduction

In recent years, cloud computing has become an essential tool for the delivery of IT-based services. With these technological advances, interest in identifying the economic effects of cloud computing has increased, although evidence is still scarce and fragmented. This policy brief describes original research that estimates the macroeconomic impact of cloud adoption for 11 countries in Asia and the Pacific—Australia, India, Indonesia, Japan, the Republic of Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, and Viet Nam.

Cloud computing is defined as on-demand delivery of IT resources via the internet with pay-as-you-go pricing. Instead of buying, owning, and maintaining their own data centers and servers, private firms and public sector organizations can purchase technology such as computing power, storage, databases, artificial intelligence (AI)/machine learning (ML) services, and multiple other resources on an as-needed basis. Organizations may procure these services directly via Cloud Service Providers (CSPs), or through IT companies such as software developers or systems integrators partnering with CSPs. Cloud computing provides a remotely accessible environment with high availability, agility, and scalability to large, small, and microenterprises, start-ups, governments, and public agencies. As an alternative to the use of on-premises IT infrastructure, cloud computing enables organizations to trade fixed expenses associated with data center investments for variable expenses, benefit from massive economies of scale and the latest technology, increase speed and agility of product and services development, and rapidly scale-up their operations.[1]

While the adoption of cloud computing has already substantially advanced in Asia and the Pacific, it has been at considerably different degrees and pace. The

[1] See for example Amazon Web Services. *Six Advantages of Cloud Computing*. https://docs.aws.amazon.com/whitepapers/latest/aws-overview/six-advantages-of-cloud-computing.html.

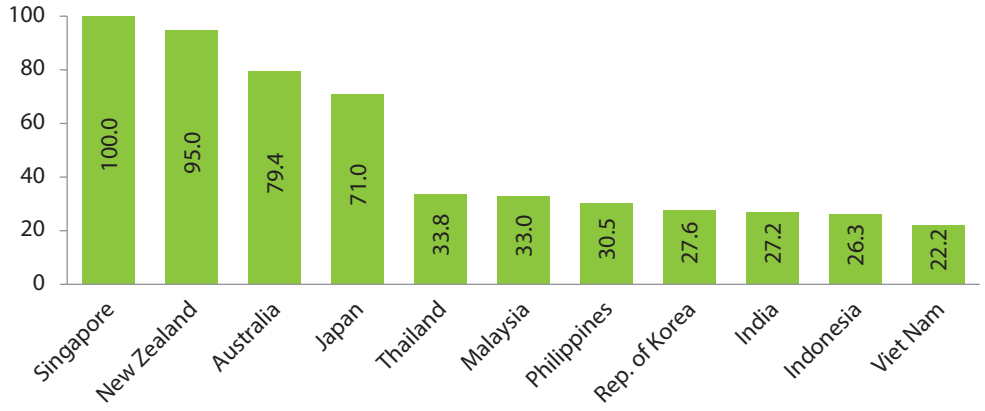
policy environment for stimulating cloud adoption also varies considerably by country. Building on previous research that has found positive economic effects of cloud computing, this policy brief describes the impact of cloud adoption on economic growth in 11 countries in Asia and the Pacific—Australia, India, Indonesia, Japan, Republic of Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, and Viet Nam.[2] We took several factors into consideration: (i) the direct spending on cloud services in a given policy environment; (ii) the spillover effects of cloud adoption by governments on the private sector; and (iii) the impact of policies to promote cloud adoption by governments and the private sector. Overall, we believe these factors have significant positive effects on the growth of economies in Asia and the Pacific.

The rest of the policy brief is structured as follows. Section 2 describes the current status of cloud adoption in select economies of the region. Section 3 describes our assessment of key cloud policy initiatives and maturity levels. Section4 provides a conceptual framework for measuring the impact of cloud adoption on economic growth. Section 5 provides estimates of the impact of cloud adoption on the economy. Section 6 describes the conclusions and policy implications for cloud policy adoption.

2. Current Status of Cloud Computing in Middle- and High-Income Countries in Asia and the Pacific[3]

Cloud computing is increasingly being adopted across many countries in Asia and the Pacific, although the pace and scale of adoption vary considerably. Over 70% of businesses in Australia, Japan, New Zealand, and Singapore are using cloud services as of 2023. Conversely, in India, Indonesia, Malaysia, Philippines, the Republic of Korea, Thailand, and Viet Nam, cloud adoption by enterprises is below 30 percent (Figure 1).

Figure 1: Cloud Adoption by Enterprises in Asia and the Pacific, 2020–2021 (%)



Note: The OECD reports cloud adoption by enterprises with more than 10 employees for either 2020 or 2021, as reported by country statistical agency surveys, for OECD members. The remaining values for non-OECD countries were estimated through predictions based on regressions relating OECD values to other cloud data where country-level data was available (see methodology in Katz, R., J. Jung, and T. Berry. 2023. Economic Impact of Cloud Adoption in Asia-Pacific: The Importance of Pro-Cloud Policies to Promote Development and Economic Growth, Appendix C. https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-asia-pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth.

Sources: OECD Stat; Telecom Advisory Services analysis.

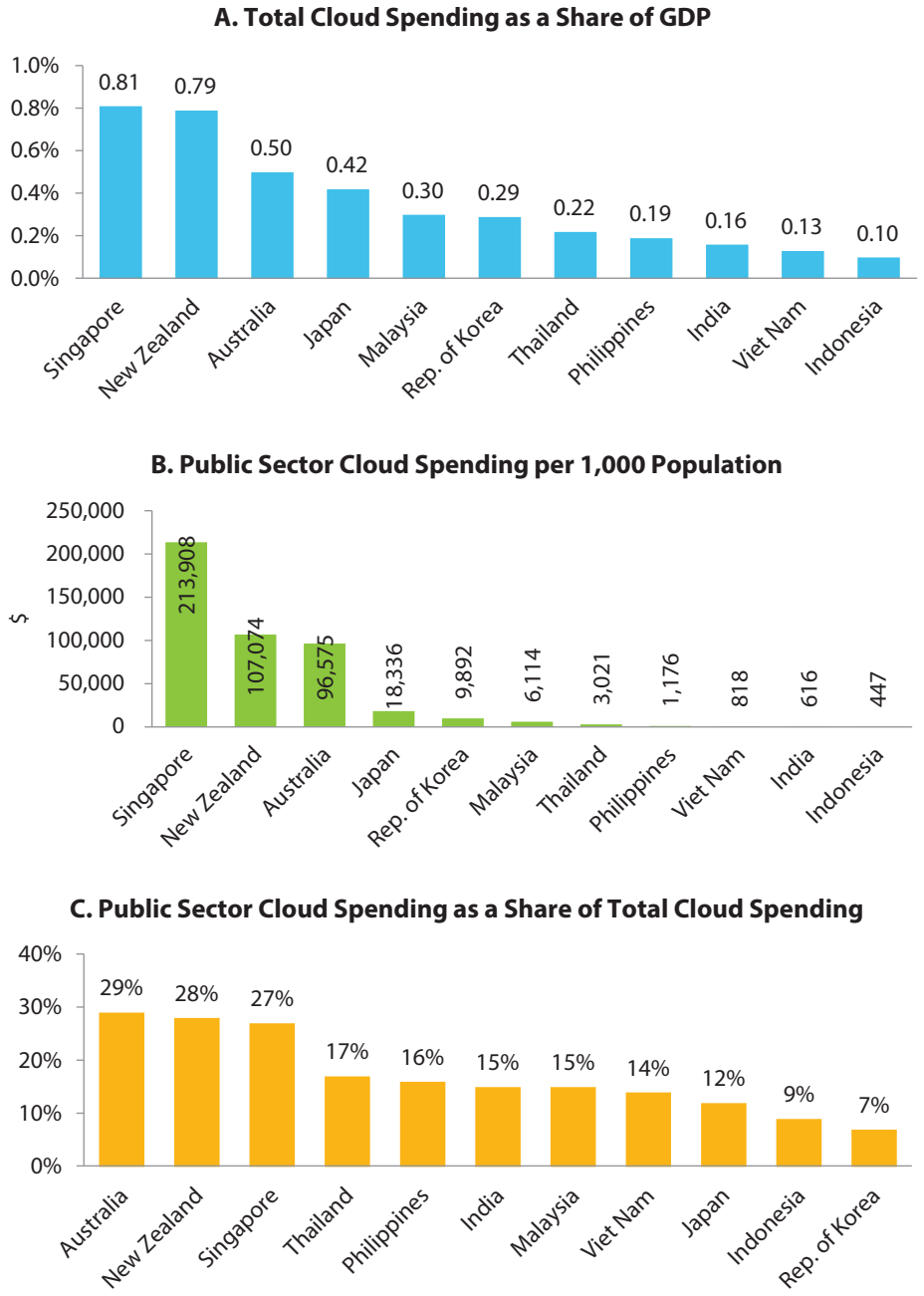
[2] Previous studies include the following: Schniederjans, D. G., and D. N. Hales. 2016. "Cloud Computing and its Impact on Economic and Environmental Performance: A Transaction Cost Economics Perspective." *Decision Support Systems* 86: 73–82. Luo, X., W. Zhang, R. Bose, H. Li, and Q. B. Chung. 2018. "Producing Competitive Advantage from an Infrastructure Technology: The Case of Cloud Computing." *Information Systems Management* 35(2): 147–160; Gal, P., G. Nicoletti, T. Renault, S. Sorbe, and C. Timiliotis. 2019. *Digitalisation and Productivity: In Search of the Holy Grail—Firm-Level Empirical Evidence from EU Countries.* OECD; Katz, R., and J. Jung. 2023. "Economic Spillovers from Cloud Computing: Evidence from OECD Countries." *Information Technology for Development*. Retrieved in: https://www.tandfonline.com/doi/full/10.1080/02681102.2023.2292108.

[3] For the 2024 fiscal year, the World Bank defines high-income economies as those with a gross national income (GNI) per capita of $13,846 and middle-income economies as those with a GNI per capita between $1,136 and $13,845. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups. In this policy brief, the first category includes Australia, Japan, Republic of Korea, New Zealand, and Singapore. The second category includes India, Indonesia, Viet Nam, Malaysia, Philippines, and Thailand.

Similar to the clustering of cloud adoption into two groups of countries seen in Figure 1, total cloud spending in Australia, Japan, New Zealand, and Singapore is higher than 0.4% of GDP, whereas in the other countries studied, it is below 0.3%. Cloud adoption by the public sector also varies across middle- and high-income countries in Asia and the Pacific (Figure 2).

On a per capita basis (Figure 2B), cloud spending by the public sector is highest in Singapore, followed by New Zealand and Australia. These countries also have the highest shares of public sector cloud spending relative to total cloud spending (Figure 2C).

Figure 2: Cloud Spending in Asia and the Pacific, 2023



Sources: Statista; IDC; World Bank; Telecom Advisory Services.

3. Assessing Key Cloud Policy Sets and Maturity Levels

Another element of our impact assessment framework relates to the economic impact of an increase in cloud policy maturity level. In our analysis, the main cloud policy sets (or frameworks) comprise: (i) policies for government cloud service provisioning; (ii) data management and processing principles; and (iii) level of cybersecurity measures.[4] There are multiple levels of government cloud policy maturity (openness).

- ***Policies for government cloud service provisioning:*** Governments may opt to source cloud services from: (i) a domestic state-owned provider only or together with a very restricted scope for domestic private CSPs ("restricted model"); (ii) a domestic state-owned CSP, domestic private CSPs, plus hyperscalers[5] (a "partially competitive model"); and (iii) hyperscalers and domestic private CSPs within a competitive market (a "fully competitive model"). Not all these options are equally effective in driving cloud adoption. Competition among CSPs is an important factor driving industry performance. Customers need to benefit from accelerated innovation, falling prices, and state-of-the-art quality of service (in particular, the latest version of cybersecurity technology) resulting from open competition. An industry composed of a single CSP—whether privately or state-owned— does not guarantee an adequate level of competition, thereby restricting choice, and limiting capital spending. A partially competitive configuration, particularly one that combines the presence of state-owned CSPs with private sector CSPs, also restricts competition and potentially distorts market behavior. Therefore, option (iii), a fully competitive model may be regarded as the most mature, followed by options (ii) and (i).

- ***Data management and processing principles:*** In determining government data residency or data localization requirements, governments face three options: (i) government data storage and processing can only be conducted locally, thereby prohibiting data transfers beyond national boundaries; (ii) government data can be stored and processed locally or overseas as determined by data classification policy; (hybrid case) and (iii) there are no restrictions or very limited ones on cross-border data transfer. In terms of incentives for the development of the cloud industry, the more restrictive the data management and processing principles, the more detrimental it is to serving user needs as they hamper the ability to achieve economies of scale, limit access to technology, and slow digital innovation and transformation. Considering the level of capital spending required for developing adequate cloud infrastructure, remote processing and/or storage—option (iii) —would be the most mature, i.e., conducive for achieving economies of scale in support of lower pricing and product innovation, followed by options (ii) and (i).

- ***Level of cybersecurity:*** The maturity of cybersecurity policy is conceptualized by the ITU Cybersecurity Index across five components: (i) enactment of laws and regulations on cybercrime and cybersecurity; (ii) existence of technical capabilities in national agencies; (iii) presence of agencies measuring fulfillment and organizational implementation of cybersecurity; (iv) capacity development in cybersecurity domain; and (v) cooperation between government agencies and between the private and public sectors.[6] Higher levels of cybersecurity across these five components provide greater incentives for migrating in-house government IT to the cloud, and are therefore regarded as more mature.

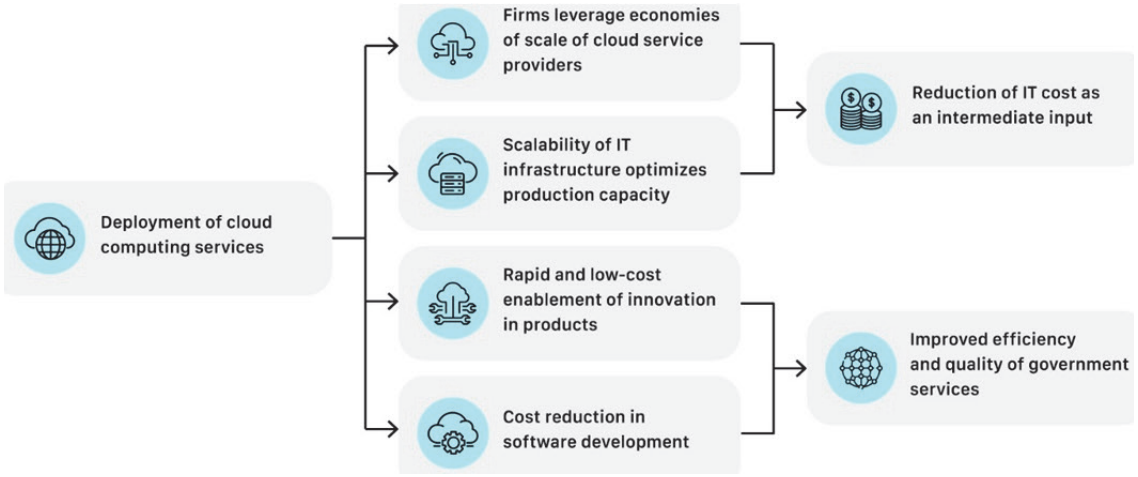
4. Conceptual Framework for Measuring the Impact of Cloud Computing on the Economy

Conceptually, the adoption of cloud computing can impact GDP growth through several transmission channels (Figure 3).

The starting point is firms leveraging economies of scale and scalability of IT use due to cloud adoption to reduce their costs and increase flexibility of operations. The resulting reduction in resource spending increases their margins and profitability, thereby contributing to GDP.[7] Cloud adoption also enables rapid and low-cost

[4] Please refer to the Appendix for an overview of maturity levels across the three cloud policy sets.
[5] Hyperscalers is a term applied to multinational large cloud service providers.
[6] See *ITU Cybersecurity Index*. https://www.itu.int/en/ITU-D/Cybersecurity/Pages/global-cybersecurity-index.aspx.
[7] Garrison, G., R. L. Wakefield, and S. Kim. 2015. "The Effects of IT Capabilities and Delivery Model on Cloud Computing Success and Firm Performance for Cloud Supported Processes and Operations." *International Journal of Information Management* 35(4): 377–393.

Figure 3: Theory of Change of Economic Contribution of Cloud Computing



Source: Telecom Advisory Services.

innovation, especially in terms of the development of new products and services.[8] It also enables governments to build cloud-native applications resulting in greater cost savings. In addition, when CSPs themselves adopt technologies enabling them to innovate and offer more comprehensive services, these innovations and related efficiency gains are passed on to cloud adopting organizations. These organizations can then focus more on systems quality, information quality, and user satisfaction, and thereby, lower their development costs. This, in turn, can lead to higher margins and, potentially, an increase in sales. The overall impact on GDP growth is, therefore, positive.[9]

The aggregated economic contribution of cloud to GDP is comprised of: (i) the domestic value-added (proxied by spending) generated by cloud users and (ii) the spillover effects of cloud services on the total economy. Spending includes the purchase of cloud services by public and private organizations, while spillover effects include benefits generated by cloud computing in terms of IT cost efficiencies, new product development, and support for the incubation of startups.[10] By adding the estimate of economic benefits generated from the use of cloud services (the spillover effect) derived from econometric analysis to the spending on cloud services (the direct effect), we can measure the total economic contribution of cloud computing.

Policies supporting cloud adoption are also an important consideration. Figure 4 shows how a shift to pro-cloud policies could increase the contribution of cloud computing to growth over time.

Government policies promoting government cloud adoption impacting the level of government efficiency can also have a spillover effect on the rest of the economy for two reasons (Figure 5). There are two causal links: (i) facilitating the transition of government operations and systems to the cloud, with consequent impacts on GDP and (ii) incentivizing the accelerated adoption of cloud among private firms with a similar effect.

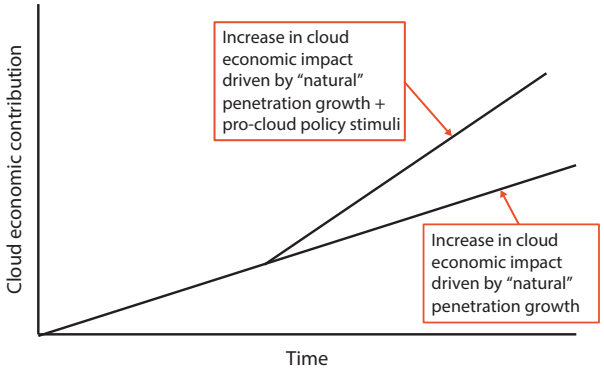
Following the theory of change outlined in Figure 5, the first causal link depicts the impact pro-cloud policies have on the migration of government systems to the cloud. This link is not automatic. A World Bank study[11] identifies three steps for migrating government systems to the

[8] Chou, C. Y., J. S. Chen, and Y. P. Liu. 2017. "Inter-firm Relational Resources in Cloud Service Adoption and Their Effect on Service Innovation." *The Service Industries Journal* 37(3–4): 256–276.
[9] Khayer, A., Y. Bao, and B. Nguyen. 2020. "Understanding Cloud Computing Success and its Impact on Firm Performance: An Integrated Approach." *Industrial Management & Data Systems* 120(5): 963–985.
[10] For example, when cloud services enable the adoption of IT services in the SME sector, which benefits from the scalability of state-of-the-art IT, that is considered to be a spillover effect.
[11] World Bank. 2022. *Government Migration to Cloud Ecosystems: Multiple Options, Significant Benefits, Manageable Risks*. Washington, D.C. https://www.worldbank.org/en/events/2022/06/12/government-migration-to-cloud-ecosystems-wbg.

cloud: (i) policy development; (ii) strategy formulation; and (iii) operational migration. The transition from strategy formulation to operational migration is one of the more complex stages. Undefined migration paths, unclear procurement policies, and limited coordination among government entities are frequent challenges. However, the transition can be successful if all practical details and institutional arrangements are well crafted.

The second causal link addressed is the impact of pro-cloud policies on increased cloud adoption in the private sector. While certain policies, such as Cloud First for governments, aim to accelerate the migration of government systems to the cloud, the impact on the private sector is a positive spillover. First, pro-cloud policies lead to investment and infrastructure deployment by hyperscalers, which in turn provide the infrastructure needed to accommodate private sector systems.[12] Second, the migration of government systems to the cloud promotes the development of domestic human capital. Third, in defining the government cloud model, which includes hosting arrangements, data classification, and regulations, pro-cloud policies partly reduce the implementation risk incurred by private enterprises in migrating to the cloud. In sum, the enactment and implementation of pro-cloud public policies have a derivative positive effect on cloud adoption by private enterprises.[13]

Figure 4: Potential Stimulation of Cloud Economic Contribution from Pro-Cloud Policies



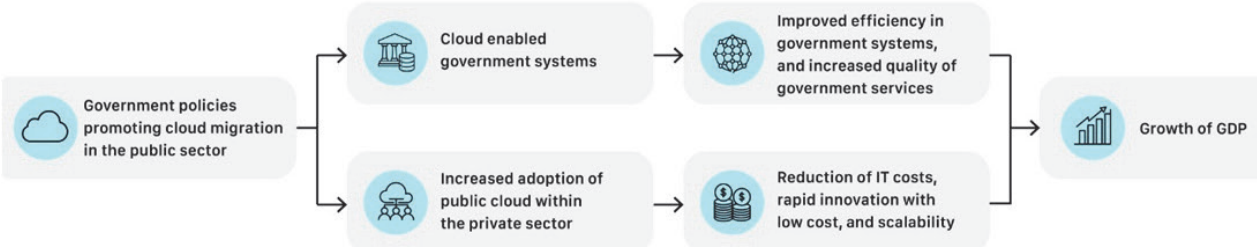
Source: Telecom Advisory Services.

5. Estimating the Impact of Cloud Computing in Asia and the Pacific

5.1 *Cloud Computing Spillovers*

We have estimated economic spillovers through a structural econometric model linking aggregate production to broadband and cloud penetration, which

Figure 5: Theory of Change Linking Government Cloud Policies to Economic Growth

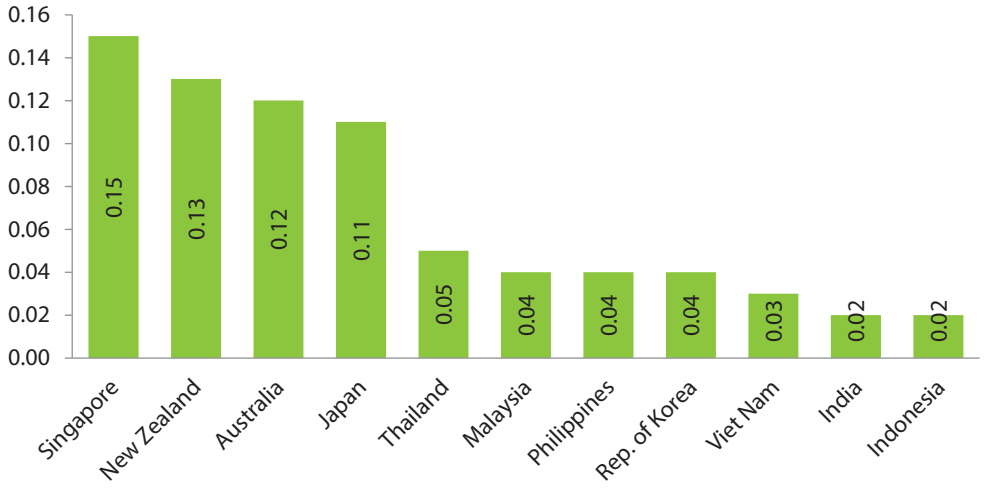


Source: Telecom Advisory Services.

[12] In New Zealand, the Digital Public Service (DPS) assists hyperscalers with the development of New Zealand-based cloud centers capable of handling government and private sector data. Hamoo, N. 2019. "New Zealand Government: Strategy for a Digital Public Service." *Public Sector Network*. November 13. https://publicsectornetwork.com/insight/new-zealand-government-strategy-for-a-digital-public-service.

[13] For example, the Cloud First policy enacted in 2013 and refined in 2017 in Australia served as an adoption incentive by the private sector, signaling that data is secure enough within public cloud platforms to receive government accreditation. In fact, the private sector is well aware of the security and compliance standards set by the government and has reacted accordingly. Mitchell, A., T. Smalidis. 2022. "Cloud Services and Government Digital Sovereignty in Australia and Beyond" *International Journal of Law and Information Technology*, 2021 29: 364–394. https://doi.org/10.1093/ijlit/eaac003.

Figure 6: Increase in GDP Driven by a 1% Increase in Cloud Adoption in Asia and the Pacific, 2022 (%)



Note: 2022 values for fixed broadband and cloud penetration for each country were used in the calculations.

Source: Katz, Jung, and Berry (2023).

are two complementary technologies.[14] According to this model, the elasticity of the impact of cloud adoption on GDP depends both on levels of cloud adoption and fixed broadband penetration. Figure 6 shows the estimated elasticities and absolute GDP impacts for the countries in our sample. While the average estimated impact of an increase of 1% in cloud adoption on GDP for middle- and high-income countries in Asia and the Pacific is 0.07%, the impact elasticity varies considerably by country. First and foremost, GDP elasticities are higher (average of 0.10%) in (Australia, Japan, New Zealand, and Singapore) than in the remaining economies with lower levels of cloud adoption (Indonesia, Malaysia, Philippines, Thailand, and Viet Nam), with an average value of 0.04%. This difference is indicative of potential "returns to scale," whereby higher cloud adoption yields a higher GDP contribution.

Despite the variability of cloud adoption across Asia and the Pacific, the aggregate economic impact, including cloud spending and the estimated spillovers on the economy, is sizable. For 2023, the impacts on GDP across countries range from 0.25% to 2.23% (Figure 7).

The economic impact of cloud adoption is higher in higher-income countries in the region, ranging from 0.64% (Japan) to 2.23% (Singapore), while the impacts in other Southeast Asian countries, Korea and India are lower, in the range of 0.25% to 0.50%. The impact on India's GDP is lower due to relatively low levels of fixed broadband penetration, a key enabling technology for cloud.

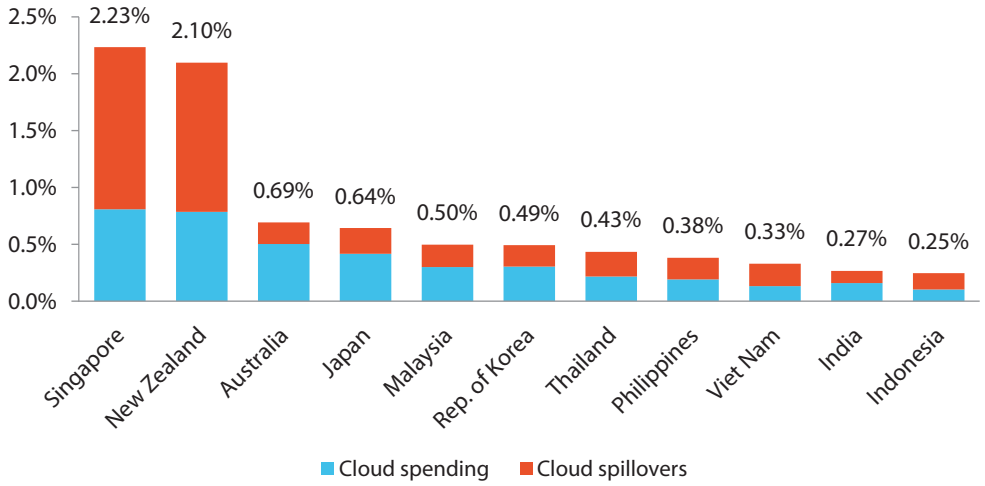
5.2 *Cloud Policy Changes*

Regarding the economic contribution of cloud policy, the combined imputed values of the three cloud policy sets described earlier were included as another term (aggregate policy variable) in the supply equation of the structural econometric model briefly discussed in section 5.1.[15] A one-step improvement in one of the policy variables leads to an increase of the aggregate policy variable in the range of 12%–33%, depending on the initial value. The results for the cloud supply equation point to a positive and significant effect of an increase in the maturity of cloud policies on increasing cloud spending, and subsequently cloud adoption.

[14] For a detailed explanation of the econometric estimation of cloud spillovers, see Katz, R, J. Jung, and T. Berry. 2023. *Economic Impact of Cloud Adoption in Asia-Pacific: The Importance of Pro-Cloud Policies to Promote Development and Economic Growth.* Chapter 5 and Appendix D. https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-asia-pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth/.

[15] See methodology in Katz, R., J. Jung, and T. Berry. 2023. Economic Impact of Cloud Adoption in Asia-Pacific: The Importance of Pro-Cloud Policies to Promote Development and Economic Growth, Appendix H. https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-asia-pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth/.

Figure 7: Cloud Adoption Economic Impact in Asia and the Pacific, 2023 (% of GDP)



Note: Singapore is close to 100% cloud adoption, so the spillover contribution has been calculated by averaging its annual growth in cloud adoption between 2020 and 2023. The same approach was used for New Zealand, which has achieved 91% in cloud adoption.

Source: Katz, Jung, and Berry (2023). https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-Asia and the Pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth/.

The elasticity estimates suggest that the above range of improvement of the aggregate policy variable would lead to an increase of cloud spending of 10.5%–28.0%, a very significant amount. By applying the effect of pro-cloud policy improvements on cloud spending and adoption, we can estimate the total economic impact if a country were to move from its current level of maturity of cloud policies to the highest maturity of pro-cloud policies.

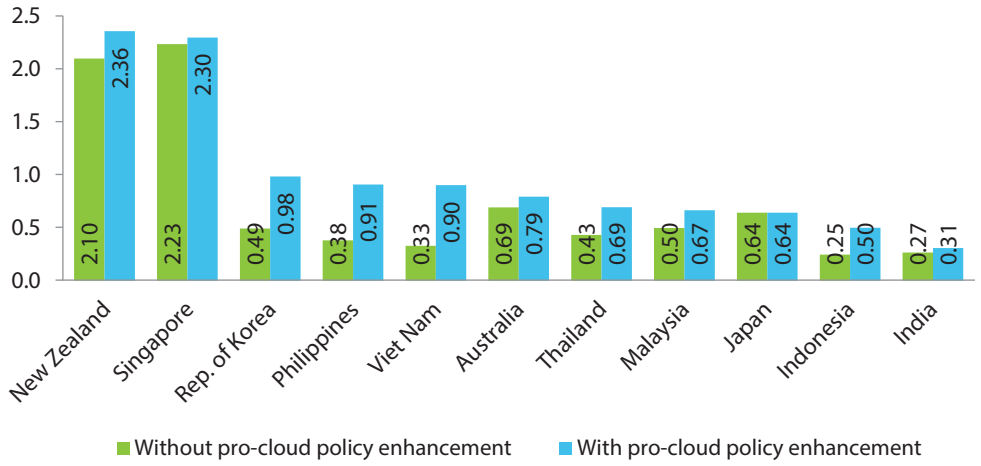
In this vein, we simulated the economic impact for the 11 countries in Asia and the Pacific. The calculated values provide a first view of the potential economic contribution of cloud computing for the 11 countries if in 2023 all of them were to achieve the highest maturity of pro-cloud policies. The model results point to a positive and significant effect of cloud policies: an improvement of cloud policies (e.g., from low to intermediate or high) yields a significant increase in cloud spending. In turn, the increase in cloud adoption yields a contribution to GDP.

The results indicate that there is significant potential for GDP gains linked to increased cloud policy maturity. In relative terms, the countries that will reap the largest gains in GDP are expected to be Viet Nam (where the extra effect of the policy reforms accounts for 0.6% of GDP), Republic of Korea, and the Philippines (0.5% of GDP), followed by Indonesia and Thailand (about 0.3% of GDP), due to the high spillover effects generated by the policy-induced increase in cloud adoption (Figure 8). While potential GDP gains are lower for countries that have already implemented cloud policy best practices, this encourages them to maintain an advanced level of cloud policy maturity.

In light of these results, the middle-income countries of Southeast Asia and Republic of Korea are facing a significant opportunity to leapfrog ahead in cloud adoption and drive their economic growth. We have considered three scenarios:

- **Low scenario:** No changes in cloud-enabling policies, and cloud spending evolves at the lowest growth rate as predicted by public sources (Statista and IDC);
- **Middle scenario:** No changes in cloud-enabling policies, and cloud spending evolves at the highest growth rate as predicted by public sources (Statista and IDC); and
- **High scenario:** Countries enhance their cloud-enabling policy frameworks to reach the most advanced level of maturity by 2028, and cloud spending evolves at the highest growth rate as predicted by industry sources (Statista and IDC).

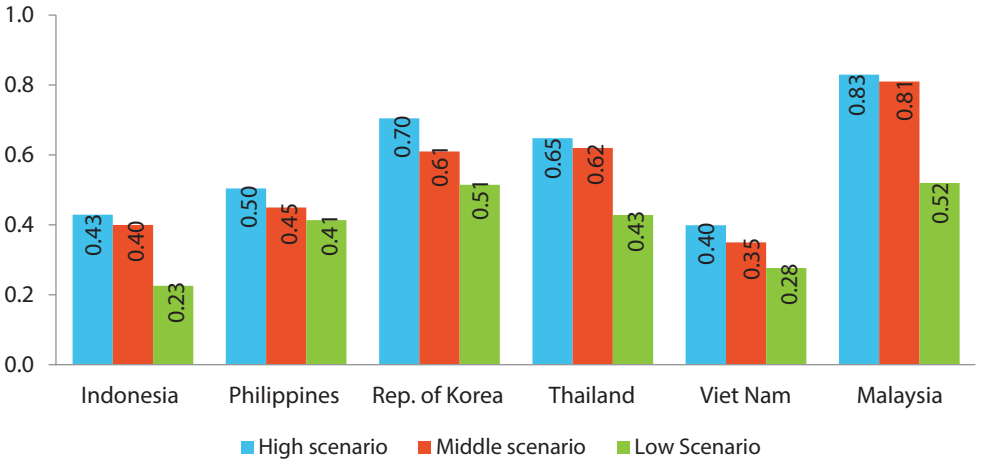
Figure 8: Total Economic Impact of Changes in Pro-Cloud Policies in Asia and the Pacific, 2023 (% of GDP)



Note: "Without pro-cloud policy enhancement" is the estimated direct contribution of cloud computing to GDP with unchanged cloud policy. Considering that Singapore is approaching 100% cloud adoption, the spillover contribution has been calculated by averaging its annual growth in cloud adoption between 2020 and 2023. The same approach was used for New Zealand, which has achieved 91% in cloud adoption. Japan does not register any impact of policy changes since the country has already reached an advanced policy level.

Source: Katz, Jung, and Berry (2023). https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-Asia and the Pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth/.

Figure 9: Cumulative Cloud Economic Impact of Alternative Scenarios in East Asia and Southeast Asia as a Share of Cumulative GDP, 2024–2028 (%)



Source: Katz, Jung, and Berry (2023). https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-Asia and the Pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth/.

The overall economic impact (considering both spending and spillover effects) for each of the three scenarios was calculated for 2024–2028 for the countries that would benefit the most from cloud-enabling policy frameworks. When measured as a share of GDP, the economic contribution is significant, reaching values between 0.4% and 0.8% of the forecasted cumulative output in the case of the most favorable scenario (Figure 9), compared with a range of 0.2%–0.5% for the low scenario. The largest gains would be in Malaysia, Republic of Korea, and Thailand.

6. Conclusions and Policy Implications

The econometric models developed in the background paper[16] for this policy brief point to a positive economic impact of cloud penetration in the 11 countries in Asia and the Pacific. However, we found some significant country-level heterogeneities, as the economic impact of cloud computing was found to be larger in more digitally advanced economies within the region. Specifically, the elasticity that links GDP growth with cloud adoption depends crucially on the relative development of this technology coupled with fixed broadband penetration. On average, we find that an increase of 1% in cloud adoption yields a GDP increase of 0.07%. In more cloud-mature countries, the elasticity values are higher, including Japan (0.11%), Australia (0.12%), New Zealand (0.13%) and Singapore (0.15%). On the other hand, the elasticity values for India, Indonesia, Republic of Korea, Malaysia, Philippines, Thailand, and Viet Nam are found to be lower, in the range of 0.02%–0.05%.

We calculated the overall direct and indirect effects of cloud computing (cloud spending plus spillovers) for each of the 11 countries for the year 2023. The average economic effect associated with cloud computing is estimated to be 0.5% of GDP. The impacts are greater in the higher-income economies in the region, ranging from 0.64% (Japan) to 2.23% (Singapore), while the impacts in other Southeast Asian economies covered in the study as well as India and Republic of Korea are lower, in the range of 0.25% to 0.50%. Finally, we also analyzed the economic effects of pro-cloud policy reforms, demonstrating significant gains. Under the most favorable growth scenarios of industry analysts and assuming that pro-cloud policy reforms can be implemented, the cumulated economic impact in those countries with relatively less mature cloud policy regimes can increase by a range of 0.5%–0.7% of the GDP during 2024–2028.

Our analysis suggests that countries interested in maximizing cloud adoption and its consequent economic contribution need to review and adjust their relevant policy frameworks (Table 1). These policies should also be complemented with related measures on expanding the coverage of high-speed fixed broadband networks.

Table 1: Policy Recommendations on Cloud Computing

1.	**Introduce "cloud first" policy and promote the development of a cloud industry model composed of commercial cloud service providers (CSPs) operating in a competitive market and certified by a government authority to offer services to the government.** Some governments may view the model of a single state-owned CSP processing cloud data as the most secure and cost-effective option. However, such an model is likely to be relatively inefficient due to the lack of competition, and there may be shortcomings in service provision due to inadequate capacity, older technology, and regulatory inconsistencies. human resources. Even a partially competitive model consisting of a state-owned CSP together with domestic private CSPs may fall short in terms of efficiency and security due to lack of competition with hyperscalers which have invested heavily in advanced security features and technical resources.
2.	**Adopt a risk-based approach to government data classification that also takes account of capabilities and infrastructure to manage those data securely.** There is a perception among some stakeholders that government data, including sensitive government and electronic payment information, needs to be stored locally. However, local storage and processing of such data may not be the most secure option, reflecting possible shortcomings and inconsistencies in security measures, capacity, and the level of technology. Conversely, working with CSPs that have the latest technology, high availability, high capacity, and sophisticated security programs is likely a more secure option.
3.	**Promote the enactment of law and regulations on cybercrime and cybersecurity, develop domestic capacity in cybersecurity domain (agencies, talent), and promote the cooperation between government agencies and the private sector.** The need to implement strong cybersecurity measures is clear, and there are no obvious trade-offs or risks from doing so. The key question is the ability to implement and enforce such measures. The rapidly growing sophistication of tools with malicious intent (malware) has made it increasingly possible to damage a government's digital infrastructure. Among cloud options, the public cloud—and in particular, hyperscale CSPs—can help government agencies increase cybersecurity by deploying cutting-edge defense mechanisms (World Bank 2022).

[16] For a detailed explanation of the econometric estimation of cloud spillovers, see Katz, R, J. Jung, and T. Berry. 2023. *Economic Impact of Cloud Adoption in Asia-Pacific: The Importance of Pro-Cloud Policies to Promote Development and Economic Growth.* Chapter 5 and Appendix D. https://www.teleadvs.com/economic-impact-of-cloud-adoption-in-asia-pacific-the-importance-of-pro-cloud-policies-to-promote-development-and-economic-growth/.

Appendix: Maturity Levels of Cloud-Related Government Policy Frameworks

The main cloud policy sets (or frameworks) comprise: (i) policies for government cloud service provisioning; (ii) data management and processing principles; and (iii) level of cybersecurity measures. Middle- and high-income countries in Asia and the Pacific may be divided into three broad groups according to the maturity of their cloud policy implementation (Table A1). The maturity levels for each type of policy are scored 1 for basic, 2 for intermediate, and 3 for advanced.

At one end of the policy spectrum, Australia, India, Japan, Malaysia, New Zealand, and Singapore have implemented public sector cloud-first policies enabling competitive cloud service provision, allowed data to be managed in the cloud, and certain categories of government data to be processed overseas (with the exception of India, which mandates localization for government data). These countries, (except New Zealand for which ITU data are not available) are also ranked at the highest tier of the ITU cybersecurity index. At the other end of the policy spectrum are Viet Nam, Philippines, Indonesia and the Republic of Korea (albeit ranked highly on cybersecurity), which have limited cloud service provision options for governments and adopted more restrictive policies on data transfers.

Table A1: Maturity Levels of Pro-Cloud Policy Frameworks in Asia and the Pacific, 2022

	Maturity Levels		
Policy	**Basic (1)**	**Intermediate (2)**	**Advanced (3)**
1. Cloud policy for public sector (government agencies)	**Restricted** • Republic of Korea • Viet Nam**	**Partially competitive** • Indonesia • Malaysia • Thailand • Philippines	**Fully competitive** • Australia • India • Japan • New Zealand • Singapore
2. Data hosting policy for the public sector (government)	**Must be processed in country** • India • Indonesia • Viet Nam	**Hybrid** • Australia • Singapore • Malaysia • Philippines • Republic of Korea • Thailand	**May be processed outside the country** • Japan • New Zealand
3. Government cybersecurity policy (score based on 2020 ITU Global Cybersecurity Index)	**Global Cyber Security Index value <85** • New Zealand* • Philippines	**Global Cyber Security Index value 85–97** • Indonesia • Thailand • Viet Nam	**Global Cyber Security Index value >97** • Australia • India • Japan • Singapore • Malaysia • Republic of Korea

Notes: Numbers in parentheses indicate the imputed score for each level of policy maturity.

*New Zealand cyber security index value (84.04) was assigned by the ITU because the country did not respond to the ITU questionnaire).

**Viet Nam does not have a formal cloud-first policy for the public sector.

Sources: World Bank GovTech Maturity Index 2022. https://www.worldbank.org/en/programs/govtech/2022-gtmi; ITU Cybersecurity Index https://www.itu.int/en/ITU-D/Cybersecurity/Pages/global-cybersecurity-index.aspx; Telecom Advisory Services desk research.

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