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How Expanding the Information Technology Agreement to an "ITA-3" Would Bolster Nations' Economic Growth

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Completing a second expansion of the Information Technology Agreement (an "ITA-3") could bring more than 400 unique ICT products under the ITA's tariff-eliminating framework, which would add more than $750 billion to the global economy over 10 years.

KEY TAKEAWAYS

- Expanding the ITA could bring products such as 3D printers, industrial robots, commercial-use drones, patient monitoring systems and other medical devices, lithium-ion batteries, solar cells, and high-definition televisions into the agreement.
- If the 82 signatories of the original ITA were to join an expanded ITA-3, the global economy would grow by nearly $766 billion over the ensuing 10 years.
- India, Kenya, Pakistan, and Nigeria would enjoy the largest relative GDP growth over 10 years—2.5 percent, 2.3 percent, 2 percent, and 1.7 percent, respectively—though all 22 countries studied would realize larger economies over that time span.
- An ITA-3 expansion could help grow U.S. GDP by $208 billion over a decade, increase U.S. exports of ICT products by $2.8 billion, and help create almost 60,000 U.S. jobs.
- For most countries, the expanded economic growth from an ITA-3 would produce more tax revenue over 10 years than would be forgone in tariff revenue.
- Expanding the ITA now would come at an important moment. The increased focus on diversification and resiliency of global ICT supply chains provides a major opening for new developing-country suppliers to begin producing and exporting ICT products.
- Countries not participating in the ITA saw their participation in global ICT value chains decline by more than 60 percent from 1995 to 2009.

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EXECUTIVE SUMMARY

The Information Technology Agreement (ITA) has been one of the World Trade Organization's (WTO's) most successful plurilateral trade agreements. Originally signed in 1996 and to which 82 countries are now signatories, it eliminates tariffs on trade in hundreds of ICT products. In 2015, 53 countries joined together in completing (and implementing in 2016) an ITA expansion (ITA-2) that eliminated tariffs on an additional $1.3 trillion in annual global trade in 201 ICT parts, components, and final products.[1] By eliminating tariffs on trade across hundreds of ICT products, the ITA has played an indispensable role in creating "zero-in/zero-out" tariff environments that have fostered the development and diversification of ICT global value chains (GVCs), helping bring developing economies previously locked out by their prohibitively high tariffs on ICT parts, components, and equipment and undeveloped telecommunications networks into GVCs for ICT goods production and assembly. Moreover, by reducing prices through tariff elimination, the ITA has facilitated greater adoption of the ICT products that lie at the core of the global digital economy and power the downstream innovative and competitive capacity of every household, enterprise, and industry that deploys them. This ITA-engendered increase in nations' ICT capital stock leads directly to greater economic growth and innovation in developed and developing nations alike.

Yet, technologies continue to evolve, and now ICT is found at the core of an ever-increasing range of products, from energy-efficient green technologies, such as storage batteries, to personal fitness monitors to the industrial robots and 3D printers that are driving the global smart-manufacturing revolution. As such, an initial group of companies has come together to identify more than 300 additional ICT six-digit product codes under the Harmonized Commodity Description and Coding System, including over 400 unique ICT products, as candidates for potential ITA inclusion.

This report examines the economic and tariff revenue impacts such an "ITA-3" would have for the European Union and 21 nations: Argentina, Brazil, Cambodia, Canada, China, Costa Rica, India, Indonesia, Japan, Kenya, Lao PDR, Malaysia, Mexico, Nigeria, Pakistan, South Korea, Taiwan, Thailand, the United States, the United Kingdom, and Vietnam.[2] An ITA-3 would include products such as high-definition televisions; energy-efficient technologies such as storage batteries, solar cells, and LED "light sources"; digital manufacturing technologies such as industrial robots and 3D printers; commercial-use drones; and certain medical technologies and devices, such as patient monitoring systems; and semiconductor manufacturing parts and supplies.

The analysis finds that ITA-3 accession would generate tangible economic growth for all nations assessed, and that for many nations, tax revenues generated from enhanced economic growth would more than make up for tariff revenues forgone. A further liberalization of tariffs for the rapidly expanding universe of ICT technologies would also advance the diversification and resiliency of global supply chains, bring more developing economies into the global technology ecosystem, raise household incomes, and support a continued expansion of global technology jobs worldwide. This report begins with an overview of the ITA and global trade in ICT products before moving on to examine how ICT drives economic growth, articulating the logic behind bringing the proposed ICT products into an ITA-3 and then turning to an analysis of the economic impact of ITA-3 accession for the study countries.

Key Findings

Participation in the ITA provides an impetus for countries to reduce tariffs, thereby lowering the prices for, and expanding the consumption of, productivity-enhancing ICT, while deepening countries' participation in GVCs for the production of ICT goods and services. Moreover, joining the ITA can engender faster economic growth and higher living standards because it gives businesses and individuals access to more-affordable and higher-quality ICT, which is the modern global economy's chief driver of productivity, innovation, high-wage employment, and economic growth. Moreover, as the world now enters an era of reshaping the structure of technology GVCs, countries that wish to capture a greater share of tech GVC participation need to ensure a competitive tariff and e-commerce customs duty environment that facilitates the cross-border movement of ICT goods and services.

An ITA-3 expansion could help grow U.S. GDP by $208 billion over a decade, increase U.S. exports of ICT products by $2.8 billion, and support the creation of almost 60,000 new U.S. jobs.

ITA accession, by lowering tariffs on and thus the prices of ICT goods, bolsters countries' levels of ICT goods consumption and capital stock, the productivity- and innovation-expanding power thereof which in turn drives increased economic and employment growth. Leveraging these dynamics, the Information Technology and Innovation Foundation (ITIF) finds that the proposed ITA-3 expansion would generate positive economic impacts by the 10th year post ITA-3 expansion for all 21 study countries and the European Union. In percentage terms, ITIF finds that India, Kenya, Pakistan, and Nigeria would enjoy the largest economic growth in the 10th year post ITA-3 accession, with cumulative economic growth over that 10-year period equivalent to 2.5 percent of Indian, 2.3 percent of Kenyan, 2 percent of Pakistani, and 1.7 percent of Nigerian gross domestic product (GDP), respectively. (See table 1.)

Table 1: Summary of economic and revenue impacts over 10 years post ITA-3 accession

Country	Cumulative 10-Year GDP Growth From ITA-3 Expansion (Billions)	Cumulative 10-Year GDP Growth From ITA-3 Expansion	Income Tax Revenue Gained (Millions)	Revenue Gained as a Share of Revenue Forgone
Argentina	$10.0	1.67%	$542.6	245%
Brazil	$31.8	1.57%	$2,241.3	181%
Cambodia	$0.3	0.70%	$14.8	35%
Canada	$4.7	0.24%	$796.5	304%
China	$147.3	0.52%	$7,911.9	190%
Costa Rica	$0.4	0.42%	$16.5	72%
EU 27	$28.7	0.16%	$3,417.5	239%
India	$101.2	2.50%	$7,795.4	192%
Indonesia	$5.7	0.38%	$218.6	108%
Japan	$12.2	0.28%	$1,234.3	241%

Country	Cumulative 10-Year GDP Growth From ITA-3 Expansion (Billions)	Cumulative 10-Year GDP Growth From ITA-3 Expansion	Income Tax Revenue Gained (Millions)	Revenue Gained as a Share of Revenue Forgone
Kenya	$3.2	2.30%	$219.2	249%
Lao PDR	$0.2	0.58%	$3.4	43%
Malaysia	$0.3	0.08%	$26.2	58%
Mexico	$2.7	0.22%	$201.7	44%
Nigeria	$10.3	1.73%	$280.0	129%
Pakistan	$10.8	1.99%	$336.3	99%
South Korea	$7.9	0.37%	$678.6	101%
Taiwan	$10.2	0.93%	$786.6	75%
Thailand	$5.5	1.11%	$313.8	35%
United States	$208.0	0.82%	$24,355.6	288%
United Kingdom	$8.6	0.27%	$983.3	299%
Vietnam	$2.0	0.35%	$117.6	23%

Moreover, if all 82 ITA-1 signatory countries were to join the proposed ITA-3, global GDP could cumulatively grow by $766 billion over the ensuing 10 years. In absolute terms, the United States would be the biggest beneficiary, followed by China. ITA-3 expansion would be poised to deliver a cumulative $208 billion in U.S. GDP growth over 10 years, equivalent to 0.82 percent greater U.S. GDP growth than would otherwise be expected. Moreover, ITIF finds that ITA-3 expansion would increase U.S. exports of ICT products by $2.8 billion, boost revenues of U.S. ICT firms by $6.9 billion, and support the creation of almost 60,000 new U.S. jobs. China's economy would cumulatively grow by 0.52 percent to be approximately $147 billion greater than would otherwise be the case as a result of ITA-3 expansion. The economic growth generated by an ITA-3 expansion would produce tax income that, for at least 12 study countries and the European Union, would well exceed tariff revenues forgone, and for four more countries would fill more than 50 percent of the revenue gaps 10 years post ITA-3 accession.

For countries contemplating participation in ITA-1, ITA-2, ITA-3, or all three, the time to move is now, as major economies are looking to diversify their sourcing and supply chains in order to promote greater supply chain resilience, security, and sustainability. As a result, large technology and industrial companies are taking a fresh look at potential suppliers and locations for production and assembly, creating an opportunity for new suppliers and economies to break into technology GVCs.

Conversely, countries declining to join ITA-1 and ITA-2, or neglecting to participate in an ITA-3, risk experiencing a technologically deficient economy, reduced productivity, and exclusion from global technology supply chains. Nonparticipation in the ITA also limits an economy's ability to partake in the expanding universe of industrial products that incorporate semiconductors and

other advanced technologies and from participating in the development and provision of services-based products that are delivered cross-border using the Internet and which require efficient telecommunications networks. Ultimately, refraining from ITA participation reduces countries' wage growth and opportunity because a technologically deficient workforce cannot be in a position to participate effectively in the advanced global technology supply chains that pay higher wages and demand greater technology training and skills.

Finally, the two iterations of the ITA—by promoting the diffusion and availability of productivity- and innovation-enhancing ICT goods—have empowered workers globally by giving them greater opportunities to work remotely (reducing commutes and commuting times); affording greater access to information regarding employment opportunities; expanding educational and training opportunities; creating opportunities to perform remote gig, consulting, and free-lance work; and expanding the potential to provide their services internationally across borders. Labor markets for many types of services (e.g., information technology, educational services, consulting, health care, finance, etc.) are much less constrained by national or international borders today and often don't require geographic proximity to a physical workplace, but can now be performed remotely over the Internet. All of this increases employment opportunities and employee bargaining power, wages, work-life balance, and ultimately worker satisfaction and fulfillment.

INTRODUCTION

In December 1996, 29 WTO member nations launched the ITA, a novel trade agreement in which participating nations eliminated tariffs on eight broad categories of ICT products (e.g., semiconductors, computers, telecommunications equipment, etc.). The ITA-1 now counts as signatories 82 nations, with these nations collectively accounting for approximately 97 percent of global trade in ITA-covered goods.. Countries that have thus far neglected to join the ITA have missed out on tremendous growth opportunities. First, countries not joining the ITA harm themselves by retaining tariffs that add to the cost of key productivity- and innovation-enhancing ICT products, thus constraining their consumption and adoption. Second, those tariffs only serve to diminish the competitiveness of countries' goods that depend on intermediate ICT inputs. Third, countries not participating in the ITA have seen their participation in GVCs for the production of ICT goods plummet since the ITA was introduced, in large part because of the higher cost they face in the manufacturing and assembly of key parts, components, and delivery systems when they're subject to tariffs. In total, the evidence shows that ITA accession has been beneficial for both countries' domestic industries and their broader economies.

In 2012, owing to the tremendous success of the original ITA, member nations initiated negotiations toward expanding the ITA to add innovative ICT products commercialized since 1996 as well as certain categories of ICT goods not included in the original agreement. ITA-expansion negotiations concluded in December 2015, and additional tariff eliminations began on July 1, 2016.[3] The expansion, which the WTO estimated would eliminate tariffs on an additional $1.3 trillion in annual global trade of ICT parts and products, represented the first major tariff-cutting deal completed at the WTO in 19 years.[4] The ITA-2 has produced annual global tariff savings of at least $13.8 billion.[5]

Digital technologies are increasingly powering the global economy. For instance, analysts at Oxford Economics estimated that by 2016 the digital economy already accounted for 22.5 percent of global GDP.[6] Analysts at the research firm IDC estimated that as much as 60 percent

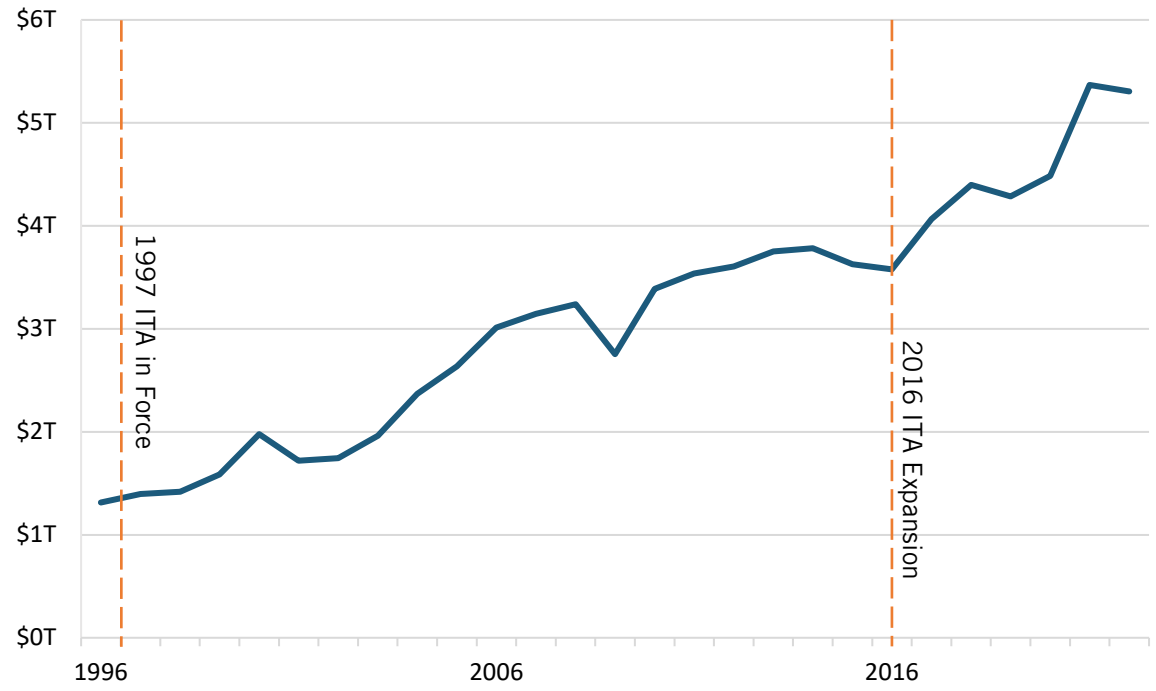
of global GDP was digitized (meaning largely impacted by the introduction of digital tools) already by 2022.[7] That aligns with estimates that as much as half of all value created in the global economy over the next decade will be created digitally.[8] And while certainly the digitalization of the global economy has brought entirely new industries, services, and enterprises to the fore—web search, social media, artificial intelligence (AI), cloud, etc.—at least 75 percent of the value of data flows over the Internet actually accrues to traditional industries such as agriculture, manufacturing, finance, hospitality, and transportation.[9]

Moreover, it's important to remember that the entire global digital economy is underpinned by ICT goods—semiconductors, servers, routers, computers, smartphones, tablets, etc.—that fundamentally power it. And by helping to reduce the price of ICT goods by eliminating tariffs on them, the ITA has played an enormous role in the growth of global production and trade in the very ICT products powering the global digital economy. For instance, the U.S. Bureau of Labor Statistics has estimated that the U.S. consumer price index for "personal computers and peripheral equipment declined 96 percent" between 1997 and 2015.[10] And while certainly Moore's Law (i.e., semiconductors' capabilities doubling as their costs halve) and other technological innovations have played a key role here, ITA-inspired tariff reductions and the evolution of efficient ICT GVCs certainly contributed as well.

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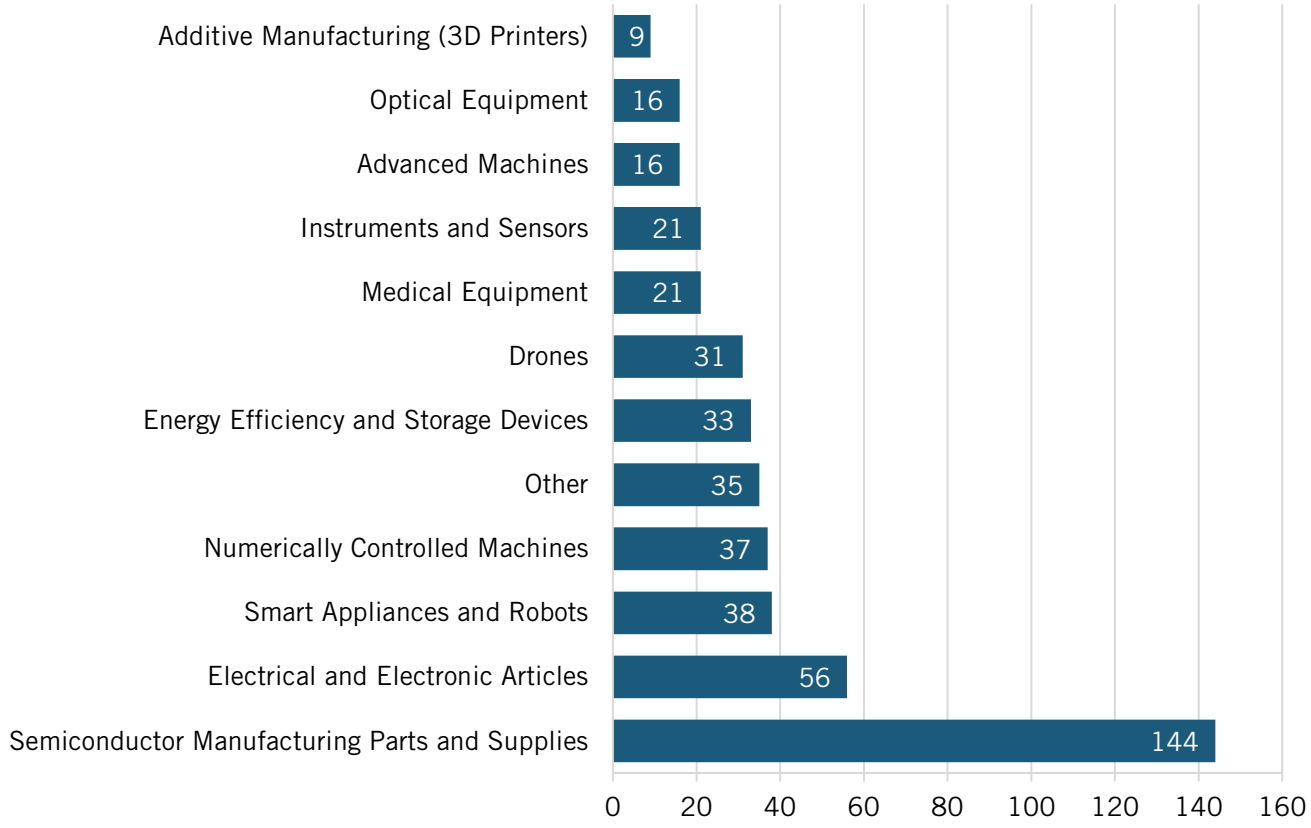
Indeed, global two-way trade in ICT products has grown more than threefold since the ITA entered force in 1997, increasing from $1.4 trillion in 1997 to $5.31 trillion in 2022. (See figure 1.) Further, global two-way trade in ICT products increased 46 percent since the 2016 ITA expansion.[11] While global imports of ICT products did decrease 3 percent from 2018 to 2019, and decreased again with the start of the COVID-19 pandemic, ICT trade grew 19.6 percent from 2020 to 2021, meaning trade in digital technologies has rebounded since the COVID-19 pandemic as businesses relying on these technologies reopened and workplace restrictions drove sales of personal computers, smartphones, and other technologies to support remote work. In fact, sales for semiconductors, a foundational technology enabling all other ICT products, grew in 2020 and another 26.2 percent in 2021 due in large measure to the added demand for ICT products engendered by the rebound since the pandemic and the global chip shortage.[12]

Figure 1: Value of two-way global trade in ICT products, 1996–2022[13]



Recognizing that ICT continues to evolve and underpin a much greater range of products—from medical devices and industrial robots to drones and energy-efficient technologies—than they did a decade ago, an initial group of companies has come together to propose an ITA-3 that would bring products included within more than 300 additional six-digit HS2017 product codes under ITA coverage (this would include well over 400 unique ICT products). An ITA-3 would ensure that new technological versions of ICT goods are included: for instance, printers were included in the original ITA, but between the ITA-2 and ITA-3 the full slate of modern 3D (additive manufacturing) printers were not covered. Similarly, just as the ITA-2 included next-generation multi-component semiconductors (MCOs) that were not part of the original ITA, an ITA-3 would include semiconductor-based transducers and other next-generation semiconductor technologies.[14] The ICT products being proposed for ITA-3 inclusion are concentrated in the following categories: semiconductor manufacturing, smart appliances and robots, numerically controlled machines, energy efficiency and storage devices, drones, instruments and sensors, and medical equipment. (See figure 2.) Subsequent sections of this report articulate the rationale for including these ICT products in an ITA-3 expansion and evaluate the economic impacts of the proposed expansion on the 22 aforementioned countries/regions. But first, the report briefly turns to exploring how ICT drives economic growth and to explaining why ITA membership is beneficial for developed and developing countries alike.

Figure 2: Counts of proposed ITA-3 products by ICT category[15]



By trade value at the aggregated six-digit HS-code level, the top 10 product lines being proposed for ITA-3 inclusion feature the following:

- Boards, panels, consoles, etc. with electrical apparatus, for electric control or distribution of electricity, for a voltage not exceeding 1,000 volts (HS 853710)
- Lithium-ion batteries (HS 850760)
- Optical devices, appliances, and instruments (HS 901380)
- Reception apparatus for television, color (HS 852872)
- Instruments and appliances for medical, surgical, or veterinary sciences; and parts and accessories thereof (HS 901890)
- Machines and mechanical appliances having individual functions (HS 847989)
- Electrical machines and apparatuses, having individual functions (HS 854370)
- Electrical conductors, for a voltage not exceeding 1000 v, fitted with connectors (HS 854442)
- Medical etc., needles, catheters, cannulae and the like; parts and accessories thereof (HS 901839)
- Parts for electrical apparatus for electrical circuits, boards, panels etc. for electric control or distribution of electricity (HS 853890)

HOW ICT DRIVES ECONOMIC GROWTH

Increasing productivity—that is, economic output per unit of input, whether that input is capital, labor, data, or technology—is the principal way economies grow over time.[16] Those productivity gains can come from all enterprises and workers in a country (e.g., banks, farms, manufacturers) becoming more productive or from countries shifting the mix of enterprises in their economy (e.g., replacing lower-value-added sectors with higher-value-added ones, such as call centers with ICT services providers).[17] While both mechanisms are important, as the McKinsey Global Institute (MGI) found in its report "How to Compete and Grow: A Sector Guide to Policy," the overwhelming source of a country's productivity growth, and thus economic growth, comes from bolstering the productivity of all the enterprises, workers, and industries that already predominantly comprise an economy.[18]

The vast majority of the economic benefits generated from ICT, especially in developing countries, stem from greater adoption of ICT across an economy.

And the principal way economies can increase their productivity arises from leveraging the power of ICT. ICT involves such powerful tools precisely because it represents a general-purpose technology that enhances the productivity and innovative capacity of every individual, enterprise, and industry it touches throughout an economy—something that holds true for both developed and developing countries alike.

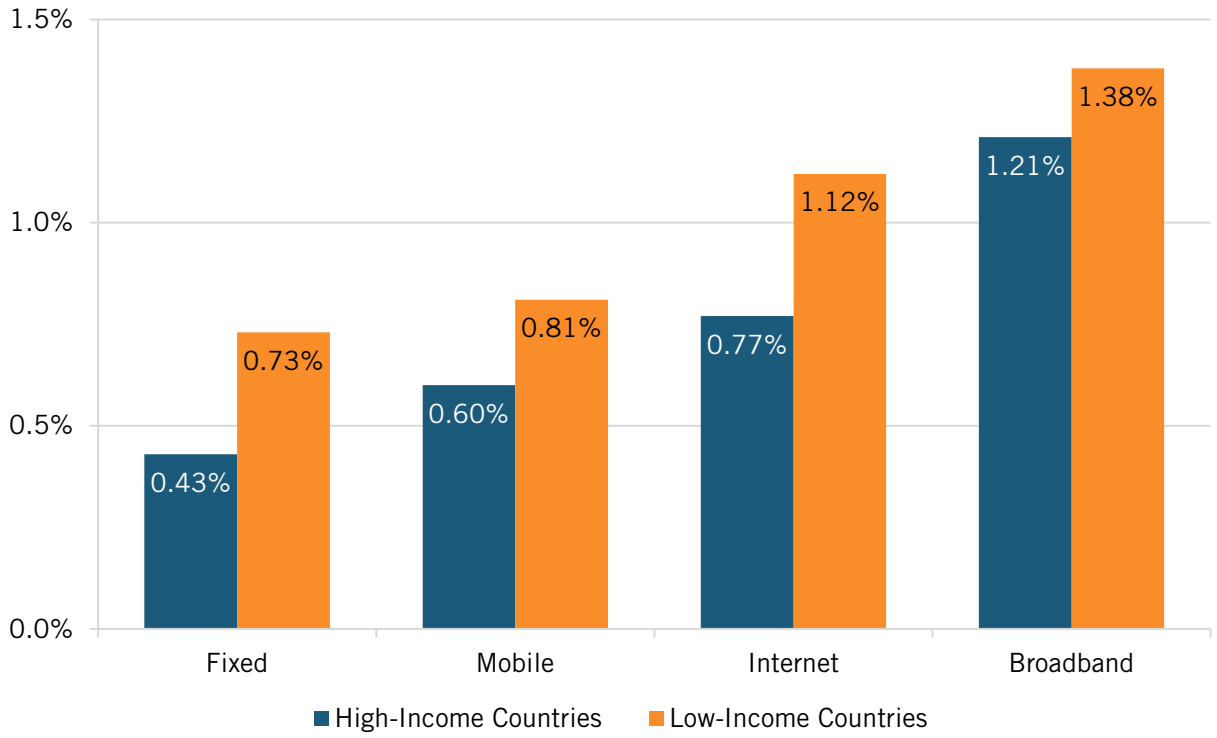
Indeed, ICT represents "super capital" that has a much larger impact on productivity than do other forms of capital. As research performed by Oxford Economics confirms, ICT generates a bigger return to productivity growth than do most other forms of capital investment.[19] For instance, ICT capital has a three to seven times greater impact on firm productivity than does non-ICT capital. ICT workers also contribute three to five times more productivity than non-ICT workers do.[20] In their report, "The Impact of ICT on East Asian Economic Growth," Ahmed and Ridzuan elucidate upon this dynamic, writing, "The ICT revolution has contributed significantly to the whole economy by raising productivity. First, ICT increases labor productivity in ICT-using industries by making labor produce more or work more efficiently. Second, ICT makes physical capital become more productive."[21] As a result, revenue collection by nations that "tax" this ICT "super capital" through tariffs and other means is particularly damaging.

It's vital to emphasize that the central way ICT drives a country's economic growth is not through the production of ICT goods (e.g., the manufacturing of computers or smartphones). Rather, the vast majority of the economic benefits generated from ICT, especially in developing countries, stems from greater adoption of ICT across an economy.[22] Ultimately, ICTs' productivity- and innovation-enabling benefits at the individual, firm, and industry levels aggregate to drive productivity and economic growth at an economy level.[23]

This explains why multiple academic studies find strong linkages between ICT consumption (i.e., usage) and economic growth. For example, a December 2010 World Bank report, "Kenya Economic Update," finds that "ICT has been the main driver of Kenya's economic growth over the last decade."[24] Specifically, the report finds that ICTs were responsible for roughly one-quarter of Kenya's GDP growth during the 2000s. Moreover, ICTs' contribution to Kenyan economic growth only grew over time, with the ICT sector providing a more than six-times-greater

contribution to Kenyan GDP in 2009 compared with 1999.[25] Similarly, ICT accounted for 38 percent of Chinese total factor productivity (TFP) growth and as much as 21 percent of Chinese GDP growth from 1980 to 2001.[26] Likewise, Ahmed and Ridzuan further found "a positive contribution of ICT to economic growth" across eight East Asian countries: China, Japan, Korea, Indonesia, Malaysia, Philippines, Singapore, and Thailand.[27] As Richard Heeks, professor of development informatics at the University of Manchester estimated, "ICTs will have contributed something like one-quarter of GDP growth in many developing countries during the first decade of the 21st century."[28]

Figure 3: Impact of a 10 percent increase in key ICT penetration on annual percent GDP growth[29]



Indeed, as Farhadi, Ismail, and Fooladi wrote in their report, "Information and Communication Technology Use and Economic Growth," "The more a country use[s] ICT, the greater is its economic growth."[30] The authors found that if countries improve their score on the "ICT Use Index" (which measures a country's number of Internet users, fixed broadband Internet subscribers, and mobile-phone subscriptions per 100 inhabitants), then their economic growth increases by 0.17 percent.[31] The World Bank has likewise documented this effect, finding that a 10 percent increase in high-speed broadband Internet penetration adds 1.38 percent to annual per capita GDP growth in developing countries. Likewise, a 10 percent increase in mobile-phone penetration adds 0.81 percent to annual per capita GDP growth in developing countries.[32] (See figure 3.)

That research has been corroborated by a study by Czernich et al. which analyzes the effects of broadband infrastructure on economic growth for 25 Organization for Economic Cooperation and Development (OECD) countries from 1996 to 2007 and finds that a 10 percent increase in a country's broadband penetration rate drives annual GDP per capita growth of 0.9 to 1.5

percent.[33] More recently, studies have found that a 10 percent increase in mobile-device penetration increases productivity by 4.2 percentage points.[34]

Indeed, evidence that an expanding base of ICT capital stock powers countries' economic growth increasingly comes from all quarters of the world.[35] For the Middle East, Nasab and Aghaei investigated the impact of ICT investments on economic growth in seven Organization of the Petroleum Exporting Countries (OPEC) nations from 1990 to 2007, finding that ICT "has a significant positive impact on economic growth in the sampled countries," and underlining the need for countries to adopt proactive policies to encourage ICT investments to boost economic growth.[36] Veeramacheneni, Ekanayake, and Vogel analyzed 10 Latin American countries from 1975 to 2003 seeking a causal relationship between ICT and economic growth and found a two-way causality between ICT and economic growth in two-thirds of the countries and, moreover, that ICT contributed to economic growth in 8 of the 10 countries included in the sample.[37] Zagorchev, Vasconcellos, and Bae, in a study of eight Central and Eastern European countries from 1997 to 2004, found that financial development and increased investment in telecommunications technology contributed significantly to GDP growth per capita.[38] Toader et al. analyzed the effect of using ICT infrastructure on economic growth in European Union countries over 18 years from 2000 to 2017 and found that an increase of 1 percent in the use of ICT infrastructure contributed to GDP per capita growth of between 0.0767 percent (fixed-broadband subscriptions) and 0.396 percent (mobile cell subscriptions).[39] On average, a 1 percent increase in ICT capital stock leads to a 0.06 percent increase in a country's GDP. This elasticity is crucial in modeling GDP growth associated with countries joining the ITA.

Developing nations' investments in telecommunications infrastructure are 10 to 40 percent more effective in generating economic growth than are similar investments made by developed countries.

The Latest Evidence Regarding the Economic Growth Impacts From ICT

Despite this impressive body of evidence documenting the powerful impact of ICT on economic growth, some skeptics have questioned the extent to which ICT adoption can increase economic growth in developing nations, arguing that developing countries may lack human capital, governance, or other ICT-complementary factors or that their labor-to-capital cost ratio is too low, making it less economical to add ICT capital.[40] And some research conducted during the late 1990s and early 2000s did appear to suggest as much, or at least that ICTs' benefits were greater for developed economies. For instance, in 2004, economist Khuong Vu, in analyzing economic growth data between 1990 and 2000, suggested that "the results indicate that ICT plays a more important role in determining the output growth for the developed economies than for the developing ones."[41] Similarly, Ayoub Yousefi investigated whether ICT contributed to economic growth across 62 countries with different levels of development from 2000 to 2006, finding that ICT exerted a greater impact on GDP growth in upper-middle-income countries than in lower-income countries.[42]

However, while it may have been the case that, in earlier decades, developed countries realized higher rates of return from ICT investments than did developing countries, that is clearly no longer the case. Analyzing ICT investments and economic growth from 1995 to 2010 for 59 countries across various stages of development, economist Thomas Niebel concluded that "the regressions for the subsamples of developing, emerging, and developed countries do not reveal a

statistically significant difference of the output elasticity of ICT between these three country groups."[43] Niebel's estimates indicate that, on average, regardless of a country's development status, a 1 percent increase in ICT investment increases economic growth by 0.05 to 0.09 percent annually.[44] Similarly, Majeed and Ayub explored how different ICT indicators influenced economic growth in 149 countries from 1980 to 2015, with the empirical results suggesting the use of ICT infrastructure had a positive and significant impact on economic growth.[45]

An increase in a nation's ICT capital stock of 1 percent leads to a 0.06 percent increase in a country's GDP.

And, in fact, it appears that ICT investments now generate higher returns than ever before. In analyzing 29 economic studies that isolate the rate of returns to ICT investment, Cardona, Kretschmer, and Strobel revealed that "ordering the studies by their average year of the data used for the estimation, we find a positive time trend."[46] Further evidence supports the contention that, going forward, developing countries stand to gain even more from adopting greater levels of ICT than do developed countries. For example, as the European Commission found, developing nations' investments in telecommunications infrastructure are 10 to 40 percent more effective in generating economic growth than are similar investments made by developed countries.[47] This may be because cell phone structures are cheaper and easier to install than landline infrastructure, and thus offer workers in developing countries with underdeveloped landline communications systems opportunities to perform services that can be delivered domestically or internationally over the Internet. And of course digital technologies enable better dissemination of job opportunities and create a wide range of gig work opportunities.

Put simply, a growing body of evidence documents the positive effects ICT has on economic growth, for both developed and developing countries. Summarizing 58 empirical studies estimating the economic impact of ICT, Stanley, Doucouliagos, and Steel found that "on average, these technologies have contributed positively to growth."[48] In terms of the magnitude to which ICT spurs economic growth, a review of econometric literature by Cardona, Kretschmer, and Strobel finds that, on average, an increase in ICT capital stock of 1 percent leads to a 0.06 percent increase in a country's GDP.[49]

HOW ITA PARTICIPATION BENEFITS COUNTRIES

The ITA has benefitted participating—and especially developing—countries considerably.[50] In 2010, developing countries accounted for 64 percent of global exports of ICT products.[51] As Xiaobing Tang, a counsellor in the Market Access Division of the WTO, noted, the experiences of Association of Southeast Asian Nations (ASEAN) such as Malaysia and Thailand "show that the ITA has helped their development and economic growth."[52] ITA participation benefits countries in three principal ways, by 1) lowering costs for and thus spurring adoption of productivity-enhancing ICT, which boosts the productivity, innovative, and competitive capacity of a country's enterprises and industries (which further creates new job opportunities); 2) deepening countries' participation in GVCs for the production of ICT goods and services; and 3) promoting technology education and training and a technologically literate work force. In total, these forces can greatly bolster countries' broader global trade participation.

Deepening Countries' Participation in ICT GVCs

GVCs represent an increasingly important feature of international trade. In fact, 85 percent of global trade can now be characterized as occurring within the GVC framework.[53] Keeping ICT prices low is paramount if countries wish to participate in GVCs for the production of ICT parts, components, and final products. In contrast, maintaining high ICT tariffs (in part, by not joining the ITA) harms both countries' ICT-producing and ICT-consuming sectors.[54] In particular, failure to join the ITA has caused nations to be left out of global production networks for ICT products (and services), causing them to miss out on significant growth opportunities.

To elaborate, in the 1970s, and with renewed interest over the past 15 years, countries such as Argentina, Brazil, and India have experimented with import substitution industrialization policies that impose high tariffs (among other trade barriers) on imported ICT products in an effort to spur development of their own nascent ICT-producing industries. Yet, in the interest of favoring one sector (ICT producers), these policies have had the unintended effect of harming the entire economy, as enterprises (large and small alike) in other industries—from finance and education to hospitality, health, and retail—are forced to use fewer, inferior, or more-expensive ICT products, thus hampering their own productivity, innovation potential, and global competitiveness. What's worse, high tariffs have proven largely ineffective at achieving these countries' aim of spurring the development of indigenous ICT-producing sectors that require access to global supply chains.

Indeed, it would be prohibitively expensive for even the most-advanced economies, such as the United States or the EU block, to seek to build wholly indigenous supply chains for most ITA products. For example, a recent study by the Boston Consulting Group for the Semiconductor Industry Association estimates that it would take an additional $1 trillion in government subsidies to localize semiconductor supply chains in the United States, resulting in a 35 to 65 percent overall increase in semiconductor prices and ultimately higher costs of electronic devices for end users.[55]

If an indigenous supply chain is unrealistic for an advanced economy such as the United States, it's even more unrealistic for developing economies (even large ones), since their markets are still far too small to support wholly indigenous domestic production dedicated only to an internal market. In the semiconductor sector, for example, the leading Chinese, European, Korean, Japanese, Taiwanese, and U.S. chip companies are focused on global markets that are necessary to support the scale of production and massive investments required to bolster development and production of cutting-edge chip technologies. Given the higher costs of indigenous production, a localized industry is unlikely to be able to access global markets because of higher costs and substandard technologies. By being shielded from best-of-breed international competitors, domestic firms lack access to a vital impetus for innovation that competition engenders as well as access to key parts, components, and technical expertise. For instance, small business owners in Argentina have complained about the country's high ICT tariffs, noting that "the lack of competition gives manufacturers an incentive to produce low-quality products and charge high prices."[56] These effects flow throughout an economy, limiting access to global markets by contributing to the production of substandard goods, particularly ones that increasingly demand that local producers incorporate advanced technologies, (e.g., washing machines, kitchen appliances, motor vehicles, medical equipment, etc.).

Further, high ICT tariffs have precluded many ICT-producing enterprises from effectively participating in GVCs for the production of ICT goods. Because of the interlinkage of global supply chains, manufacturers scour the globe searching for the highest-quality and most cost-competitive production locations. This means global production networks consist of highly fragmented but specialized units of production, predicated on countries being open to trade. To illustrate, in 1962, intermediate goods accounted for 30 percent of total trade within the same industry globally—a percentage that doubled to 60 percent by 2006.[57] (A 2020 United Nations Conference on Trade and Development report estimates that intermediate products represented approximately half of world trade in goods, just under $8 trillion, in 2019).[58] Deficient communications networks limit an economy's ability to participate in global services trade, as an increasing range of services (e.g., software, accounting, law, semiconductor design, help desks, etc.) are being delivered over the Internet. For example, modern software and semiconductor design development is a 24/7 endeavor as teams around the world collaborate on projects.

Failure to join the ITA has caused nations to be left out of global production networks for ICT products, causing them to miss out on significant growth opportunities.

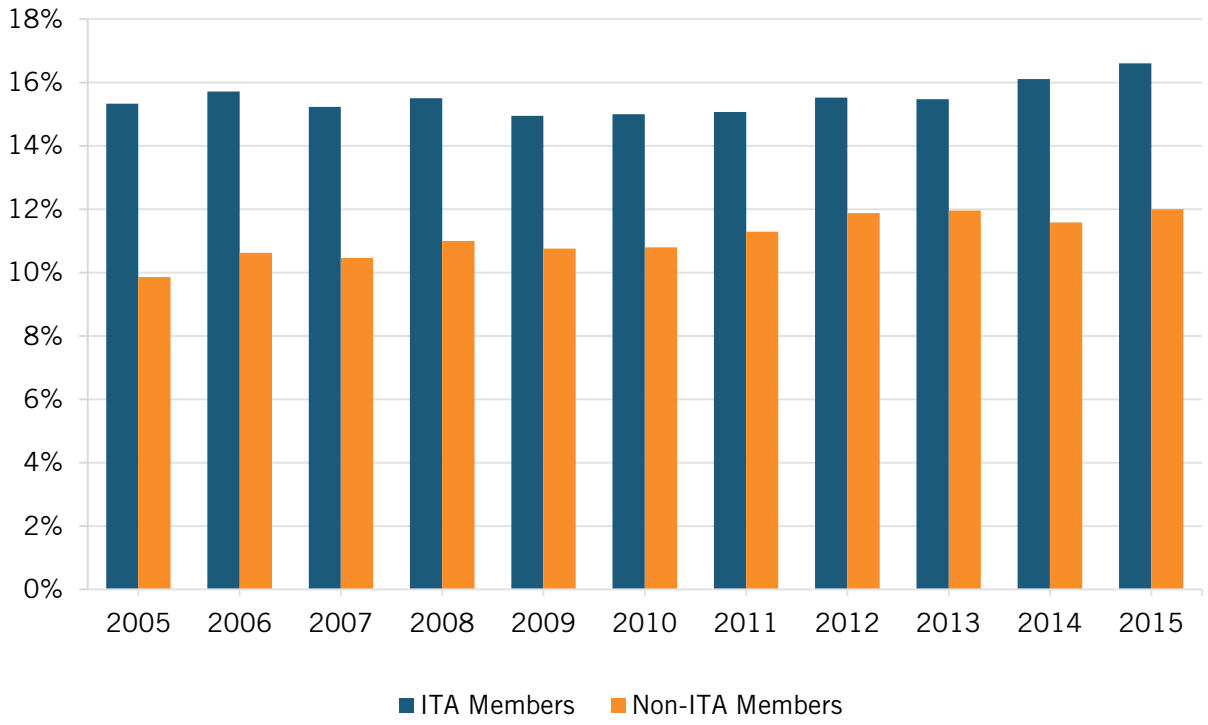
Put simply, countries imposing high tariffs on ICT parts and products only make themselves unattractive to multinational enterprises wishing to seamlessly integrate into global production networks. This explains why OECD has found that countries not participating in the ITA saw their participation in global ICT value chains decline by more than 60 percent from 1995 (two years before the ITA went into effect) to 2009.[59] (See figure 4.)

Figure 4: Participation in global ICT value chains, indexed as a share of gross ICT exports[60]



In contrast, countries participating in the ITA saw their participation rise since 1995. Similarly, OECD provides data on countries' participation in ICT GVCs (considering their forward and backward participation rates in those value chains), and the evidence clearly shows that, from 2005 to 2015, ITA-member nations enjoyed nearly one-third greater participation in ICT GVCs than did non-ITA-member nations. (See figure 5.)

Figure 5: Participation in global ICT value chains, indexed as a share of gross ICT output[61]



Brazil provides a compelling example: Brazilian innovation in ICT has lagged behind that of the rest of the world primarily because the country hasn't been involved in ICT GVCs and has enjoyed limited market-based technology and skills transfer in the ICT sector. Put simply, if countries wish to participate in GVCs for ICT products, they have to remove the barriers. As OECD's "Measuring Trade in Value Added" research finds:

> The growing fragmentation of production across borders has important policy implications. It highlights the need for countries wanting to reap the gains from value chain participation to have open, predictable and transparent trade and investment regimes as tariffs and other unnecessarily restrictive non-tariff measures impact foreign suppliers, international investors, and domestic producers.[62]

It's also important to note that it's not just about producing final goods; countries can derive significant value added from the production of intermediate inputs. A zero-in/zero-out tariff environment can help countries attract production across a wide range of goods; and over time, as countries' enterprises and their employees develop knowledge, skills, and relationships with international partners, they can move up the value chain to the production of higher-value-added goods.

Another benefit of the ITA, for developed and developing nations alike, is that it has furthered the development of more diversified global supply chains, which can facilitate resilience and resistance to supply chain shocks and provide new opportunities. As MGI found in its report, "Risk, resilience, and rebalancing global supply chains," that matters because, "[c]hanges in the environment and in the global economy are increasing the frequency and magnitude of shocks. Forty weather disasters in 2019 caused damages exceeding $1 billion each—and in recent years, the economic toll caused by the most extreme events has been escalating."[63] The report estimates that companies today should expect supply chain disruptions of one to two weeks occurring at least once every 2 years; 2 to 4 weeks occurring once every 2.8 years; 1 to 2 months every 3.7 years; and 2 months or more every 4.9 years. By fostering more diversified and resilient global ICT supply chains, the ITA can help address this challenge.

Countries that don't participate in open, cross-border flows of ICT products only end up excising themselves from GVCs and production networks for ICT products and services.

As a result, joining the ITA is important for a country's growth; however, implementation of the agreement is just as important. Poor implementation of the ITA is no different from imposing high tariffs. For example, India is part of the ITA, yet it maintains high tariffs on key intermediate inputs to semiconductor manufacturing and continues to impose a 10 percent duty on printed circuit boards.[64] In April 2023, the WTO found that India imposes tariffs up to 20 percent on specific ICT products, a violation of its WTO commitments.[65] The continued imposition of such tariffs (in contravention of India's ITA-1 commitments) will only diminish the benefits the nation can gain from its ITA membership.

But the message is clear: Countries that don't participate in open, cross-border flows of ICT products (by imposing high tariffs on ICT or other restrictive measures such as localization barriers to trade) only end up excising themselves from GVCs and production networks for ICT products and services while reducing opportunities for employment and economic growth.[66]

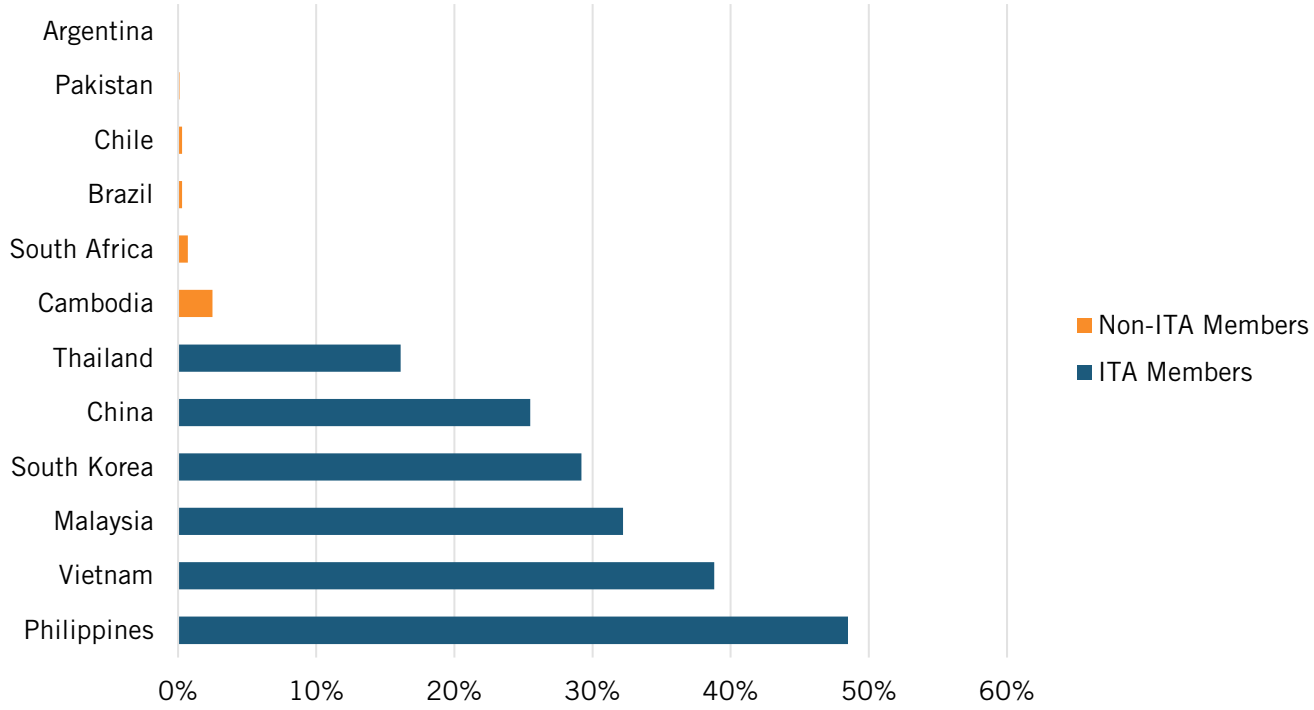
Boosting Countries' Exports of ICT Goods and Services

The ITA has helped boost countries' levels of exports of both ICT goods and services. For instance, from 1996 to 2008, developing-country ITA exports expanded at an annual rate of 33.6 percent, compared with 7.2 percent for developed countries.[67] And the evidence shows that countries that have systematically reduced barriers to trade in ICT goods—including by eliminating tariffs, embracing trade facilitation, and eschewing other nontariff barriers such as localization requirements—have experienced increased ICT goods exports, both as a share of their total goods exports and in absolute value terms.

In fact, ICT goods exports as a share of total goods exports are consistently and significantly higher in ITA-member than in non-ITA-member countries. For instance, ICT goods exports account for nearly half of the Philippines' goods exports, 39 percent of Vietnam's, 32 percent of Malaysia's, 29.2 percent of South Korea's, 25.5 percent of China's, and 16.1 percent of Thailand's. (Incidentally, the U.S. figure was 9.1 percent and for India 2.2 percent.) In contrast, ICT goods exports account for a much-lower (and, indeed, incredibly meager) share of goods exports for non-ITA countries, including for just 2.5 percent of Cambodia's goods exports, 0.7 percent of South Africa's, and less than half a percent each for Brazil, Chile, Pakistan, and

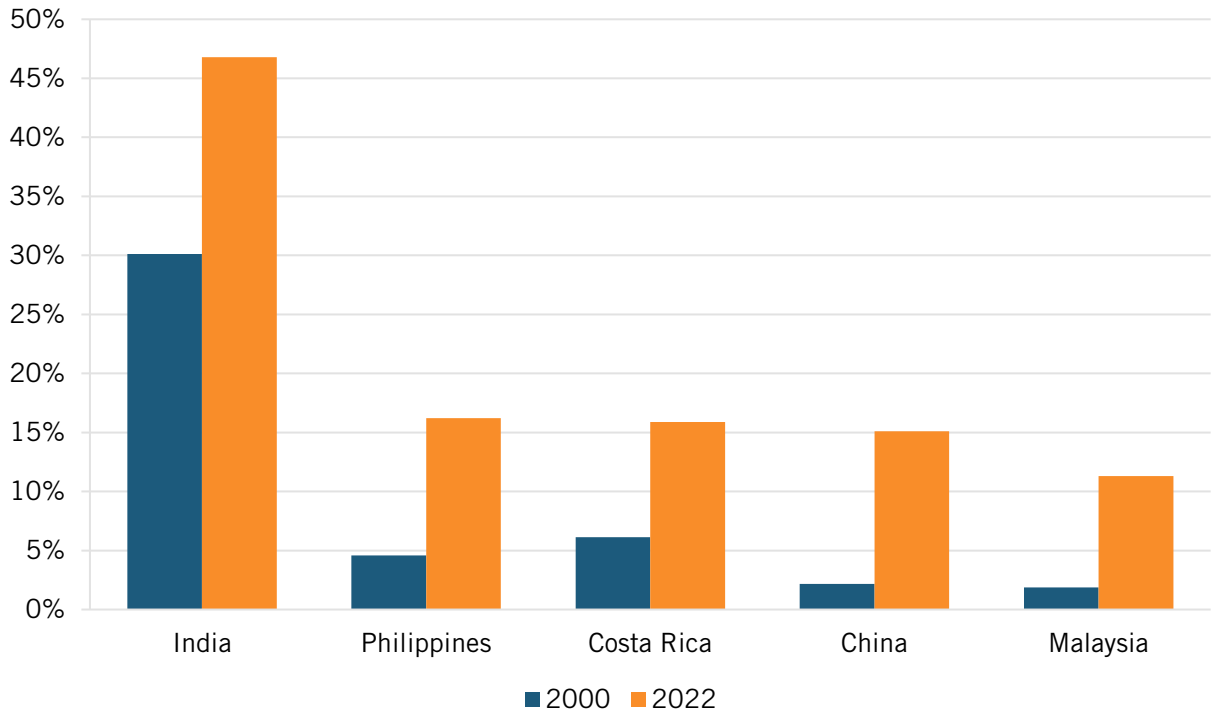
Argentina. (See figure 6.) And it's not that the first six countries shown in figure 6 are in the ITA because they are strong ICT goods exporters; rather, they are robust ICT goods exporters in considerable part because they have become members of the ITA. This data truly corroborates the argument that countries that have elected not to join the ITA have simply seen themselves excluded from GVCs for the production of ICT goods.

Figure 6: ICT goods exports as a share of total goods exports, select ITA and non-ITA members, 2021[68]



Beyond ICT goods exports, a similar story plays out in ICT services. In 2022, ICT services exports accounted for over 45 percent of India's total services exports, 16 percent of the Philippines' and Costa Rica's, 15.1 percent of China's, and 11 percent of Malaysia's. (See figure 7.) In 2020, India's ICT services sector contributed 8 percent of GDP, a significant increase from the just 1.2 percent it did in 1998, shortly after India joined the ITA.[69] All these countries have experienced significant increases in ICT services exports' share of total services exports since 2000, and part of the dynamic here is that ITA membership helped to lower prices for key ICT hardware inputs ICT services enterprises depend on, helping them to innovate and become more globally competitive.

Figure 7: ICT services exports as a share of total services exports, select countries, 2000 and 2022[70]



THE LOGIC FOR BRINGING ADDITIONAL ICT GOODS UNDER ITA-3 COVERAGE

An ITA-3 would bring a number of emerging (as well as more-modern versions of existing) technologies driving the global digital economy under ITA-coverage. As noted, an ITA-3 would include goods such as next-generation semiconductors, energy-efficient technologies such as storage batteries and LED "light sources," digital manufacturing technologies such as industrial robots and 3D printers, certain medical technologies such as photographic X-ray plates, and some unmanned aerial vehicles (UAVs), among other products. The following section explores the logic of why several of these specific product categories merit ITA coverage, focusing especially on semiconductors, digital (or "smart") manufacturing technologies, energy-efficiency technologies, commercial-use drones, and medical devices. These benefits are not limited to technology products, as many traditional industrial products (e.g., cars, appliances, HVAC systems) now incorporate semiconductors and other "smart" technologies, and products that lack such digital brains are losing competitiveness.

Semiconductors, Semiconductor Manufacturing Equipment, and Related Components

To be sure, semiconductors have been included as ITA products since the original agreement. But semiconductors continue to evolve, which is one reason why multicomponent semiconductors—a single semiconductor device that performs complex or multiple functions previously performed by two or more semiconductor devices, thanks to a variety of components integrated into a single unit—were an important part of the ITA-2 agreement.[71] Similarly, an ITA-3 would ensure that the latest next-generation semiconductor technologies, such as semiconductor-based transducers, are part of the agreement. The proposed ITA-3 would also bring a litany of products and materials involved in the manufacture of semiconductors under ITA coverage, including the following:

- Circular polishing pads used in the manufacturing of semiconductor wafers (HS 3919.90)
- Nonelectrical articles of carbon fiber used for the production or processing of semiconductor parts (HS 6815.10)
- Diamond blades for sawing semiconductor wafers (HS 8202.39)
- Liquid pumps used to blend and deliver process slurries used in polishing wafer surfaces (HS 8413.81)
- Filtering or purifying machinery used in the manufacturing of semiconductor devices (HS 8421.21)

Ensuring inclusion of the vast majority of inputs that comprise semiconductor manufacturing equipment—the machines and their components that make the actual semiconductors—matters because semiconductors are foundational to the modern global economy. Semiconductors underpin everything from AI systems, cloud computing, and the Internet of Things to advanced wireless networks, smart grids, smart buildings, smart cities, digital health care devices, and even the next generation of quantum computing.[72] Moreover, semiconductors lie not only at the heart of every piece of ICT equipment, from desktop or laptop computers to tablets, servers, and smartphones, but to an increasingly wide variety of consumer goods from automobiles to home appliances to fitness monitors— something vividly illustrated by the global semiconductor shortage that hit in the wake of the COVID-19 pandemic.[73]

In addition to powering consumer goods, semiconductors also play a crucial role in addressing global climate change. Multiple industries, including transportation, manufacturing, construction, and agriculture, rely on semiconductors to enable their energy efficient or clean energy production, which in turn reduces emissions. For example, the United Nations Environment Programme noted that the building and construction sector accounts for 37 percent of carbon emissions.[74] However, the implementation of semiconductor-enabled smart devices could drastically reduce energy consumption in that sector. Indeed, the American Council on Energy Efficient Economy found that "smart devices" could reduce energy consumption by inefficient commercial buildings by at least 30 percent.[75] As a result, the World Economic Forum found that semiconductor-enabled technologies can reduce global emissions by up to 15 percent, or one-third of the needed reduction by 2030.[76]

The semiconductor sector itself represents a $470 billion highly globalized industry that helps create $7 trillion in global economic activity and is directly responsible for $2.7 trillion in total annual global GDP.[77] Broadening the set of semiconductor production inputs and end products covered by the ITA would help lower semiconductor prices—and makes perfect sense for the global economy.

Energy-Efficient Technologies

The ITA-3 expansion proposal includes numerous ICT-powered energy-efficiency technologies, such as the following:

- Solar water heaters (HS 8419.19)
- Photovoltaic generators (HS 8501.31, 8501.33, 8501.34, 8501.61, 8501.62, 8501.63, 8501.64)

- Wind-powered generating sets (HS 8502.31)
- Lithium and lithium-ion batteries (HS 8506.50, 8507.60)
- Light-emitting diode (LED) light sources (HS 8539.50)

Semiconductors not only move bits (1s and 0s), but they also help control flows of electricity (i.e., power). Whether it comes to a nation's power grid or the electrical flow within a factory, computer, smartphone, or even a single LED light bulb, they all rely on microchip systems that control, measure, and convert electricity. In fact, 80 percent of the energy generated globally passes through some kind of power electronics.[78] And in the United States, more than half of all electricity flows through some form of semiconductor-controlled motor.[79]

As semiconductors—and thus the devices they power and control—have become more powerful and more energy efficient, they portend the ability to deliver significant energy efficiencies across not only a variety of industries but even entire national economies and thus reduce carbon emissions. Indeed, ICT such as semiconductors represents a powerful technology that enables other sectors of an economy to become more energy efficient.[80] For instance, a 2009 study by the American Council for an Energy Efficient Economy (ACEEE) estimates that the United States could realize 1.2 trillion kilowatt-hours (kWH) in energy savings by accelerating the adoption of semiconductor-enabled technologies by just 1 percentage point per year.[81] According to ACEEE estimates, that would translate to 22 percent less electricity consumed than the then-prevailing U.S. Department of Commerce Reference Case, resulting in 733 million metric tons less carbon dioxide emitted in 2030, as many as 296 energy plants that wouldn't need to be built to deliver that power, and $1.3 trillion in cumulative savings from 2010 to 2030.[82] Driving these gains, ACEEE identified more than two dozen semiconductor-enabled technologies, including commercial and residential lighting, high-efficiency industrial motors and motor systems, programmable thermostats, and residential water heaters.[83] Several of these items are now proposed for ITA-3 expansion.

Semiconductors are driving power efficiencies across a wide range of products, enabling computing efficiency (the number of computations per kilowatt hour of electricity) to double approximately every 1.6 years, a phenomenon known as "Koomey's law."[84] For instance, data centers can reduce energy demand by 56 percent by using semiconductor-enabled technologies such as efficient uninterruptible power supplies, variable speed fans and pumps, and server virtualization.[85] In 2010, data centers consumed 194 terawatt hours (TWh) of electricity, about 1 percent of global electricity consumption. Since then, the global installed base of servers has increased by 30 percent; compute instances have increased more than sixfold; data center Internet protocol traffic has increased by a factor of 11; and data center storage capacity has experienced a 25-fold increase.[86] However, over this time, greater storage-drive efficiencies and densities have reduced storage energy use by nearly 90 percent. Overall, the energy intensity of data centers has decreased about 20 percent annually since 2010.[87] Elsewhere, semiconductors enable solar panels to harvest up to 57 percent of power normally lost to real-world conditions such as clouds, dirt, and animal interference.[88]

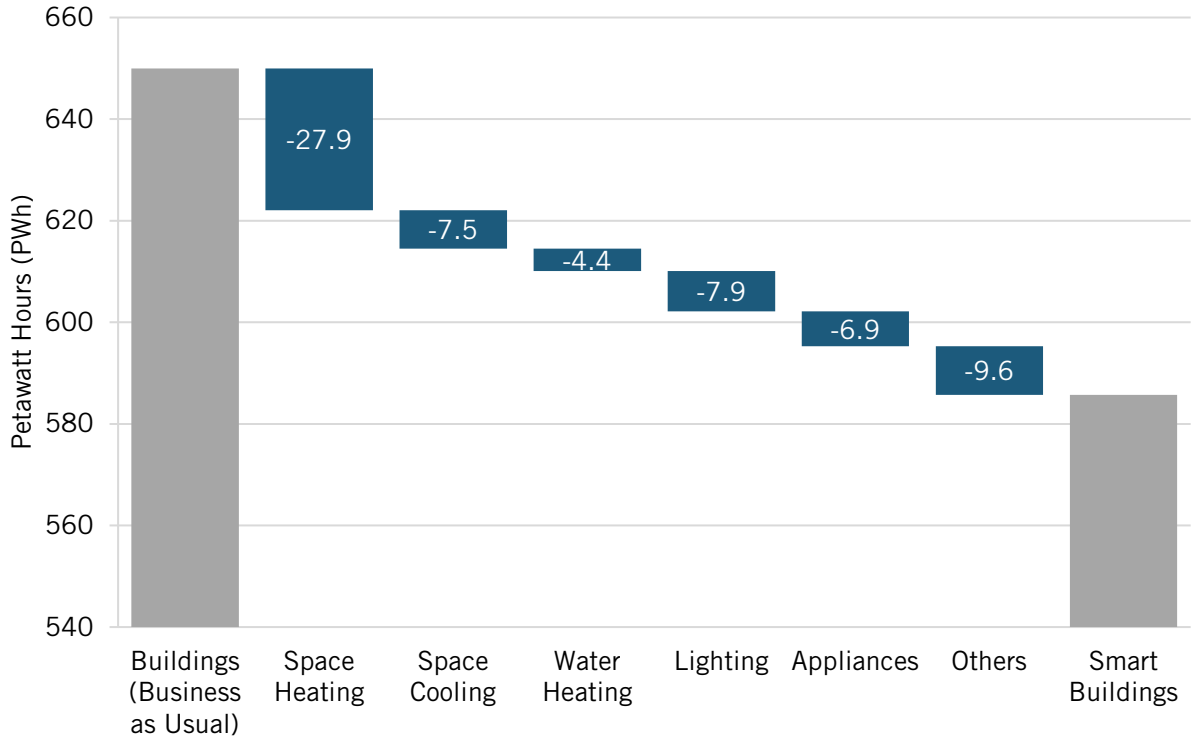
Semiconductor-powered sensors, controllers, and meters—several specific types of which are herein proposed for ITA-3 inclusion—will have a tremendous impact on the energy efficiency of commercial buildings and residential homes. For instance, one study finds that integrating smart sensors and controls throughout the commercial building stock has the potential to save as much

as 29 percent of building energy consumption.[89] Smart sensors and controls can enable buildings to reduce their peak electricity load by 10 to 20 percent, for example, by shifting some energy services to times of day when energy demand is low.[90] Likewise, smart thermostats that help households and building managers monitor and regulate heating and cooling can reduce electricity demand by 15 to 50 percent, depending on the building and control technology.[91]The U.S. Department of Energy has estimated that sensor and control technologies alone could reduce building energy consumption in the United States by 1.7 quads (~500 billion kWh) by 2030, generating $18 billion in annual energy savings.[92]

As semiconductors—and thus the devices they power and control—have become more powerful and more energy efficient, they portend the ability to deliver significant energy efficiencies across not only a variety of industries but even entire national economies.

Similarly, the International Energy Agency's 2017 report, *Digitalization & Energy*, identifies the global potential energy savings from smarter energy use in buildings, finding that ICT integration can reduce annual electricity use by up to 4.65 petawatt hours (PWh), or nearly 25 percent, over the next two decades with energy savings realized across a range of applications including lighting, water heating, metering, application of smart thermostats, etc. (See figure 8.) Given their potential to save energy, save costs, and help the environment—especially as the world attempts to meet the Paris Agreement's climate goals—the energy-efficient technologies identified as candidates for ITA-3 coverage certainly merit inclusion.

Figure 8: Cumulative energy savings in buildings from widespread digitalization, by energy use (2017–2040)[93]



Smart Manufacturing Technologies

Smart manufacturing—the application of ICT (such as industrial robots, 3D printers, the Internet of Things, AI, big data, etc.) to every facet of modern manufacturing—is in the midst of transforming how products are designed, fabricated, used, operated, and serviced post sale, just as it's transforming the operations, processes, and energy footprint of factories and the management of manufacturing supply chains.[94] MGI has estimated that this advent of manufacturing digitalization may increase global manufacturing productivity by 10 to 25 percent, with the potential to create as much as $1.8 trillion in new value per year across the world's factories by 2025.[95] This concords reasonably well with a General Electric report, "Industrial Internet: Pushing the Boundaries of Minds and Machines," that estimates the Industrial Internet could boost annual U.S. productivity growth by 1 to 1.5 percentage points and add $10 trillion to $15 trillion to global GDP over the next 20 years.[96] The ITA would promote global manufacturing digitalization by bringing more products, such as industrial robots and 3D printers, under ITA coverage. Adding up global imports in 2020 for both the components and end products representing industrial robots and 3D printers that are proposed for ITA-3 inclusion shows that the total import value for such products exceeds $70 billion.[97]

Industrial Robotics

Industrial robots will be a critical driver of this transformation. As of October 2022, there were 3.5 million industrial robots operating across the world's factories, with the 517,385 new industrial robots installed in 2021 representing a 31 percent increase over the prior year.[98] Seventy-four percent of the newly deployed industrial robots deployed globally in 2021 were fielded in Asia, led by China, Japan, and Korea.[99] The global industrial robot marketplace was valued at $14.6 billion in 2020 and is expected to grow to $31.1 billion by 2028 at a compound annual growth rate (CAGR) of 10.4 percent.[100]

Robots improve productivity when applied to tasks wherein they can reduce error and execute tasks at high levels of efficiency and consistency. In this way, robots help produce goods more economically, expanding the range of global access to a wide variety of manufactured goods—from automobiles to refrigerators to smartphones—and thus have played an instrumental role in enhancing global standards of living and driving global economic growth more broadly.[101] Their impact has been enormous. Georg Graetz and Guy Michaels of the Centre for Economic Performance concluded that robot densification increased annual growth of GDP and labor productivity between 1993 and 2007 by about 0.37 and 0.36 percentage points, respectively, across 17 countries studied.[102] Their study finds that robots accounted for 10 percent of GDP growth in studied countries, and that productivity in robot-enabled industries in these countries increased by 13.6 percent.[103] As the authors concluded, "For the industries in our sample, robot adoption may indeed have been the main driver of labor productivity growth."[104] They also found that robot densification is associated with increases in both TFP and wages and reductions in output prices.[105] To put the power of industrial robots in context, Graetz and Michaels estimated that industrial robots exerted a greater economic impact over that 14-year study period than did the steam engine from 1850 to 1910, a harbinger of the impact the newest generation of far more capable industrial robots—and indeed digital manufacturing technologies more broadly—may have in the future.[106] To that end, MGI has predicted that up to half of the total productivity growth needed to ensure a 2.8 percent growth in global GDP over the next 50 years will need to be driven by automation.[107] And in that regard, the Boston Consulting Group has forecasted

productivity improvements of 30 percent over the next 10 years, spurred particularly by the uptake of robots in small to medium-sized enterprises as robots become more affordable, more adaptable, and easier to program.[108]

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In other words, the competitiveness of a nation's manufacturing enterprises—both large and small—will increasingly hinge on their ability to deploy and leverage industrial robots. And, if industrial robots are included in an ITA-3, then countries joining such an agreement will be at an advantage because eliminating tariffs on these productivity-enhancing goods will lower their prices and put domestic manufacturers at a competitive advantage. Industrial robots represent an obvious choice for ITA-3 inclusion.

3D Printing

Additive manufacturing, or 3D printing, refers to a manufacturing process in which successive layers of material are built up to synthesize a three-dimensional solid object composed in a digital file, with each layer a thinly sliced horizontal cross-section of the eventual object.[109] 3D printing enables fundamentally new shapes and even mechanical linkages that simply can't be achieved through traditional subtractive manufacturing techniques, while offering many applications for improving speed and efficiency, reducing errors, and eliminating as much as 70 percent of waste generated from traditional subtractive manufacturing processes.[110]

The current $12.6 billion global marketplace for 3D printers is expected to grow to $62.8 billion by 2028, at a 21 percent CAGR.[111] Especially as 3D printing becomes cost competitive across a range of materials—from plastic to metals such as titanium—it heralds the potential to transform manufacturing by "democratizing it" (i.e., making it more globally achievable), enabling the production of goods closer to final markets (thus reducing transportation costs), and permitting mass customization (i.e., production lot sizes of one, as opposed to one million). A recent report from ING Bank estimates that the rise of 3D printing could see the share of 3D printed goods in global manufacturing rise to 5 percent over the next two decades—a significant increase from the current share of 0.1 percent—and that the greater extent of manufacturing closer to final consumption would at most decrease global trade flows by a modest rate of 0.2 percentage points less trade growth per year.[112] A growing market for 3D printing therefore would bring positive economic benefits to importing countries but would not impose a disincentive to trade flows at large. Moreover, digital manufacturing technologies such as 3D printing could actually cause international trade flows to increase by enabling the creation of new and innovative products for export. For instance, a 2019 study by the World Bank's Caroline Freund, Alen Mulabdic, and Michele Ruta finds that the use of 3D printing in the hearing aid industry increased trade in that field by 58 percent over nearly a decade compared with what would otherwise have been expected.

As with industrial robots, 3D printers represent a device ripe for ITA-3 inclusion, and the manufacturers that have access to the lowest-cost, most-innovative 3D printers will find themselves at a competitive advantage.

Drones for Commercial and Personal Use

The global UAV marketplace stands at $27.4 billion and is projected to reach $58.4 billion by 2026, at a 16.4 percent CAGR. But far from being playful toys, drones represent a productivity-enhancing tool that is already delivering beneficial impacts across a range of industries, from agriculture to energy to medicine.

The United Nations Food and Agricultural Organization has projected that global food production will need to increase by 70 percent by 2050 to meet the world's food needs.[113] Precision agriculture leverages a variety of ICT including GPS-enabled UAVs, Internet of Things, AI, and big data to enable targeted interventions designed to enhance agricultural output and quality.[114] Indeed, UAVs are increasingly enabling a sustainable agriculture-management approach that allows agronomists, agricultural engineers, and farmers to help streamline their operations, using robust data analytics to gain effective insights into their crops. For instance, drones can facilitate the monitoring of large areas of farmland, considering factors such as slope and elevation, for instance, to identify the most suitable seeding prescriptions or to identify regions where irrigation needs to be provided, fertilizer applied, or crops pruned.[115] Drones are much more efficient and cheaper than the satellites or manned aircraft traditionally used to monitor agriculture, and can produce high-quality imagery over a wide expanse of terrain more safely, efficiently, and regularly. As such, analysts expect the agriculture drone market alone to reach $32.4 billion by 2025, indicating a growing global technology platform ripe for ITA inclusion.

Drones have also proven instrumental in the real-time delivery of urgent medical supplies. In October 2016, the start-up Zipline partnered with the Rwandan government to facilitate the real-time delivery of urgent medical supplies, such as blood and vaccines, to patients in remote locations via drones (named "Zips").[116] The Zips, which have a 75-kilometer service radius and can carry 1.5 kilograms of payload per sortie and operate in most weather conditions, seamlessly fly over treacherous terrain in as little as 30 minutes—a trip that traditionally took as much as four hours to cover in a vehicle.[117] By May 2017, Zipline averaged more than 20 weekly deliveries, providing near-real-time access to life-saving medical supplies for more than 8 million Rwandans, or nearly two-thirds of the country's total population of 12 million.[118]

Countries joining an ITA-3 expansion would give their domestic manufacturing enterprises a competitive advantage by reducing the prices of capital goods such as industrial robots and 3D printers that powerfully drive industrial productivity.

Commercial-use drones also played an important role in combatting COVID-19. In 2020, Zipline partnered with a North Carolina hospital to become the first emergency drone logistics operation to help U.S. hospitals respond to the pandemic.[119] Elsewhere, America's United Parcel Service (UPS) teamed up with the CVS drugstores to begin delivery of prescription medicine via Matternet's M2 drones to Florida residents.[120] Similarly, the Alphabet subsidiary Wing and Nevada-based start-up Flirtey are working to pioneer drone delivery of groceries and household goods, with customer demand for the service increasing 350 percent during the pandemic.[121] A June 2021 *GlobeNewswire* report noted that "rising demand for contactless deliveries of medical supplies and other essentials using drones owing to COVID-19 are some of the factors driving the growth of the UAV market [in 2020]."[122] Drones are playing increasingly important roles in

ensuring individuals' health, improving quality of life, and enhancing the productivity and innovation capacity of a wide variety of industries, and therefore certainly merit ITA-3 inclusion.

Medical Technologies

Medical devices play critical roles in health care, from devices that directly protect patient health (e.g., implantable cardiac devices) to those that facilitate diagnosis (e.g., magnetic resonance imaging (MRI) machines) to remote patient monitoring devices (e.g., fall monitors) or ones that improve quality of life (e.g., personal fitness trackers). Medical devices contribute to improved quality of life, to a greater ability to productively work, and to longer lives, all of which contribute to nations' economic growth. For instance, economists Kevin Murphy and Robert Topel estimated that increases in life expectancy between 1970 and 1990 contributed $57 trillion, or $2.8 trillion per year, to the U.S. economy, with the average additional year of life estimated to be worth $150,000 per person (although this varies with age).[123] Moreover, in the United States, advanced medical technology helped reduce the number of days spent in hospitals by 59 percent from 1980 to 2010, and the use of key medical technologies in four disease areas alone (diabetes, colorectal cancer, musculoskeletal disease, and cardiovascular disease) expanded U.S. GDP by $106.2 billion, providing a net annual benefit of $23.6 billion to the economy due to better treatment, reduced disability, and increased productivity.[124] No doubt, nations around the world similarly realize both patient health and broader economic benefits from the greater availability and cost efficiency of medical devices.

The 2016 ITA-2 introduced for the first time a variety of medical devices, including MRI machines and computed tomography (CT) scanners, into ITA coverage.[125] The ITA-3 expansion again proposes widening the range of medical devices and equipment receiving coverage, including, among others, Cameras designed for internal organ exams (HS 9006.30) and Medical etc., needles, and catheters (HS 9018.39).

These items should be included in an ITA-3. Moreover, with the world still reeling from the consequences of the COVID-19 pandemic, nations should be considering doing all they can to reduce the costs of medical goods and equipment—and by bringing those with heavy ICT components under ITA coverage, they can further such aims.

THE ECONOMIC IMPACT OF A PROPOSED ITA-3 EXPANSION

For most countries that have joined the ITA, participation has succeeded in fostering ICT-driven economic growth. ICT boosts productivity, supports innovations, empowers workers, and expands access to digital services that improve quality of life and productivity. Since less-economically developed nations may suffer a shortfall in their stock of ICT capital, an effective way to grow their ICT capital stock is by joining the ITA and increasing participation in global technology supply chains. As noted, this report examines the economic impact of 22 countries and regions joining the proposed ITA-3. (A subsequent section will examine the economic impact for countries not in the ITA-1 and/or ITA-2 joining the ITA all the way through the first two agreements as well as the proposed ITA-3.)

ITIF selected these countries both because they are among the most important in ICT goods production and trade and because they provide a sample set of large and small economies to model impacts of the proposed ITA-3 expansion. This section proceeds by briefly describing the economic framework and methodology used in the analysis, applying the model in order to

estimate the anticipated 1-year and 10-year economic impacts of full ITA accession for study countries, and then assessing the impact ITA accession would likely have on government income.

Summary Explanation of Methodology and Data Sources

Data for calculating trade in ITA goods comes from the UN Comtrade Database. International trade accounts for products using HS2017 codes detailing imports with the specificity of six digits to categorize items. A six-digit code, however, still encompasses multiple items. Many countries, including the United States, distinguish product codes based on the HS categorization beyond six digits. The United States maintains HS codes at the eight-digit level, allowing ITIF to approximate the percentage of products within an HS6 code incorporated into the proposed ITA-3 expansion. Applied tariff rates at the six-digit level per country for each trading partner are available via the World Bank's World Integrated Trade Solution (WITS) database. By multiplying the corresponding effective tariff rates (while accounting for most favored nation and preference agreements) with a given country's import value data (excluding reimports) for the 301 proposed HS6 codes comprising the proposed ITA-3, ITIF calculated a country's average effective applied tariff rate on ITA-3 goods by dividing the sum of effective ITA-3 tariff revenue by the sum of ITA-3 total import value. This average tariff rate under the ITA-3 expansion would be reduced to zero for participating countries. The removal of tariffs on ITA-3 products would effectively function as a price cut on ICT products to the benefit of domestic consumers (organizations and individuals alike) that could then afford more ICT at a reduced price.

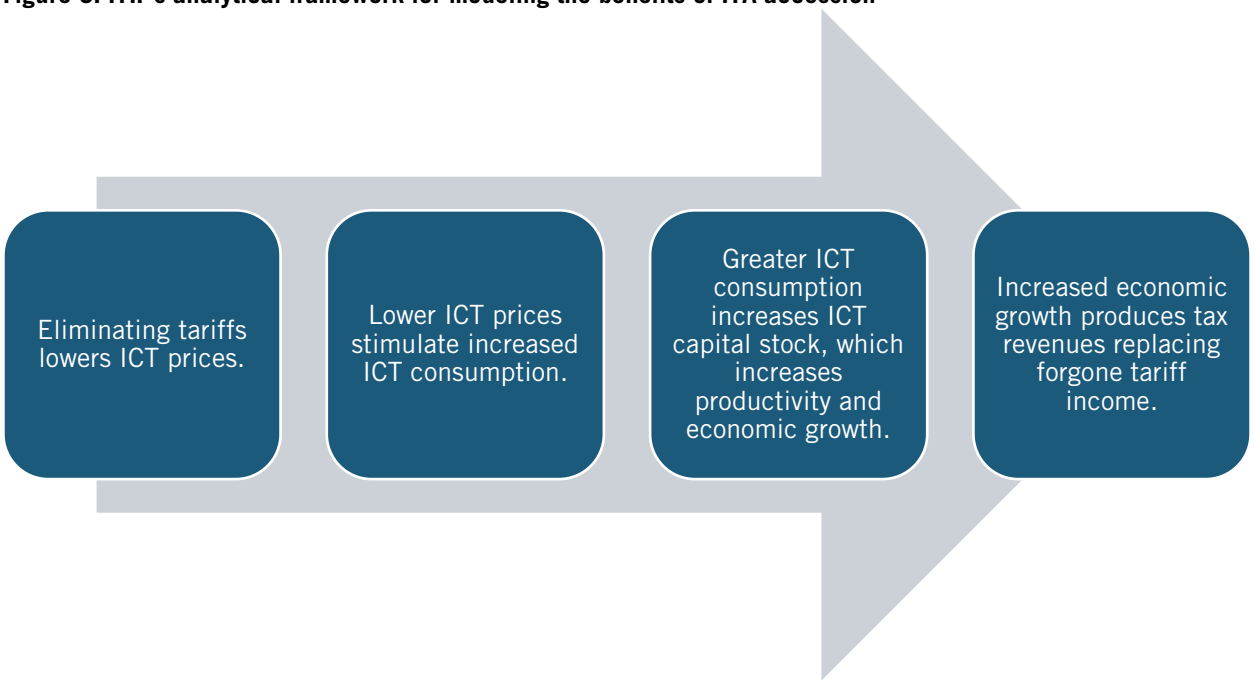
Moreover, economists have found that demand for ICT products is price elastic, whereby ICT consumption rises by a factor greater than its price reduction. ITIF's model for estimating the economic impacts of ITA-3 accession uses a price elasticity of 1.3 for ICT products based on research findings pioneered by Cette et al. in 2012.[126] A country's imports, however, could be inhibited in part by domestic producers' ability to respond competitively by lowering costs and maintaining an advantage against imports when tariffs are eliminated. ITIF opted for this estimate regarding the price elasticity of ICT imports because it was estimated controlling for a substitution effect on imports that comes from competing domestic firms after ITA accession. This resulting price elasticity for ICT demand allows one to estimate the annual growth in imports of ICT goods anticipated by eliminating tariffs on ITA-3 products, whereby a 1.0 percent decrease in ICT price (via removed tariffs) induces a 1.3 percent increase in consumption of those goods, with this heightened consumption further increasing the extent of a country's ICT capital stock.

Economists have found that demand for ICT products is price elastic, with a 1 percent decrease in ICT price inducing on average a 1.3 percent increase in consumption of ICT products.

Over time, increased ICT consumption and the resulting growth in a nation's ICT capital stock creates widespread positive externalities. A proliferation of ICT allows workers to provide services more efficiently and businesses to innovate their products and operations, thus raising overall productivity and economic growth. Leveraging Cardona et al.'s research, ITIF applied a growth factor suggesting that a 1 percent increase in a nation's net ICT capital stock generates a 0.06 percent increase in a nation's real GDP.[127] Multiplying a country's estimated annual net growth in ICT capital stock by this growth factor provides an estimate of the potential GDP growth from extending ITA coverage onto proposed ITA-3 products. ITIF computed 10-year average growth

rates for real GDP and imports specific to each country. Yearly net ICT capital stock and GDP growth estimates enable forecasting of the total cumulative GDP growth a nation may experience over 10 years due to joining the proposed ITA-3 expansion. The following flowchart summarizes the analytical framework ITIF's model uses to estimate the economic impacts of ITA-3 on the study countries. (See figure 9.)

Figure 9: ITIF's analytical framework for modeling the benefits of ITA accession



As the model illustrates, while tax revenues fall in the short run (e.g., one year post ITA-3 accession) due to tariffs on products that would come under ITA coverage reducing to zero, additional tax revenue is recovered in the long run (e.g., 10 years post ITA-3 accession) through standard means of taxation as economies grow. A growing economy means businesses increase revenues and workers earn higher incomes (thus consuming more goods and services), a dynamic that helps countries recover some, if not all, tariff revenues initially lost due to joining the ITA.

Modeling the Economic Impacts of ITA-3 Accession

ICT Import Profile of Countries

Despite global digitalization trends, many countries still vary widely in their ICT import profile. Using the common base year for available import data of 2021, ITIF calculated the total value of ITA-3 imports per country. Table 2 provides the ICT import profile of each country, showing the full value of ITA-3 imports per country as well as total tariff revenue raised from ITA-3 imports alongside officially reported trade statistics to control for any unobservable inconsistencies between model and official reporting of import findings.

Table 2: ICT imports for ITA-3 products[128]

Country	Total ITA-3 Imports (Millions)	Total of All Imports (Millions)	ITA-3 Share of Total Imports	Total ITA-3 Tariff Revenue (Millions)	Official Sum of Tariff Revenue Across All Imports (Millions)	Average Effective Applied Tariff Rate on ITA-3 Imports
Argentina	$2,178	$63,184	3.45%	$228	$3,902	6.17%
Brazil	$9,047	$219,408	4.12%	$1,165	$11,464	5.22%
Cambodia	$470	$28,703	1.64%	$19	$566	1.97%
Canada	$19,560	$489,703	3.99%	$70	$4,296	0.88%
China	$85,668	$2,675,680	3.20%	$3,839	$45,086	1.69%
Costa Rica	$1,028	$18,431	5.58%	$4	$286	1.55%
EU 27	$121,002	$3,118,390	3.88%	$1,559	$17,188	0.55%
India	$14,871	$570,402	2.61%	$1,151	$47,255	8.28%
Indonesia	$6,660	$195,694	3.40%	$79	$2,492	1.27%
Japan	$30,477	$773,721	3.94%	$14	$7,707	1.00%
Kenya	$527	$19,288	2.73%	$46	$1,635	8.47%
Lao PDR	$199	$5,871	3.38%	$1	$117	1.99%
Malaysia	$8,321	$238,321	3.49%	$360	$619	0.26%
Mexico	$36,388	$506,565	7.18%	$299	$3,819	0.75%
Nigeria	$1,487	$52,442	2.83%	$152	$3,126	5.96%
Pakistan	$1,727	$73,107	2.36%	$145	$4,803	6.57%
South Korea	$23,157	$615,034	3.77%	$371	$7,540	1.23%
Taiwan	$12,677	$382,961	3.31%	$323	$11,672	3.05%
Thailand	$12,704	$269,102	4.72%	$492	$2,680	3.87%
United States	$162,625	$2,935,314	5.54%	$1,551	$86,719	2.95%
United Kingdom	$26,990	$695,578	3.88%	$118	$7,165	1.03%
Vietnam	$18,311	$330,752	5.54%	$114	$3,584	1.08%

Economic Impact of the Elimination of ITA-3 Tariffs

By confirming our estimates against total officially reported tariff revenues in the OECD's Global Revenue Statistics (GRS) database, ITIF calculated the average effective applied tariff rate on ITA-3 imports for study countries. Of the 21 countries and the European Union, Kenya maintained the highest average effective tariff rate applied to ITA-3 goods at 8.5 percent. India followed Kenya at 8.3 percent, with Pakistan next at 6.6 percent and Argentina at 6.2 percent. (See table 3.) Many nations—such as Mexico, Costa Rica, the United States, and Vietnam—have substantial ITA-3 shares of total imports but maintain low average tariff rates, near or below 3 percent. These nations seek to capitalize on a steady inflow of ICT imports with low average

tariffs on those products to produce revenue without heavily distorting sensitive technology markets that comprise ICT trade. But this still fails to maximize the total economic benefits to be gained from importing ICT. This tariff rate is indicative of the corresponding price decrease ITA-3 products would effectively enjoy when imported under the proposed ITA-3 expansion. If signatories set tariff rates to zero under ITA coverage, eliminating such tariffs would increase consumption of ITA-3 imports even further due to the high price elasticity of ICT.

Table 3: Impact of tariff elimination on ITA-3 product imports[129]

Country	Average Effective Applied Tariff Rate on ITA-3 Imports	Increase in ITA-3 Imports	Increase in ITA-3 Imports (millions)	Growth in Total Imports Post ITA-3 Accession
Argentina	6.2%	8.0%	$175	0.28%
Brazil	5.2%	6.8%	$614	0.28%
Cambodia	2.0%	2.6%	$12	0.04%
Canada	0.9%	1.1%	$223	0.05%
China	1.7%	2.2%	$1,877	0.07%
Costa Rica	1.6%	2.0%	$21	0.11%
EU 27	0.6%	0.7%	$867	0.03%
India	8.3%	10.8%	$1,602	0.28%
Indonesia	1.3%	1.7%	$110	0.06%
Japan	1.0%	1.3%	$395	0.05%
Kenya	8.5%	11.0%	$58	0.30%
Lao PDR	2.0%	2.6%	$5	0.09%
Malaysia	0.3%	0.3%	$28	0.01%
Mexico	0.8%	1.0%	$357	0.07%
Nigeria	6.0%	7.7%	$115	0.22%
Pakistan	6.6%	8.5%	$147	0.20%
South Korea	1.2%	1.6%	$369	0.06%
Taiwan	3.0%	4.0%	$502	0.13%
Thailand	3.9%	5.0%	$640	0.24%
United States	3.0%	3.8%	$6,246	0.21%
UK	1.0%	1.3%	$361	0.05%
Vietnam	1.1%	1.4%	$258	0.08%

Based on the price elasticity of 1.3 for ICT goods demanded, ITIF estimated an expansion of ITA-3 imports of between 0.3 and 11 percent among countries sampled, dependent on those countries' current tariff rates. (See table 3.) Kenya, the nation with the highest applied tariff rate on ITA-3 imports (8.5 percent), could expect an 11 percent increase in ITA-3 imports.

Conversely, Malaysia could expect a 0.3 percent increase in ITA-3 imports, given it has the lowest average applied tariff rate on ITA-3 imports (0.3 percent).

While 12 countries and the European Union—the majority in the study—would expect an increase of ITA-3 imports of less than 3 percent, a few percentage points increase in ITA imports swiftly grows those nations' stocks of ICT capital. In one year following ITA-3 accession, all countries' net ICT capital stock would grow between 0.12 and 4 percent due to increased ITA imports. (See table 4.) Using an unweighted average derived from depreciation rates from the Conference Board, ITIF estimated an average depreciation rate of ICT capital of 32.4 percent.[130] This expansion in ICT capital stock occurs even with the high rate of depreciation common to ICT. Since this model ties ICT capital stock growth to increased ICT consumption due to eliminating tariffs, countries expecting the highest net growth in ICT capital stock are the same nations with the highest average effective applied tariff rates. Table 4 provides details regarding each country's expected growth in ICT capital stock in one year from joining the ITA-3. India and Kenya, for example, would experience the highest growth in ICT capital stock, about 4 percent, since their tariff rates are the highest in the set. Conversely, with the lowest average tariff rate on ICT, the European Union and Malaysia would have the lowest growth in ICT capital stock at 0.24 and 0.12 percent, respectively.

Table 4: Nations' ICT capital stock growth from joining an ITA-3[131]

Country	Current ICT Capital Stock (millions)	ITA-3 Attributable Contribution to ICT Capital Stock (millions)	Percent of ITA-3 Attributable Growth in ICT Capital Stock
Argentina	$6,777	$175	2.58%
Brazil	$27,075	$614	2.27%
Cambodia	$1,281	$12	0.94%
Canada	$57,877	$223	0.39%
China	$223,096	$1,877	0.84%
Costa Rica	$2,941	$21	0.71%
EU 27	$357,550	$867	0.24%
India	$41,063	$1,602	3.90%
Indonesia	$18,615	$110	0.59%
Japan	$94,550	$395	0.42%
Kenya	$1,434	$58	4.05%
Lao PDR	$530	$5	0.97%
Malaysia	$23,831	$28	0.12%
Mexico	$111,728	$357	0.32%
Nigeria	$4,404	$115	2.62%
Pakistan	$4,789	$147	3.08%
South Korea	$66,640	$369	0.55%

Country	Current ICT Capital Stock (millions)	ITA-3 Attributable Contribution to ICT Capital Stock (millions)	Percent of ITA-3 Attributable Growth in ICT Capital Stock
Taiwan	$34,646	$502	1.45%
Thailand	$37,827	$640	1.69%
United States	$470,941	$6,246	1.33%
UK	$82,163	$361	0.44%
Vietnam	$48,392	$258	0.53%

ICT Capital Stock and Economic Growth

This report's model for calculating ITA-spurred growth closely follows the methodology developed in ITIF's 2017 report, "How Joining the Information Technology Agreement Spurs Growth in Developing Nations," which was ultimately based on modeling best practices from Bora et al. in 2010 and Henn et al. in 2015.[132] However, the growth-revenue estimation model employed in this paper brings nuance to the literature by providing more-precise estimates of ITA imports traded between countries using HS6 adjustment factors. The model accounts solely for consumption and capital imports to exclude any reimports that would distort growth estimates and calculates adjustment factors as the share of 8- or 10-digit codes within a single 6-digit code covered under ITA-3 treatment via UN Comtrade data. These adjustment factors serve as proxies applied to other countries to account for the share of goods traded within a six-digit code to be fully covered by the proposed ITA-3 expansion.

Following the expansion of a nation's ICT capital stock, ITIF's model connects it to other countries' economic growth. As noted, several papers document this linkage. Niebel found that, on average, a 1 percent increase in ICT capital stock is associated with 0.05 to 0.09 percent GDP growth in a given year, regardless of a country's level of economic development.[133] Cardona et al. found, after extensive review of econometric literature covering the statistical relationship between ICT capital stock and economic growth, that a 1 percent increase in ICT capital stock associates with a 0.06 percent increase in GDP growth.[134] Here, ITIF defaulted to a conservative estimate of 0.06 percent both to intentionally prevent overstating findings and to maintain consistency with prior ITIF studies modeling economic impacts of countries' ITA accession. Due to this conservative growth factor, GDP growth estimated from ITA-3 accession is likely even higher than reflected here.

Table 5 provides GDP growth estimates in the first year following ITA-3 accession. Again, this methodology finds that countries with the highest tariffs imposed on ITA-3 goods stand to gain the most. India, Kenya, Pakistan, and Nigeria are the countries that could anticipate the greatest economic growth in a given year as a result of ITA-3 accession. By reducing its average effective tariff rate of 8.5 percent applied to ITA-3 goods to zero, Kenya could expect 0.24 percent GDP growth just one year after ITA-3 accession. India could expect a 0.23 percent increase in GDP growth in the first year after eliminating its 8.3 percent average ITA-3 tariff rate. Pakistan and Nigeria, imposing a 6.6 and 6 percent average effective tariff rates on ITA-3 goods, respectively,

could both expect a 0.18 and 0.16 percent increase in GDP a year after having accepted the ITA-3 proposal.

India, Kenya, Pakistan, and Nigeria are the countries that could anticipate the greatest economic growth in a given year as a result of ITA-3 accession.

All study countries could experience notable annual GDP growth from joining an ITA-3. Even the lowest-tariff-imposing country, Malaysia, and the European Union would still experience a 0.01 percent growth in GDP in the first year of joining. While 0.01 percent may sound negligible, the additional GDP growth attributable to ITA-3 accession after 10 years would be undeniable.

Table 5: Projected one-year economic growth resulting from ITA-3 accession[135]

Country	Annual Real GDP Growth (2017–2021)	ITA-3 Attributable GDP Growth (Year One)
Argentina	-0.27%	0.15%
Brazil	1.01%	0.14%
Cambodia	4.27%	0.06%
Canada	1.40%	0.02%
China	6.00%	0.05%
Costa Rica	2.54%	0.04%
EU 27	1.44%	0.01%
India	3.81%	0.23%
Indonesia	3.38%	0.04%
Japan	-0.17%	0.03%
Kenya	4.37%	0.24%
Lao PDR	5.07%	0.06%
Malaysia	2.52%	0.01%
Mexico	0.17%	0.02%
Nigeria	1.36%	0.16%
Pakistan	3.66%	0.18%
South Korea	2.35%	0.03%
Taiwan	4.19%	0.09%
Thailand	1.18%	0.10%
United States	2.13%	0.08%
UK	0.45%	0.03%
Vietnam	5.44%	0.03%

Table 6 details the long-term economic growth countries could enjoy as a result of ITA-3 expansion. Even though it would have the lowest percentage growth rate, ITA-3 accession could still add nearly $348 million to Malaysia's economy over 10 years. It would also add $28.7 billion to the European Union's economy over the same timespan. Beyond the example of the minimum-tariff country, Japan and South Korea could expect 10-year cumulative growth of 0.28 and 0.37 percent, respectively. The remaining 18 countries could expect near or above a 0.22 percent increase in GDP attributable to ITA-3 expansion. The countries poised to realize the greatest GDP growth (as a share of their original 2021 GDP) by joining the ITA-3 are India, Kenya, Pakistan, and Nigeria. Over 10 years, as noted, India's economy could cumulatively grow by 2.5 percent, Kenya's by 2.3 percent, Pakistan's by 2 percent, and Nigeria by 1.7 percent. In absolute terms, the top four highest-growing economies due to ITA-3 accession (in order) would be the United States, China, India, and Brazil simply due to their already far-higher GDP and populations than the other (largely developing) nations in the study.

Table 6: Projected long-run economic growth benefits from joining an ITA-3[136]

Country	GDP (2021, billions)	Average Annual Real GDP Growth (2017–2021)	Cumulative 10-Year GDP Growth Attributable to ITA-3 Expansion (%)	Cumulative 10-Year GDP Growth Attributable to ITA-3 Expansion (billions)
Argentina	$616	-0.27%	1.67%	$10.0
Brazil	$1,830	1.01%	1.57%	$31.8
Cambodia	$24	4.27%	0.70%	$0.3
Canada	$1,680	1.40%	0.24%	$4.7
China	$15,802	6.00%	0.52%	$147.3
Costa Rica	$66	2.54%	0.42%	$0.4
EU 27	$15,213	1.44%	0.16%	$28.7
India	$2,782	3.81%	2.50%	$101.2
Indonesia	$1,066	3.38%	0.38%	$5.7
Japan	$4,435	-0.17%	0.28%	$12.2
Kenya	$90	4.37%	2.30%	$3.2
Lao PDR	$20	5.07%	0.58%	$0.2
Malaysia	$355	2.52%	0.08%	$0.3
Mexico	$1,207	0.17%	0.22%	$2.7
Nigeria	$520	1.36%	1.73%	$10.3
Pakistan	$379	3.66%	1.99%	$10.8
South Korea	$1,694	2.35%	0.37%	$7.9
Taiwan	$727	4.19%	0.93%	$10.2
Thailand	$439	1.18%	1.11%	$5.5

Country	GDP (2021, billions)	Average Annual Real GDP Growth (2017–2021)	Cumulative 10-Year GDP Growth Attributable to ITA-3 Expansion (%)	Cumulative 10-Year GDP Growth Attributable to ITA-3 Expansion (billions)
United States	$20,529	2.13%	0.82%	$208.0
UK	$3,037	0.45%	0.27%	$8.6
Vietnam	$332	5.44%	0.35%	$2.0
Total	**$72,843**			**$611.8**

Figure 10: Projected economic growth attributable to ITA-3, cumulatively over 10 years[137]

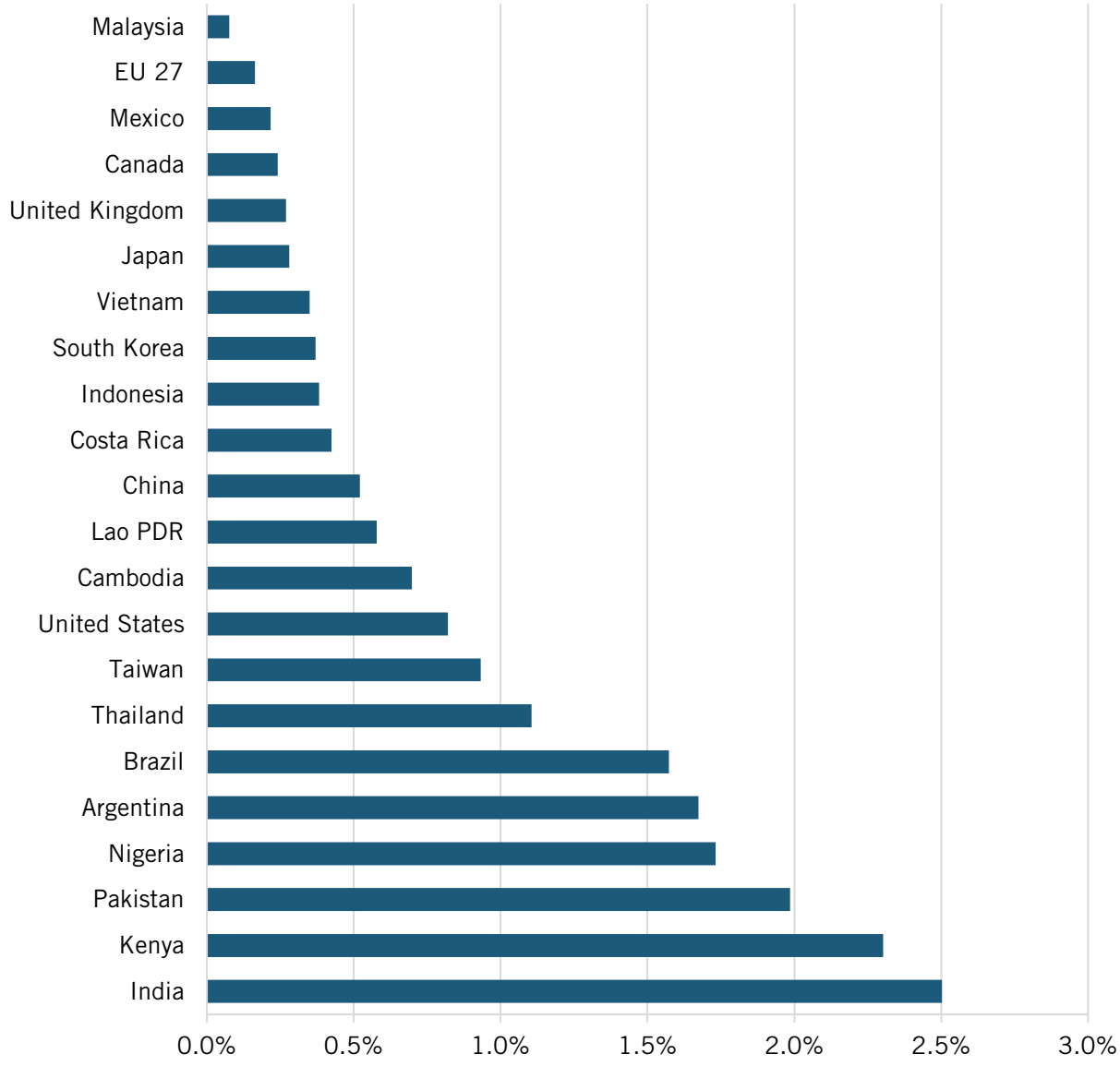


Figure 10 provides a ranking of the European Union and the 21 nations' 10-year cumulative growth anticipated from joining the proposed ITA-3. Here, India, Kenya, Pakistan, Nigeria, Argentina, and Brazil are the largest beneficiaries of an ITA-3. While all nations benefit considerably, these seven nations experience the highest relative growth in real GDP due to an ITA-3 expansion.

Over 10 years from their accession to this proposed ITA-3, this set of 21 countries and the European Union could expect to generate a combined cumulative increase to global GDP of over $600 billion. This set of 21 countries and the European Union comprised about 78 percent of global ICT imports in 2021, and as noted, the WTO found that the 82 ITA-1 signatories account for 97 percent of global trade in ITA-covered products. Using these two statistics to scale total global GDP impacts between modeled countries, ITIF finds that global GDP could be expected to cumulatively rise by $766 billion over 10 years if all 82 signatories of ITA-1 were to join the proposed ITA-3.

If all 82 ITA-1 signatory countries were to join the proposed ITA-3, global GDP could cumulatively grow by $766 billion over the ensuing 10 years.

Addressing Developing Countries' Potential Concerns Regarding ITA Accession

While the potential economic benefits for developing countries joining an ITA-3 are evident, some concerns may remain for policymakers. Multiple developing nations, some modeled in this study, still have not joined the ITA in any capacity. Such countries usually justify their nonparticipation in the ITA based on the fear of losing revenues from tariffs on ICT goods or protectionist grounds of seeking to preserve domestic ICT industries and employment. However, ITIF's modeling finds robust evidence regarding tax revenues recovered elsewhere from a growing economy that further justifies ITA membership among developing nations.

ITA Tariffs and Government Finances

Some developing-nation policymakers have argued against joining the ITA believing that tariff revenue from ICT goods imports is too essential to forgo. Tariff revenues on ICT in developing countries are often easily collected and may comprise a considerable share of government revenue, thereby seeming like a stable revenue stream to policymakers. However, ITIF's growth-revenue modeling finds this policy rationale flawed. While in the short run tariffs forgone as a result of ITA accession could create a revenue shortfall, the ICT-fueled growth created from joining the ITA provides alternative sources for raising additional taxes. Most developing countries rely more on tariffs to raise government funds than do developed ones. Figure 11 depicts this, showing that for the 21-country sample and the European Union, developing countries such as Cambodia, India, and Taiwan are the most tariff revenue-intensive nations. Further, developed and emerging countries such as the United Kingdom, Japan, and the European Union are the least tariff revenue intensive, after Malaysia. (Malaysia is an outlier here due to its especially low effective applied rates.)

Figure 11: Tariff revenue as a share of GDP, 2020[138]

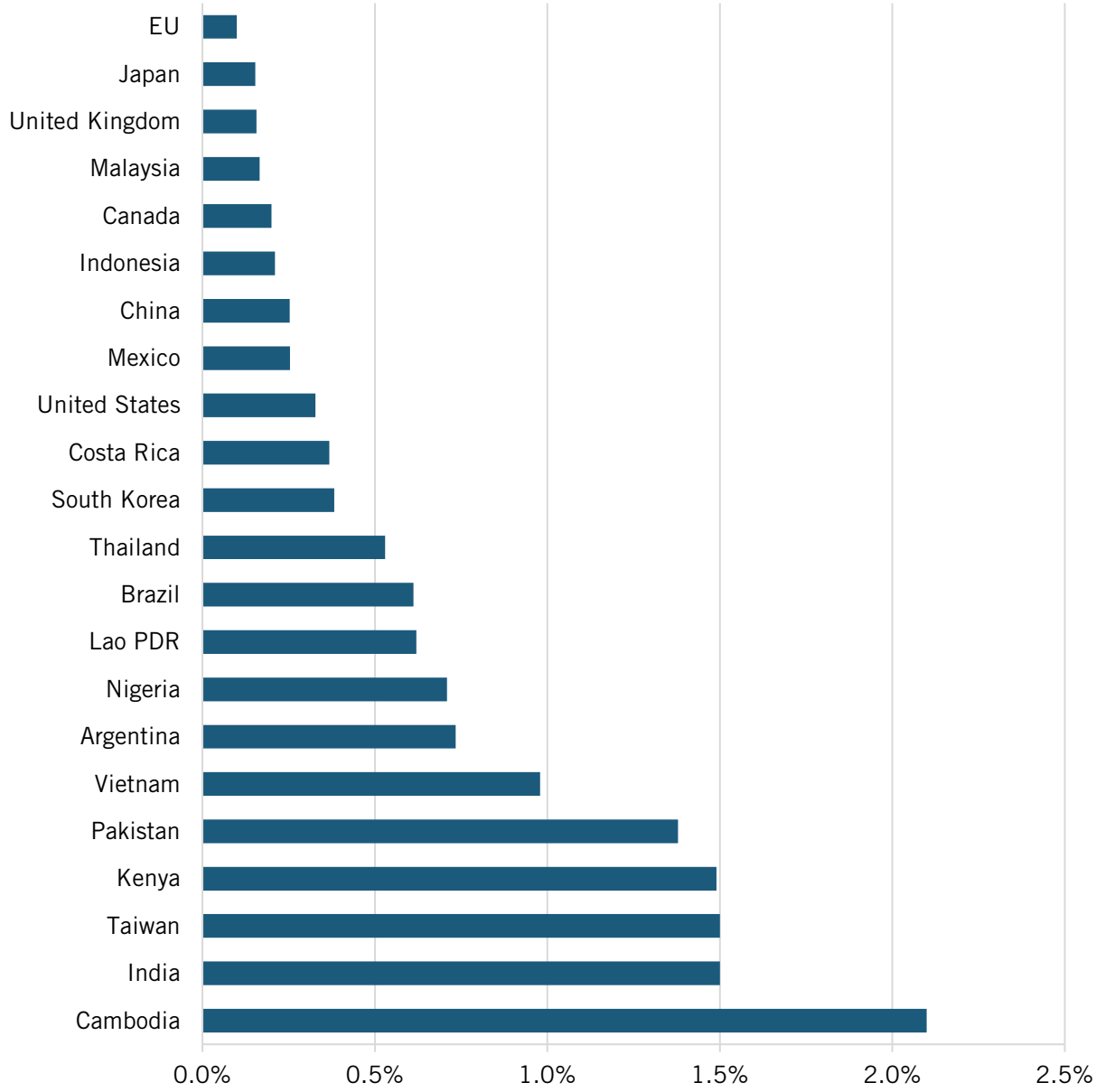
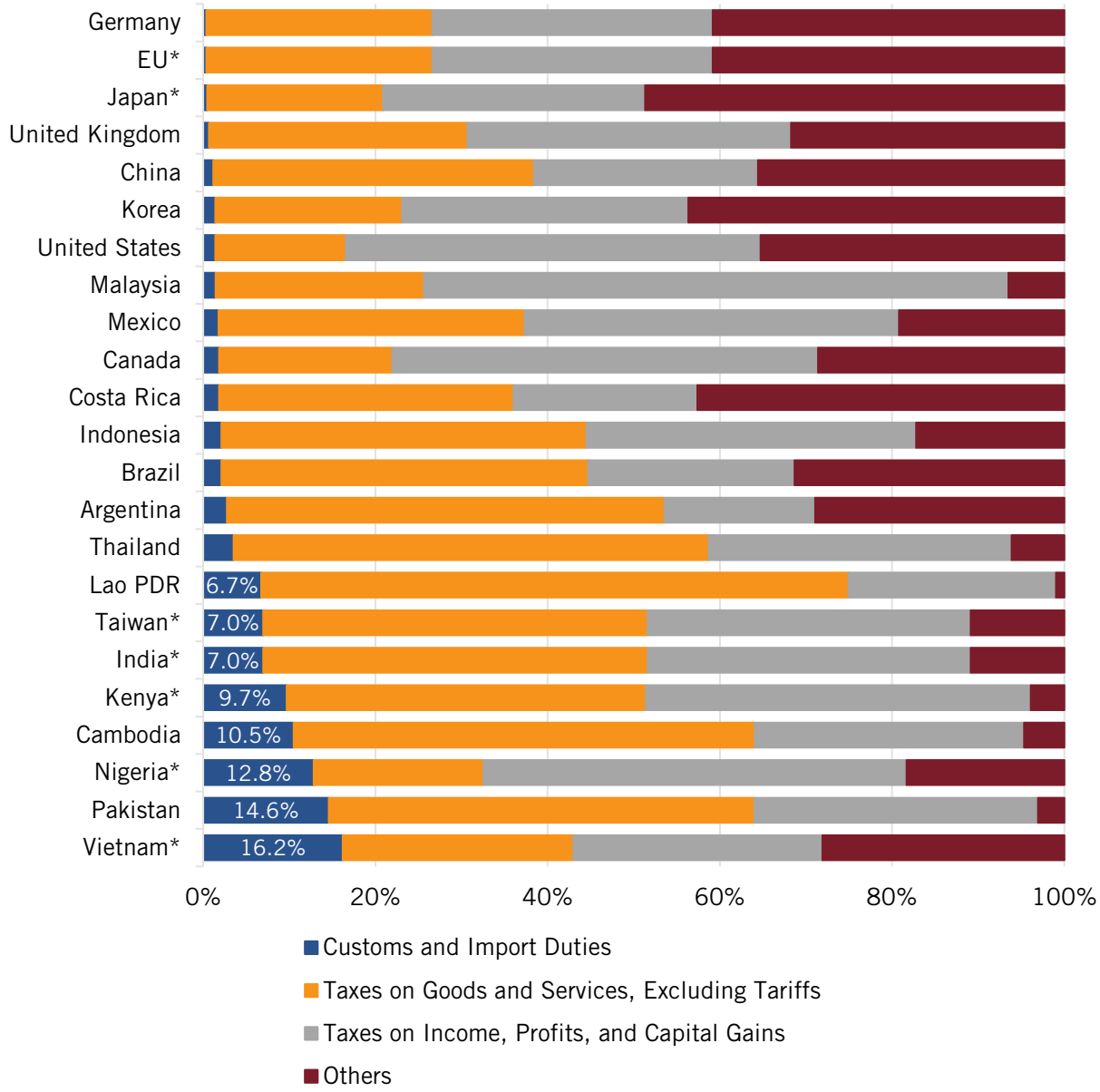


Figure 12 illustrates a similar trend in countries' taxation compositions. Vietnam, Pakistan, Nigeria, Cambodia, Kenya, India, and Taiwan maintained the highest tariff shares of total government taxation in 2021. Pakistan collected 14.6 percent of its taxes via tariffs, whereas the European Union, using Germany as a proxy, was the least tariff reliant with 0.4 percent of its taxes collected from tariffs. Wealthier nations such as the United States, United Kingdom, China, and Korea were less tariff reliant in their taxation.

Figure 12: Tariff revenue as a share of total taxation, 2021 (*=countries that use proxies)[139]



Tax Revenue Analysis Post ITA Accession

To provide complete analysis of the net economic benefits of ITA-3 accession, ITIF analyzed projected tax revenues resulting from each country's entrance into an ITA-3. Combining tax rate data with ITA-3 import data and the growth estimates provided in this paper's previous section, ITIF quantified losses in tariff revenue forgone and the collection of tax revenues made by countries thanks to the ICT-driven growth they could experience from an ITA-3. As a nation's economy grows, businesses increase revenues and workers take home higher incomes and thus increase their consumption. These two main channels—income and consumption—increase tax revenue when an economy is growing. To approximate average tax rates for income and consumption by country, ITIF used OECD data from its GRS database.[140] Income tax (attempting to aggregate national income) is approximated by the GRS database's indicator "Taxes on

Income, Profits, and Capital Gains." Consumption tax (aggregating consumer activity nationwide) is proxied by the GRS indicator "General Taxes on Goods and Services." Table 7 summarizes the tax rates used to assess each country's growth-revenue estimates attributable to ITA-3 accession.

Table 7: Generalized effective tax rates[141]

Country	ITA-3 Tariff Rate	Income Tax Rate	Consumption Tax Rate on Goods and Services
Argentina	6.17%	5.41%	10.87%
Brazil	5.22%	7.04%	11.68%
Cambodia	1.97%	5.90%	6.16%
Canada	0.88%	17.10%	4.70%
China	1.69%	5.37%	6.09%
Costa Rica	1.55%	4.54%	4.54%
EU 27	0.55%	11.90%	6.50%
India	8.28%	7.70%	4.60%
Indonesia	1.27%	3.85%	2.92%
Japan	1.00%	10.09%	4.94%
Kenya	8.47%	6.87%	3.49%
Lao PDR	1.99%	1.84%	2.73%
Malaysia	0.26%	7.52%	1.04%
Mexico	0.75%	7.57%	4.23%
Nigeria	5.96%	2.72%	0.99%
Pakistan	6.57%	3.12%	4.12%
South Korea	1.23%	8.58%	4.20%
Taiwan	3.05%	7.70%	4.60%
Thailand	3.87%	5.75%	3.48%
United States	2.95%	11.71%	2.15%
United Kingdom	1.03%	11.50%	6.49%
Vietnam	1.08%	5.95%	5.44%

The model applies these generalized effective tax rates onto ITIF's estimations of GDP growth attributable to the ITA-3. Table 8 and table 9 summarize the short- and long-run revenue implications of ITA accession. In all short-run cases, removing tariffs on ITA-3 products indeed creates a revenue shortfall. Even countries with the highest share of revenues recovered, such as Argentina and Brazil, whose high tariff rates cause them to recover an estimated 52.5 percent and 52.3 percent of revenue forgone, respectively, still experience a short-term loss. Despite this, Argentina and Brazil already recover more than half of the revenue lost in the first year. Conversely, Lao PDR, Thailand, Malaysia, and Vietnam would be impacted the most in the short term, as these four countries would recover about 10 percent of revenue lost in the first year.

Table 8: Year 1 tax revenue impact from joining an ITA-3[142]

Country	Tariff Revenue Forgone (millions)	Consumption Tax Revenue Gained (millions)	Income Tax Revenue Gained (millions)	Revenue Gained as Percentage of Revenue Foregone
Argentina	$134.5	$19.0	$51.5	52.5%
Brazil	$472.7	$71.8	$175.4	52.3%
Cambodia	$9.3	$0.7	$0.8	16.5%
Canada	$171.6	$10.5	$66.4	44.8%
China	$1,443.5	$114.2	$428.5	37.6%
Costa Rica	$16.0	$0.9	$1.3	13.9%
EU 27	$666.9	$56.4	$263.4	47.9%
India	$1,232.0	$73.7	$501.3	46.7%
Indonesia	$84.8	$3.2	$14.6	21.0%
Japan	$303.6	$19.5	$112.0	43.3%
Kenya	$44.7	$2.0	$15.1	38.3%
Lao PDR	$3.9	$0.1	$0.2	8.9%
Malaysia	$21.6	$0.3	$1.9	10.1%
Mexico	$274.3	$15.1	$17.5	11.9%
Nigeria	$88.6	$1.1	$22.2	26.3%
Pakistan	$113.4	$6.1	$21.8	24.6%
South Korea	$283.9	$15.5	$48.3	22.5%
Taiwan	$386.4	$23.1	$48.7	18.6%
Thailand	$492.1	$22.3	$25.6	9.7%
United States	$4,804.5	$134.2	$1,913.1	42.6%
UK	$278.0	$23.4	$92.2	41.6%
Vietnam	$198.4	$14.0	$6.3	10.3%

Table 9: Year 10 tax revenue impact from joining an ITA-3

Country	Tariff Revenue Forgone (millions)	Consumption Tax Revenue Gained (millions)	Income Tax Revenue Gained (millions)	Revenue Gained as Percentage of Revenue Foregone
Argentina	$234.6	$33.2	$542.6	245%
Brazil	$1,351.5	$205.3	$2,241.3	181%
Cambodia	$55.8	$4.5	$14.8	35%
Canada	$267.1	$16.3	$796.5	304%
China	$4,345.9	$344.0	$7,911.9	190%
Costa Rica	$24.8	$1.5	$16.5	72%
EU 27	$1,483.1	$125.3	$3,417.5	239%
India	$4,186.4	$250.3	$7,795.4	192%
Indonesia	$210.4	$8.0	$218.6	108%
Japan	$525.2	$33.7	$1,234.3	241%
Kenya	$89.8	$4.1	$219.2	249%
Lao PDR	$8.8	$0.3	$3.4	43%
Malaysia	$46.3	$0.6	$26.2	58%
Mexico	$524.7	$28.8	$201.7	44%
Nigeria	$219.2	$2.8	$280.0	129%
Pakistan	$360.7	$19.3	$336.3	99%
South Korea	$712.2	$38.9	$678.6	101%
Taiwan	$1,141.8	$68.3	$786.6	75%
Thailand	$1,025.1	$46.4	$313.8	35%
United States	$8,525.6	$238.1	$24,355.6	288%
UK	$338.7	$28.6	$983.3	299%
Vietnam	$730.8	$51.6	$117.6	23%

However, significant losses in the short run don't necessarily mean large losses over the long run. These macroeconomic net effects recover as time passes and ICT bolsters the economy. By Year 10, Malaysia recovers more than half of the annual revenue hole created from eliminating ITA-3 tariffs. In Year 1, Lao PDR and Thailand recover smaller shares of revenue forgone than Vietnam, but by Year 10, Vietnam's share of taxes recovered only rises by about 13 percentage points.

ITA-3 accession is an especially win-win trade policy for nations estimated to experience economic growth while also fully closing their tariff revenue hole by Year 10. For instance, Kenya grows its economy by 2.3 percent after 10 years of cumulative ICT-induced growth. It also recovers 249 percent of tariff revenue forgone during its 10th year after joining the ITA-3, more than completely filling the revenue shortfall created from eliminating the tariffs. India, after 10 years, grows its economy by over 2.5 percent and recovers 192 percent of revenue forgone. India's new tax revenue in Year 10 nearly doubles the value of tariff revenues forgone in Year 10 due simply to the fact that its expected GDP growth raises income and consumption taxes collected.

Tariff losses in the short run from ITA-3 accession don't necessarily indicate large revenue losses over the long run, thanks to the increased economic growth ITA participation engenders.

Moreover, the European Union and Kenya both recover about the same share of revenue foregone: 239 and 249 percent, respectively. While the European Union and Kenya differ in their ITA-3 tariff rates and total GDP growth attributable to ITA-3, they experience roughly the same shares of revenue recovered in Year 10 because of the European Union's larger absolute GDP but slower GDP growth rate in the status quo before joining the ITA-3. The European Union's 2021 real GDP was over 168 times larger than Kenya's, so the nation raises higher total revenues that make its share of recovered revenue in Year 10 similar to Kenya's. Argentina's generalized effective tax rates are also unique to the set. It's the only country in the study whose consumption tax is more than twice as high as its income rate. Argentina's low income tax rate of 5.41 percent means that its government may expect a lower rate of return than would other countries on taxable growth. Even so, it remains a top beneficiary of an ITA-3 in both growth and revenue recovery. Of the 21 countries and the European Union, 12 countries and the European Union create more tax revenue than they forgo by the 10th year after ITA-3 accession. Further, four more countries—Pakistan, Taiwan, Costa Rica, and Malaysia—recover over half of their tariff revenue shortfall by Year 10.

Two notable outliers in the study are Cambodia and Vietnam with their low share of forgone revenue recovered in Year 10. Cambodia recovers 35 percent and Vietnam recovers just 23 percent. Their outlier status is due mainly to three factors. First, they are developing nations with lower absolute GDP than other countries in the study. Second, they have exceptionally high annual import growth rates in the status quo with no ITA-3 accession, at rates more than double their average yearly GDP growth rates. And third, the two nations have low average tariff rates on ITA-3 goods. These three economic characteristics lower the marginal value of taxing GDP growth instead of import growth. With high import growth rates (19.7 percent for Cambodia and 13.9 percent for Vietnam) in the status quo, and also low tariff rates, these countries are rare exceptions wherein imports are relatively price inelastic. Import growth remains high even with minor tariffs imposed, so their marginal increase in imports by lifting ITA-3 tariffs is less

valuable for revenue creation than for other countries in the study. These circumstances, however, do not indicate that these countries, or any other country in the model, lack clear economic benefits from joining an ITA-3. All countries still experience valuable GDP growth over 10 years attributable to an ITA-3. However, some countries would still face long-run trade-offs in their revenue policy when considering joining the ITA-3. But for almost every country examined in this model, that trade-off is clear: ITA-3 accession promotes increased consumption of ICT imports, which increases a nation's ICT capital stock. A growing ICT capital stock produces numerous positive economic benefits by raising productivity and expanding access to digital services. Productivity-enhancing ICT expansion ultimately drives at-large economic growth.

Further Implications for Developing Nations

Bridging the Digital Divide

Joining the ITA provides a pro-growth alternative for nations to collect tax revenues more efficiently, while helping developing countries bridge the digital divide, participate in global technology supply chains, and improve quality of life in a larger and more-productive economy. Among study countries, most identify as developing economies under the WTO (although China should now certainly be accounted for as a developed economy, especially with respect to the ICT sector). While members of the WTO declare their development status because the WTO provides no formal definition between developed and developing countries, some general disparities still remain. Developing nations typically have lower GDP per capita and lower overall standards of living.[143]

One particular line observed between developed and developing countries is the growing digital divide between them. Developing nations, lagging behind the developed world's level of digital services, technology innovations, and overall ICT capital stock, have a unique advantage in joining the ITA. As detailed in the previous section, joining the ITA-3 provides clear economic growth potential, which can help countries recover a large share of tax revenue forgone. In addition, an expansion in ICT capital stock achieved by joining the ITA is a benefit all its own for developing nations. Beyond implications on growth and revenue, developing countries' improving access to world-leading technologies used by global pacesetters improves their competitive edge and produces other positive externalities through the proliferation of new ICT-powered digital services and participation in GVCs.

In most cases, developing nations experience more significant cumulative growth in their ICT capital stock over 10 years than do developed ones. While developed nations would create more considerable additions to their ICT capital stock in absolute terms, their percentage growth is heavily outweighed by developing partners. On average, in this sample, developing nations can anticipate a 10-year growth in their net ICT capital stock of 80 percent due to an ITA-3, whereas developed ones (European Union, Japan, South Korea, the United Kingdom, Canada, and the United States) only realize a 38 percent increase. (See table 10.)

Table 10: Nations' ICT capital stock growth resulting from an ITA-3 accession[144]

Country	Real GDP per Capita, 2021	Annual Real GDP Growth Rate (2017–2021)	Net ICT Capital Stock, Year 1 (millions)	Cumulative 10-Year % Growth in Net ICT Capital Stock Attributable to ITA-3	Cumulative 10-Year Growth in Net ICT Capital Stock Attributable to ITA-3 (millions)
Argentina	$13,448	-0.27%	$6,777	36.45%	$2,470
Brazil	$8,538	1.01%	$27,075	78.85%	$21,349
Cambodia	$1,428	4.27%	$1,281	183.73%	$2,354
Canada	$43,948	1.40%	$57,877	27.53%	$15,936
China	$11,188	6.00%	$223,096	101.83%	$227,180
Costa Rica	$12,894	2.54%	$2,941	32.69%	$993
EU 27	$34,021	1.44%	$357,550	50.57%	$180,826
India	$1,977	3.81%	$41,063	119.90%	$49,236
Indonesia	$3,893	3.38%	$18,615	69.54%	$12,944
Japan	$35,291	-0.17%	$94,550	27.97%	$26,449
Kenya	$1,706	4.37%	$1,434	71.25%	$1,022
Lao PDR	$2,655	5.07%	$530	69.61%	$369
Malaysia	$10,570	2.52%	$23,831	51.84%	$12,354
Mexico	$9,525	0.17%	$111,728	35.13%	$39,248
Nigeria	$2,437	1.36%	$4,404	69.31%	$3,052
Pakistan	$1,637	3.66%	$4,789	107.15%	$5,132
South Korea	$32,731	2.35%	$66,640	65.54%	$43,674
Taiwan	$31,071	4.19%	$34,646	93.82%	$32,505
Thailand	$6,126	1.18%	$37,827	50.87%	$19,242
United States	$61,830	2.13%	$470,941	42.03%	$197,917
UK	$45,304	0.45%	$82,163	11.51%	$9,455
Vietnam	$3,409	5.44%	$48,392	119.72%	$57,935

Benefits of ITA-3 Membership by Regional Organization or Economic Agreement

In addition to analyzing the economic impact of individual countries and the European Union, ITIF's study also examines the impact of possible ITA-3 membership by region and economic agreement. The 21 countries in the study and the European Union were grouped into five regions to further analyze the impact of a possible ITA-3. The five regions are the Americas, Asia, Africa, Europe, and the Middle East. Moreover, the study examines the collective impact of ITA-3 membership on Asia-Pacific Economic Cooperation (APEC) and ASEAN countries.

Table 11 summarizes key findings from this regional analysis of potential ITA-3 accession. ITIF has found that if the Middle Eastern countries studied in the report joined an ITA-3, the region would stand to grow the most 10 years post accession, or 1.99 percent greater than without accession. The economies of the other regions could also grow between 0.18 percent and 1.86 percent 10 years post ITA-3 accession. All regions, except the Middle East, could expect to recover their tariff revenues foregone from the tax revenue generated from greater consumption and economic growth. Africa and Europe are expected to recover the most tax revenue, at 228 and 249 percent of tariffs forgone, respectively. The Middle East is also expected to recover almost all (98.6 percent) of its foregone tariffs.

Table 11: Regional economic and tariff impact of ITA-3 accession[145]

Region	GDP (2021, billions)	Weighted Average Effective Applied ITA Tariff Rate	Year-1 GDP Growth Attributable to Full ITA Membership	Cumulative 10-Year GDP Growth Attributable to Full ITA Membership	Cumulative 10-Year GDP Growth Attributable to Full ITA Membership (billions)	Tax Revenue Generated, as Share of Tariff Revenue Forgone (%)	Difference in Tax Revenue during Year 10 of ITA Accession (millions)
Americas	$25,929	2.61%	0.07%	0.73%	$226.8	195.13%	$10,269
Asia	$27,675	2.12%	0.06%	0.64%	$265.6	146.07%	$5,559
Africa	$611	6.64%	0.18%	1.86%	$13.6	228.46%	$370
Europe	$18,250	0.64%	0.02%	0.18%	$38.0	249.01%	$2,757
Middle East	$379	6.57%	0.18%	1.99%	$10.8	98.59%	-$5
APEC	$47,059	1.94%	0.05%	0.57%	$362.3	175.25%	$13,404
ASEAN	$2,235	0.94%	0.03%	0.29%	$8.7	44.01%	-$634

The APEC and ASEAN countries in our study could expect to grow 0.57 and 0.29 percent, respectively, 10 years post-ITA accession. In absolute terms, this means the APEC region could expect $362 billion in GDP growth and ASEAN could realize $8.7 billion. APEC countries would be able to recover their tax revenue foregone (175 percent) from eliminating tariffs and ASEAN countries could expect to recover almost half (44 percent) of tariff revenue foregone. ASEAN's low tax revenue generated as a share of tariff foregone is partially because five of the six ASEAN countries in our dataset (Indonesia the exception) couldn't sufficiently recover tariffs foregone.

Among specific nations, three stand out in particular that could especially benefit from full ITA accession: Costa Rica (joining an ITA-3), the Dominican Republic (joining an ITA-3), and Vietnam (joining ITA-2 and ITA-3). That's particularly so because those countries are richly poised to benefit from the ongoing restructuring of GVCs for the production of ICT goods. Box 1 examines these nations' ICT economies in further detail.

Box 1: The Benefits of Full ITA Participation for Costa Rica, the Dominican Republic, and Vietnam

Costa Rica

Between 1995 and 2022, Costa Rica's exports of ICT services grew from $57 million to over $1.8 billion.[146] Those exports represent a nontrivial segment of Costa Rica's traded services. In 2022, ICT services comprised almost 16 percent of the country's services exports. That was up from only about 5 percent for service exports in 1995.[147] Additionally, the information and communications services sector provides about 45,800 Costa Rican jobs.[148]

Entrance into an ITA-3 would provide considerable support to Costa Rica's ICT workforce. It would also have additional effects on the ICT industry and the country's economy more broadly. ITIF estimates that doing so would increase the country's ICT capital stock by around $21 million, as shown in table 4. Additionally, ITIF estimates that Costa Rica's 10-year GDP would increase by around $400 million, or 0.42 percent, as shown in table 1.

Dominican Republic

The Dominican Republic has a relatively small, but quickly growing, ICT sector. Exports of ICT goods have nearly tripled from about $94 million in 2010 to $278 million in 2021.[149] Similarly, between 2012 and 2021, those exports more than doubled from 0.9 percent to 2.4 percent of all goods exports.[150] On top of ICT goods exports, there has also been noticeable growth in exports of ICT services, which grew from about $174 million in 2005 to $483 million in 2016.[151] Additionally, information and communications industries employ around 45,400 persons, which is about 1 percent of the country's non-farm labor force.[152] In addition to its ICT goods and services exports, the country also imports a fair amount of ICT goods, which have grown from being 2.6 percent to 5.0 percent of all goods imports from 2004 to 2021.[153]

The Dominican Republic's government already offers tax incentives via the establishment of free economic zones.[154] The country also offers logistical advantages over its regional competitors, as its infrastructure ranks among the best in Latin America and the Caribbean.[155] The Dominican Republic should consider supporting the latest proposed expansion of the ITA. Doing so would not only exert a positive effect on the ICT industry, but also by continuing to provide a zero-in/zero-out tariff environment for all ITA-covered goods, the country could maximize its attractiveness as a location for semiconductor assembly, test, and packaging value chain activity while also bolstering its economy more broadly. Moreover, by reducing tariffs on (and thus the prices of) ICT goods via entrance into an ITA-3, the Dominican Republic could experience an increase in its ICT capital stock, which, in turn, would result in long-term productivity gains and greater competitiveness of its ICT exports.

Vietnam

ICT goods have grown to become a significant component of Vietnam's traded sector. Exports of ICT goods have risen from constituting 5.4 percent of its goods exports in 2000 to almost 39 percent of goods exports in 2020.[156] The information and communications services sector also employs almost 314,000 workers.[157]

Joining the ITA-3 would be especially critical for Vietnam's ICT exporters. ITIF estimates that Vietnam's ICT capital stock would increase by around $258 million, as shown in table 4. Additionally, ITIF estimates that Vietnam would add around $2 billion, or 0.35 percent, to its 10-year GDP, as shown in table 1.

Assessment of Full ITA Membership for Non-ITA or ITA-1-Only Nations

In addition to analyzing the economic impacts of the proposed ITA-3, ITIF's study also examines the economic impact of full ITA accession for the study countries that aren't yet fully in either the ITA-1 or ITA-2, which for this analysis meant analyzing Argentina, Brazil, Cambodia, Kenya, Lao PDR, Mexico, Nigeria, and Pakistan's full accession to the ITA (ITA-1, ITA-2, and ITA-3) and for Vietnam, India, and Indonesia, their joining the ITA-2 and ITA-3.[158]

If Brazil and Pakistan joined the ITA all the way through the here-proposed ITA-3, they could expect their economies to become 8.6 percent and 7.7 percent larger, respectively, after 10 years than would otherwise be the case.

Table 12 summarizes key findings from an economic analysis of these countries' potential full ITA accession. The analysis finds that if Brazil and Pakistan joined the ITA in full, each could expect their economy to cumulatively grow to be approximately 8.6 and 7.7 percent higher, respectively, than would otherwise be the case over the 10 years post ITA-3 accession. The economies of the other nations without any access to the ITA could grow between 0.49 and 6.8 percent 10 years post ITA-3 accession. Five of the eight countries without ITA accession would more than fully recover their tariffs forgone after 10 years and Lao PDR and Mexico would come close (more than half of the way there) while Cambodia would need to seek revenue alternatives.

Of the three remaining countries with ITA-1 accession, Vietnam and Indonesia could expect a lower growth of 0.44 and 0.77 percent, respectively. Their lower growth compared to nations without any ITA accession is partially because both are already part of ITA-1. India is an outlier in this group because it could expect its economy to grow 8 percent 10 years post ITA-2 and ITA-3 accession. This is because of its higher average effective ITA applied tariff rate compared with Vietnam and Indonesia. Two of these three countries—India and Indonesia—could fully recover their tariffs foregone after 10 years while Vietnam (due to its unique tax structure) would need to seek revenue alternatives.

Under full ITA accession, all nations modeled would experience more improvement in long-run growth than in the scenario of just joining the ITA-3. These estimates vary in their marginal improvements based on a country's intensity of tariffs and volume of trade for products included under ITA-1 and ITA-2. But extending the methodology for ITA-3 estimates to full ITA membership introduces modeling limitations. For instance, calculating net ICT capital stock in the status quo when tracking all products covered in full ITA membership gives a larger estimate for a nation's base value of ICT capital stock in the status quo (before any ITA adoption) than would be estimated with just ITA-3 products. So to maintain consistency when analyzing countries within the model, the same estimates for base ICT capital stock in the ITA-3 model are applied to full ITA models.

Table 12: The economic and tariff impact of full ITA membership, select nations[159]

Country	GDP (2021, billions)	Weighted Average Effective Applied ITA Tariff Rate	Year-1 GDP Growth Attributable to Full ITA Membership	Cumulative 10-Year GDP Growth Attributable to Full ITA Membership	Cumulative 10-Year GDP Growth Attributable to Full ITA Membership (billions)	Tax Revenue Generated, as Share of Tariff Revenue Forgone (%)	Difference in Tax Revenue during Year 10 of ITA Accession (millions)
Argentina	$616	5.2%	0.56%	6.1%	$36.7	264.9%	$1,309
Brazil	$1,830	7.1%	0.71%	8.6%	$174.6	170.0%	$5,513
Cambodia	$24	2.7%	0.20%	2.4%	$0.9	29.9%	-$156
Kenya	$90	5.1%	0.45%	4.3%	$5.9	368.6%	$302
Lao PDR	$20	1.3%	0.09%	0.9%	$0.3	75.7%	-$2
Mexico	$1,207	0.5%	0.04%	0.5%	$6.0	58.3%	-$370
Nigeria	$520	7.5%	0.62%	6.8%	$40.3	121.0%	$192
Pakistan	$379	6.2%	0.71%	7.7%	$41.6	103.6%	$48
Vietnam	$332	0.3%	0.04%	0.4%	$2.5	23.2%	-$697
India	$2,782	7.1%	0.76%	8.0%	$323.6	198.8%	$12,764
Indonesia	$1,066	0.9%	0.07%	0.8%	$11.5	108.6%	$36

Second, average effective applied tariff rates between products in full ITA coverage may be lower than rates calculated solely for ITA-3 in some countries if they simply have lower average effective tariffs applied on ITA-1 and ITA-2 products than they do on ITA-3 goods. With a lower average effective tariff rate on full ITA membership, growth could be underestimated compared with ITA-3 estimates, even when full ITA membership accounts for more imports. To help correct for this, ITIF calculated trade volume-weighted average tariff rates per country to more accurately reflect tariff rates applied to ITA-3 goods and previous ITA goods. Despite these limitations, the results regarding the economic impacts of full ITA accession add robustness to the findings reported by the general ITA-3 model. Smaller developing nations such as Vietnam and Kenya still find their ICT capital stock growing at much faster rates than do developed ones from joining the ITA. Moreover, all countries, regardless of their development status, enjoy higher economic growth cumulatively over 10 years and, through regular taxation on consumption and income, recover some or all of their tariff revenue forgone to spur ICT-driven growth.

THE IMPACT OF ITA-3 EXPANSION FOR THE UNITED STATES

Evidence suggests that the ITA has been beneficial for the United States, both in terms of fostering the competitiveness of U.S. ICT industries and (as noted earlier) in reducing prices for ICT products that bolster productivity and enhance quality of life, such as personal computers

and TVs. Regarding enhancing the competitiveness of the U.S. ICT sector, a 2016 study by the U.S. International Trade Commission "suggests that the ITA had a positive and statistically significant impact on U.S. exports of the covered products to the ITA member countries. The estimated impact on U.S. exports was $34.4 billion in 2010 (a 56.7 percent increase relative to the baseline)."[160]

ITIF finds that an ITA-3 would also produce considerable benefits for the U.S. economy, including by contributing $208 billion in economic growth over a 10-year period, boosting U.S. exports of ICT products by $2.8 billion, increasing revenues of U.S. ICT firms by $6.9 billion, and supporting the creation of almost 60,000 new U.S. jobs.

U.S. exports of proposed ITA-3 products to the 21 other nations and the European Union in this study tallied $56.3 billion in 2021.[161] Noting that these 21 nations and the European Union account for 75.8 percent of global ICT imports, ITIF applied a scaling factor of 1.32 to account for the exports of ITA-3 products U.S. firms make to other nations not in the study, leaving an estimate that total U.S. exports of proposed ITA-3 products to the world equals $74.2 billion. The country-weighted average of tariffs imposed on ITA-3 products by the 21 other countries in this report (plus EU 27 countries) is 2.9 percent (which ITIF here used as a rough proxy for a global average), so applying this and the aforementioned 1.3 elasticity multiplier suggests that the increase in global import demand for U.S. exports of ITA-3 products would be $2.8 billion.

Given that the U.S. Department of Commerce reports that, for every $1 billion in manufacturing exports, 6,250 jobs in manufacturing companies are created or supported, ITA-3 expansion would directly support the creation of approximately 17,453 jobs.[162] In January 2019, the Economic Policy Institute (EPI) provided updated employment multipliers for certain jobs in the U.S. economy, finding that each 100 jobs in durable manufacturing support an additional 289.1 jobs; that is, they have a multiplier of 2.89.[163] Applying this factor to 17,453 jobs created from the increased exports of ITA-3 products yields 50,438 new U.S. jobs created.

An ITA-3 would also produce considerable benefits for the U.S. economy, including by contributing $208 billion in economic growth over a 10-year period, boosting U.S. exports of ICT products by $2.8 billion, increasing revenues of U.S. ICT firms by $6.9 billion, and supporting the creation of almost 60,000 new U.S. jobs.

However, new American jobs would also be created through an additional dynamic. ITIF estimated, based on applying the previously described dynamics of decreasing tariff rates and the elasticity multiplier, that a fully implemented ITA-3 would result in a $19.8 billion increase in global imports of such ITA-3 products. Since U.S.-headquartered ICT enterprises account for about 34.7 percent of global ICT market share as of 2021, this means a significant share of this increased global demand will be filled by U.S. ICT-headquartered enterprises, even if those U.S. ICT goods manufacturers assemble certain products in Taiwan, China, or elsewhere that are destined for sale in Germany or South Africa.[164] In other words, it's not just about exports from within U.S. borders. Making the ITA larger would expand the overall global ICT market, making the U.S. ICT industry stronger in the process.[165] Thus, U.S. headquartered-enterprises, even if filling export orders from foreign affiliates, subsidiaries, or factories, may capture as much as $6.9 billion of this market. Indeed, even when some of those jobs are filled abroad, they often

support U.S. employment at home, because employment in U.S. parents is likely to increase with increases in U.S. affiliate activity. In fact, one study finds that an increase in U.S. affiliate employment of 1 percent is associated with an increase in parent employment of 0.2 percent.[166] In other words, U.S. affiliate activity abroad is often a complement to, rather than a substitute for, the activity of parent companies in the United States.[167]

Considering that the average revenue per employee of the top 10 U.S. ICT goods manufacturers is about $500,000, this suggests that about 13,712 new workers will be needed to meet this demand. And with the average ratio of U.S. to foreign employees for the top 10 U.S. ICT goods manufacturers being about 0.47, this suggests that about 6,444 new jobs would be located in the United States. Presuming that many of these jobs would likely be in supportive research and development, supply chain, logistics, or other administrative roles, ITIF applied the very modest EPI multiplier of 1.42 for jobs in professional, scientific, and technical services fields to arrive at a total number of about 9,151 new jobs created through this dynamic, thus arriving at the total of 59,590 U.S. jobs created from a possible ITA-3 expansion.[168]

CONCLUSION

The ITA represents one of the world's most successful plurilateral trade agreements. By creating zero-in/zero-out tariff environments, it has played a catalytic role in contributing to the evolution of global ICT GVCs that have enabled countries and enterprises to specialize in market segments wherein they enjoy a competitive advantage for the production of ICT goods. This, for instance, has led to semiconductors becoming the world's fourth-most-traded product.[169] At the same time, by reducing their prices through tariff elimination, the ITA has facilitated greater global consumption of the ICT goods that lie at the heart of and fundamentally make possible the global digital economy. This increasing ICT capital stock within nations bolsters the productivity and innovation capacity of businesses (large and small alike), workers, households, and individuals, translating to increased economic growth for all participants.

Embracing an ITA-3 would expand the range of productivity- and innovation-enhancing ICT products under ITA coverage, ensuring that the most novel, cutting-edge ICT products (including the most-current-generation forms of these technologies) are included. As noted, these products are already delivering significant environmental, health, climate, and production benefits—and nations would be wise to include such products in an ITA-3 both to bolster the competitiveness of their own domestic industries and in the interest of achieving greater domestic, and global, economic growth. Moreover, an ITA-3 would produce considerable economic, export, and employment growth for the United States and the world. Now nearly a decade from when global stakeholders began to consider the initial ITA expansion, and seven years on from ITA-2 implementation, it is time for nations to start thinking about an ITA-3, and carrying forward the robust momentum produced by the original ITA and its 2016 expansion.

APPENDIX A: LIST OF COUNTRIES BY CURRENT ITA MEMBERSHIP[170]

ITA Signatory	Joined ITA-2?	ITA Signatory	Joined ITA-2?
Afghanistan	No	**Liechtenstein**	Yes
Albania	Yes	**Lithuania**	Yes
Australia	Yes	**Luxembourg**	Yes
Austria	Yes	**Macao**	No
Bahrain	No	**Malaysia**	Yes
Belgium	Yes	**Malta**	Yes
Bulgaria	Yes	**Mauritius**	Yes
Canada	Yes	**Moldova**	No
China	Yes	**Montenegro**	Yes
Colombia	Yes	**Morocco**	No
Costa Rica	Yes	**Netherlands**	Yes
Croatia	Yes	**New Zealand**	Yes
Cyprus	Yes	**Nicaragua**	No
Czech Republic	Yes	**Norway**	Yes
Denmark	Yes	**Oman**	No
Dominican Republic	No	**Panama**	No
Egypt	No	**Peru**	No
El Salvador	No	**Philippines**	Yes
Estonia	Yes	**Poland**	Yes
Finland	Yes	**Portugal**	Yes
France	Yes	**Qatar**	No
Georgia	No	**Romania**	Yes
Germany	Yes	**Russia**	No
Greece	Yes	**Saudi Arabia**	No
Guatemala	Yes	**Seychelles**	No
Honduras	No	**Singapore**	Yes
Hong Kong	Yes	**Slovakia**	Yes

ITA Signatory	Joined ITA-2?	ITA Signatory	Joined ITA-2?
Hungary	Yes	**Slovenia**	Yes
Iceland	Yes	**South Korea**	Yes
India	No	**Spain**	Yes
Indonesia	No	**Sweden**	Yes
Ireland	Yes	**Switzerland**	Yes
Israel	Yes	**Taiwan**	Yes
Italy	Yes	**Tajikistan**	No
Japan	Yes	**Thailand**	Yes
Jordan	No	**Turkey**	No
Kazakhstan	No	**Ukraine**	No
Kuwait	No	**United Arab Emirates**	No
Kyrgyz Republic	No	**United Kingdom**	Yes
Latvia	Yes	**United States**	Yes
Lao PDR	Yes	**Vietnam**	No

APPENDIX B: GROWTH-REVENUE ESTIMATES METHODOLOGY

Calculating ITA Trade Flows

Data for calculating trade in ITA goods comes from the UN Comtrade Database. The database provides the value and weight of imports and exports between each country and its trading partners broken down by year and commodity type. Of the three classification systems provided by UN Comtrade, ITIF identified commodities codes covered under the ITA through the HS. Since signatories first formed the ITA in 1996, HS1996 codes have identified product classification of ITA-covered imports. Similarly, negotiating countries of the 2015 ITA expansion identified ITA-covered goods using HS2007 codes. While the HS is extensive, some commodities covered under the ITA lack a relevant HS code, which ITA clauses refer to as "Attachment B" products.

As new iterations of the HS are released, more Attachment B products become accounted for under HS6 codes. Whereas ITIF's 2017 analysis on the ITA utilizing HS2007 six-digit codes counted 144 product codes in the ITA-1 and 201 in the ITA-2, recounting them for this paper's analysis on full ITA accession (plus ITA 3 Proposal) under their HS2017 six-digit codes identifies 223 codes included by ITA-1 and 266 codes in ITA-2. Beyond products recognized by the HS2017 update, ITIF's analysis excludes those remaining Attachment B products for consistency purposes across countries.

From a list of more than 400 recommended product descriptions produced by industry leaders in international ICT trade, ITIF formed a set of 301 unique six-digit product codes according to the HS2017 classification system. To maintain consistency between modeling the ITA-3 with HS2017 codes versus modeling ITA membership in full (including ITA 3 Proposal), HS2007 codes for ITA-1 and ITA-2 identified by ITIF's 2017 study "How Joining the Information Technology Agreement Spurs Growth in Developing Nations" are transposed to corresponding codes under HS2017.[171] Since the HS classification makes significant changes to its product groupings with each update, ITIF changed ITA-1 and ITA-2 codes from HS2007 first to HS2012 and then to HS2017 counterparts to ensure accuracy when comparing present import data for originally identified ITA-1 and ITA-2 products alongside proposed ITA-3 products.

While the most-specific product coding maintained between all countries is at the six-digit level, only some HS six-digit codes listed under ITA coverage have all commodities within their coding included under the enacted/proposed agreement's coverage. To capture the share of items per HS6 codes that are covered, ITIF used adjustment factors calculated from the UN Comtrade Database's harmonized tariff schedule codes (HTS) for the United States, which further designate commodity classifications by 8-digit (HTS8) and even 10-digit (HTS10) codes. Adjustment factors are the shares of U.S. HTS8/HTS10 codes included by ITA coverage out of all products contained by a given HS6 code. Adjustment factors calculated this way are then applied as proxies to adjust import values for all countries in the model set.

In transposing ITA-1 and ITA-2 codes into the HS2017 six-digit level, some codes appear as duplicates in two or even all lists. Duplicate codes appear either due to the six-digit commodity group only being partially covered in one agreement and then partially covered again in the other(s) or due to updates from HS2007 to HS2017 changing the types of commodities within that six-digit commodity line. Because the completed list of ITA products underwent multiple transformations, and in each of those transformations, some commodity codes did not fully

translate onto their updated codes, our finalized data on traded goods contains some degree of unavoidable error. UN Comtrade provides trade flows at the HS2017 six-digit level, and each country's total value of ITA imports is summed based on each HS2017 six-digit line covered in ITIF's list of ITA products. By multiplying these import-value sums per HS2017 six-digit code in every country by their corresponding proxy adjustment factor, ITIF accounted for the total value of HS codes partially covered by the ITA agreement.

Some products, however, within a commodity code may be similar enough to one another to be substituted for certain ICT products. As countries eliminate tariffs on ITA-covered products within a commodity, some consumers of non-ITA-covered substitutes within the same commodity code could expect to switch their demand to the product included by ITA coverage. This substitution effect would induce additional demand beyond what ITIF calculated using import demand elasticities, thus making capital stock growth from ITA accession more significant than what ITIF can compute from its growth-revenue model.

Calculating ITA Tariffs

Data for estimating the value of tariffs comes from the World Bank's World Integrated Trade Solution (WITS) TRAINS database. ITIF's model takes tariff line rates from the database and collapses that data to an HS6 basis using a simple average for each country. WITS TRAINS imports data provides most-favored-nation rates and preference rates between countries, allowing ITIF to produce trade-value-weighted average tariff rates applied to ITA products. The value of ITA tariff revenues are derived from the relative share of reported tariff revenues collected by the government. Data on the total reported tariff revenues collected by each country's government comes from OECD's GRS Database. Since OECD data does not include Taiwan and India, the entry for Asia-Pacific approximates it instead. OECD data also did not provide tariff revenue figures for Vietnam. As a result, the excise tax on imports as a share of GDP was used with 2021 official GDP figures as a proxy. Therefore, the model assumes all international trade tax revenues are equivalent to tariff revenues. When extending this assumption, other tax-revenue sources collapse into broader categories to target specific tax effects when eliminating ITA tariffs.

ITIF calculated tariff revenue obtained from ITA imports by multiplying the import value of each ITA HS six-digit commodity by its corresponding most-favored-nation/preference-adjusted tariff derived from the WITS database. Next, the model takes the total reported WITS tariff revenue for all ITA imports. The first estimate expresses the unadjusted value of ITA tariff revenue as a share of total unadjusted tariff revenue. The model likely overestimates unadjusted tariff revenue because it does not discriminate against the country expectedly importing more from partners with which it has existing trade agreements. However, by adjusting this share by the actual tariff revenue obtained from the government, a suitable estimate for tariff revenue gained through ITA imports is derived, which partially accounts for the heterogeneity of tariffs across products and acknowledges ITA trade agreements' tariff revenue-distorting effects.

Some further friction may occur within the adjusted ITA tariff revenues due to countries reporting their tax revenues by fiscal year compared with trade data reported by calendar year. ITIF calculated the real effective tariff rate on ITA products, once adjusted by the actual tariff revenue, by dividing the total value of ITA imports by the adjusted tariff revenue from ITA imports.

APPENDIX C: ITA PRODUCT CODES

Table 13, table 14, and table 15 provide references of all HS2017 codes that include ITA products. However, not all products in a code are ITA products.

Table 13: HS2017 codes included in the original Information Technology Agreement[172]

ITA-1							
381800	847030	847982	851780	852499	853339	854270	901042
701710	847040	847989	851781	852510	853340	854280	901049
841989	847050	847990	851782	852520	853390	854290	901110
841990	847090	848071	851790	852530	853400	854310	901120
842119	847110	848610	851810	852540	853650	854311	901190
842191	847120	848620	851829	852550	853669	854330	901210
842489	847130	848630	851830	852560	853690	854370	901290
842490	847141	848640	851950	852580	854110	854380	901720
844331	847149	850440	852020	852790	854121	854381	901790
844332	847150	850450	852311	852810	854129	854389	902610
844339	847160	851410	852312	852820	854130	854390	902620
844399	847170	851420	852313	852910	854140	854441	902680
845610	847180	851430	852320	852990	854150	854442	902690
845611	847190	851490	852329	853120	854160	854449	902720
845612	847191	851710	852340	853190	854190	854451	902730
845690	847192	851711	852341	853210	854213	854470	902750
845691	847193	851712	852349	853221	854214	854800	902780
845699	847199	851718	852351	853222	854219	854890	902790
846410	847290	851719	852380	853223	854221	900659	903040
846420	847310	851720	852390	853224	854229	900911	903081
846490	847321	851721	852421	853225	854230	900921	903082
846691	847329	851722	852422	853229	854231	900990	903089
846900	847330	851730	852423	853230	854232	900991	903090
846910	847340	851740	852431	853290	854233	900992	903140
846911	847350	851750	852439	853310	854239	900993	903141

ITA-1							
847010	847710	851761	852440	853321	854240	900999	903149
847021	847790	851762	852490	853329	854250	901020	903190
847029	847981	851769	852491	853331	854260	901041	

Table 14: HS2017 codes included in the first expansion of the Information Technology Agreement[173]

ITA-2							
350691	844399	848690	852010	852691	854231	901310	902490
370130	845611	850440	852031	852692	854232	901320	902519
370199	845612	850450	852032	852711	854233	901390	902590
370500	845620	850490	852033	852712	854239	901410	902710
370590	845630	850590	852039	852713	854290	901420	902780
370790	845690	851430	852090	852719	854320	901480	902790
390799	846221	851490	852110	852721	854330	901490	902830
841459	846229	851519	852190	852729	854340	901510	902890
841950	846599	851521	852290	852731	854370	901520	903010
842010	846610	851529	852321	852732	854389	901540	903020
842129	846620	851580	852329	852739	854390	901580	903031
842139	846630	851590	852330	852790	880250	901590	903032
842199	846692	851720	852340	852791	880260	901790	903033
842320	846693	851761	852341	852792	880390	901811	903039
842330	846694	851762	852349	852799	880520	901812	903083
842381	847210	851769	852351	852812	880521	901813	903084
842382	847290	851770	852352	852813	880529	901819	903089
842389	847340	851810	852359	852821	900120	901820	903090
842390	847520	851821	852380	852822	900190	901850	903110
842489	847521	851822	852410	852849	900219	901890	903149
842490	847590	851829	852421	852871	900220	902150	903180
842839	847619	851830	852422	852910	900290	902190	903190

ITA-2							
842890	847689	851840	852423	852990	900912	902211	903220
843139	847690	851850	852432	853180	900922	902212	903281
844230	847720	851890	852451	853190	900930	902213	950410
844240	847730	851921	852452	853630	901020	902214	950430
844250	847740	851929	852453	853650	901030	902219	950450
844331	847759	851940	852460	853690	901050	902221	950490
844332	847780	851981	852520	853810	901060	902229	
844339	847990	851989	852530	853939	901110	902230	
844351	848610	851991	852550	854210	901180	902290	
844360	848620	851992	852560	854211	901190	902300	
844390	848630	851993	852580	854212	901210	902410	
844391	848640	851999	852610	854220	901290	902480	

Table 15: HS2017 codes included in the proposed second expansion of the Information Technology Agreement

ITA-3							
280461	391620	750210	842211	847529	851440	854099	901730
281122	391690	750890	842240	847590	851610	854310	901780
281290	391740	760110	842310	847790	851650	854330	901814
281820	391910	760519	842710	847950	851660	854370	901831
282300	391990	761290	843311	847989	851671	854419	901832
282590	392049	761699	845011	847990	851679	854420	901839
282619	392099	800110	845640	848071	851680	854442	901890
282739	392119	800700	845650	848180	851690	854449	901910
283090	392190	810194	845710	848410	851920	854519	901920
284590	392310	810199	845720	850131	851930	854690	902140
284690	392390	810294	845730	850133	852210	854710	902290
285000	392490	810320	845811	850134	852721	854720	902511
285390	392610	810390	845891	850161	852842	854790	902580

ITA-3							
292090	392690	810520	845921	850162	852852	871160	902810
292111	400510	810820	845931	850163	852859	880211	902820
293139	540771	810890	845941	850164	852862	880212	902910
293190	560311	811219	845951	850231	852869	880220	902920
320890	591140	811221	845961	850431	852872	880230	902990
321410	680421	811229	845970	850511	852873	880240	903210
321590	681510	811292	846012	850519	853110	880260	903289
340220	690911	811299	846022	850590	853540	900110	903290
340290	690912	820239	846023	850610	853590	900211	903300
340590	690919	820890	846024	850640	853610	900490	910291
350691	700220	830130	846031	850650	853641	900510	910511
350699	700231	830140	846040	850660	853669	900580	911320
370242	700600	841381	846090	850680	853670	900590	911390
370710	701710	841410	846120	850720	853710	900630	940169
380110	702000	841490	846130	850730	853890	900691	940310
381010	710691	841583	846150	850740	853950	900699	940320
382499	710813	841810	846190	850750	854011	900850	940390
390230	711590	841821	846231	850760	854012	901090	940540
390290	720390	841911	846241	850780	854020	901310	940592
390469	732690	841919	846291	850790	854040	901380	950300
390599	740319	841950	846299	850980	854060	901390	950450
390730	740819	841989	846510	851290	854079	901530	950691
390740	740829	842121	846592	851310	854081	901600	950691
391000	740919	842129	846595	851410	854089	901710	
391610	741999	842139	847480	851430	854091	901720	

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About ITIF

The Information Technology and Innovation Foundation (ITIF) is an independent, nonprofit, nonpartisan research and educational institute focusing on the intersection of technological innovation and public policy. Recognized by its peers in the think tank community as the global center of excellence for science and technology policy, ITIF's mission is to formulate and promote policy solutions that accelerate innovation and boost productivity to spur growth, opportunity, and progress.

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