

Economic Impact of ICT Exports on Developing Nations During the COVID-19 Pandemic

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Abstract

This study seeks to review the economic impact of Information Systems and Computing during the COVID-19 pandemic on developing nations. Trends in high technology exports, information and computing technology (ICT) service exports, and annual gross domestic product (GDP) are examined. Brazil, Russia, India, China, and South Africa (BRICS) countries, and the Oriental Republic of Uruguay, Austria, Switzerland, Emirates, and Singapore (OASES) countries are analyzed using economic and technology indicators in the context of the United Nations' sustainable development goals. Results show that for BRICS and OASES nations high-technology exports and ICT service exports have a relationship with annual GDP, however, the varying degrees may account for recovery variability and inequality among nations. Policy implications including the e-government development index (EGDI) and digital technology inclusion are reviewed.

Keywords: Information Systems and Computing, ICT, EGDI, BRICS, OASES, COVID-19

1. INTRODUCTION

The COVID-19 pandemic initially increased trade in information and communication technology (ICT) goods due to digitalization, which was declining before the pandemic (UNCTAD, 2021). This increase was partly due to the use of digital technologies and work-from-home devices during the COVID-19 pandemic and related lockdown periods. High-technology commerce and exports were able to overtake product trade during the COVID-19 pandemic due to the increase in communications, computer processing, data, and storage technology for remote connectivity. However, individual countries have benefited differently from the increased demand for ICT (UNCTAD, 2021). The increase in ICT exports primarily occurred within developing regions, whereas exports declined in the least developed

countries. The COVID-19 pandemic may have caused further divides in digital trade and digitalization, along with income earnings and mortality impacts between countries (UNCTAD, 2021; Ikram & Sayagh, 2023). The COVID-19 pandemic resulted in a global economic crisis with emerging economies experiencing a severe economic impact due to income losses which heightened preexisting economic conditions (The World Bank, 2022). The pandemic recovery is as uneven as the initial impacts, with emerging economies and economically disadvantaged groups requiring additional recovery time for pandemic-induced losses (The World Bank, 2022).

Emerging Economies

The largest emerging global economies Brazil, Russia, India, China, and South Africa are

collectively known as BRICS. These countries account for nearly a quarter of the global annual gross domestic product (GDP), make up 42 percent of the world's population, and include 3.2 billion people as of 2021 (The World Bank, 2023). By 2030, BRICS' share of the global annual GDP is projected to be 50 percent (Devonshire-Ellis, 2022). However, instead of the largest economies serving as the forerunners of global governance, there could be a role for smaller economies that succeed in economic policy and international mediation (World Economic Forum, 2022). Collectively, the abbreviation OASES, which stands for the Oriental Republic of Uruguay (ORU), Austria, Switzerland, the United Arab Emirates, and Singapore, can be used to refer to these nations (World Economic Forum, 2022).

OASES economies play a larger role in maintaining the global economy's stability since they host or participate in regional finance arrangements that support local economic stability (Lissovolik, 2022). The OASES economies and their urban hubs are emerging as the primary wealth management hubs in their respective areas, in part because of these stability functions played on a regional and global scale. OASES economies can further serve as role models for urban development and economic modernization in their regions. To create a global platform that would prioritize sustainable development and advance best practices in economic modernization and governance, the OASES grouping's main unifying goal is to bring together the relatively small but innovative and open economies from each of the world's major regions (Lissovolik, 2022).

2. DEVELOPING NATIONS

BRICS Nations Growth

The BRICS countries have experienced economic growth over the past several years, but in recent years the economic growth rate in these countries has slowed, partly as a result of the COVID-19 pandemic and global financial crisis (WHO, 2021). Quarantines, mask requirements, product shortages, business closures, and a scramble to find alternative revenue streams were all brought about by the pandemic. Almost 216 million cases have been identified as of August 2021, and roughly 4.4 million individuals have died because of the COVID-19 pandemic globally (WHO, 2021). The intensity of the COVID-19 pandemic also has an impact on countries. India, Brazil, and Russia are among the five most severely afflicted nations in terms of the number of confirmed cases, while South Africa is among the top 20. This demonstrates the extent of COVID-19 in the

group of these developing nations (Gourinchas, 2022; The World Bank, 2023). While many believe the slowdown was driven primarily by weak demand in the advanced economies caused by the nationwide pandemic, others believe these emerging markets have exhausted the easy economic gains and there is a larger shift happening. For example, China's growth rate reached a high of 10 percent in 2010 but was only 2.2 percent in 2020. India's economic expansion dropped from 3.6 percent to -6.6 percent from 2019 to 2021, and Brazil's growth rate was cut from 6 to 2 percent in 2020 (Gourinchas, 2022; The World Bank, 2023).

China's government is focused on reducing overcapacity, lowering borrowing by provincial governments, increasing transparency in their market for debt, and reducing China's dependence on export markets by stimulating internal demand (Gourinchas, 2022). Authorities in Brazil do not believe the country will return to pre-crisis growth levels, but they believe the reforms that have raised the incomes of the poorest people will sustain the economy and private investments will continue to cover new infrastructure such as railways and airports. Authorities in India believe the decline was due to an adverse external environment but believe they will continue to see 6-8 percent growth over the next three years. In Russia, authorities believe the country's slower rate of growth is due to the economic conditions of its main trading partners (China and Europe) and believe that internal policy constraints red tape, bureaucracy, and insufficient support for subject matter experts are the main roadblocks to progress. The South African economy was expected to grow by 1.9 percent in 2022, even though the COVID-19 outbreak has left the country's economy recuperating more slowly than expected. Authorities feel that despite the uncertain future, continued reforms and investments are necessary to guarantee higher growth outcomes and the eradication of poverty (Gourinchas, 2022).

OASES Nations Growth

OASES nations have high ICT growth rates but poor economic growth, in contrast to the BRICS economies, which have strong economic growth and slowing ICT growth rates. For instance, Uruguay has one of the highest rates of internet access in Latin America. In addition, about 98 percent of the population is literate, and 90 percent of the communications network is digital. Further Internet usage and development are predicted to boost demand for imports of computers and other technologies as Uruguay does not produce computer hardware (Trade,

2022ab). Austria's international ICT market is expected to grow at a compound annual growth rate (CAGR) of 6 percent throughout the projected period. The Switzerland ICT market, which was estimated to be worth 38.19 billion in 2021, will expand and the market will increase at a compound yearly growth rate of 7.6 percent CAGR to reach \$55.2 billion by 2026 (Trade, 2022cd).

OASES economies are at the forefront of digital growth in their respective areas. Switzerland is ranked first in Europe, Singapore is first in Asia, the UAE is first in the Middle East and Africa, and Uruguay is second in South America behind Chile. In addition to being the first nation in South America to implement a 5G commercial mobile network, Uruguay is also the only economy in the world that provides free computers to every student and teacher in schools. OASES are also important stability anchors and some of the biggest reserve repositories in the world economy. OASES economies collectively make up 11.5 percent of the world's foreign exchange reserves, compared to a 0.5 percent population share for this group of nations (Lissovolik, 2022; Huawei, 2023; Trade, 2022ef).

Nonetheless, there are structural limitations that can impede the achievement of sustainable development objectives. The OASES nations have moved through a more advanced stage of the demographic shift and are now restructuring their political structures, which is resulting in significant economic expenses. Uruguay specifically confronts difficulties integrating women into economic activities, changing educational and labor institutions to better take advantage of technology advancements, encouraging infrastructure investment, and integrating into global value chains. Despite Uruguay's relatively low rate of poverty compared to other countries in the area, there are large disparities in terms of age, gender, location, income, and origin, which the COVID-19 pandemic may have intensified (Lissovolik, 2022; Huawei, 2023). A deeper examination of economic and information technology indicators is offered for each of the BRICS and OASES nations.

3. ECONOMIC AND TECHNOLOGICAL INDICATORS DATA ANALYSIS

Methods

This research seeks to examine trends in high technology exports, ICT service exports, and annual gross domestic product for BRICS and OASES nations. The data was collected from the

World Bank website (The World Bank, 2023). Due to historical and current-year data availability, data was collected where possible across the variables for the three years available from 2019 through 2021. Data was initially evaluated using an exploratory data analysis (Toskin, 2023). As part of the exploratory analysis, data quality was assessed, and missing values were replaced through statistical imputation, using a calculated mean by year. To measure or estimate the relationship between high-technology exports, ICT service exports, and annual GDP, both correlation and regression analysis statistical methods were applied (Ghosal, Sengupta, Majumder, & Sinha, 2020). Pearson's correlation coefficient is used to measure the strength of the relationship between variables and ranges from -1 to 1 with a correlation of 0 indicating no relationship present (Schneider, Hommel, & Blettner, 2010; Duquesne University, 2023). The correlation analysis is shown in Table 1 and includes a strong correlation between annual GDP and high-technology exports, with a weak correlation between annual GDP and ICT service exports.

	<i>High-Technology Exports</i>	<i>ICT Service Exports</i>	<i>Annual GDP</i>
High-Technology Exports	1		
ICT Service Exports	0.23799	1	
Annual GDP	0.96085	0.35676	1

Table 2: Correlation Analysis

A multivariate regression analysis was run with strong goodness of fit [Adjusted R² = 0.93622]. The analysis of variance (ANOVA) and overall F statistic (Pr>F) is used to test and confirm the overall model significance [F < 0.00001]. Reviewing the significance of the variables in the model, both high-technology exports [P < 0.00001] and ICT service exports [P = 0.00906] data suggest a significant model contribution. A multivariate regression analysis was also run for BRICS and OASES nations, the results showed similar overall model significance [F < 0.00001]. The BRICS nation's data suggests a significant model contribution for both high-technology exports [P < 0.00001] and ICT service exports [P = 0.00107]. In contrast, the OASES nation's data suggests a significant model contribution for only ICT service exports [P = .04695], with data on high-technology exports failing to show significance [P = 0.65938].

Gross Domestic Product (GDP)

The GDP represents the sum of value added by producers less any subsidies. The annual GDP, GDP per capita, and GDP growth rate are expressed in US dollars (WorldBank, 2023). Russia and China had the highest anticipated GDP per capita among the BRICS nations in 2021, at between \$12,000 and \$13,000. India has a GDP per capita above \$2,000, whereas Brazil and South Africa are anticipated to have a GDP per capita closer to \$7,000 (O'Neil, 2023). This contrasts with data on global annual GDP, which demonstrates that China's economy is the largest in total dollars, with India's coming in a close second. This disparity is brought on by the size of the population. While China's population and annual GDP are both over 10 times larger than those of Russia, for example, they have comparable GDPs per capita. South Africa also outperforms India in terms of GDP per capita despite having the smallest population of the BRICS countries (Bea, 2022). Figure 1 shows notable differences in the GDP growth rates, with China being the only member of the BRICS or OASES to have positive annual percentage growth in 2020. Despite having seen a negative growth rate of 4.1 percent in 2020, the Singaporean economy expanded by 7.6 percent in 2021 for OASES. In 2021, it will have the third-highest growth rate after China and India.

It's crucial to note that the expansion of 2021's annual GDP reflected the continued financial effects of the COVID-19 pandemic. The COVID-19 pandemic caused continued restrictions and interruptions in how companies operated in numerous parts of the country and world. All BRICS and OASES GDP growth rates decreased in 2020 because of the COVID-19 pandemic, but have since recovered in 2021. Recovery growth rates varied due to the termination or curtailment of different federal programs, government aid payments in the form of grants to state and local governments, forgiven loans to businesses, and social benefits. The COVID-19 pandemic has slowed down the rebalancing from investment to consumption, from manufacturing to services, and from rural to urban migration. To achieve sustainable and fair growth, all these processes must be resumed (OECD, 2022). Throughout the investment-driven recovery, investment efficiency remained low, indicating ongoing capital misallocation. Corporate debt has increased to levels seen before the COVID-19 pandemic because of crisis-related and long-term reasons, such as implicit assurances for state-owned enterprises and other public organizations (OECD, 2022). Due to weaker economic growth and continuous tax cuts, fewer financial resources

will be available, necessitating the need for consistent income from personal income taxes and earnings from state-owned firms. Even though its population is rapidly aging, China may still reap the benefits of the "reform dividend" provided steps are made to preserve sustainable productivity growth. Increased competition in the product marketplace is one of the reforms that might lead to considerable gains in productivity (OECD, 2022).

High-Tech Exports

Throughout the past ten years, there has been a surge in the global trade of high-tech goods. High-technology exports are products with a high R&D intensity including aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery (WorldBank, 2023). Several studies demonstrate that high-tech product imports and exports both enhance competitiveness. The European Commission's policy objectives of "Environment and climate," "Our digital future," and "Jobs and economy" all place a high priority on the use of high-tech goods. As shown in Figure 2, Singapore, exported more than half of its high-tech goods as a percentage of manufactured goods in 2021. The cost of software and services is expected to keep driving the expansion of ICT expenditures in Singapore's highly developed and lucrative corporate sector (Trade, 2022gh).

The COVID-19 pandemic generated up to a 24% decrease in general exports, with exports declining nearly \$100 billion in 2020. Exports to the US decreased the most at over \$40 billion, with China at over \$18 billion (Ikram & Sayagh, 2023). Because of the pandemic, the high-tech industry is expanding and entering a new era of massive digitalization to remain relevant and continue to prosper. The Singaporean government has invested around \$9bn in ICT during the last four years (Trade, 2022gh). China produced the biggest dollar amount of tech exports in 2020, even though Singapore leads BRICS and OASES in terms of export percentage, they rose 10.1 percent annually to 757 billion. When China's high-tech exports grew to \$942bn in 2021, the trend persisted. Phones (\$111.7bn), data processing equipment (\$102.7bn), integrated circuits (\$50.3bn), routers (\$43.1bn), and phone components and technology (\$40.2bn) were China's top high-tech exports during the first 11 months of 2020 (Miller, 2021).

ICT Service Exports

ICT service exports include computer and communications services and information services such as computer data and news-related

service transactions. The BRICS nation's overall economic efficiency is being boosted by the substantial expansion in services trade that has occurred during the previous two decades. Services trade as a percentage of annual GDP in the BRICS nations varied from 5.5 percent (China, Brazil) to nearly 12 percent (India) in 2020. It is slightly higher than, the 5.6 percent in the United States in 2020 (ITC, 2022). However, it is still far below the main European nations of France (18.7 percent) and Germany (16 percent) (ITC, 2022). As shown in Figure 3, ICT service exports as a percentage of service exports were again the greatest in India at nearly 50 percent. For OASES nations, Emirates was omitted due to unavailable data, with Uruguay having the highest percentage in 2021 at 26 percent. Austria and China were nearly equivalent at 14 percent in 2021.

The BRICS nations started from a poor foundation and only make up a small percentage of global trade in services. Data from The World Bank show that in 2020, 10 percent of global services exports and 13 percent of global services imports were accounted for by the BRICS. Most of this proportion is made up of China and India, which together account for 8.7 percent and 10.5 percent of global services exports and imports, respectively (ITC, 2022). Except for India and, to a lesser extent, China, conventional industries like transportation and tourism tend to dominate the BRICS services trade. India is one of Asia's biggest and fastest-growing marketplaces for digital consumers, but corporate adoption is uneven. Digital technology is positioned to swiftly drive every area of the Indian economy as digital capabilities rise and connection becomes pervasive (Mordorin, 2023). In OASES nations, Uruguay is highlighted as the leading ICT exporter in Latin America, with high rates of software exports, and IT exports per capita exceeding neighboring Brazil. Uruguay also is noted for digital policies that improve citizens' lives, including being one of the countries with the greatest average upload and download speeds for broadband connections (Sotelo & Rizzi, 2021).

4. DISCUSSION AND POLICY IMPLICATIONS

For BRICS and OASES nations, high-technology exports, and ICT service exports have a relationship with annual GDP, however varying degrees may account for recovery variability among nations. For BRICS nations, high-technology exports have the greatest relationship with annual GDP. For OASES nations ICT service exports have the greatest relationship with

annual GDP. Singapore, among the OASES nations, has the largest percentage of technology exports and the largest exports of ICT services in US dollars, with Singapore in OASES having a similar position as China in BRICS, albeit differently. A vital strategy for nations to enhance their digital value chains is the continued development of e-government, digital infrastructure, and digital inclusion.

E-Government Development Index

The state of e-government development in United Nations Member States is shown by the E-Government Development Index (EGDI). The EGDI includes access criteria, such as infrastructure and educational levels, in addition to an evaluation of a nation's website development trends, to indicate how a nation is utilizing information technology to enhance access and inclusion of its citizens. The supply of online services, telecommunication connections, and human capability make up the three key e-government elements that make up the EGDI. The EGDI intends to rate the performance of national governments in relation to one another rather than to represent the growth of e-government in an absolute sense. The EGDI is based on a thorough survey of all 193 United Nations Member States' online presence, which evaluates national websites and how e-government policies and plans are implemented generally and sectors for the provision of basic services. Instead of being an absolute measurement, the evaluation compares how well each country is performing in terms of e-government. The results are tallied and coupled with a group of metrics that represent a nation's potential to engage in the information society, without which the immediate value of attempts to establish e-government is severely constrained (Cenderello, 2022).

Digital Technology and Digital Inclusion

Digital inclusion must be improved in developing nations to reduce the digital gap rather than grow it and ensure that no one is left offline (Cenderello, 2022). The digital gap is significantly influenced by national economic levels, but there are other factors at play as well. The pace of adoption is also influenced by political will, strategic leadership, and a nation's ideological commitment to provide digital services. These three characteristics can help developing market nations accelerate the development of their digital infrastructure and services, and subsequently stimulate economic growth. India, Brazil, and South Africa reflect the experience of developing countries as their citizens increasingly move online. According to

the research, 66 percent of individuals in developing countries would welcome a single digital identity (ID) when engaging with the government, and 44 percent of them would prefer to access public services conveniently across various channels (Cebderello, 2022).

Moreover, there is a definite interest among these nations' citizens to stay up with technological advancements, especially in OASES, with Singapore (91 percent) and Emirates (90 percent). Compared to residents of wealthy nations, citizens in emerging economies are also more positive about how technology will enhance their interactions with public services. Governments in developing nations must upgrade their digital infrastructure to match these public expectations. One illustration is Latin America. Brazil, Uruguay, and other countries are now included among the world's more developed digital economies in the most recent UN E-Government Study (Public Administration, 2022).

5. CONCLUSION AND FUTURE DIRECTIONS

Governments and leaders may take several measures to further mitigate the effects of the COVID-19 pandemic on their economic systems and ICT innovation. Supply chains were one of the most impacted and disrupted areas during the COVID-19 pandemic, leading to shortages and decreased economic activity. Countries should rebuild and strengthen supply chains, also with increasing consumer demand through fiscal and monetary policies. Governments can support high-tech global enterprises through tax waivers, credits, and deferrals. Financial support can also be provided through grants, subsidies, and low-interest loans. To support sustainable economies and ensure success in a post-pandemic environment, governments can invest in digital transformation, through broadband internet, digital payments, and development of emerging technologies such as artificial intelligence (Ikram & Sayagh, 2023).

The COVID-19 pandemic also demonstrated the importance of digital connectivity for societal resilience and business continuity. However, the poorest emerging economies may require additional financial support to ensure competition, resilience, and digital inclusion (Stursani & Hounghonon, 2020). There are also several trends projected over the next several decades for developing economies for additional examination, including slower global and population growth, continued emerging market growth, and greater inequality within countries than between countries (Daly & Gedminas,

2022). In addition, the analysis should be run as new annual data is available during the economic recoveries and other potential changes, such as expanded BRICS or OASES membership (Devonshire-Ellis, 2022).

6. ACKNOWLEDGMENTS

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Appendix

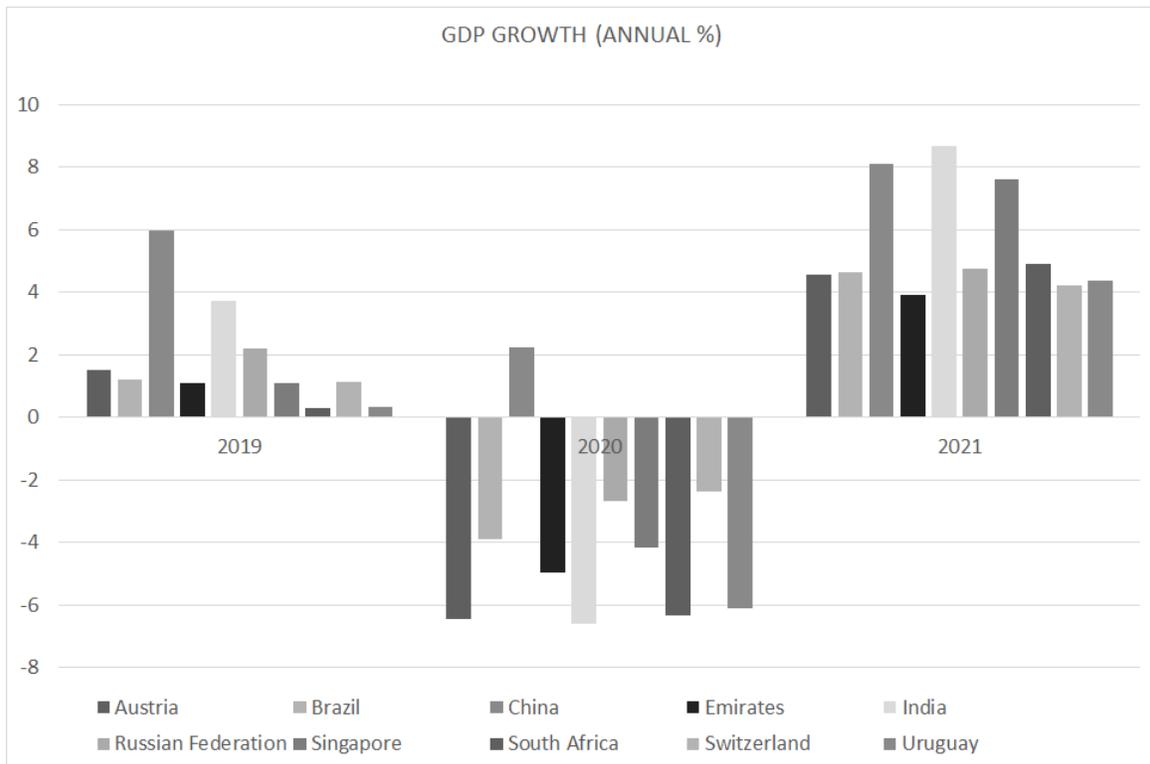


Figure 1: GDP Growth (Annual %) By Year by Country

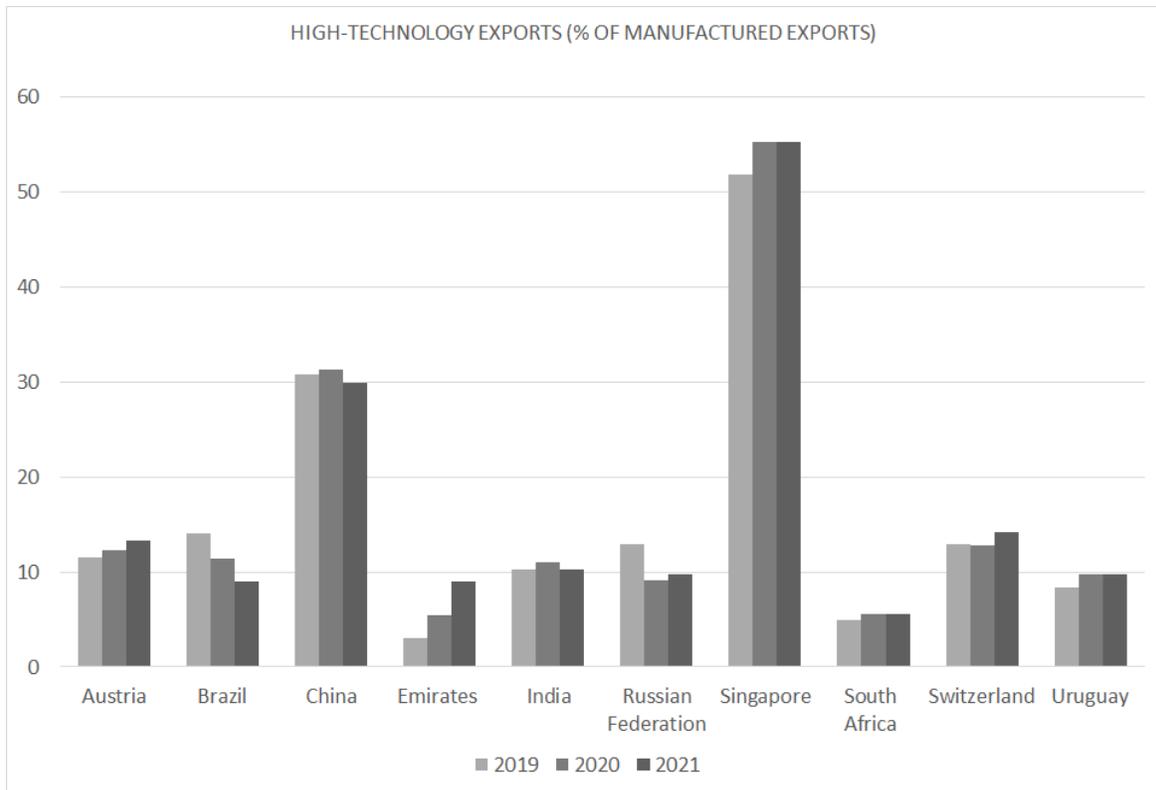


Figure 2: High-Technology Exports (% of Manufactured Exports) by Country by Year

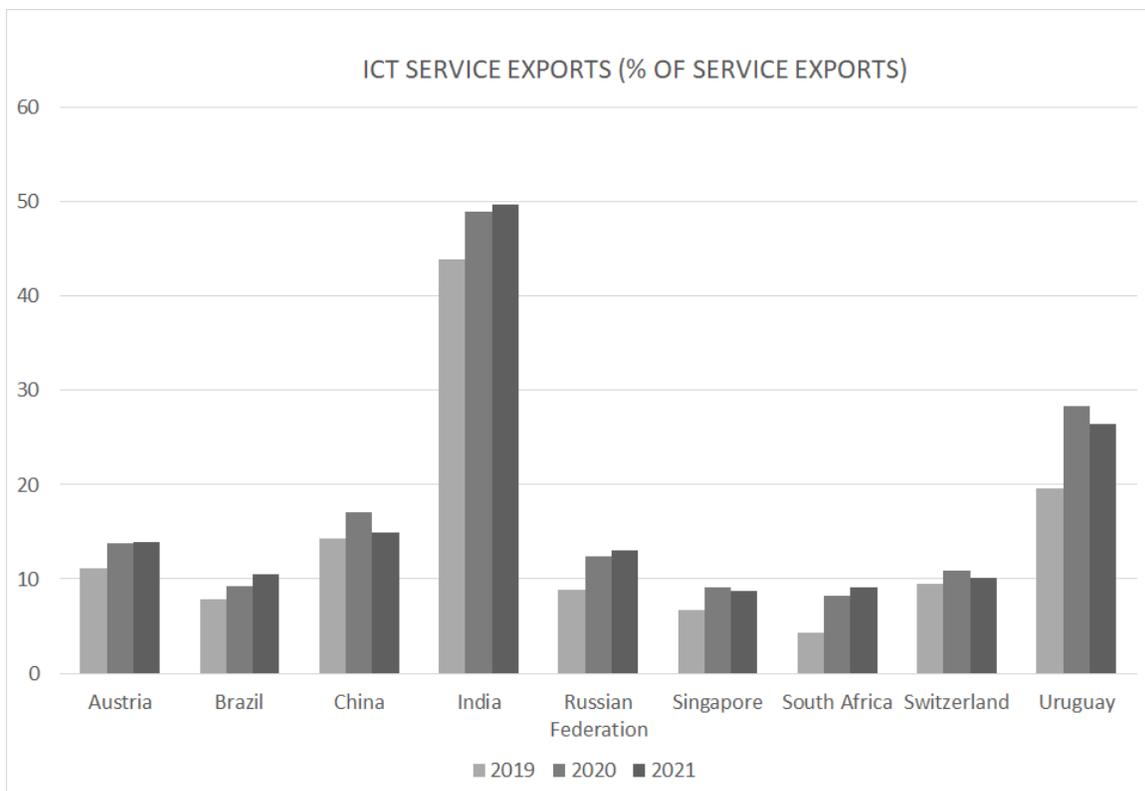


Figure 3: ICT Service Exports (% of Service Exports) by Country by Year