

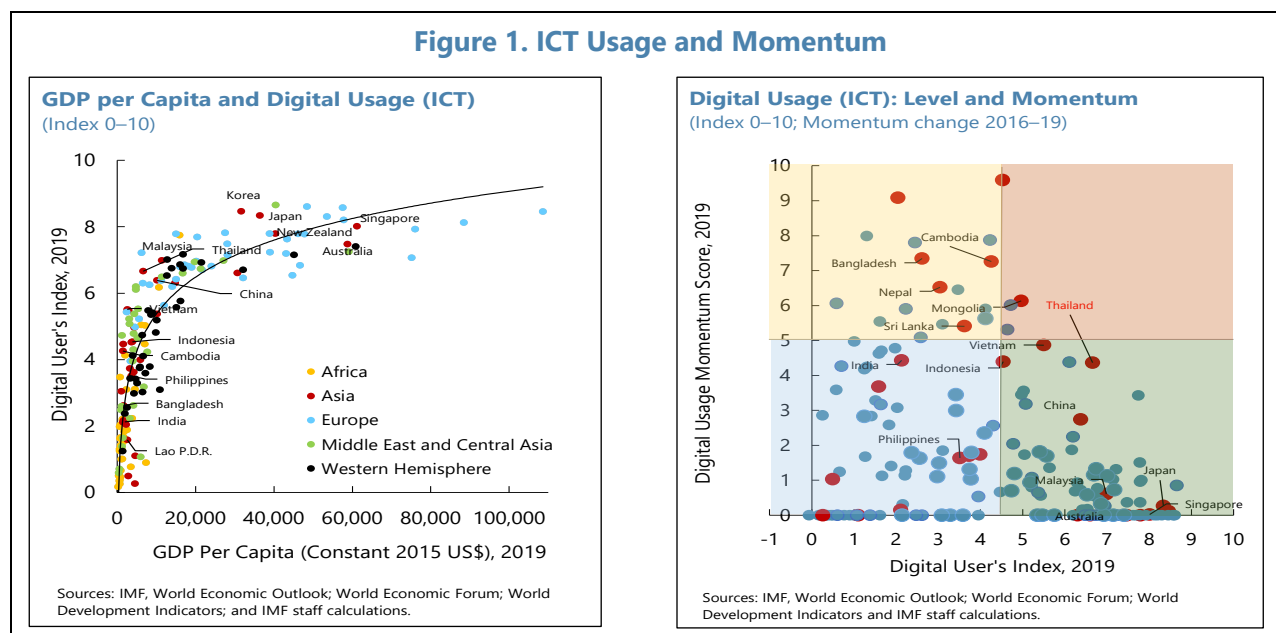
# DIGITALIZATION AND EXPORT SOPHISTICATION: MOVING TO A RESILIENT GROWTH MODEL<sup>1</sup>

Thailand has made significant progress in digital development, including through its industrial transformation policy (Thailand 4.0). In line with the global trend, the COVID-19 pandemic and associated safe distancing measures have further accelerated the digital revolution. Empirical analysis, using granular product-level export data, suggests that digitalization (ICT infrastructure and usage, industrial robot installation and patents) is positively associated with higher export sophistication. While digitalization has been increasing in Thailand, there is sizable scope to further expand digital infrastructure and research and development. The analysis suggests that a multi-pronged approach with emphasis in three key dimensions—technology, investment and training—is needed to appropriately reap the benefits from digitalization.

## A. The Digital Economy Landscape in Thailand

**1. Holistic measures of digitalization are still lacking.** A narrow definition of digitalization refers to the information and communication technology (ICT) sector. IMF (2018) proposed a broad definition of the digital economy that includes both the ICT sector and parts of traditional sectors that have been integrated with digital technology. Considering the diversity of digital innovations—and its pervasiveness across various dimensions of economic activity—this chapter assesses the digital landscape in Thailand across various aspects – ICT sector, digitalization of production (robotics), digitalization of consumption (e-commerce) and digitalization of finance (digital payments).<sup>2</sup>

Figure 1. ICT Usage and Momentum

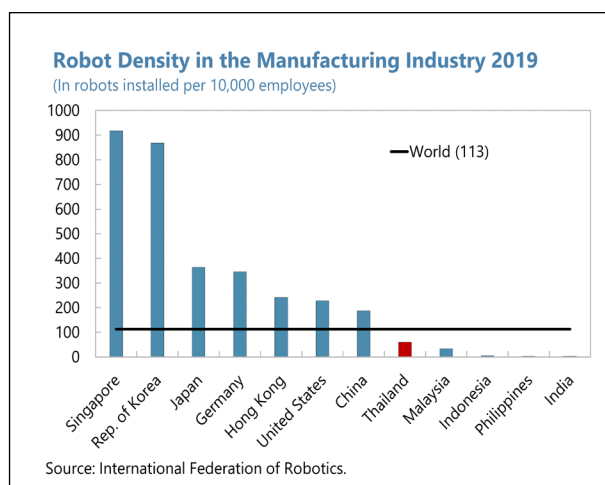


<sup>1</sup> Prepared by Umang Rawat.

<sup>2</sup> The empirical analysis focuses on a subset of these digitalization measures due to data limitations.

**2. Thailand is making considerable strides in terms of ICT digital usage.** The digital user's index, which captures various aspects of mobile and internet usage, highlights that Asia as a region has the highest dispersion in digital technologies (Figure 1).<sup>3</sup> Thailand's digital usage is in line with other emerging market economies in the region, although much lower than the Asian advanced economy frontier. However, Thailand is making significant strides as reflected by a relatively high level of momentum (Figure 2).

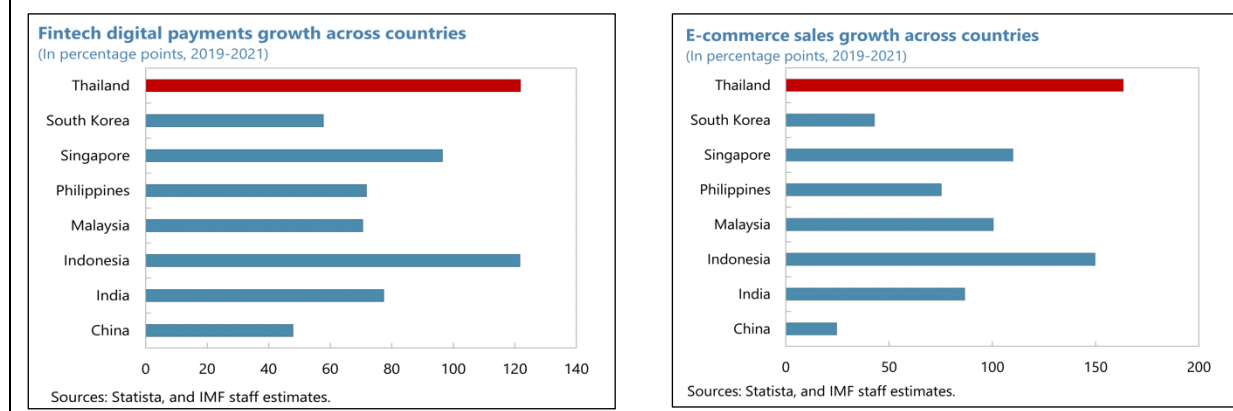
**3. While the digitalization of production through industrial robots is still under development, the outlook is promising.** Industrial robots are higher-end digitalization products predominantly used for automation in the manufacturing sector. Thailand's stock of operational robots in the manufacturing sector has rapidly increased in the past decade, from about 1,500 robots in 2008 to above 21,000 robots in 2018. However, the robot density in Thailand in 2019, at 60 per 10,000 employees, was significantly lower than the world average of 113. By industry, robotics usage in Thailand is concentrated in the automotive industry (50 percent of all industrial robots in 2019), with another 30 percent in the electrical and electronics sectors. The adoption rate of robots is highly correlated with higher wages and human labor shortages. In Thailand, for example, demand for robots is expected to surge as wages rise and labor supply falls with the aging population.



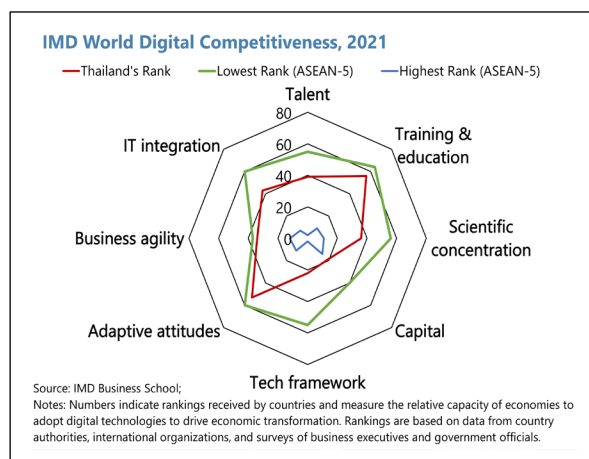
**4. E-commerce has grown manifolds in recent years, including in response to the pandemic, and supported by growth in digital payments.** E-commerce sales grew from less than 1 percent of GDP in 2017 to around 4 percent of GDP in 2021. The acceleration in e-commerce growth picked up after the pandemic. Between 2019 and 2021, e-commerce sales grew by over 140 percent in Thailand (highest in ASEAN-5 region). The recent acceleration in e-sales, including in response to the COVID-19 pandemic, may last longer, supported by a conducive digital environment and growth in digital payments (that have thrived since the launch of PromptPay in 2017).<sup>4</sup>

<sup>3</sup> The Digital User's Index is a composite index created by IMF staff that consists of the average of six indicators: mobile phone subscriptions in terms of subscriptions per 100 population; percentage of individuals using the Internet; percentage of households with a personal computer; percentage of households with Internet access; fixed broadband Internet access in terms of subscriptions per 100 population; and mobile-broadband subscriptions in terms of subscriptions per 100 population.

<sup>4</sup> PromptPay is a real-time electronic fund transfer system, which was part of a national strategy aimed at the development of an integrated digital payment infrastructure. It enables consumers, businesses and government agencies to make real-time payments in Thai baht. PromptPay has also facilitated a real time cross-border QR payment linkage with Malaysia, Singapore and Indonesia.

**Figure 2. Selected Asia: Digital Payments and E-Commerce**

**5. While Thailand ranks well on digital capital and technological frameworks, significant work is needed to build digital skills.** Thailand ranks 38 among the 64 countries surveyed as part of the IMD digital competitiveness survey (10 among 14 Asian countries surveyed). Thailand has performed well with regards to investment in telecommunications and in the use and distribution of robots, but it ranks particularly low on training and education with low public expenditure on education and low share of scientific and technical employment. The rapid pace of digitalization underscores the importance of reskilling and upskilling to provide complementary high-skilled labor as automation replace low-to-mid skilled jobs.



## B. Sophistication of Exports in Thailand: Key Facts

**6. We create a measure of export sophistication based on Rodrik (2006) and Hausmann et. al. (2007).** The authors defined PRODY and EXPY indexes to compute sophistication levels for individual goods and a country's overall export basket, respectively. The formula of the PRODY index is denoted in Equation (1):

$$PRODY_k = \sum_j \frac{x_{jk}/X_j}{\sum_j x_{jk}/X_j} Y_j \quad (1)$$

where the PRODY of product k is the ratio of the export share of k in country j ( $x_{jk}$ ) to the sum of the export shares of k in all countries weighted by their per capita incomes ( $Y_j$ ) of the countries that export the product. Accordingly, a higher PRODY score indicates a higher sophistication level. Based on the PRODY index, the sophistication level of a country's overall export basket (EXPY) could be

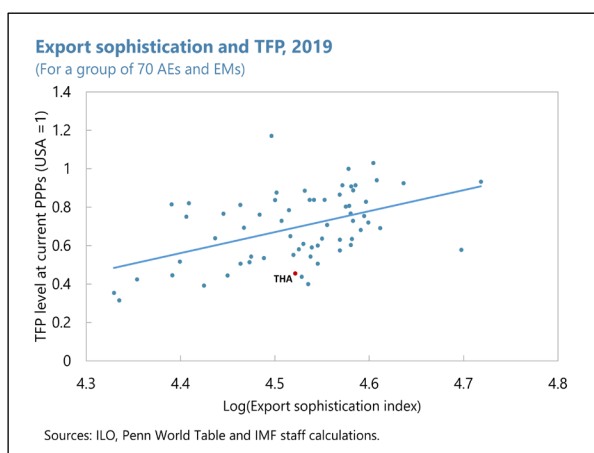
calculated as the weighted average of the sophistication index of all export products in this country. Equation (2) denotes the calculation of EXPY:

$$EXPY_i = \sum_l \left( \frac{x_{il}}{X_i} \right) PRODY_l \quad (2)$$

As a product of the PRODY index, a higher EXPY index also indicates higher sophistication level<sup>5</sup>.

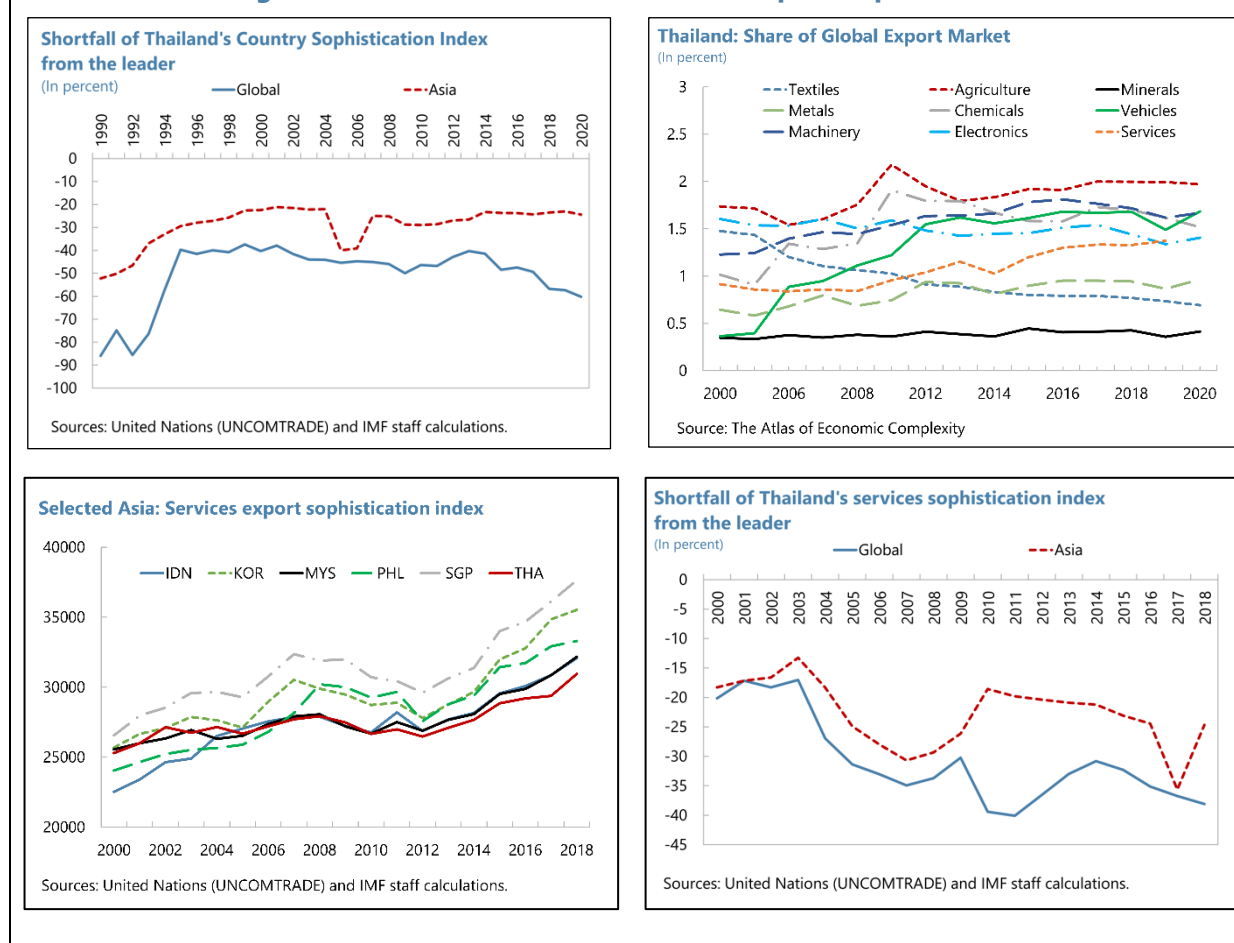
**7. After having significantly improved in past decades, Thailand's export sophistication has stagnated more recently.** At its peak Thailand's goods export sophistication was 37 percent lower than the global frontier and 21 percent lower than the frontier in Asia (based on the index). Thailand's key high-tech goods' exports include computer parts and accessories, integrated circuits, auto parts and accessories, and petro-chemical products. However, after about a decade of stagnation, the gap from the global frontier has widened in the recent past. This underlies an increase in export sophistication outside Asia as the gap from the Asian frontier has remained relatively stable. While overall export sophistication has increased in all ASEAN-5 countries, Thailand continues to be at the lower end of the spectrum. The stagnation in goods export sophistication is also reflected in Thailand's declining share in global export markets. Export sophistication in the services sector has performed worse than in the goods sector. Thailand's services export is largely concentrated in low value-added tourism services with lowest sophistication in ASEAN-5 region. Further, the distance from sophistication frontier in the services sector has been on an increasing trend. This implies that Thai economy can gain significantly from moving towards more sophisticated products (Figure 3).

**8. There is a positive correlation between export sophistication (EXPY) and productivity growth.** For example, Felipe, Kumar and Abdon (2012) find that countries unable to upgrade and diversify their exports may become caught in a middle-income trap. Jarreau and Poncet (2012) similarly find that regions specializing in more sophisticated goods in China grew faster subsequently. We find that our export sophistication index is positively correlated with both labor productivity and total factor productivity.



<sup>5</sup> The product-based sophistication index (PRODY) is calculated using product (at the four-digit level comprising of 1260 products) export data collected from UNCOMTRADE.

Figure 3. Thailand: Goods and Services Export Sophistication



## C. Digitalization and Export Sophistication: Empirical Analysis

**9. This section explores the role of digitalization in promoting export sophistication.** The determinants of export sophistication are analyzed using data for 76 advanced and emerging market economies over the period 1990-2020.<sup>6</sup> In particular, we estimate the following regression using system GMM:

$$LEXPY_{it} = \alpha_0 + \alpha_1 LEXPY_{it-1} + \gamma_1 D_{it} + \beta X_{it} + \delta_i + u_{it}$$

Where  $LEXPY_{it}$  is the log of export sophistication index,  $D_{it}$  is a measure of digitalization,  $X_{it}$  is a vector of control variables including FDI inflow, tertiary education enrolment (human capital), and access to credit. Country fixed effects are included to control for unobserved country characteristics.

**10. The results indicate that various measures of digitalization (ICT, patents, robots) are positively related with export sophistication.** An increase in both ICT infrastructure and its usage

<sup>6</sup> Please see annex table I for list of countries.

is associated with an increase in export sophistication. Similarly, countries with higher patent applications are likely to have higher export sophistication. Finally, installations of industrial robots also are associated with greater export sophistication.

**Table 1. Thailand: Determinants of Export Sophistication**

<b>Dependent Variable: Log (Export sophistication) - Goods</b>					
<i>L.export sophistication</i>	0.683***	0.803***	0.791***	0.806***	0.967***
<i>FDI inflow</i>	0.004	-0.014	0.007	0.046*	0.126**
<i>Tertiary enrollment ratio</i>	0.057*	0.021*	0.022**	0.063**	-0.004
<i>Domestic Credit/GDP</i>	0.021*	0.002	0.006	0.011	-0.004
<i>Internet users (% of population)</i>	0.001**				
<i>Digital user index</i>		0.009***			
<i>ICT</i>			0.004*		
<i>Log (Patent applications)</i>				0.007***	
<i>Log (Robot installations)</i>					0.003*
Constant	3.156**	1.979***	2.087**	1.905***	0.344
Observations	1,371	1,156	1,084	1,336	762
Number of country_code	75	75	74	74	56
AR(2)	0.995	0.138	0.137	0.730	0.0613
Hansen	0.149	0.347	0.518	0.308	0.174
<b>Dependent Variable: Log (Export sophistication) - Services</b>					
<i>L.export sophistication</i>	0.527***	0.676***	0.462***	0.524***	0.845***
<i>FDI inflow</i>	0.047***	0.048***	0.042***	0.042***	-0.0113
<i>Tertiary enrollment ratio</i>	0.023*	0.01	0.01	0.046**	0.021
<i>Domestic Credit/GDP</i>	0.008	0.0007	0.004	0.0141	0.006
<i>Internet users (% of population)</i>	0.0009***				
<i>Digital user index</i>		0.007**			
<i>ICT</i>			0.005***		
<i>Log (Patent applications)</i>				0.006***	
<i>Log (Robot installations)</i>					0.0004
Constant	4.835***	3.329**	5.486***	4.815***	1.551
Observations	1,018	1,035	1,007	954	650
Number of country_code	74	74	74	71	56
AR(2)	0.584	0.520	0.612	0.386	0.922
Hansen	0.168	0.0900	0.176	0.280	0.102

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**11. FDI and Human capital, proxied by tertiary enrollment, are also important determinants of export sophistication.** Our results indicate that higher FDI also leads to greater sophistication of exports. This implies positive knowledge spillovers to domestic firms from foreign firms. In this respect, liberalizing regulations on FDI inflow, easing to do business, promoting rule of law and securing property rights might be good policies to attract FDI. However, technology and knowledge diffusion require that local firms are able to absorb new information. To ease absorption,

investments in physical and digital infrastructure should be complemented with investments in education to make the work force better prepared for a transition to digital economy.

## D. Policy Implications

**12. The analysis illustrates that reaping the benefits of digitalization would require concerted policy actions along various dimensions.** A multi-pronged reform strategy is needed to leverage on evolving trends in digitalization to move to high-income status. This includes policy actions along three key dimensions – technology, investment, and training. Thailand’s ambitious 20-year strategy (Thailand 4.0)—designed to promote innovation, research and development, advanced and green technologies—should remain a priority.

**13. There is a need to leverage on the existing manufacturing base to rise up the value chain through production of more complex products and greater linkages to services.** In the near term, there is scope to diversify into related products in industries where Thailand currently has competitive advantage (particularly in machinery and electronics). However, overtime Thailand should use its established manufacturing core to diversify into related but higher-value-added global innovator services (finance, ICT, and professional services).<sup>7</sup>

**14. Expanding R&D and access to digital technologies can expand channels for innovation, boost product sophistication, and ultimately result in higher productivity.** The adoption of high-tech and digital technologies would help in product sophistication and hence advanced participation in global value chains. In this regard, the development of 5G network infrastructure, providing impetus for innovation implementation (including via enhanced mobile broadband, connectivity/internet of things (IoT), and a reliable form of communication technology) are welcome. The authorities should continue with their plans to develop EECi (R&D and innovation infrastructure in EEC) and the EEC tech park to provide a R&D oriented innovation hub as well as EECd to nurture and promote digital industry ecosystem.

**15. Government can play a catalytic role in promoting investment in advanced technologies and digital solutions, as is currently envisaged under the EEC development.** The Thai government has provided various incentive packages, as part of the EEC, to promote private sector investment in high-tech industries. These include tax holidays and 50 percent reduction in corporate income tax for knowledge-based activities, high-tech activities and activities using advanced technology as well as non-tax incentives such as granting ownership of land and residence and foreign entry. However, in the medium-term, the design of these schemes can be improved based on lessons learnt from EEC and eventually expand the scheme to all firms to level the playing field with non-promoted companies, particularly SMEs.

<sup>7</sup> Nayyar et. al. (2021) note that services increasingly account for much of the value added in the supply chain of manufactured goods. This servicification of manufacturing implies that leading firms in high-income countries have typically retained the more skill intensive parts of the chain, such as the upstream (such as R&D and product design services) and downstream services (such as branding and advertising services), while outsourcing the labor-intensive assembly of manufactured goods to low- and middle-income countries.



**16. Further liberalization of FDI restrictions, particularly in services sectors, is needed to foster greater convergence towards Thailand 4.0.** According to the OECD FDI regulatory restrictiveness index, Thailand's primary and services sectors remain particularly restrictive to foreign investment. To achieve Thailand 4.0, the service sector will need to be further developed to match servicification of manufacturing activities seen in high-income countries.<sup>8</sup> In addition to restrictions on foreign entry, Thailand also maintains a stringent regulatory regime as measured by the OECD services trade restrictiveness index (capturing restrictions on movement of people, barriers to competition, regulatory transparency and other discriminatory measures). The authorities should continue with their reforms to remove activities from the list of restrictive business categories that require obtaining a foreign business license under the Foreign Business Act (FBA), particularly those in digital industries crucial to the Thailand 4.0 vision.<sup>9</sup>

**17. Finally, human capital needs to be ready to support the transition to a digital economy.** The digital competitiveness ranking highlights the skills gap in Thailand as a major deficiency. This partly reflects low and inefficient public investment in education. According to a recent study, in 2020, 42 percent of the workforce in Thailand were at high risk of being supplanted by automation, with the largest threat to the accommodation, food services, and manufacturing sectors. Medium-skills jobs, which comprise the largest pool of workforce available in Thailand, are at the highest risks of elimination. While disruptive technology skills are in high demand, their availability is still limited posing a major constraint to the adoption of technology (World Bank 2022). Labor force upskilling and reskilling should be a priority to ensure that human capital is developed to address the changing needs of the ongoing digital revolution.

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<sup>8</sup> Services account for about 30 percent of the value added embedded in its manufacturing exports in Thailand, which is only slightly below the OECD average, but only about half of it is domestically generated (the rest being imported), against about 90 percent in OECD economies (OECD, 2021).

<sup>9</sup> In 2019, the foreign business commission identified four activities to be removed from the restrictive list, namely: (i) telecommunications business; (ii) treasury centres in accordance with exchange control act; (iii) certain aircraft maintenance; (iv) high value-added software development activities.



## Annex I. List of Economies Used in Analysis

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Australia	Azerbaijan	Korea	Mongolia	
Austria	Bulgaria	Netherlands	Morocco	Romania
Belgium	Bahrain	New Zealand	Nigeria	Russia
Canada	Belarus	Norway	Peru	Saudi Arabia
Cyprus	Brazil	Georgia	Portugal	Serbia
Czech Republic	Chile	Ghana	Singapore	South Africa
Denmark	China	Hungary	Slovak Republic	Thailand
Finland	Colombia	India	Slovenia	Tunisia
France	Croatia	Indonesia	Spain	Turkey
Germany	Ecuador	Iran	Sweden	Ukraine
Greece	Egypt	Jordan	Switzerland	United Arab
Hong Kong SAR	Iceland	Kazakhstan	Taiwan POC	Emirates
Albania	Ireland	Kenya	United Kingdom	Uruguay
Argentina	Israel	Malaysia	United States	Vietnam
Armenia	Italy	Maldives	Philippines	
Bangladesh	Japan	Mexico	Poland	

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