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Global Supply Chains in a Post-Pandemic World:
Seeking viable alternatives in a "China-Plus-One" Strategy

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Abstract

Asia played a significant role in globalization in general, and global supply chains in particular, since the mid-1970s. In this process, China has been an undisputed leader and emerged as the hub of global supply chains, supported by other countries in emerging Asia. However, since the global financial crisis of 2008, there seems to be some lull in the strength and intensity of this narrative. In more recent times, threats of the trade war and later, the COVID19 pandemic has thrown some sand in the wheels of global supply chain management. In such as situation, countries may be contemplating of diversifying its dependence on China – a strategy known as "China-Plus- One". Towards understanding this phenomenon, we propose a methodology of arriving at an aggregate ranking of the major economies of emerging Asia, built on a few standard indices such as, World Bank's Logistic Performance Index, World Bank's Ease of Doing Business Indicator, World Economic Forum's Global Competitiveness Index, and Economic Complexity Index of the Harvard University. Accordingly, we rank seven countries of emerging Asia (viz., Thailand, Malaysia, India, Vietnam, Indonesia, the Philippines and Bangladesh) next to China as possible destinations of selecting the "Plus one" country. We also run some robustness checks for the inclusion of newer indicators like Economist Magazine's Country Rating of Financial Strength, and Transparency International's Corruption Perceptions Index. While it would be difficult for the global supply chains to move out of China, going forward, these other countries may play a much more significant role.

Key-words: Global Supply Chain, China, Pandemic, Asia, China-Plus-One.

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Global Supply Chains in a Post-Pandemic World:
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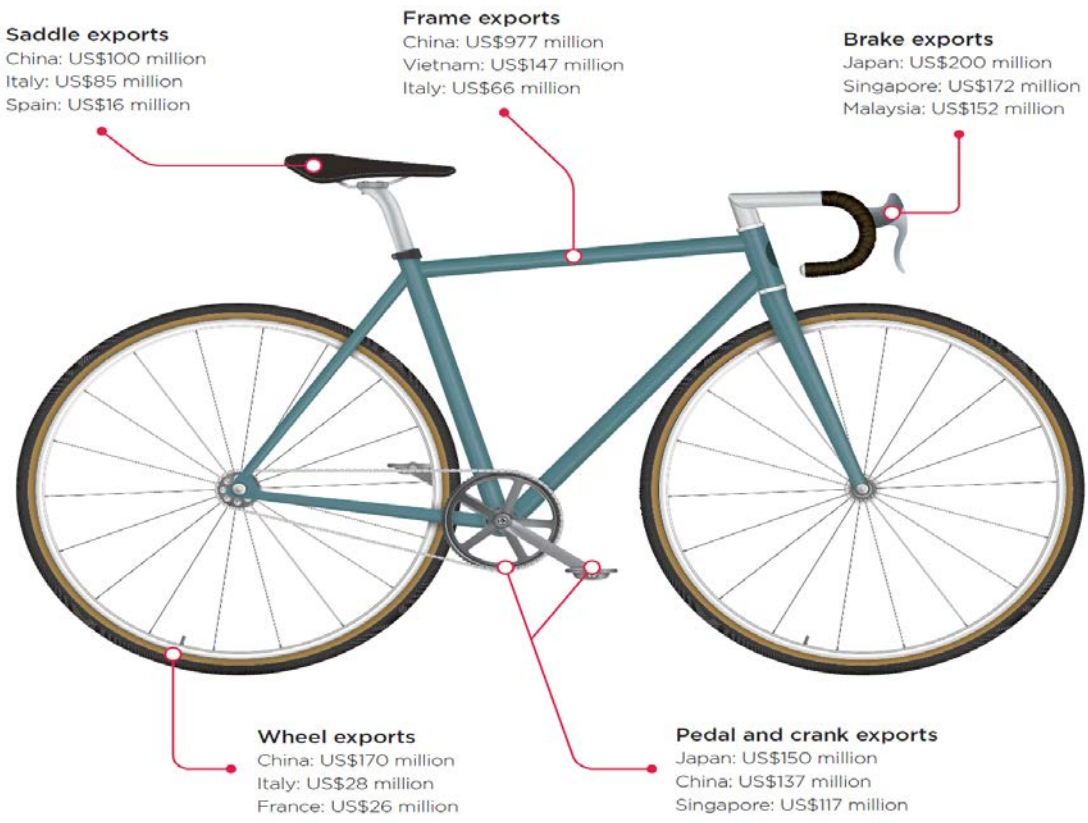
1. Introduction

Global supply chains have played a significant role in enhancing the forces of globalization. With the reduction in transport cost and tariff and entry of China to the World Trade Organization (WTO) in 2001, international trade has become the engine of global growth. Interestingly, with the spread of global supply chains, as a particular product represented bundling of various sub-components, processes and intellectual property rights, the brand of "made in country x" has started appearing to be a misnomer. *World Development Report 2020* has given an illustration of a simple product like a cycle, where its different parts could come from as diverse countries as China, Japan, Vietnam, Singapore, Italy, Spain, and France (Figure 1).

Figure 1: Where do Bicycles come from?



Source: World Bank (2020): World Development Report, 2020, p. 16.

Notwithstanding such diversity of supply chains, China has emerged as the most important hub of global supply chains. While in some sense, China's high growth performance for an extended period might appear to be an enigma, it is in line with the three major strands of economic growth and development, viz., (a) the classical Harrod-Domar type of growth model (whereby high domestic savings and productivity were contributing to rapid growth); (b) the Solow-type growth model (highlighting the role of labor-augmented technical progress); and (c) the standard Lewis model of economic development (whereby labor gets relocated from low-productivity agriculture to high-productivity industry) (Raiser, 2019; World Bank, 2019). Apart from China, the story is valid, perhaps to a varying degree, for various other countries of emerging Asia as well.

Is this story of China-based global supply chains being diluted in the current context of the trade war, de-globalization and the COVID-19 pandemic? If the global supply chains move out of China, where can they be relocated? Will firms adopt a diversifying strategy that is increasingly known as "China- plus-One"? This paper probes into some of these questions.

Specifically, the present paper looks into the attractiveness of the major Asian emerging economies as potential and actual business destinations. Such an investigation is expected to shed light on two dimensions. First, it may explain the emergence of various Asian economies. Second, in case the current condition demands moving away from China, it could throw some light on possible destinations of diversions. In focussing on this issue, we looked at different existing ratings/indicators of various global agencies / think tanks like the World Bank, Global Economic Forum, or Harvard University and tried to capture the relative attractiveness of different economies in terms of a single grand rank that can form the basis of preference of global corporations.

The rest of the paper is organized as follows. Section 2 is in the nature of a big picture of the emergence of Asia and globalization. The implication of the current pandemic for the fault lines of global supply chains is discussed in section 3. Section 4 probes into the data, methodology and results of our construction of a catch-all index of the attractiveness of an emerging Asian economy. While concluding the paper, section 5 puts forward a few conjectures about the shape of things to come in global supply chains.

2. The emergence of Asia and Globalization: The Big Picture

2.1 Asia and the globalization

With hindsight it does not seem to be an exaggeration that the story of globalization has been one of Asia. This story comes out very clearly from the long time series data constructed by the Organization of Economic Cooperation and Development (OECD), led by economic historian, Angus Maddison. OECD has released the distribution of global GDP over the thousand years 1000 – 2001 according to certain country-grouping. While the absolute numbers of GDP may have various limitations, for our purpose, we look at the country-group wise composition of global GDP (Table 1).

Table 1: Country-Group wise Distribution of Global GDP (%)								
	1000	1500	1820	1870	1913	1950	1973	2001
1. Western Europe	8.7	17.8	23.0	33.0	33.0	26.2	25.6	20.3
2. Western offshoots	0.7	0.4	1.9	10.0	21.3	30.7	25.3	24.6
3. Japan	2.7	3.1	3.0	2.3	2.6	3.0	7.8	7.1
4. Asia (excluding Japan)	67.6	61.9	56.4	36.1	22.3	15.4	16.4	30.9
5. Latin America	3.9	2.9	2.2	2.5	4.4	7.8	8.7	8.3
6. Eastern Europe & former USSR	4.6	6.1	9.0	12.0	13.4	13.0	12.9	5.6
7. Africa	11.7	7.8	4.5	4.1	2.9	3.8	3.4	3.3
8. World	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Source: Maddison (2004)								

A look at Table 1 allows one to discern an interesting big picture trend of Asia. Asian economies (excluding Japan), which had a near-secular decline in their share over 1000-1973, could nearly double their share over 27 years, 1973-2001. There is no other instance of any group of countries experiencing such a spectacular rise in their global share.[3] What happened in Asia? With the benefit of hindsight, three significant developments may be highlighted.

First, several East Asian countries experienced a quantum leap in their GDP growth as part of a process that is now known as the "East Asian miracle" since the 1970s. Stiglitz (1996) identified eight East Asian countries behind the phenomenon of the "East Asian Miracle", viz., Hong Kong, Japan, South Korea, Singapore, Taiwan (China), Indonesia, Malaysia, and Thailand. Of these Hong Kong, Japan, South Korea, Singapore and Taiwan are classified as advanced countries by the IMF. Despite the temporary setback in the East Asian crisis during the late 1990s, the comparative advantage of these East Asian countries remained intact.

Second, China emerged as a global growth pole since the late 1980s. The success of the grand strategy of economic opening up in China since the 1980s got reflected in the fact that over the last 100 years, China became the only economy that grew at an average rate of 10 percent per annum during the 27 years, 1980 – 2007 (Luo, 2014; Bruton et al., 2019). It has now become the world's second-largest economy. It is interesting to note that the engines of Chinese growth have been investment and foreign trade and not consumption (like the US or India). Three related developments seemed to have shaped the emergence of foreign trade as an engine of growth in China: (a) its entry to the World Trade Organization (WTO) in 2001; (b) its emergence as a preferred hub of global supply chains and advent of a "made in China" model; and (c) establishment of several different types of successful special economic zones along the coastal regions.

Third, India opened its economy since the early 1990s and got integrated with the global economy while dismantling the cobweb of a control regime that used to be known as "license-

[3] Peter Drucker was prophetic when in the context of the changing contours of the world economy, as early as in the mid-1980s, when he remarked, "The greatest increases, both in absolute and in relative terms, however, have been in developing countries: in India, in post-Mao China and in the rice-growing countries of Southeast Asia" (Drucker, 1986).

permit raj" (Ahluwalia, 2002). The Indian model of economic growth has been distinct from the Chinese model in several ways, viz., (a) late opening up in India after a lag of little more than ten years than China; (b) predominance of consumption and services sector as engines of Indian growth; and (c) India having a huge trade deficit, which is turned into a manageable current account deficit due to a substantial surplus on account of services (primarily information technology) and inward remittances.

Since the 1960s, US firms have been exploring low cost and capable suppliers and manufacturers offshore; initially, it was production-sharing or "twin plant" program with Mexico (Geraffi and Lee, 2012). However, in the 1970s and 1980s, there was a fundamental shift from "producer-driven" supply chains to "buyer-driven" chains. The geography of these chains expanded from regional production-sharing arrangements to full-fledged global supply chains, with a growing emphasis on East Asia (Gereffi, 1996). In the 1990s and 2000s, the global supply chains grew exponentially, covering not only finished goods but also components and subassemblies, and moving beyond manufacturing industries, to energy, food production and all kinds of services. The range of services was varied covering diverse activities like call centers, accounting, medical procedures and core research and development (R&D) activities, and world's leading multinational corporations moved to newer territories such as India, Bangladesh and Vietnam (Engardio et al., 2005; Wadhwa et al., 2008).

As the western world moved significant portions of their supply chains eastward to take advantage of procurement and production cost arbitrage, contract manufacturing firms such as Hon Hai/Foxconn, Flextronics and Quanta flourished in China (Sturgeon and Kawakami, 2010). China emerged as the world's manufacturing shop floor based on its cheaper production and labor costs and low corporate tax rates (Gloria and Ding, 2008; Eichengreen and Tong, 2006). Companies such as Avon, GE, Apple and Nike shifted significant portions of their manufacturing to China (Carney, 2005). Many Chinese manufacturers proliferated and became significant international competitors. Examples are: Lenovo for personal computers, Haier for refrigerators, TCL for TV sets, Gree for air conditioners and Galanz for microwave ovens. Trading firms such as Li & Fung that offer services in product design, development, procurement, vendor compliance, manufacturing and distribution became influential agents in global supply chains taking advantage of their China-based supply network. Mathews (2006) refers to firms such as Li & Fung as "Dragon Multinationals" and argue that the innovative features of these firms, such as their accelerated internationalization and organizational innovation, fit particularly well with the characteristics of the emergent global supply chains as one of the complex inter-firm linkages. Gereffi and Lee (2012) point out that China has turned scale driven specialization into a competitive advantage by building "supply chain cities". From foreign direct investment-driven clusters in Guangdong to single-product clusters in Zhejiang, China has developed regional manufacturing clusters that are linked to suppliers of critical parts and components, and distribute finished products to global buyers (Gereffi 2009).

Over the years, China has emerged as the global leader in manufacturing in which global value chains have played a key role.[4] China's prime position in the global supply chain is most evident from its share of global exports and imports. McKinsey (2019) in this context has used an interesting taxonomy. Depending upon the extent of involvement with global supply chains, the manufacturing sector of the Chinese economy has been divided into five archetypes, viz., (i) high level of integration; (ii) high exposure to Chinese exports; (iii) high exposure to Chinese imports; (iv) global chain with little trade exposure to China; and (v) local production for local consumption. Interestingly, in sectors like computer, electronics and optical products, or electrical equipment, China is highly integrated with global supply chains, whereas in sectors like textiles, apparel or furniture, the world has been dependent on Chinese imports (Table 2).

Table 2: China's Share of Global Exports and Imports (Per cent)

		China's Share of Global Exports (%)		China's Share of Global Imports (%)	
Archetype	Sector name	2003-07	2013-17	2003-07	2013-17
High level of integration	Computer, electronic, and optical products	15	28	12	16
	Electrical equipment	16	27	7	9
	Other machinery and equipment	7	17	8	9
High exposure to Chinese exports	Textiles, apparel, and leather	26	40	5	5
	Furniture, safety, fire, other	17	26	2	4
	Other non-metallic mineral products	11	22	5	8
	Rubber and plastics	10	19	5	7
	Basic metals	8	13	8	8
High exposure to Chinese imports	Mining and quarrying	1	1	7	21
	Chemicals	4	9	9	12
	Paper and paper products	3	9	6	12
Global chains with little trade exposure to China	Other transport equipment	3	6	3	5
	Pharmaceuticals	2	4	1	3
	Motor vehicles and trailers	1	3	2	7
	Coke and refined petroleum products	2	4	4	6
Local production for local consumption	Food, beverages, and tobacco	3	4	3	6
	Fabricated metal products	14	23	3	5
	Wood and wood products	11	22	2	3
	Printing and media	8	18	2	4
	Agriculture, forestry, and fishing	5	5	7	19

Source: McKinsey (2019)

Low production costs and cheap labor have enabled Chinese manufacturing firms to enjoy a critical edge in global markets over the last four decades. However, now Chinese firms face severe competition from other low-cost countries, such as Malaysia, Thailand and Vietnam. Thus, to pursue the cost-leadership strategy, Chinese firms have to pay continuous

[4] As per the United Nations data, as of 2018, China's share in global manufacturing had been close to 30 per cent, next to the US whose share was around 17 per cent.

attention to cost control and seek new ways to improve production efficiency. In this context, theories of "strategic trade policy" may be helpful (Brander and Spencer, 1985). It is by now well-known that "government policies such as export subsidies and import restrictions can, under the right circumstances, deter foreign firms from competing for lucrative markets …government policy here serves much the same role that "strategic" moves such as investment in excess capacity or research and development (R & D) serve in many models of oligopolistic competition" (Krugman, 1987).[5] China's trade policy precisely followed this path and emerged as a trading superpower. Empirical investigations revealed that nearly three-fourth of China's industries are dynamic and registered very high growth because of market liberalization, falling trade barriers and a favorable exchange rate (Fetscherin et al., 2010).

On the contrary, India started attracting the world's interest because of its impressive economic performance, brought about by the liberalization process that started in the early 1990s. A significant driver of the Indian growth story has been information technology (IT) and IT-enabled services (ITeS), providing remote services to clients across the world (Sheth, 2008). Riding of the spectacular dynamism shown by the IT services sector, India became the outsourcing epicenter of the world. Indian IT companies such as TCS, Infosys and Wipro rode high on the growth wave and joined the billion-dollar club in the early 2000s. The manufacturing sector in India, however, has traditionally lagged China in cost, quality and contribution. This lag was also reflected in terms of exports. However, with government initiatives such as *Make in India* that aim to make India an integral part of the global supply chain, the Indian manufacturing sector is in the process of catching up to some extent. Multinational giants such as Apple, Mercedes Benz, BMW, Hyundai, Honeywell, OnePlus have started investing heavily in terms of developing their manufacturing bases in India (Saranga et al., 2017). While today, India lags China by a considerable margin in this sector, going forward, India has the potential to become a global manufacturing and supply chain hub in the days to come.

2.2 Constituents of Emerging Asia

In this context, apart from China and India, many other Asian countries deserve attention. Our focus of attention in this paper is not the whole of Asia, but countries in emerging and developing Asia. Among the Asian economies, the following countries are treated as advanced economies, viz., Japan, South Korea, Hong Kong, Macao, Singapore and Taiwan by the International Monetary Fund (IMF). Apart from these six economies that account for 7.4 percent of global GDP (at PPP), 30 countries in Asia are classified as "emerging and developing economies" (EMDEs) accounting for 34.2 percent of global GDP. Of these, 30 countries, the share of GDP of 22 countries less than 0.5 percent of global GDP (at PPP). In the rest of this paper, we exclusively focus our attention on these remaining eight countries, viz., China, India, Indonesia, Thailand, Malaysia, Philippines, Bangladesh and Vietnam. Thus, our quest for the "Plus One country" has been confined to seven countries in this list. Note that while these eight

[5] Illustratively, it has been documented that in CSPV (Crystalline Silicon Photovoltaic) industry Chinese Government heavily intervened through several non-WTO-compliant trade and investment measures. Specifically, these measures were employed in such a way upstream price differentials, midstream subsidization and downstream export promotion were created effectively favouring China (Kümmerle, and Schmidkonz, 2014).

economies account for nearly one-third of global GDP, in per capita terms, these are much poorer than the advanced Asian economies (Table 3).

Table 3: Size of the Asian Economies: 2019 (Per Cent)

	No.		Share (% of GDP at PPP in global GDP)	GDP (at MER) (USD Billion)	GDP (at PPP) (USD Billion)	Per Capita GDP (at MER) (USD)
Advanced Asia	1	Japan	4.05	5,154	5,747	40,847
	2	Korea	1.64	1,630	2,320	31,431
	3	Singapore	0.41	363	585	63,987
	4	Taiwan (Province of China)	0.92	586	1,300	24,828
	5	Hong Kong SAR	0.35	373	491	49,334
	6	Macao SAR	0.06	55	78	81,152
	7	**Total**	**7.42**			
Emerging & Developing Asian	1	China	19.25	14,140	27,309	10,099
	2	India	7.98	2,936	11,326	2,172
	3	Indonesia	2.64	1,112	3,737	4,164
	4	Thailand	0.98	529	1,383	7,792
	5	Malaysia	0.76	365	1,079	11,137
	6	Philippines	0.72	357	1,026	3,294
	7	Bangladesh	0.59	317	838	1,906
	8	Vietnam	0.54	262	770	2,740
	9	Others	0.74			
	10	**Total**	**34.20**			

Note:
1. SAR: Special Administrative Region; PPP: Purchasing Power Parity; MER: Market Exchange Rate.
2. Others include Myanmar, Sri Lanka, Nepal, Cambodia, Lao P.D.R., Mongolia, Brunei Darussalam, Papua New Guinea, Fiji, Bhutan, Maldives, Timor-Leste, Samoa, Solomon Islands, Vanuatu, Kiribati, Marshall Islands, Micronesia, Nauru, Palau, Tonga, and Tuvalu.

Source: World Economic Outlook Database, IMF, October 2019.

3. Current Pandemic and Assessing Global Supply Chain Potential in Asia

While trade in global supply chains proliferated during the 1990s and the initial years of the new millennium, it stagnated after the 2008 global financial crisis (World Bank, 2020). Thereafter, threats of a trade war had put some sand in the wheels of global supply chains.[6] The latest threat in this regard is the COVID19 pandemic. While revealing the fragility of modern global supply chains does the coronavirus crisis have severe implications for the conceptual foundation of global supply chain management?

Over the years, supply chain management has been focussing on efficiency measures such as lean concepts and single-sourcing based on cost parameters. This phenomenon has seen global supply chain bases shifting predominantly to China. These concepts work well when the market conditions maintain the *status quo*. The COVID19 pandemic has brutally exposed the

[6] For example, employing a dynamic supply chain model, Walmsley and Minor (2020) found that while both the US and China would be losers, the rest of the world could gain, as they fill the gaps left by the US and Chinese producers; see also Abraham and Ray (2020).

drawbacks of these standard measures. According to Fortune 2020, 94% of the Fortune 1000 companies have been affected by Coronavirus inflicted disruptions. These companies had globally spread supply chains with more than 12,000 facilities (warehouses and factories) located in COVID19's quarantine areas. Supply chain risk assessment and management have till now concentrated on resilience (Ribeiro and Barbosa-Povoa, 2018). The primary focus has been on risk mitigation and contingency measures that try to minimize the impact on sales, revenues and finally, the bottom line. However, is supply chain resilience enough when the entire network is affected by supply as well as demand shocks in the time of a global pandemic? The analysis of the disruptive impact of COVID19 should be concerned with long-term survivability, i.e., ensuring the viability, rather than with the performance impact of disruptions in individual SCs in terms of revenue or annual sales, as traditional SC resilience analysis usually does (Ivanov & Dolgui, 2020). As an example, the auto industry has been severely impacted by this crisis. There have been production stops, the danger of bankruptcies and the need for governmental support. The pertinent question of staying viable goes beyond the existing state-of-the-art in supply chain resilience since they cannot be resolved within a narrow supply chain perspective but instead require analysis at a larger macro level. Therefore, the broader question is: are the traditional global supply chains viable now? Put differently, how do global supply chains morph themselves to remain viable in this unprecedented crisis?

3.1 How does COVID-19 change the scenario?

China's reputation as the 'factory of the world' has been severely affected by the origin of the dreaded Coronavirus in Wuhan.[7] Multinational companies with offices and factories in China were the first to face disruption in their supply chains. Impediments to logistics operations because of lockdowns majorly affected industrial production in China. Clearly, as an aftermath of this unprecedented crisis, notwithstaing China's speedy recovery, reliance upon global supply chains could reduce. Subsequently, this could also potentially lead to more encouragement of domestic production and manufacturing. This is where global supply chains can convert adversity into new opportunities. The crisis could open new avenues for firms and their supply chains and contribute to their viability in the long run. Right now, with widespread disruptions, global supply chains are either broken or severely affected. How these supply chains react and revamp in the face of the crisis will determine not only their viability but also how the global economy moves in the next decade.

The first and most crucial change post COVID19 will be the rise of domestic sourcing to make supply chains more local. This would throw up new opportunities for other emerging economies as countries try to develop their manufacturing and logistics infrastructure. Firms looking to maintain their operations in Asia might turn towards ASEAN countries. Countries such as Vietnam has signed numerous international trade deals and invested significantly in industrial infrastructure over the past decade, and has experienced an increase in textiles and apparel manufacturing, among other industries. Labor costs being cheaper than China is another added advantage. In an attempt to react to the specific needs of the post-pandemic landscape, lawmakers in the Philippines are considering changes to the long-pending Corporate Income Tax and Incentives Rationalisation Act to streamline and incentivize firms located in

[7] Illustratively, the US President Donald Trump had repeatedly called the novel Coronavirus as the Chinese Virus.

special economic zones by progressively lowering the rate of corporate income tax. The Malaysian government allows 100 percent foreign ownership in healthcare, retail, education, as well as professional, environmental, and courier services sectors. Export-dependent Malaysia is keenly trying to attract FDI and promote high-value manufacturing. Investment incentives like corporate income tax exemption and tax allowance are provided in industries, such as advanced electronics, medical devices, biotechnologies, and green technologies. Thailand is also encouraging investment in value-based, digital, innovation-driven, as well as services-based industries through the "Thailand 4.0" development plan. The ten targeted industries under this plan include automotive, electronics, high-value tourism and medical tourism, efficient agriculture, food innovation, automation and robotics, aerospace, bioenergy and biochemical, digital technology, and healthcare.

India could be another potential destination as global supply chains look to shift their base out of China. Many firms would now want to source form the domestic market. For example, for pharmaceuticals, the Government of India has decided to promote domestic manufacturing of critical Key Starting Materials (KSMs)/Intermediates and APIs in the country.[8] The approved scheme will promote Bulk Drug Parks with a financial investment of INR 30 billion in the next five years. Initiatives for procuring expedited environmental clearances, simplifying the complicated labor laws, possible tax concessions and boosting technological competence through automation are essential for making domestic manufacturing competitive. India may have to sort its trade preferences, logistic costs, transportation infrastructure, and work on non-tariff barriers and restrictions along with creating a robust supply chain framework to become a viable destination for global supply chains. More recently, Indian Prime Minister Narendra Modi has given a call for an *Atmanirbhar* (self-reliant) India whereby there is a "need to make in India to make for the world".[9]

Nonetheless, relocating outside China may not be financially feasible for cash-starved firms recovering from the devastating impact post-COVID-19. Another complicating factor is related to parts and raw materials, with many countries still heavily dependent on China for the components, from electronic parts to textiles, to raw pharmaceutical materials. Nevertheless, China has been losing its cost advantage and competitiveness in comparison to other ASEAN countries over the last few years. Furthermore, the recent US-China trade wars have prompted China-based global supply chains to diversify their operations by adding another location in Asia. This strategy is known as the "China-Plus-One" model (Enderwick, 2011).[10]

Countries such as Bangladesh and Vietnam have seen unprecedented growth as a garment exporter as an aftermath of the 'China-Plus-One' policy taken by the big brands operating in China deciding to establish additional manufacturing facilities outside China.[11] Vietnam has

[8] Recent research has revealed that Bangladesh could have a high potential for possible COVID-19 vaccines; see Chaudhuri (2020) for details.
[9] Also, note that India and China had some border skirmishes in May 2020.
[10] In fact, Abraham et al. (2020) noted, "China's integration with the globaleconomy in terms of international finance, investment, construction and as a low-cost location for global production is now so deep that such changes will neither be quick nor painless".
[11] http://textilefocus.com/china-plus-bangladesh-vietnam/

indeed emerged as a critical destination for that sourcing or diversifying operations in Asia as part of the "China-Plus-One" strategy by bringing in changes in its legal framework, making significant infrastructure investments and adopting business-friendly policies. These efforts have succeeded in attracting some significant telecommunications companies, such as Samsung, to relocate to Vietnam.[12] In addition to Vietnam, other destinations of choice for moving low-cost manufacturing include Indonesia, the Philippines, Thailand, and Malaysia. India, with an English speaking highly skilled but inexpensive workforce and a growing market of 1.3 billion people with increasing disposable income can also be a viable option for the "China-Plus-One" destination.[13]

However, in selecting the "Plus-One" in a "China-Plus-One" strategy, it is essential to note the trading patterns and trading partners of these eight countries of emerging Asia. Table 4 reveals some interesting trends in this regard. First, out of these eight countries, while China, Thailand, Malaysia and Vietnam have current account surplus, the other four, viz., India, Indonesia, Philippines, and Bangladesh have current account deficits. Second, China emerges as the most dominant importer. Third, notwithstanding some diversification, electrical and other machinery (including computer parts), automobile parts, pharmaceuticals, and garments tend to dominate the export basket.

Table 4: Major Trading Products and Partners of select Countries in Emerging Asia

Country	CAB (US$ billion–2018)		Major Products	Major Exporter / Importer
China	49.1	Export	Electrical and other machinery (including computers and telecommunications equipment), Apparel, Furniture, Textiles	US 19.2%, Hong Kong 12.2%, Japan 5.9%, South Korea 4.4%
		Import	electrical and other machinery, including integrated circuits and other computer components, optical and medical equipment, metal ores, motor vehicles;	South Korea 9.7%, Japan 8.6%, US 7.3%, Germany 5%, Australia 4.9%
India	-57.2	Export	petroleum products, precious stones, vehicles, machinery, iron and steel, chemicals, pharmaceutical products, cereals, apparel	US 15.6%, UAE 10.2%, Hong Kong 4.9%, China 4.3%
		Import	crude oil, precious stones, machinery, chemicals, fertilizer, plastics, iron and steel	China 16.3%, US 5.5%, UAE 5.2%, Saudi Arabia 4.8%, Switzerland 4.7%
Indonesia	-31.1	Export	mineral fuels, animal or vegetable fats (includes palm oil), electrical machinery, rubber, machinery and mechanical appliance parts	China 13.6%, US 10.6%, Japan 10.5%, India 8.4%, Singapore 7.6%, Malaysia 5.1%, South Korea 4.8%
		Import	mineral fuels, boilers, machinery, and mechanical parts, electric machinery, iron and steel, foodstuffs	China 23.2%, Singapore 10.9%, Japan 10%, Thailand 6%, Malaysia 5.6%, South Korea 5.3%, US 5.2%
Thailand	32.4	Export	automobiles and parts, computer and parts, jewelry and precious stones, refine fuels, electronic integrated circuits, chemical products, rice, fish products	China 12.4%, US 11.2%, Japan 9.5%, Hong Kong 5.2%, Vietnam 4.9%, Australia 4.5%, Malaysia 4.4%
		Import	machinery and parts, crude oil, electrical machinery and parts, chemicals, iron & steel and product, jewelry	China 20%, Japan 14.5%, US 6.8%, Malaysia 5.4%

[12] https://home.kpmg/xx/en/home/insights/2020/05/from-recovery-to-a-new-reality-preparing-for-the-new-global-trade-order.html
[13] https://hbr.org/2020/05/as-COVID-19-disrupts-global-supply-chains-will-companies-turn-to-india

Table 4: Major Trading Products and Partners of select Countries in Emerging Asia				
Country	**CAB (US$ billion– 2018)**		**Major Products**	**Major Exporter / Importer**
Malaysia	7.5	Export	semiconductors and electronic equipment, palm oil, petroleum and liquefied natural gas, wood and wood products, palm oil, rubber, textiles,	Singapore 15.1%, China 12.6%, US 9.4%, Japan 8.2%, Thailand 5.7%, Hong Kong 4.5% (2017)
		Import	electronics, machinery, petroleum products, plastics, vehicles, iron and steel products, chemicals	China 19.9%, Singapore 10.8%, US 8.4%, Japan 7.6%, Thailand 5.8%, South Korea 4.5%, Indonesia 4.4%
Philippines	-8.7	Export	Semiconductors and electronic products, machinery and transport equipment, wood manufactures, chemicals, processed food and beverages, garments,	Japan 16.4%, US 14.6%, Hong Kong 13.7%, China 11%, Singapore 6.1%, Thailand 4.3%, Germany 4.1%, South Korea 4%
		Import	electronic products, mineral fuels, machinery and transport equipment, iron and steel, textile fabrics, grains, chemicals, plastic	China 18.1%, Japan 11.4%, South Korea 8.8%, US 7.4%, Thailand 7.1%, Indonesia 6.7%, Singapore 5.9%
Bangladesh	-7.8	Export	garments, knitwear, agricultural products, frozen food (fish and seafood), jute and jute goods, leather	Germany 12.9%, US 12.2%, UK 8.7%, Spain 5.3%, France 5.1%, Italy 4.1%
		Import	cotton, machinery and equipment, chemicals, iron and steel, foodstuffs	China 21.9%, India 15.3%, Singapore 5.7%
Vietnam	5.8	Export	clothes, shoes, electronics, seafood, crude oil, rice, coffee, wooden products,	US 20.1%, China 14.5%, Japan 8%, South Korea 6.8%
		Import	machinery and equipment, petroleum products, steel products, raw materials for the clothing and shoe industries, electronics, plastics, automobiles	China 25.8%, South Korea 20.5%, Japan 7.8%, Thailand 4.9%
Notes: (1) Percentage distribution of exports and imports pertain to 2017 for most of the countries except for China for which it pertains to 2018. (2) CAB = Current Account Balance = Exports of Goods & Services – Imports of Good & Services. Sources: (1) The Word Factbook, https://www.cia.gov/library/publications/the-world-factbook/ ; (2) The World Economic Outlook Database, IMF.				

Thus, as global supply chains grapple with the challenges of restructuring their value propositions, we try to identify possible relocation options for these global players. The aggregate ranking of the East Asian countries based on the various metrics provide critical pointers towards relocation opportunities.

4 Selecting "Plus One" in the "China-Plus-One" Strategy

4.1 Comparing Select Asian Economies based on Aggregate Ranking

As already indicated, our focus in this paper is the potential of eight countries (viz., China, India, Indonesia, Thailand, Malaysia, Philippines, Bangladesh and Vietnam) in emerging Asia. In the absence of any pan Asian survey data, while assessing the supply chain potential and attractiveness of these economies, we looked at a few standard indices assessing the strength of an economy.

4.2 Selection of the Indices

Specifically, to begin with, we considered the following four popular indices to understand the potential of these eight economies to become/maintain their position in global supply chains.

World Bank's Logistic Performance Index (LPI): The LPI is an interactive benchmarking tool "created to help countries identify the challenges and opportunities they face in their performance on trade logistics and what they can do to improve their performance". Six indicators are used for the construction of LPI: (1) efficiency of customs and border management clearance; (2) quality of trade- and transport-related infrastructure; (3) the ease of arranging competitively priced international shipments; (4) competence and quality of logistics services; (5) ability to track and trace consignments; and (6) frequency with which shipments reach consignees within the scheduled or expected delivery time.[14]

World Bank's Ease of Doing Business Index (DBI): The DBI takes into account information based on the following ten indicators for any country: (1) Starting a Business; (2) Dealing with Construction Permits; (3) Getting Electricity; (4) Registering Property; (5) Getting Credit; (6) Protecting Minority Investors; (7) Paying Taxes; (8) Trading across Borders; (9) Enforcing Contracts; (10) Resolving Insolvency.[15]

World Economic Forum's Global Competitiveness Index (GCI): *The Global Competitiveness Report* series was first launched in 1979. The GCI is the product of an aggregation of 103 individual indicators, derived from a combination of data from international organizations as well as from the World Economic Forum's Executive Opinion Survey. Indicators are organized into 12 pillars: Institutions; Infrastructure; ICT adoption; Macroeconomic stability; Health; Skills; Product market; Labour market; Financial system; Market size; Business dynamism; and Innovation capability.[16]

Economic Complexity Index (ECI) of the Harvard University: The economic complexity of a country is calculated based on the "diversity" of exports a country produces and their "ubiquity", or the number of the countries able to produce them (and those countries' complexity). Diversity and ubiquity are in some sense "crude approximations of the variety of capabilities available in a country or required by a product". While diversity measures how many different types of products a country can make, ubiquity measures the number of countries that can make a product.[17]

How to determine the attractiveness of an economy in terms of these indices? After all, each of these indicators may have some specific information and may follow a distinct methodology. Hence, instead of looking at the index values, we looked at the ratings and tried to arrive at some sort of aggregate rating, using the following methodology.

4.3 Methodology of Aggregate Ranking

Our objective is to capture the relative attractiveness of different economies in terms of a single grand rank that can form the basis of preference of global corporations. Hence, we need to apply a rank aggregation method in terms of deriving a single grand ranking that aggregates and combines all the different rankings.

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[14] The LPI 2018 allows for comparisons across 160 countries and is available at https://lpi.worldbank.org/.
[15] The DBI 2020 covers 190 countries and is available at https://www.doingbusiness.org/en/rankings.
[16] The GCI-2019 covers 141 countries and is available at http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf.
[17] ECI-2019 is available for 133 countries and is available at https://atlas.cid.harvard.edu/rankings.

Rank aggregation (RA) is the process of combining multiple ranked lists into a single ranking. RA has been traditionally applied in the fields of information retrieval, applied psychology, social choice and political election studies. Recently, it has found novel applications in genomic studies and web search applications for integrating information from individual genomic studies that address the same biological question or determining the relative efficacy of search engines in response to a given query (Aslam and Montague, 2001; Li et al., 2019).

Optimization-based RA methods are one of the most popular methods and have a long history dating back to the 1950s (Mallows, 1957; Fligner and Verducci, 1986). They are designed to minimize some distance measure so that the aggregated rank is as close as possible to all base ranks. Two commonly used measures are Kendall's tau and Spearman's foot rule distances. When initially proposed, these methods were computationally challenging because of the large number of comparisons the algorithm had to perform amongst the different rankings. However, with the advancement in technology and computational horse-power, these methods have become much more usable in practical problems.

The optimization-based RA methods are explained below. We first define the objective function that would determine a "super"-list, which would be as "close" as possible to all individual ordered lists simultaneously.

$$(1) \quad \emptyset\,(\delta) = \sum_{i=1}^{n} w_i\, d(\delta, L_i)$$

where L_i is the i^{th} ranked list, δ is a proposed ordered list of length $k = |L_i|$, w_i is the importance weight associated with the list L_i and d is a distance function.

Our objective is to derive δ^* that would minimize the distance between $L_i's$.

$$(2)\ \delta^* = argmin \sum_{i=1}^{n} w_i\, d(\delta, L_i)$$

There are two choices for finding the appropriate distance function d, which would measure the distance between the ranked lists: Spearman foot rule distance and Kendall's tau distance.

Spearman foot rule distance

Spearman foot rule distance is an intuitive generalized distance metric for comparing two ordered lists that calculate the summation of the absolute differences between the ranks of all unique elements from both ordered lists.

Let $r^{L_i(A)}$be the rank of A in the list L_i(rank 1 denotes the best ranking) and $r^{\delta(A)}$ be the rank of A in the list in any ordered list δ. The Spearman's foot rule distance between L_i and any other ordered list δ is defined as:

$$(3)\ \mathrm{S}(\delta, L_i) = \sum_{t \in L_i \cup \delta}^{n} \left| r^{\delta}(t) - r^{L_i}(t) \right|$$

As we observe from the definition, Spearman foot rule distance is the summation of the absolute differences between the ranks of all unique elements from both ordered lists combined. The smaller the value of the metric, the more similar the lists.

Kendall's tau distance

The Kendall's tau distance utilizes pairs of elements from the union of two ranked lists to calculate the distance and is defined as follows:

$$(4)\ K(\delta, L_i) = \sum_{t \in L_i \cup \delta} K_{tu}^{p}$$

where,

$$(4a)\ K_{tu}^{p} = \begin{cases} 0\ if\ r^{\delta}(t) < r^{\delta}(u), r^{L_i}(t) < r^{L_i}(u)\ or\ r^{\delta}(t) > r^{\delta}(u), r^{L_i}(t) > r^{L_i}(u) \\ 1\ if\ r^{\delta}(t) < r^{\delta}(u), r^{L_i}(t) < r^{L_i}(u)\ or\ r^{\delta}(t) > r^{\delta}(u), r^{L_i}(t) > r^{L_i}(u) \\ p\ if\ r^{\delta}(t) = r^{\delta}(u) = k+1\ or\ \ r^{L_i}(t) = r^{L_i}(u) = k+1 \end{cases}$$

Here, $p \in [0,1]$is a parameter that needs to be specified for Kendall's tau. Intuitively, Kendall's tau calculation works in the following way: if the two elements t and u have the same ordering in both lists, then no penalty is incurred (a good scenario). If the element t precedes u in the first list and u precedes t in the second list, then a penalty of 1 is imposed (a bad scenario). A case when both t and u do not appear in either one of the lists (their ranks are $k+1$) can be handled by selecting p on a spectrum ranging from very liberal (0) to very conservative (1).

The main distinction between the distance measures is that Kendall's tau only accounts for discordant pairs, while Spearman's foot rule accounts for the magnitude of the rank differences. To solve the optimization problem and determine the aggregate rank combining the various ranked lists with either the Spearman foot rule distance metric or Kendall's tau distance metric, two methods are applied in practice. One is based on the cross-entropy Monte Carlo simulation approach that works in the context of rare event simulation and combinatorial optimization (Lin and Ding, 2009; Rubinstein and Kroise, 2013). This method uses importance sampling to iteratively search for the ranked list that minimizes the overall distance. The other is based on a Genetic Algorithm (Goldenberg, 1989). In our paper, we considered both the optimization methods by using the *RankAggreg* package in the *R* Programming language. The *RankAggre*g package provides an easy and convenient interface to handle complex rank-aggregation problems. It provides the user with two choices of optimization methods for aggregation as well as two different distance functions, as explained above.

4.4 Results and Discussion

Baseline Results

To begin with, we looked at the rankings of the eight countries as per these four indices and derived their relative ranking among these eight economies (Table 5).

Table 5: Rankings of Eight EMDEs of Asia as per select Indices / Rating

		World Bank's Logistic Performance Index (LPI): Ranking (2018)		World Bank's Ease of Doing Business Index (DBI): Ranking (2020)		World Economic Forum's Global Competitiveness Index (GCI): Ranking (2019)		Harvard University's Economic Complexity Index (ECI): Ranking (2019)	
		Ranking	Relative Ranking	Ranking	Relative Ranking	Ranking	Relative Ranking	Ranking	Relative Ranking
1	China	27	1	31	3	28	2	19	1
2	India	42	4	63	4	68	6	45	5
3	Indonesia	51	6	73	6	50	4	63	7
4	Thailand	34	2	21	2	40	3	25	2
5	Malaysia	35	3	12	1	27	1	28	3
6	Philippines	64	7	95	7	64	5	33	4
7	Bangladesh	100	8	168	8	105	8	104	8
8	Vietnam	45	5	70	5	67	7	57	6
Source: Authors' calculations from Different Indices									

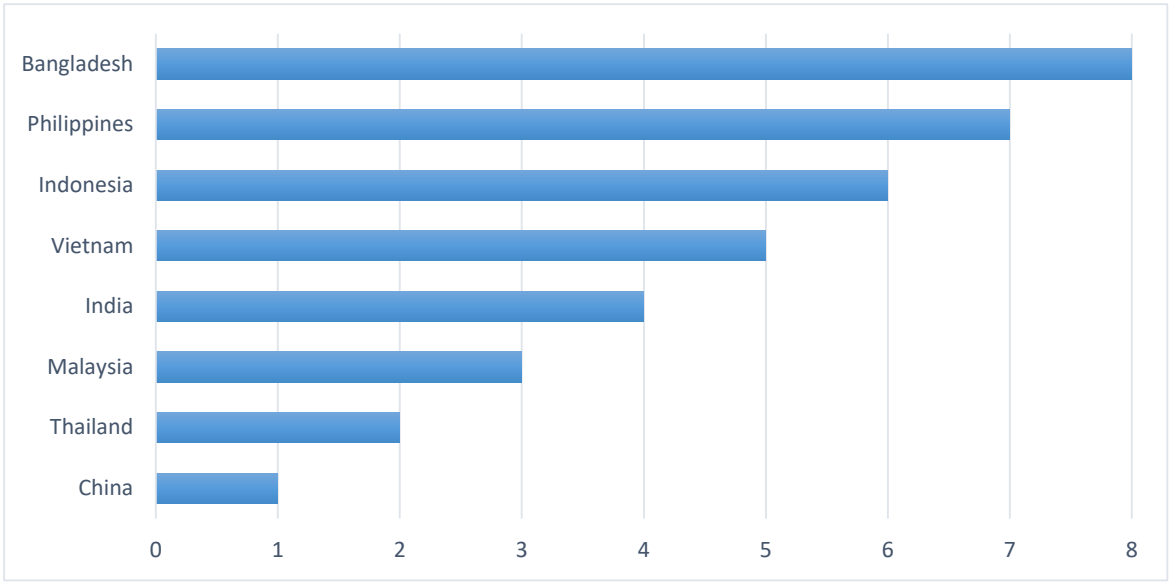
How close are these rankings? We calculated the Spearman rank correlation coefficients of the relative rankings of the eight countries based on the four indices; some of the correlations are not that high (Table 6). The relatively low values of the Spearman correlation coefficients (for example, 0.738 between LPI and GCI rankings, 0.736 between GCI and ECI rankings) indicate that there exist different rankings of the countries across the different indices. Hence, an aggregate ranking that combines the individual rankings under each index would be useful in this context.

Table 6: Pairwise Rank Correlation between the Six Indices

	LPI	DBI	GCI	ECI	CPI	FSR
Logistic Performance Index (LPI)	1.000	0.905	0.738	0.857	0.012	-0.238
Ease of Doing Business Index (DBI)		1.000	0.786	0.762	0.107	-0.429
Global Competitiveness Index (GCI)			1.000	0.736	0.298	-0.238
Economic Complexity Index (ECI)				1.000	0.227	0.119
Corruption Perceptions Index (CPI)					1.000	-0.036
Financial Strength Ranking (FSR)						1.000

As explained above in section 3, we used the *RankAggreg* package available in the *R* Programming language to determine the aggregate ranking of the eight countries based on the individual ranking across these four indices. In the aggregate ranking, we find that China ranks first followed by Thailand, Malaysia, India, Vietnam, Indonesia, Philippines and then Bangladesh (Figure 2). Insofar as global supply chain management is concerned, this sequence gives us some idea of the possible shifts, however marginal, from China to any of these seven countries of emerging Asia.

Figure 2: Aggregate Ranking of Eight Asian Economies as Per Four Indices



Source: Authors' Calculation

Adding two more indices

How do business leaders choose their destinations? In this menu of ideal attributes, we have selected four significant criteria that in our judgment would constitute the core decision making in zeroing in on a business destination. Towards a robustness check, we looked at two more rankings, viz., Economist Magazine's Country Rating of Financial Strength (FSR), and Transparency International's Corruption Perceptions Index (CPI).

FSR is based on four measures of financial strength, viz., public debt, foreign debt, cost of borrowing, and reserves cover. The ranking is for 66 emerging economies.[18] The Transparency International complies CPI by aggregating data from several different sources that "provide perceptions by business people and country experts of the level of corruption in the public sector"; the CPI 2019 is calculated using 13 different data sources from 12 different institutions that capture perceptions of corruption within the past two years for 140 countries.[19] The rankings, as well as the relative rankings of these eight economies as per FSR and CPI, are presented in Table 7.

We calculated the Spearman rank correlation coefficients of the relative rankings of the eight countries based on the six indices; some of the correlations are now very low (for example, 0.107303 between DBI and CPI, 0.298063 between GCI and CPI) and some are even negative (for example, -0.238095 between LPI and FSR, -0.428571 between DBI and FSR) (Table 6). Hence, the importance of an aggregate ranking that combines the individual rankings under each index becomes more useful in this context.

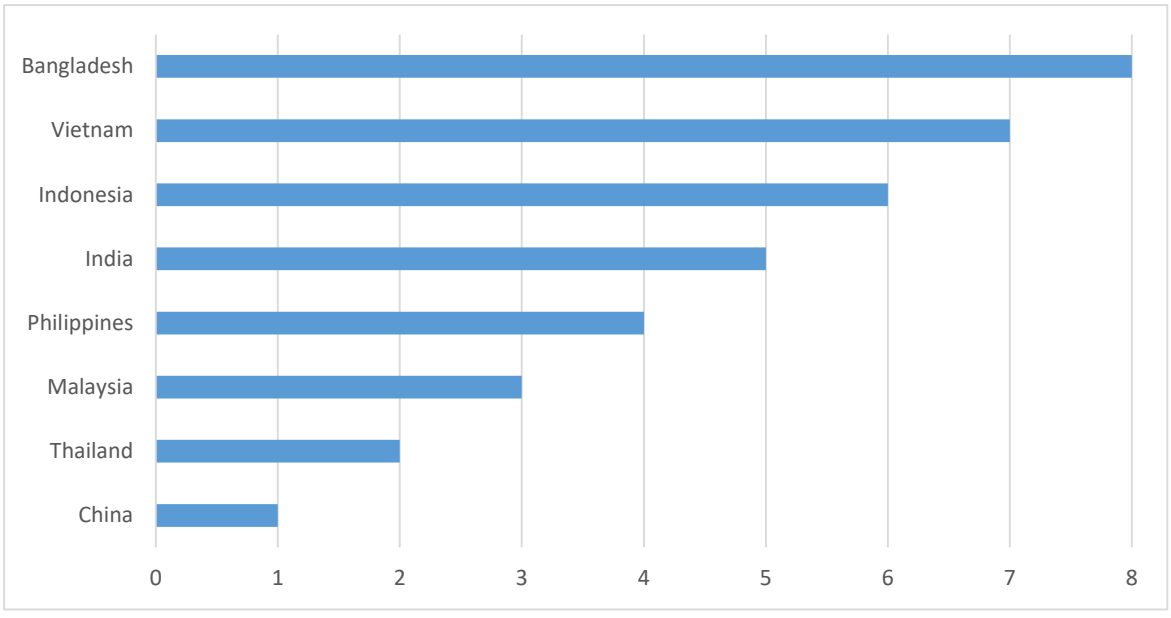
[18] Available at https://www.economist.com/briefing/2020/05/02/which-emerging-markets-are-in-most-financial-peril

[19] Available at https://www.transparency.org/en/cpi/2019

Table 7: Rankings of Eight EMDEs of Asia as per select Indices / Rating					
		Transparency International's Corruption Perceptions Index (CPI): Ranking (2018)		Economist Magazine's Country Rating of Financial Strength (FSR): Ranking (2020)	
		Absolute Ranking	Relative Ranking	Absolute Ranking	Relative Ranking
1	China	87	3	10	4
2	India	78	2	18	7
3	Indonesia	89	4	16	6
4	Thailand	99	5	7	2
5	Malaysia	99	5	25	8
6	Philippines	61	1	6	1
7	Bangladesh	149	8	9	3
8	Vietnam	117	7	12	5

When these two additional rankings are taken into account, the grand rankings of the eight countries look slightly different (Figure 3). While the ranking of the first three countries in Asia, viz., China, Thailand and Malaysia, as well as the eighth rank for Bangladesh remain unaltered, in between there is some change in the relative positions of the other four countries.

Figure 3: Aggregate Ranking of Eight Asian Economies as Per Six Indices



Source: Authors' Calculation

5. Concluding Observation

Asia, in general, and China, in particular, had played a significant role in globalization. In this process, China emerged as the undisputed leader of global supply chain management. Admittedly, several countries in emerging Asia also played vital roles. However, since the global financial crisis of 2008, there has been some drop in the ever-increasing pace of China's production and supply chain activities. Later, with the US-China trade war and the recent COVID-19 pandemic, there may have been some thinking, however nascent, in multinational corporations in terms of moving away from China.

Insofar as the pursuit of this diversifying strategy from China is concerned, our conclusions are as follows. First, it is challenging to move away from China in the short run. Secondly, in all likelihood corporations will pursue a "China-plus-One" strategy, whereby they may move marginally from China and relocate part of their supply chain elsewhere. Third, in looking for alternative locations, corporations in all likelihood may look for the following countries in emerging Asia, viz., Thailand, Malaysia, India, Vietnam, Indonesia, Philippines and then Bangladesh. Aggregating different ranking as per different indices, we have indicated a grand ranking of these seven countries indicating their attractiveness as "Plus One" countries in that diversification initiatives.

The relationship between geography and management success is complex. Geo-politics, institutions, cultural factors, availability of cheap land, labor and finance – all could play a role in that. In this paper, at the current juncture of de-globalization, we have tried to develop a macro approach (and a methodology) of the relevant metrics that could be relevant in making that decision. Admittedly, our menu of attributes of various rankings is far from being exhaustive, and these can be extended depending on the context of the business.

While at this time of uncertainty, we have no way to infer the shape of things to come in the near future, the strategic role of Asian corporations and countries in future global growth and development can hardly take a back seat in the post-pandemic world. To conclude, we echo the sentiments of Lawrance Summers, who said, "If the 21st century turns out to be an Asian century as the 20th was an American one, the pandemic may well be remembered as the turning point" (Summers, 2020).

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