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Impact of DEAs on ASEAN Development: Lessons from Singapore's DEAs*

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Abstract

Technology strategy and governance have turned from a priority to an imperative for firms and governments alike in today's digital economy. Paving the way for the future, ASEAN has entered discussions for a ASEAN Digital Masterplan in 2025 to improve economic integration, and promote inclusive, sustainable growth for the region. We conduct a computable general equilibrium analysis on the impacts of the DEA on the signatories' economy, the ASEAN region, and the world.

We find that DEAs will positively increase the output of the ICT sector and has downstream benefits for the business services & financial sector, increasing their output by an average of 6.78%. The DEAs which aims to improve the interoperability of digital systems between countries will also increase inter-regional trade by an average of 7.27%. Data localisation clauses that are overly restrictive may be counterproductive and decrease the ICT sector's sectoral output. We also find that countries with a higher proportion of unskilled labour would see the most considerable growth in demand for skilled labour in ICT, reiterating the importance of reskilling the workforce. In sum, we find that analysing the DEAs currently in force to be instructive for gleaning lessons in renewing and deepening ASEAN integration.

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1 Introduction

Technology will touch and transform virtually every aspect of the economy, and the integration of data and technology has become a hallmark in digital trade. Singapore as a trading hub needs to constantly establish good trading relationships with its partners, especially in the present digital era. Furthermore, as ASEAN grapples with Covid-19 and uncertain recovery, regional cooperation in this volatile economic environment has become even more critical. This combination of internal push factors from the stagnating growth of intra-ASEAN trade and external forces of technology has led Singapore to initiate and create this new economic agreement. It is crucial to study the impacts of the DEA within this evolving context.

This paper seeks to discuss how the economic impact of DEA quantitatively using a Computable General Equilibrium (CGE) model. CGE models are popular in trade-policy-related analyses. We interpret the inception of DEAs as changes in trade policy of productivity. Fundamentally, there will be three improvements to cross-border trade due to the DEA. Firstly, productivity in the ICT sector will improve. Secondly, e-commerce transactions will be smoother. Thirdly, data regulations will be improved. We map each of these improvements to a plausible variable in the CGE model, and project changes in other key economic variables, assuming that the DEAs are in place. We also use it to model the impact of a multi-regional DEA on ASEAN.

Our paper is one of the first to study the quantitative impact of cross-border digital collaborations. Other studies such as [Bukht and Heeks \(2017\)](#); [Barefoot et al. \(2018\)](#); [Pepper et al. \(2016\)](#) have either examined digital economy or cross-border trade, but not a combination of these two. The uniqueness of the DEAs lies in its emphasis on the ICT sector and the subsequent spillover effects on the overall economy. It also pertains to international trade activity that particularly relies on e-commerce. These aspects have seldom been studied in the existing literature.

We present three major findings from the counterfactual simulations. We find that enhancing ICT collaboration leads to greater positive spillovers into the service sectors and countries should strive to strengthen the inter-industry linkages of these downstream sectors. Cross-border data flow policies should balance between ease of doing business and issues of data security and policymakers should restrict data flow on an “as-needed basis”. ASEAN integration would be greatly enhanced with the implementation of DEAs as there are strong trade relations between the countries.

The paper will be organised as follows. [Section 2](#) will introduce Singapore’s DEA. [Section 3](#) discusses the CGE model and the conceptual modelling of the impacts from the DEA. [Section 4](#) discusses the results of the simulations. [Section 5](#) offers policy implications & concludes.

2 Singapore’s Digital Economy Agreements

Singapore has long been a trading hub. Establishing good trading relationship has always been an important task. Entering the digital era, Singapore is also motivated to collaborate with its trading partners on growing the digital economy. As such, Singapore has signed several digital economy agreements with its major trading partners. New economic agreements such as the DEA need to be set up to balance and promote business growth and safeguard users’ interests in this digital age.

There is relevance between the free trade agreements and the DEA. The establishment of free trade agreements (FTAs) to promote trade and investment between countries was well known and accepted by many researchers and analysts to foster economic development and growth. With the advent of the internet and pervasive use of ICT, the era of digitalisation has arrived and ascended as the new impetus for innovation and growth. Every industry leverages digital technology to compete internationally. In tandem with that trend, protagonists of free trade view that collaboration and cooperation among countries can enhance their benefits from digitalisation by establishing digital economic agreements (DEAs), much in the same spirit as FTAs.

The DEA is a treaty that establishes digital trade rules and digital economy collaborations between two or more economies. Through DEAs with key partners, Singapore hopes to develop international frameworks to foster interoperability of standards and systems and support our businesses, especially Small & Medium Enterprises (SMEs), engaging in digital trade and electronic

commerce. It should be noted that DEA is not simply a form of FTA to remove trade barriers relating to trade in digital goods and services. Countries can explore ways to expand access to, and use of, open government data to generate new opportunities for businesses, especially for SMEs. This includes jointly identifying sectors where open data sets, particularly those with global value, can be used to facilitate technology transfer, talent formation and innovation. The DEA can facilitate cross-border data sharing and facilitate the innovation of new products and services.

Deepening regional economic integration has been the primary motivation behind Singapore's existing DEAs. The Digital Economy Partnership Agreement (DEPA) between Singapore, Chile and New Zealand is the first DEA concluded by Singapore. The DEPA is a first of its kind agreement that establishes new approaches and collaborations in digital trade issues, promotes interoperability between different regimes and addresses the new issues brought about by digitalisation. It also has the objectives of promoting business partnerships (e.g. consortia-building), promoting economic growth (e.g. productivity, competitiveness) and promoting research partnerships. The Singapore-Australia Digital Economy Agreement (SADEA) is Singapore's second DEA. The SADEA enhances existing digital trade arrangements between Singapore and Australia under the Singapore-Australia Free Trade Agreement. It also includes seven Memoranda of Understandings (MOUs) to operationalise some of the modules in the DEA by identifying or mapping collaboration projects, specifically in the areas of AI, Data Innovation, Digital Identities, Personal Information Protection, E-invoicing, Trade Facilitation and E-certification on Agricultural Commodities. Singapore is currently in discussion with South Korea, Vietnam, UK and China to set up DEAs.

In addition to the potential for deeper regional integration, the technological landscape has been evolving rapidly around the world, providing another impetus for the creation of DEAs. With the world becoming increasingly digital, technology has touched and transformed the economy across many dimensions such as the productivity of the ICT sector, e-commerce and cross-border data flows. While these technologies bring about efficiency and convenience, ethical use of them requires coordination from jurisdictions at stake. Governing the digital economy has become one of the most pressing issues policymakers have to tackle today. The DEAs are designed to put these technologies into good use. We summarize three fundamental changes introduced by the DEAs.

Firstly, DEAs ensure ethical and collaborative use of advanced technologies. Disruptive new technologies such as artificial intelligence (AI), blockchain and FinTech are poised to emerge and disrupt the modern economic system. AI is well known to be revolutionary and disruptive to the economy, society, and beyond (King et al., 2017; Puaschunder et al., 2019; Melnyk et al., 2019). While imaginative upsides are often anticipated, potential negative impacts of AI such as job losses and lost tax revenues exacerbates inequality and other societal issues. Hence, it is a strategic priority to maximise the gains of AI while minimising the potential harms through the DEAs. The DEAs govern and ensure the ethical usage of AI, strengthen collaboration between partners to develop AI technologies further, and find novel use cases of such powerful technologies. With room for innovation and the DEA will positively impact the productivity of the ICT sectors directly.

Secondly, the DEAs are expected to promote e-commerce with the help of interoperable systems. Although the benefits of e-commerce are widely recognised, large scale free trade agreements to facilitate cross-border e-commerce has seldom succeeded. This is due to the inability of world trading systems to adjust to modern business realities in its multilateral rule architecture (Janow and Mavroidis, 2019). E-commerce has taken off in the age of digitalisation and booming technological growth. What is needed for businesses to penetrate overseas markets is a compatible system from different countries. DEAs aim to standardize regulations and remove obstacles to trade across jurisdictions, using FinTech, digital ID & e-invoicing technologies to improve interoperability of data and processes between systems. A modern, consistent framework will improve trade and commerce processes, easing international market access for both businesses and consumers. The DEA also aims to support small-medium enterprises in digital trade by providing them with easier access to such new technologies, allowing them to engage more effectively in e-commerce.

Thirdly, the DEAs aims to strike a balance among ease of trade, firm productivity and cybersecurity. Data has become an increasingly important factor of production and plays an integral role in digital trade. While liberal collection and usage of data are beneficial for firm innovation

and competitiveness, unregulated is a significant privacy concern of consumers. Furthermore, there are also security concerns relating to data, from consumer rights and health care data, to national security issues such as the protection of telecommunications data. DEAs will protect national security interests and users' privacy while pursuing the goals of economic growth and firm innovation via regulated data flows. Of note, the data localisation module in the DEA seeks to achieve this objective by restricting the terms of use of collected business data. It is expected that DEAs' clauses on data flows will profoundly improve the firm's productivity and profitability in compliance with the country's respective data regulations.

Hence, in a world filled with disruptions and a constant need for innovation, a DEA is essential to help firms grow and harness the full potential of emerging technologies. The DEA can also anticipate and regulate potential disruptive technologies whilst protecting the rights of trading parties.

3 Methodology and Estimation of DEAs Effect

3.1 Theoretical Foundations of Digital Trade

Digital trade is a broad concept, capturing not just the sale of consumer products on the internet and the supply of online services, but also data flows that enable global value chains, services that enable smart manufacturing, and a myriad of other platforms and applications. [González and Jouanjean \(2017\)](#) develops a framework for analysing digital trade and describes it as encompassing digitally enabled transactions in trade in goods and services that can be digitally or physically delivered involving consumers, firms and governments. One of the features of the DEA, like the FTA, is to remove or lower barriers to digital trade. In the USTR report, four significant barriers to digital trades are highlighted: data localisation barriers, technology barriers, barriers to internet services, and other barriers. Data localisation barriers include excessively stringent requirements to locate computing facilities or store data within designated jurisdictions, including complete bans on cross-border data transfers. Technology barriers comprise regulations setting up demanding security standards and requirements to disclose proprietary source code without relevant intellectual property protection. Barriers to internet services concern the application of inapt regulations to novel business models and placing unreasonable burdens on such new internet platforms. The other barriers stated include issues surrounding e-payments and authorisation, digital products and other unfair practices. Concrete examples may be instructive here. For example, in China, foreign-invested enterprises are not allowed to directly offer cloud computing services within China, which is of serious concern to US-based companies. In Vietnam, cross-border suppliers are restricted from directly interacting with customers. Advertisers must contract with locally-based advertising agencies to place advertisements on foreign websites targeting Vietnam.

Digitalization also has impacts on the economy resulting from e-commerce, such as lower transaction costs, larger market size, and a more significant degree of market competition through cost-savings from digital platforms' facilitation of e-commerce ([Wong, 2019](#)). Furthermore, digitalisation has impacts on the trade price-volume dynamics. A higher degree of digitalisation encourages more business in a closed economy and increases the volume of international trade ([Wong, 2019](#)). However, it is not necessarily true that free trade prices will decrease unless digitalisation encourages exporting countries to sell more than importing countries ([Wong, 2019](#)). Coordinated global efforts are necessary to prevent 'digital protectionism' on e-commerce that would hinder the development of a digital economy, which calls for greater international effort to balance the need for regulations and market freedom ([Nakatomi, 2019](#)).

Data is also commonly regarded as the 'fourth factor of production' in the digital economy. Data is non-rival and leads to increasing returns, with social gains to data being used widely by firms, even in the presence of privacy concerns ([Jones and Tonetti, 2020](#)). [Jones and Tonetti \(2020\)](#) also find that when firms hoard data due to fear of creative destruction, it may lead to social welfare losses. Hence, it is important to introduce regulations that can address privacy issues and encourage data sharing between firms to maximise returns to the economy.

The DEA signed by Singapore seeks to impact the three barriers – technology barriers, barriers related to e-payment and authentication, and data localisation barriers, which the paper looks at in the following section. As there is a lack of statistics and detailed time series data on the digital economy, it is challenging to measure the impacts of such agreements, and we will utilise the CGE to assess the DEA.

3.2 CGE Model

CGEs are a workhorse tool utilised by policymakers and academics to study both traditional trade issues & modern economic policy instruments such as non-tariff measures (Fugazza and Maur, 2008; Tarr, 2014). It has also been utilised to conduct scenario analysis and the impact of new technologies on the economy (Chu et al., 2020; Gunasekera and Valenzuela, 2020; Ríos, 2002). Furthermore, the importance of inter-linkage effects arising from the pervasive use of technology and data across the economy lends itself well to using CGE models over econometric approaches to assess the potential effect of DEA (Flaig et al., 2016). The model would also be able to assess the multi-dimensional impacts the DEA would have on the ICT, business, finance, and retail sectors and how they will, in turn, affect the region on a broader level. In this paper, we utilise the Global Trade Analysis Project (GTAP) model with standard closures. It is a multi-regional and multi-sectoral computable general equilibrium with perfect competition and constant returns to scale (Corong et al., 2017).

The ASEAN countries (Myanmar has been omitted as their data is not available in the GTAP database) have been disaggregated to analyse the impact of the DEAs that Singapore has signed on the immediate ASEAN region. Australia and New Zealand have been disaggregated and included as standalone regions, as Singapore has concluded negotiations on two DEAs with the countries. China is also included as a separate country as they are deeply integrated into the ASEAN regional value chains in the global production network. EU & USA are also separated as they have a significant presence in global trade. The remaining 101 regions are placed into the rest of world (ROW). The 65 sectors are aggregated into 15 broad sectors, where industries that are identified to be impacted by the DEAs to a larger extent has been identified and disaggregated. As such, the wholesale & retail trade, information & communications, financial services, and business services sectors have been separated. Details are given in [Appendix A](#).

3.3 Conceptual Modelling of the Digital Economy Agreement

We will now describe the conceptual modelling of the DEAs and how it may concretely contribute to the economy by analysing the text of the DEAs currently in operation. The paper looks into three barriers to digital trade listed by the USTR – technology barriers, barriers relating to e-payments, and data localisation barriers. The main measurements used to assess the impacts of the DEAs would be industrial output, value-added, employment and trade.

3.3.1 DEA as a commitment to adopt the Digital Economy

Firstly, the DEA signed can be seen as a commitment to remove technology barriers through the collaborative development of various technologies such as AI and other digital solutions. AI is widely accepted to positively impact the economy’s productivity via channels such as increasing labour productivity and more efficient use of technology. An essential module in the SADEA deals with finding new ways to “better link the AI ecosystems” between the various partners to identify opportunities to commercialise innovative AI firms. It also seeks to increase productivity and speed up development by sharing resources, data, and infrastructure between the signatories. Collaborating on applying advanced digital solutions such as the IoT, AI in partnership with technology providers and service providers would boost data innovation to create new products and value. Furthermore, the agreement also seeks to set up testbeds so such novel technologies can be deployed quickly to both economies to boost productivity.

This significant push towards innovation and collaboration between countries will be modelled as a removal of technological barriers, a general increase in productivity in the ICT sector. Furthermore,

DEAs will enable ICT in the business services & financial sector to increase their efficiency as intermediate inputs, bringing additional value to downstream industries. This effect will be modelled as decreased costs, increased subsidies to the ICT sector’s development, and increased productivity of ICT sector inputs.

3.3.2 Digital Trade & E-commerce

Secondly, to encourage greater e-commerce trade flows, regulations regarding technologies such as e-invoicing, digital payment infrastructure are being developed by policymakers. The DEAs that Singapore has signed aim to serve as a modern instrument that can facilitate smooth trade flows of e-commerce activities through an improved trade system and positively impact e-commerce activities regionally. A key objective is to harmonise digital trade systems through technologies such as e-invoicing and digital payment infrastructures. Within the SADEA, both parties recognise the importance of e-invoicing to increase the “efficiency, accuracy and reliability of commercial transactions” and will take measured steps to implement it. Both parties also recognise the need to increase the efficiency, accuracy and reliability of commercial transactions and will take measured steps to ensure the implementation of cross-border e-invoicing frameworks.

Furthermore, the agreement also sets out to promote the global adoption of such e-invoicing systems to improve regulations, trust and security. Such integrated trade systems maintain a seamless, trusted and secure interface with the other countries to facilitate administration data exchange to improve operations and develop quick, consistent and transparent shipments whilst maintaining appropriate customs control. This systematic improvement would be modelled as removing barriers relating to e-payment, authentication and signatures as defined by the USTR.

Our model will introduce lowered transportation costs to trade, i.e. cheaper to move goods between countries due to more effective interoperable trade systems, as a shock to the economy.

3.3.3 Preventing Data Localisation

Thirdly, as data usage proliferates, it is vital to unify data standards so that users across multiple regions can seamlessly and securely share data. However, it is also essential to correctly value and regulate such cross-border data flows. A significant challenge would be balancing the domestic requirement in privacy and rights of consumers with data openness for cross border collaboration and innovation.

The SADEA has been set up to support cross-border data flow via electronic means and promote data-driven innovation in the digital economy. It aims to deepen collaboration on data-sharing projects and develop standards for data portability between partners. To further support e-commerce, it has also set out to develop data exchange systems that can facilitate trade data flow. Specifically, the SADEA states that neither party shall prohibit or restrict data flow if the activity is for the conduct of business of a covered person (SADEA). It also does not impose restrictions on the transfer of information greater than are required to achieve the objective (SADEA), signalling the adoption of a conditional transfer model. The SADEA also explicitly sets out clauses to allow parties to use or locate computing facilities or data centre locations freely, which does not impose unnecessary costs to the firms.

On the other hand, the SADEA also recognises the economic and social benefits of protecting personal data, such as enhancing consumer confidence in e-commerce. The signatories set out to adopt a framework that protects consumers’ personal information, taking into account compatible international guidelines such as the APEC Cross-Border Privacy Rules System, OECD Guidelines Governing the Protection of Privacy and Trans-border Flows of Personal Data. These principles limit and restrict the collection of data by specifying the purpose of collection and usage to increase the accountability of businesses in the use of personal data of consumers.

Restrictions on data movement can be modelled as increased taxes and costs on output as they need to bear higher costs on operating data centres and limitations on data privacy and collection issues, implicating their business operations. This will be represented as an increased production

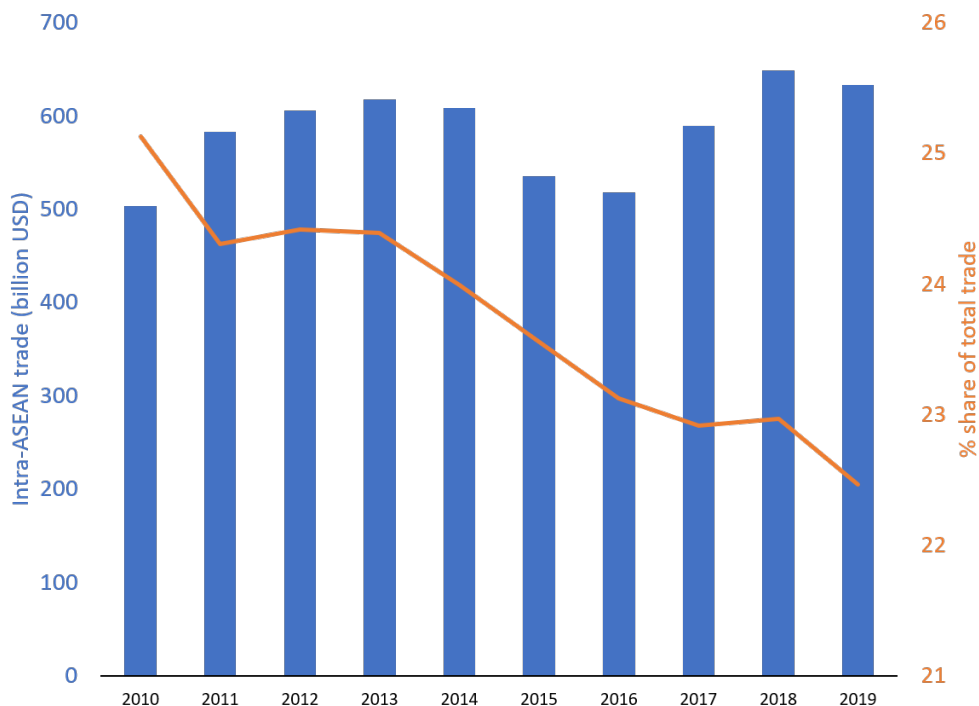


Figure 1: Value of Intra-ASEAN trade in goods between 2010 and 2019

cost on ICT sectors in our model, with its magnitude varying according to the severity of the restrictions.

3.3.4 ASEAN DEA

Finally, based on the three impacts of the DEA, we conduct a counter-factual analysis on the potential gains of a broader ASEAN-wide DEA which seeks to integrate the nations.

The DEAs were signed in a context of stagnating intra-ASEAN trade and rapidly evolving technologies that have deeply impacted the economy. ASEAN is a regional cooperation organisation made up of countries where economic disparities are stark, making economic integration challenging (Kobayashi et al., 2017). While there has been steady progress since its inception, it is difficult to achieve true integration due to the region’s political, social, and cultural diversities and the rapid changes of the economic landscape globally.

The ASEAN Free Trade Area (AFTA) was established in 1992 to facilitate trade opportunities, which attracts inward foreign direct investment flows within the region. Following the AFTA, ASEAN began preparing to set up the ASEAN Economic Community (AEC), which was realised in 2015. The AEC was established to deepen the economic integration of ASEAN and aims to promote the free movement of goods and services, investments, labour and capital. Additional efforts to facilitate the integration and growth of ASEAN’s e-commerce includes the e-ASEAN framework agreement to accelerate the adoption and development of new technologies (Chen and Kimura, 2019). However, evaluations of ASEAN’s economic integrations are mixed, with scholars suggesting little progress of its integration. This can be seen in Figure 1, where intra-ASEAN trade in goods has stagnated. ASEAN being a work-in-progress, requires additional effort and collaboration within the region to achieve economic integration. The ASEAN economic ministers have agreed to study a region-wide digital economy pact by 2023 and start negotiations on the ASEAN Digital Economy Framework Agreement by 2025 (Kang, 2021).

Technology presents an opportunity for deeper economic integration within ASEAN, boosting

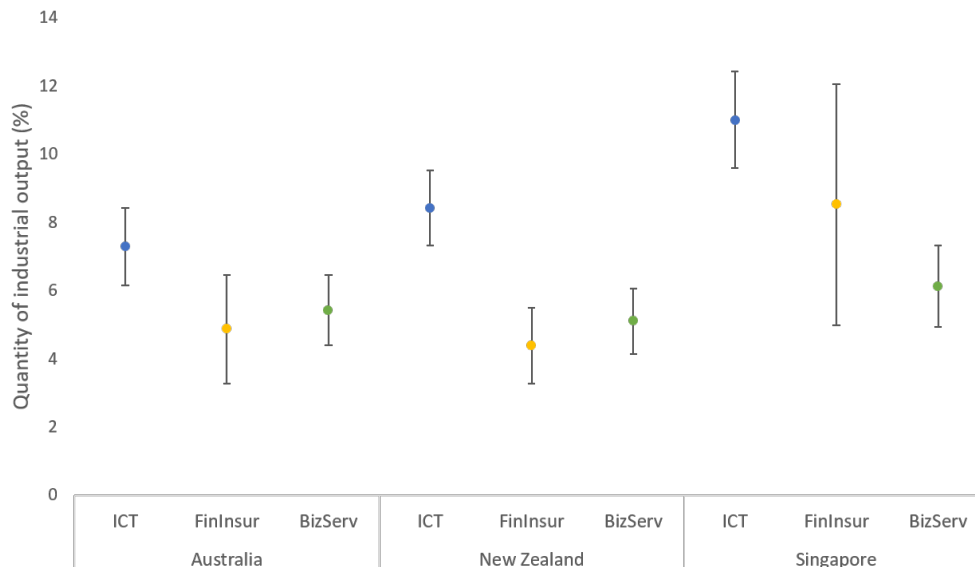


Figure 2: DEA causing ICT and downstream industries to increase industrial output. Intervals depict the high and low end of estimates, with the coloured points being the mean of the estimate. See [Appendix B](#) for numerical values.

intra-ASEAN trade and economic cooperation. Unlike traditional physical infrastructure with high initial costs and are not easily scalable, technological platforms and digital systems are easily scalable once implemented. The scalability and ease of distribution of technology present an opportunity to level the disparities of the trade environment between partners. Distributing and sharing standards concurrently with the digital platform around the region would provide a good way forward in unifying trade standards between partners.

Hence a DEA that focuses on developing an infrastructure to enable smooth flow of goods, services and data will ensure ASEAN continues to attract global trade and investments, putting themselves in a better position for future economic growth. Combined with consistent frameworks, such technologies provide leap-frogging opportunities for members and aid ASEAN in achieving proper economic integration. Hence, in the final section, we apply the simulation framework set out in the preceding sections onto the ASEAN countries to quantify the impacts of such a region-wide DEA.

4 Simulation Results

4.1 Increase in productivity of ICT sectors and downstream industries

As a commitment to adopt the digital economy, the DEA will require more of the ICT sector to reorganise and operationalise its objectives, such as building technological systems and enabling digital IDs. This will drive greater demand for the ICT sector and allow for greater innovation within the ICT space, leading to increased ICT productivity.

[Figure 2](#) shows the increase in output of ICT, Financial & Insurance, and Business Services sectors of the three signatories of the DEA. The range of estimates are obtained across a range of productivity shocks to the country's ICT sectors. The output of Australia's ICT industry is expected to increase around 6.1-8.4%. New Zealand and Singapore will have a more significant positive increase in ICT output due to a more robust ICT sector and are expected to increase around 7.3-9.5% & 9.6-12.4%, respectively. Furthermore, the growth in ICT will create positive spillover effects for industries that lie downstream from it. The Financial & Insurance and Business Service



Figure 3: DEA increasing value-added of ICT, Finance & Insurance, Business Services sector to the whole of the reion

sectors are expected to increase their output the most as well. With the Business Services sector benefiting more in Australia and New Zealand, and the Financial & Insurance sector increasing their output more in Singapore. In this scenario, the output of Australia’s Financial & Insurance sector is expected to increase by 3.2-6.5% and New Zealand by 3.3-5.5%.

Figure 3 shows the increase in value-added of the various industries that the DEA impacts. As expected, the ICT industry will have the most significant increase with its greater productivity and increase in its spillover downstream to the Finance & Insurance and Business Services.

Finally, Figure 4 shows similar growth in the digital economy amongst the three countries due to the agreements, with Singapore having slightly more significant growth at about 6.1%. This will serve as a good benchmark for measuring growth in the ASEAN digital economy with counterfactual simulations.

4.2 Boost in e-commerce and digital trade

One of the main objectives of the DEA is to enhance digital trade facilitation. Engaging with digital IDs, e-invoicing systems, and novel FinTech tools will promote interoperability between different data systems to facilitate cross-border trade. Firms will benefit from lower operational costs and ease of access to a broader international market, increasing the volume of international trade. The increased ease of conducting trade abroad can be modelled as lowered transportation costs of trade.

Figure 5 shows the change in retail and wholesale trade volume between the economies. Singapore, which is highly trade oriented would have a significant increase in export to Australia and New Zealand, by 5.64% and 5.08% respectively. Australia and New Zealand would also grow in their exports to Singapore, at about 6.38% and 6.22% respectively. Although a direct digital economy agreement is not modelled between Australia and New Zealand, they will both have an increased export of about 1.75% and 1.93% with each other. This is possibly due to their strong trade relations, and will continue to indirectly benefit from the DEAs with Singapore.

Figure 6 shows the comparison between the change in quantity demanded by households for domestic and imported goods. Demand for imported goods increased across all three economies, with New Zealand having the most significant increase at about 1.76%. The demand for domestic goods

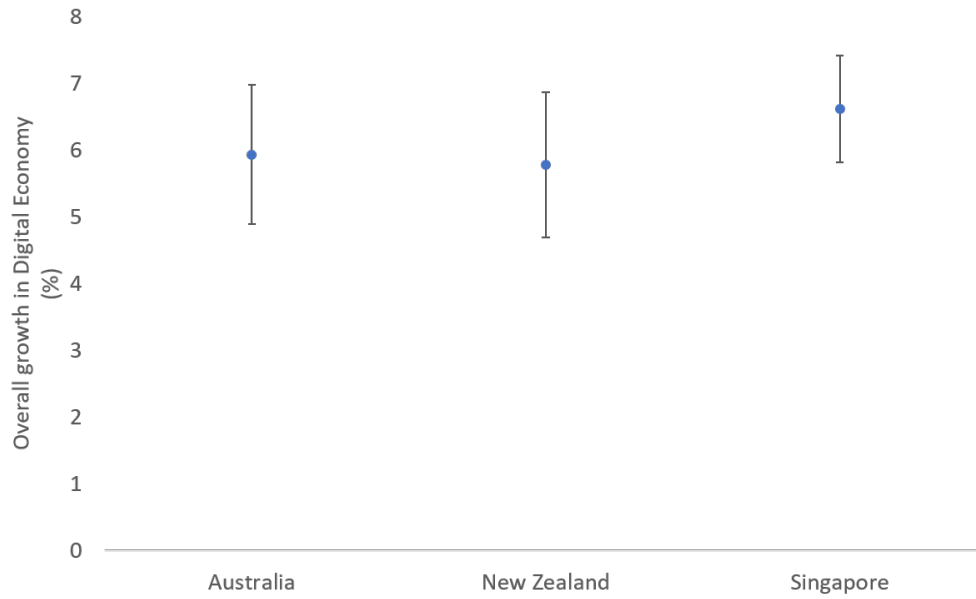


Figure 4: DEA and impact on growth of overall Digital Economy

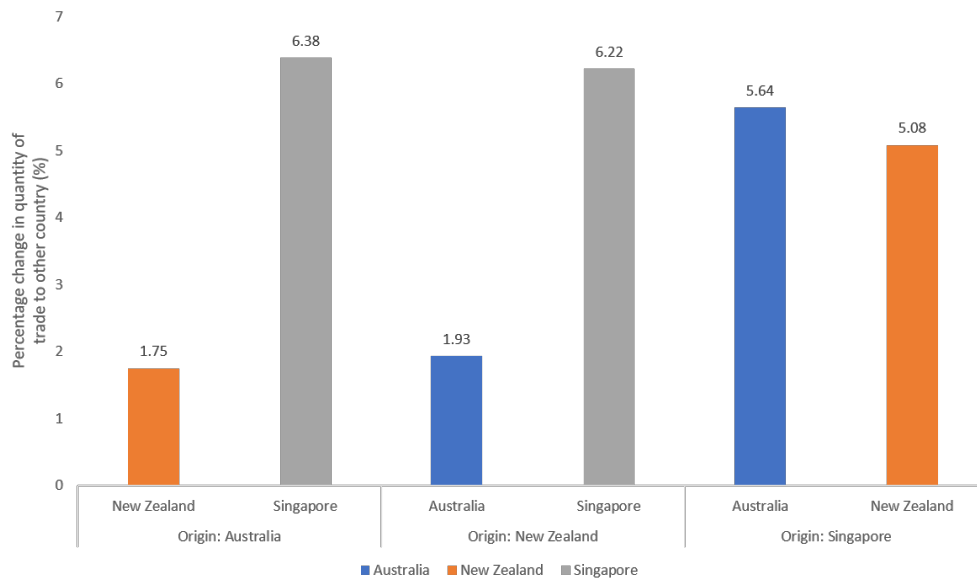


Figure 5: Percentage change in trade volume between origin and destination economies

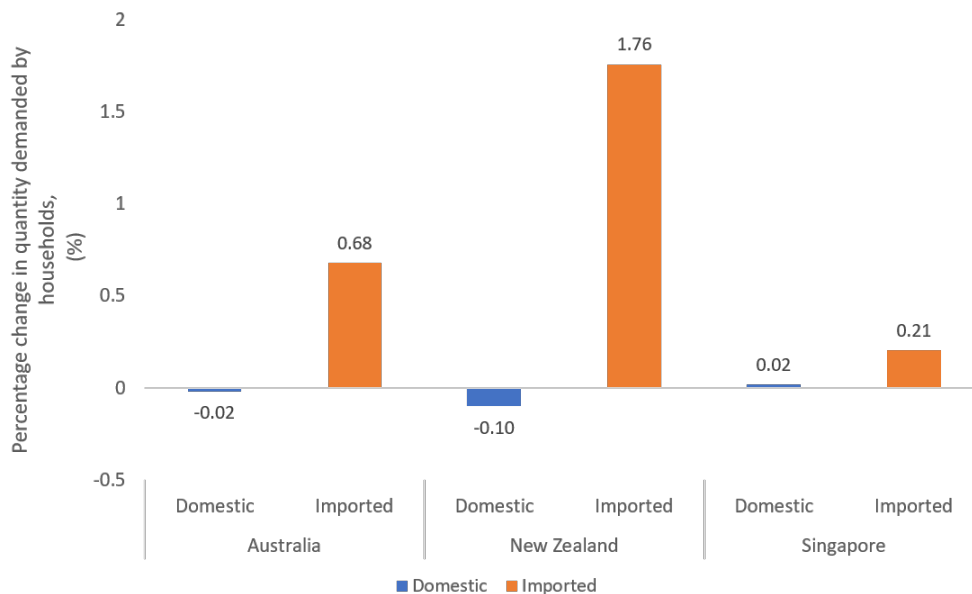


Figure 6: Percentage change in quantity of imported vs domestic trade by region

very slightly decreased for Australia and New Zealand, at about -0.02% and -0.1%, respectively, pointing to a possible change in domestic consumers preference for imported goods.

Figure 7 shows the GDP increase of the countries, with Singapore having the most significant increase at about 0.06%. The DEAs, which enable firms greater market access, and households easier and more convenient access to the broader market, leads to an overall increase in the wholesale & retail trade sector of all signatories and an overall growth in GDP due to increased exports.

4.3 Data localisation clause

The flow of data underpins digital trade and the regulation of cross-border data flows has become a priority on the global governance agenda (World Bank Group, 2020). As data flows are a means of production, restrictions on cross border data flows are a form of digital ‘border control’. This restricts and impedes digital trade, especially for firms in digital communications and the retail services sector (Farhoomand et al., 2000; United States International Trade Commission). In the present economy with highly connected production networks and global value chains, limiting data flows across borders also burden the production of goods and productivity of local firms using digital technologies (World Bank Group, 2020). Thus, policymakers must balance between businesses and protecting the privacy of consumers.

Domestic regulatory and legal regimes are developed independently before international standards emerge. Several different data and information economy regimes are developed independently, notably in the US, Europe, and China (Janow and Mavroidis, 2019). This lack of standardisation comes at the cost of losing opportunities for greater data innovation and collaboration. Hence it is essential to design policies that allow for the smooth flow of business data while safeguarding private personal data. Excessively strict data localisation laws threaten the possibility of outsourcing services to cheaper countries (Chander and Lê, 2014). Data localisation has different definitions and methods of operationalisation.

It ranges from the most restrictive, where all data must be stored locally, to less restrictive regulations where only one copy of the data is stored locally in domestic servers during processing (World Bank Group, 2020).

Figure 8 shows three different simulation scenarios, varying in degree of strictness in the projected data localisation clauses between the signatory states.

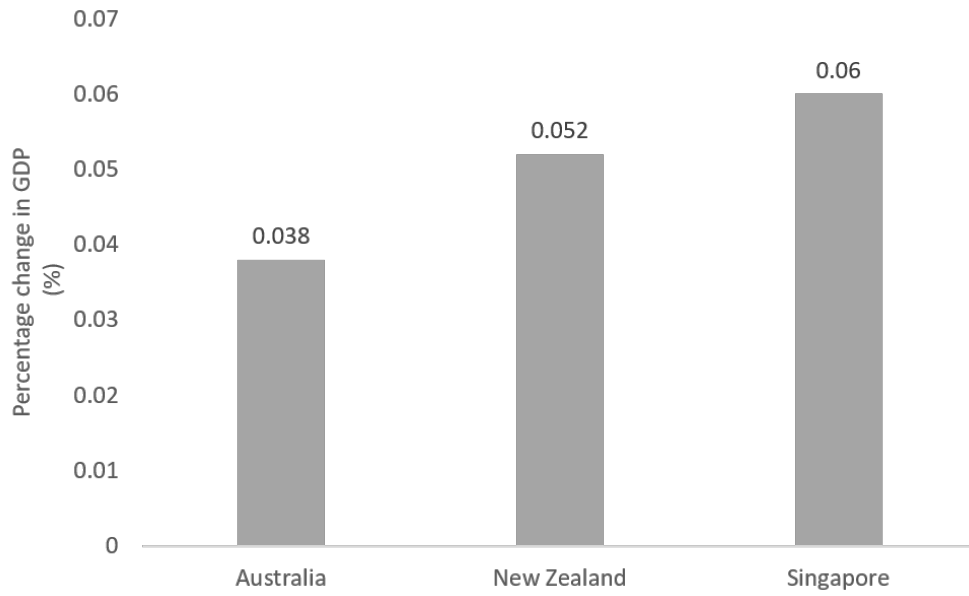


Figure 7: Percentage change in GDP of signatories

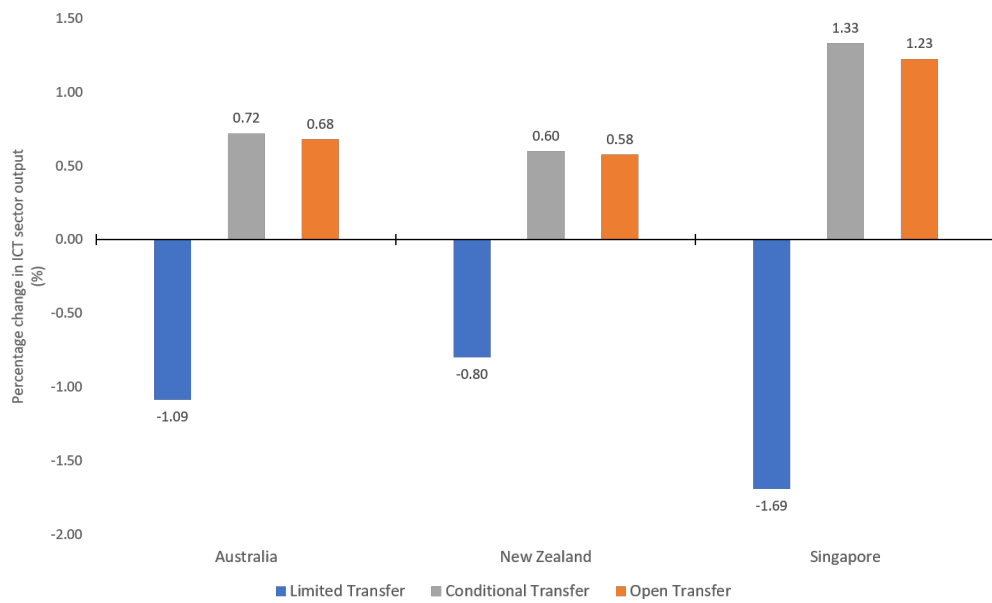


Figure 8: Impact of data localization clauses on signatories

Under the strictest clauses, all personal data has to be kept locally and cannot be transmitted overseas for analysis and research. The ICT sector output decreases in all countries under the strictest data localisation regime. Australia output of ICT and Financial Services decreases by 1.09% and 0.78%, respectively. New Zealand’s output of ICT and Business Services decreases by 0.8% and 0.36%. Finally, the output of Singapore’s ICT largest relative drops 1.69%. We can see that excessively strict limitations on data transfer would negatively impact the output of the ICT sector.

The main reason for this result would be due to the business environment becoming uncompetitive for firms. Overly strict data localisation clauses become counterproductive and make it difficult for a firm to continue operations in the country. As operating and storing data costs are not negligible (Mihaylova, 2016), it might become too costly to keep data in local data centres. Firms will also have to take on additional compliance costs for their operations as well. The effect of data localisation clauses goes beyond the operating and compliance costs of firms. Being restricted to sharing and moving data back to where their best employees are based might also impact their competitiveness and innovativity. It is possible that as these costs compound and become inhibitive high, firms may find it more economically viable to conduct their operations at a cheaper location.

?? shows the impact data localisation clauses has on neighbouring countries ICT sectors output. Under the most restrictive scenario, countries like Brunei, Cambodia, and Laos stand to gain the most. With cheaper ICT infrastructure and growing development of IT professionals, Brunei, Cambodia, & Laos ICT sector grows by 0.08%, 0.09% and 0.10% respectively under this simulated scenario. Amongst the countries that stand to gain the most is China, whose ICT sector grew the largest in absolute terms.

On the other end of data liberalisation, under the open transfer model where data can move freely between borders, Australia’s output of ICT increase 0.68%, New Zealand’s ICT output increases 0.58%, and SG output of ICT increase by 1.23%. While there is a positive growth in ICT output, the excessive usage and collection of data might not be optimal.

Under the conditional transfer model, where only certain types of data can be transferred, we can see an even greater increase in ICT output from all the countries, signalling the importance of prudent data flow management.

Overall, the results also show that the potential downsides of overly strict data localisation regulations would be greater than the potential upsides to be gained. Hence it is important to ensure that any regulations on cross-border data flows be sufficiently free to allow firms to be innovative and efficient in their usage. It is important to balance between protecting the privacy rights of users while preventing the stifling of firm innovation.

4.4 DEAs to improve ASEAN Economic Integration

Although traditionally international frameworks might be expected to form between partners with the most friendly relations and largest trade flows, multilateral frameworks can offer transparency and consistency to the stakeholders. This section explores the potential benefits of a broad and multilateral DEA within the ASEAN region. We present similar simulations as the preceding three subsections, applied to the ASEAN region.

Figure 9 presents the increase in collaboration of ICT sectors in ASEAN and its associated increase in output. In an optimistic scenario where countries jointly develop and agree to a broad multilateral framework for active collaboration in the ICT sector, there would be on average a 5.9% increase in ICT output across all ASEAN countries. The most significant gains would be experienced by ICT sectors in developing countries such as Cambodia, Laos and Vietnam, with an increase of 9.4, 9.0 and 7.4 percentage points, respectively. In a conservative scenario where countries sign a DEA but do not collaborate actively or are unable to achieve complementary gains in productivity would be able to increase their output by 2% on average. Countries with weaker ICT infrastructure, such as Brunei, would only increase 0.63% in their output.

Figure 10 shows the increase in the volume of trade between ASEAN countries if the countries are able to adopt a digital trade system. Singapore, being an open economy and trading partner, would increase its volume of trade to other ASEAN economies by 7.3%. All signatories of the

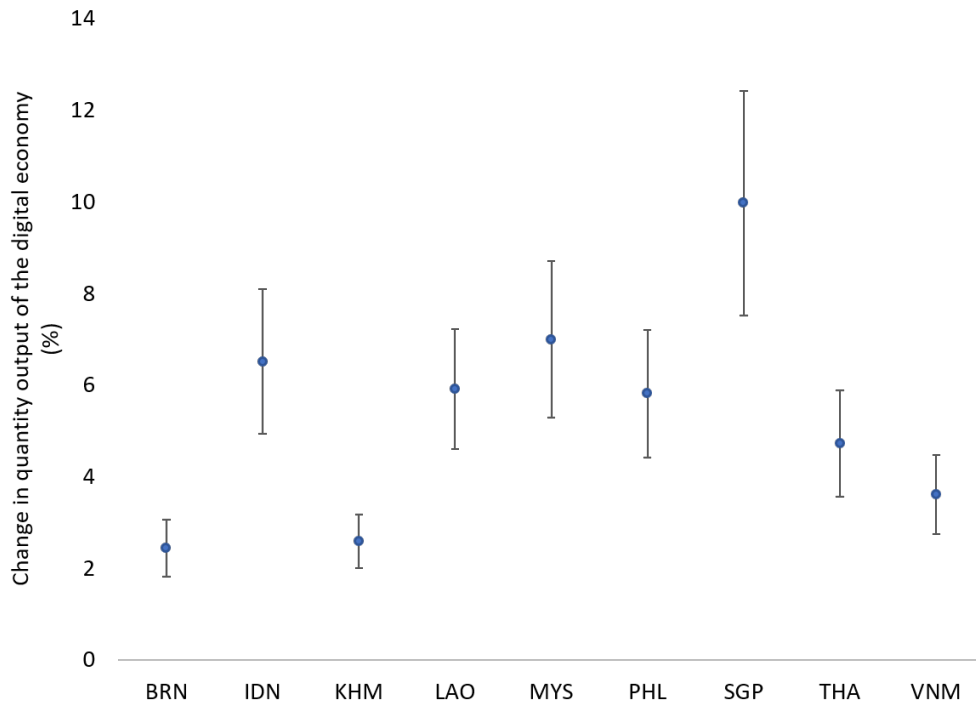


Figure 9: Boost in ICT output after signing ASEAN DEA

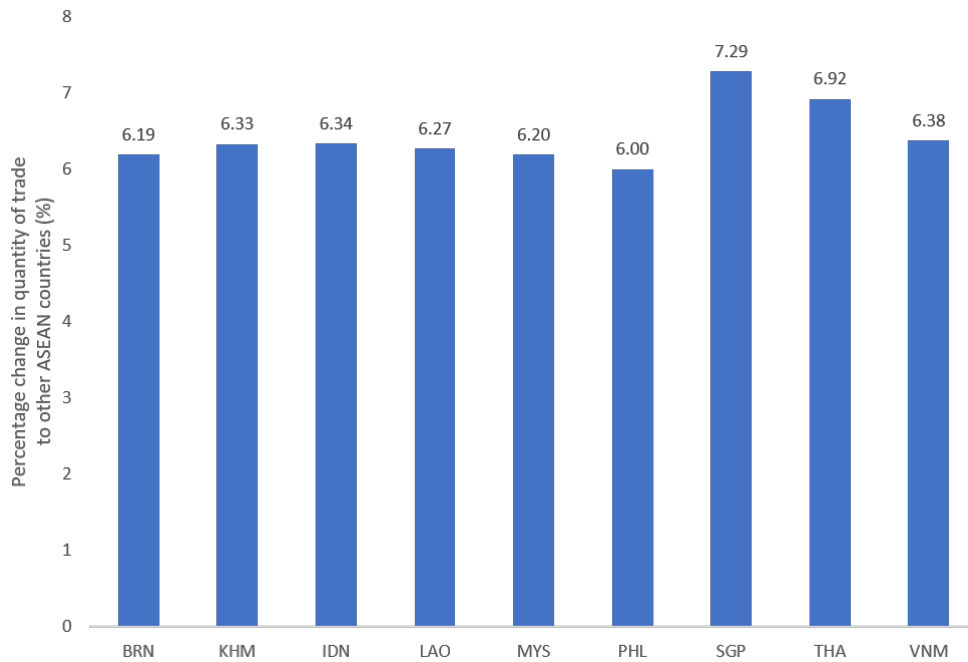


Figure 10: Increase of trade volume to all other ASEAN countries

		Destination								
		BRN	KHM	IDN	LAO	MYS	PHL	SGP	THA	VNM
Source	BRN		6.8	4.7	6.7	6.3	6.4	7.9	6.0	6.7
	KHM	2.7		1.0	3.0	2.6	2.6	3.6	2.3	3.0
	IDN	6.8	7.1		7.1	6.7	6.7	8.3	6.4	7.1
	LAO	2.7	3.0	1.0		2.6	2.6	3.6	2.3	3.0
	MYS	6.5	6.8	4.8	6.8		6.4	7.9	6.1	6.8
	PHL	6.4	6.8	4.8	6.8	6.3		7.9	6.0	6.7
	SGP	7.2	7.6	5.6	7.6	7.2	7.2		6.8	7.6
	THA	6.4	6.7	4.7	6.7	6.3	6.3	7.8		6.7
	VNM	6.5	6.8	4.8	6.8	6.4	6.4	7.9	6.1	

Figure 11: Increase in Exports from Source to Destination Country

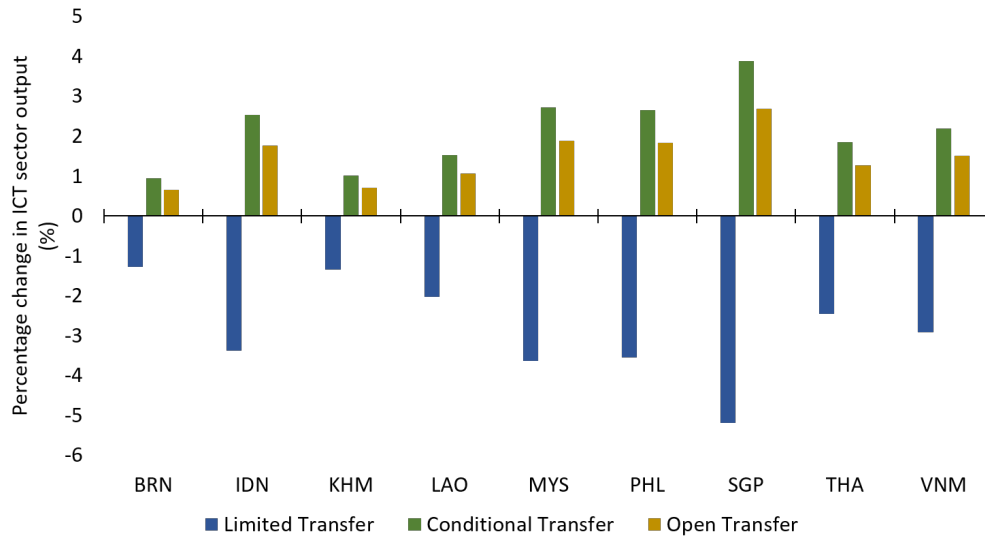


Figure 12: Increase of ICT output under Optimal Conditional Transfer Model

agreement would also be able to increase trade volume by about 6%. This general increase in trade within ASEAN would be able to achieve the goal of trade integration further.

Figure 12 we show the increase in ICT output if ASEAN is able to develop a data transfer model. Singapore, as a country who has a developed ICT sector would have the largest increase in ICT output at 1.42%.

Finally in Figure 13 shows the percentage change in demand for skilled labour across different countries and industries. We see that in developed economies like Singapore, the increase in demand for labour would be smaller, due to an already well-developed ICT sector, with fewer workers moving from unskilled industries to the growing ICT sector. In less developed countries like Cambodia and Laos, skilled labour demand will increase considerably. This is due to the unskilled workforce moving into the rapidly growing ICT industries.

In an increasingly connected world with tightly bounded production networks and value chains, it is in every partner's interest to leverage on the inter-connectedness of their economies and collaborate toward a broad multi-regional DEA.

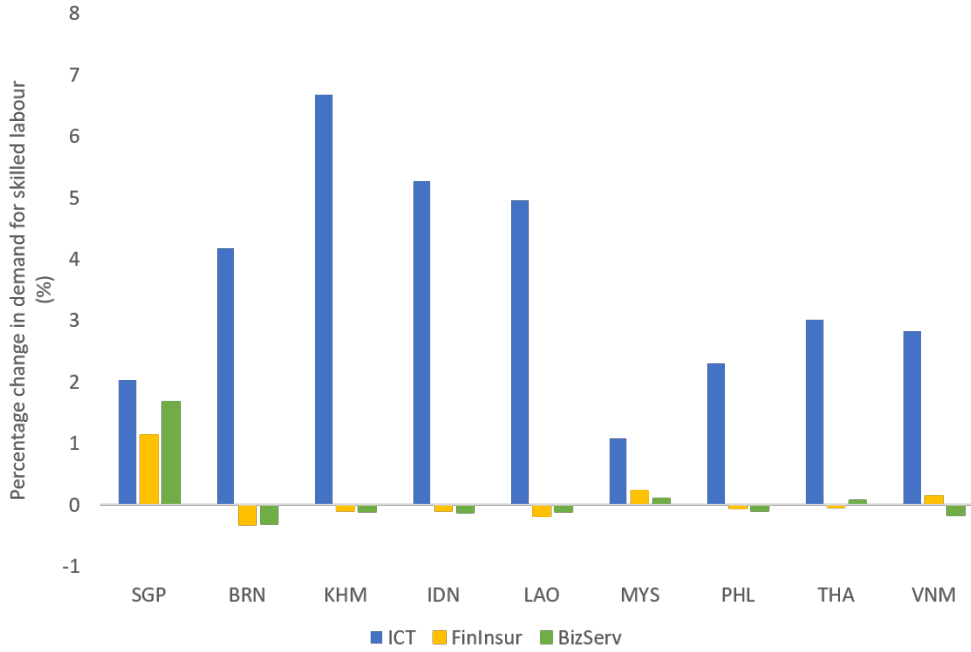


Figure 13: Percentage change in demand for skilled labour by country and industry

5 Policy Implications & Conclusion

The usage of data and technology has proliferated, and securing the success of digital trade within the digital economy has become a key issue for policymakers. DEAs are a vital economic tool to address digital trade barriers to ensure continued economic growth and integration. We have discussed the various ways the DEA may impact the economy concretely by lowering related technology barriers, standardisation barriers and data localisation barriers. We have also analysed the impact a region-wide DEA will have on ASEAN. We offer the following policy implications and suggestions.

With practical and targeted measures to foster open innovation and guide firms towards enhancing their digital capabilities, a data-driven transformation for the ICT can be achieved, leading to increased output and value-added to the economy. Policymakers should also look at developing the downstream industries such as Business Services, Financial & Insurance. These related downstream industries that increasingly rely on the ICT industry will create more value-added, which has far-reaching implications on the economy.

As digital payments and accounting systems improve in their capabilities and become more commonplace, different operating standards will also emerge, possibly leading to increasing complexities and frictions. This might hamper transactions between partners, disrupting trade flows. E-commerce needs to be supported by free data flow and strong linkages between partners in the network. Creating an e-commerce friendly ecosystem, improving the interoperability and harmonisation of such systems regionally will be increasingly important and the key driver to increase digital trade volume between all partners.

The guiding principle regarding trade data flows should be liberal and open for non-personal data whilst keeping sufficient information security measures in place. This is to foster innovation and growth and the protection of consumers privacy rights.

All in all, from the three mechanisms detailed in our work, policymakers should above all improve connectivity and collaboration between partners, creating consistent standards amongst partners to lower digital trade barriers and ensure free data flow. These regulatory frameworks should be planned in continuous conversation, accounting for the costs and benefits of all stakeholders.

In an increasingly networked economy, Singapore should also forge the way forward in initiating a multi-regional DEA agreement with its ASEAN neighbours. A systematic, broad, and inclusive DEA would be able to take advantage of the network effect, improving the ICT sector and producing more extensive downstream benefits for other sectors in the regional value chain. The ICT sector will create more value-added and higher demand in skilled labour, replacing the unskilled workforce demand. Hence it will be of utmost importance for countries to continually increase the quality of their human capital through rigorous training and education - improving the country's ability to thrive in a digital economy.

The agreements, if executed well, will enable Singapore to capture the full potential of technologies and maximise the growth of the digital economy – allowing Singapore to lead an increasingly digital future.

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A Aggregation Tables

Table A1: Sectoral Aggregation Table

	Aggregated Sector
Paddy rice	Grains and Crops
Wheat	
Cereal grains nec	
Vegetables, fruit, nuts	
Oil seeds	
Sugar cane, sugar beet	
Plant-based fibers	
Crops nec	
Processed rice	
Bovine cattle, sheep and goats	Livestock and Meat Products
Animal products nec	
Raw milk	
Wool, silk-worm cocoons	
Bovine meat products	
Meat products nec	
Forestry	Mining and Extraction
Fishing	
Coal	
Oil	
Gas	
Minerals nec	
Vegetable oils and fats	Processed Food
Dairy products	
Sugar	
Food products nec	
Beverages and tobacco products	
Textiles	Textiles and Clothing
Wearing apparel	
Leather products	Light Manufacturing
Wood products	
Paper products, publishing	
Metal products	
Motor vehicles and parts	
Transport equipment nec	
Manufactures nec	
Petroleum, coal products	Heavy Manufacturing
Chemical products	
Basic pharmaceutical products	
Rubber and plastic products	
Mineral products nec	
Ferrous metals	
Metals nec	
Computer, electronic and optic	Electronic/digital goods
Electrical equipment	

Table A1 continued from previous page.

	Aggregated Sector
Machinery and equipment nec	
Electricity	
Gas manufacture, distribution	Utilities and Construction
Water	
Construction	
Trade	Wholesale and Retail Trade
Accommodation, Food and services	Accommodation, Food and services
Transport nec	
Water transport	Transport
Air transport	
Warehousing and support activities	
Communication	Information and communication
Financial services nec	
Insurance	Financial Services
Real estate activities	
Business services nec	Business Services
Recreational and other services	
Public Administration and defence	
Education	Other Services
Human health and social work	
Dwellings	

Table A2: Regional Aggregation Table

Aggregated Region	
Australia	
China	
Korea	
New Zealand	
USA	
Singapore	
Brunei	
Cambodia	
Indonesia	
Laos	
Philippines	ASEAN
Thailand	
Vietnam	
Malaysia	
Austria	
Belgium	
Bulgaria	
Croatia	
Cyprus	
Czechia	
Denmark	
Estonia	
Finland	
France	
Germany	
Greece	
Hungary	
Ireland	EU-27
Italy	
Latvia	
Lithuania	
Luxembourg	
Malta	
Netherlands	
Poland	
Portugal	
Romania	
Slovakia	
Slovenia	
Spain	
Sweden	
Rest of World	

Data Transfers Model
adapted from WBR. 21

Model	Features	Policy Goals	Regulatory Costs	Digital Trade Flow	Examples
Limited Transfer	Broad Requirements to use domestic servers for data storage and/or processing	Cybersecurity and other security concerns	Higher	Limited by transfer approval or data localization requirements	Certain personal data in China, health data in Australia and UK, Russian Federation telecom data, US govt data
Conditional Transfer	Prior approval required for data transfers Consent	Protection of personal data	Medium	Subject to regulatory conditions	EU General Data Protection Regulation (GDPR)
Open Transfer	Adequacy findings Private sector assessment (codes of conduct, binding corporate rules, contractual arrangements) No a priori mandatory requirements Private sector accountability based on voluntary standards	Business freedom	Lower	Largely open	US federal rules APEC Privacy Framework

B Result Tables

Table B1: Percentage change in industrial output and value-added.

	ICT		Financial & Insurance		Business Services	
	Output	Value-added	Output	Value-added	Output	Value-added
Australia	7.29	4.225	4.86	1.80	5.42	2.34
New Zealand	8.41	4.79	4.38	0.77	5.10	1.46
Singapore	11.00	8.56	8.51	6.08	6.12	3.67

See [Figure 2](#) & [Figure 3](#).

Table B2: Impact of data localisation clauses on neighbouring regions.

	Limited Transfer	Conditional Transfer	Open Transfer
BRN	0.08	-0.05	-0.05
KHM	0.09	-0.07	-0.06
IDN	0.03	-0.02	-0.02
LAO	0.10	-0.07	-0.06
MYS	0.03	-0.02	-0.02
PHL	0.02	-0.02	-0.01
THA	0.03	-0.02	-0.01
VNM	0.03	-0.02	-0.02
CHN	0.03	-0.02	-0.01
EU	0.02	-0.02	-0.01
USA	0.01	-0.01	0.00
ROW	0.02	-0.01	-0.01

See ??.

Table B3: Percentage change in industrial output after signing ASEAN DEA.

	ICT	Financial & Insurance	Business Services	Other Services
AUS	6.80	3.38	4.59	1.99
NZL	8.42	3.51	4.42	2.21
SGP	11.24	5.08	5.20	1.13
BRN	1.25	0.25	0.25	0.16
KHM	6.25	0.035	-0.021	0.045
IDN	1.79	0.091	0.044	0.088
LAO	6.01	0.056	0.19	0.11
MYS	4.99	1.08	0.68	0.47
PHL	4.00	0.58	0.47	0.35
THA	2.25	0.23	0.51	0.13
VNM	4.99	0.69	0.040	0.29

See [Figure 9](#).

Table B4: Percentage change in demand for skilled labour by country and industry.

	ICT	Financial & Insurance	Business Services
SGP	2.04	1.14	1.68
BRN	4.18	-0.32	-0.31
KHM	6.67	-0.09	-0.11
IDN	5.27	-0.09	-0.12
LAO	4.96	-0.18	-0.11
MYS	1.09	0.24	0.11
PHL	2.3	-0.05	-0.09
THA	3.02	-0.03	0.07
VNM	2.83	0.15	-0.17

See [Figure 13](#).