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A Decade of Supply Chain Initiatives: Opportunities and Challenges in Post-COVID-19 Recovery

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Introduction

Global value chains (GVCs) or global supply chains, where the different stages of the production process are located across borders, have become a dominant feature of world trade.[1] This international production sharing has largely been driven by transnational corporations in industrialised economies. Transnational corporations, together with their affiliates, account for two-thirds of international trade and play a leading role in supply chain networks.[2]

The transnational corporations, in seeking continuous productivity gains, have engaged in restructuring their businesses and reorganising their production activities. One manifestation of this is the offshoring of manufacturing from industrialised economies to developing economies, often with different components of a product manufactured in different economies, to maximise efficiency and exploit economies of scale. For example, a smartphone manufacturing network may be spread across 49 economies, while a vaccine producer may have over 5,000 suppliers.[3]

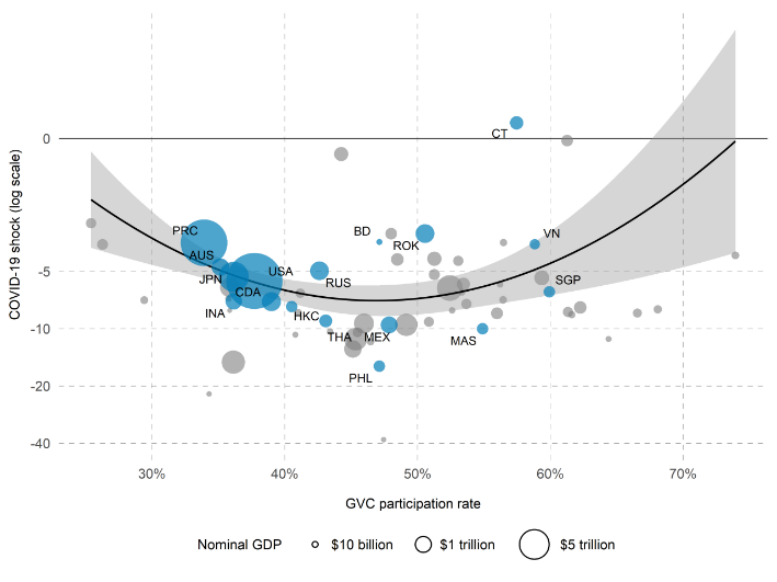
Pre-COVID-19, then, efficiency gains largely determined the development and composition of global supply chain networks. However, the COVID-19 outbreak has challenged conventional wisdom regarding the nature of efficiency and the risks in global supply chains. The pandemic caused the biggest and broadest supply chain shocks in recent memory, the most immediate and early of these shocks being the supply crunch affecting urgently needed medical products such as personal protective equipment and respirators. Later on, the pandemic exposed the fragility of the world's food supply chains.[4] More recently, semiconductor shortages have caused production delays, affecting supply of automobiles, electronics, medical devices and technology equipment – further underscoring the vulnerability of global supply chains.[5] These waves of critical supply disruptions led to widespread concern over mitigating supply chain risks, and are increasingly shaping the post-pandemic economic landscape.

No comprehensive assessment of the cumulative effects of COVID-19 at the individual economy level is possible because the situation is still unfolding. A preliminary assessment of 'COVID-19 shock' by the Asian Development Bank (ADB) serves as a useful starting point.[6] Figure 1 tracks the interaction between COVID-19 shock and GVC participation rates in APEC economies.

All the APEC economies in Figure 1 (highlighted in blue) registered significant levels of GVC participation (over 30 percent). The most GVC-integrated economies – Korea; Malaysia; Singapore; Chinese Taipei; Viet Nam – are in East Asia, and all presented GVC participation rate of 50 percent and above. COVID-19 shock also varied greatly across APEC economies. For instance, among the most GVC-integrated economies, Malaysia faced significant shock at minus 10 percent, whereas Chinese Taipei exceeded its Gross Domestic Product (GDP) forecast.

[1] According to the Organisation for Economic Co-operation and Development (OECD), about 70 percent of international trade involves global supply chains, while the World Bank estimates that GVCs account for almost 50 percent of global trade.
[2] E. Gentile et al., "Productivity Growth, Innovation, and Upgrading along Global Value Chains," in Asian Development Bank (ADB) et al., "Global Value Chain Development Report 2021: Beyond Production" (ADB et al., 2021), Ch. 3, http://dx.doi.org/10.22617/TCS210400-2
[3] "Message in a Bottleneck," *Economist*, 3 April 2021.
[4] World Bank, "Food Security and COVID-19," 13 December 2021, https://www.worldbank.org/en/topic/agriculture/brief/food-security-and-covid-19
[5] B. Vakil and T. Linton, "Why We're in the Midst of a Global Semiconductor Shortage", *Harvard Business Review*, 26 February 2021, https://hbr.org/2021/02/why-were-in-the-midst-of-a-global-semiconductor-shortage
[6] For more on the methodology to assess the relationship between GVC participation and COVID-19 shock, see: ADB, "Part III: Global Value Chains – The COVID-19 Shock and the Two Faces of Global Value Chains" (ADB, 2021), 230–89, https://www.adb.org/sites/default/files/publication/720461/part3-gvcs.pdf

Figure 1. Relationship between global value chain participation and COVID-19 shock, 2020



AUS=Australia; BD=Brunei Darussalam; CDA=Canada; PRC=China; HKC=Hong Kong, China; INA=Indonesia; JPN=Japan; ROK=Korea; MAS=Malaysia; MEX=Mexico; PHL=the Philippines; RUS=Russia; SGP=Singapore; CT=Chinese Taipei; THA=Thailand; USA=United States; VN=Viet Nam;

Note: COVID-19 shock is estimated as the difference between the reported final demand (GDP) for 2020 and the forecasts for 2020 at the start of that year.
Source: Asian Development Bank (ADB) et al., "Global Value Chain Development Report 2021: Beyond Production" (ADB et al., 2021), http://dx.doi.org/10.22617/TCS210400-2

At the firm level, the unprecedented COVID-19 shock has prompted a rethink of the trade-off between efficiency and risk inherent in supply chain management. Supply chain resilience, that is, the ability to return to normal operations in an acceptable period of time after being disrupted,[7] has assumed new importance relative to efficiency and cost considerations. The responses to heightened uncertainty had been extremely diverse across firms, involving automation, digitalisation, diversification, 'just in case' capacity buffers, regionalisation, nearshoring and shorter GVCs for some products.[8]

Against this background, supply chain connectivity has become an important agenda for both governments and firms, to address the COVID shock and maintain a robust and sustainable recovery. Therefore, this policy brief will focus on the role of supply chain connectivity in supporting post-COVID economic recovery by identifying the major chokepoints.

The policy brief will unfold in four parts, starting with a quick review of earlier implementations of the APEC Supply-chain Connectivity Framework Action Plan (SCFAP): SCFAP I (2010–2015) and SCFAP II (2017–2020). This brief will go on to review key trends in GVC development, and consider the new challenges and opportunities found in the digital economy. Finally, it will suggest the chokepoints that are of essential relevance to strengthening supply chain connectivity and regional economic integration in the Asia-Pacific region.

Lessons learned from SCFAP I

APEC's SCFAP began with the conclusion of two consecutive Trade Facilitation Action Plans, in 2002 and 2006, respectively. The plans had aimed to reduce transaction costs by 5 percent, primarily by addressing customs and other trade procedures that hinder, delay or raise the cost of moving goods across borders. The intention of the SCFAP was to move beyond reducing transaction costs, and to extend the scope to include improving trade logistics as part of the trade facilitation agenda, thus supporting the private sector in conducting their global business operations.

In 2009, the APEC Annual Ministerial Meeting in Singapore endorsed the Supply-chain Connectivity

[7] OECD, "COVID-19 and Global Value Chains: Policy Options to Build More Resilient Production Networks," 3 June 2020, https://www.oecd.org/coronavirus/policy-responses/covid-19-and-global-value-chains-policy-options-to-build-more-resilient-production-networks-04934ef4/

[8] ADB et al., "Global Value Chain Development Report 2021."

Framework which identified eight chokepoints in regional supply chains and suggested actions to address them.[9] Accordingly, the APEC SCFAP I (2010–2015) set a target of 10 percent reduction in time, cost and uncertainty by 2015 by addressing the eight chokepoints. The chokepoints are:

1) *Transparency*: Lack of transparency/ awareness of the full scope of regulatory issues affecting logistics; lack of awareness and coordination among government agencies on policies affecting the logistics sector; absence of a single contact point or champion agency on logistics matters.
2) *Infrastructure*: Inefficient or inadequate transport infrastructure; lack of cross-border physical linkages such as roads and bridges.
3) *Logistics capacity*: Lack of capacity among local/regional logistics sub‑providers.
4) *Clearance*: Inefficient clearance of goods at the border; lack of coordination among border agencies, especially relating to clearance of regulated goods 'at the border'.
5) *Documentation*: Burdensome procedures for customs documentation and other procedures (including for preferential trade).
6) *Multimodal connectivity*: Underdeveloped multimodal transport capabilities; inefficient air, land and multimodal connectivity.
7) *Regulations and standards*: Variations in cross-border standards and regulations for movements of goods, services and business travellers.
8) *Transit*: Lack of regional cross-border customs-transit arrangements.

The final review of SCFAP I notes the following progress and outcomes: a slight improvement on overall logistics performance; faster time to complete trade transactions; lower cost to import and export in real terms (inflation adjusted); and a marked improvement in the border clearance environment.[10]

However, the report also acknowledges that high logistics costs were still an issue. Costs stemming from inefficient and poor-quality transportation infrastructure could hinder the development of domestic value chains. Often, rising wages were mentioned as contributing to rising logistics costs as labour accounts for 20 percent of supply chain costs.[11] Informal (corrupt) payments remained a concern for economies with lower logistics performance, according to the 2016 Logistics Performance Index (LPI) report.[12]

Improving the quality of domestic logistics services is particularly important for economies with low LPI scores. In these economies, delays and uncertainty were particularly damaging, and they occurred more frequently. The 2016 LPI report suggests three areas of concern in this regard; apart from informal payments, low logistics performers diverge from high performers in terms of compulsory warehousing and pre-shipment inspection.

The SCFAP I report also suggests several policy objectives that should be kept in mind when identifying the chokepoints for SCFAP II: simplifying and improving customs and border procedures and processes; improving the quality of, and access to, transportation infrastructure and services; maintaining reliable, secure and efficient logistics services; fostering stronger regulatory cooperation and harmonisation; and improving the policy and regulatory infrastructure for e-commerce.

Lessons learned from SCFAP II

SCFAP II addresses five major chokepoints in supply chains:

1) Lack of coordinated border management, and underdeveloped border clearance and procedures
2) Inadequate quality of, and lack of access to, transportation infrastructure and services
3) Unreliable logistics services and high logistical costs
4) Limited regulatory cooperation and best practices
5) Underdeveloped policy and regulatory infrastructure for e-commerce.

According to the final review of SCFAP II, APEC economies have generally performed well on chokepoints 1 and 2 (as of 2019).[13] Cost and time to import and export have fallen, connectivity has increased, and transparency has improved. Quality of transportation services and infrastructure under

[9] APEC, "2009 APEC Ministerial Meeting," 11 November 2009, https://www.apec.org/meeting-papers/annual-ministerial-meetings/2009/2009_amm

[10] APEC, "Supply Chain Connectivity Framework Action Plan 2010–2015: Final Assessment" (Singapore: APEC, 2016), https://www.apec.org/docs/default-source/Publications/2016/11/APEC-Supply-Chain-Connectivity-Framework-Action-Plan-2010-2015-Final-Assessment/SCFAP-Final-Assessment-Report_Final.pdf

[11] P. Burnson, "Higher Minimum Wages Will Have Impact on Supply Chain Management," *Supply Chain Management Review*, 21 March 2016, https://www.scmr.com/article/higher_minimum_wages_will_have_impact_on_supply_chain_management

[12] J. Arvis et al. 2016. "Connecting to Compete 2016: Trade Logistics in the Global Economy – The Logistics Performance Index and Its Indicators" (Washington, DC: World Bank, 2016), https://openknowledge.worldbank.org/handle/10986/24598.

[13] APEC, "Final Review of the APEC Supply-Chain Connectivity Framework Action Plan 2017–2020 (SCFAP-II)" (Singapore: APEC, 2021), https://www.apec.org/publications/2021/11/final-review-of-the-apec-supply-chain-connectivity-framework-action-plan-2017-2020-(scfap-ii)

chokepoint 2 has also improved since 2016, both in terms of ensuring better shipping connectivity as well as a more stable environment for infrastructure investment.

Overall, performance on chokepoint 3 remains mixed (it should be noted that there were no updates for most of the indicators used in the analysis). Based on the literature, the COVID-19 pandemic has worked against improvements in this area as warehouse capacity contracted and inventory costs shot up in 2020 and early 2021. APEC economies are leveraging digital technologies to reduce costs and improve coordination and transparency in logistics services.

Alignment of processes and digitalisation of systems have facilitated sharing of information and cooperation. Conscious efforts have also been made to implement article 12 of the World Trade Organization (WTO) Trade Facilitation Agreement which encourages customs cooperation, particularly in facilitating the exchange of information between customs agencies. As a result, the performance of APEC economies on chokepoint 4 has notably improved since 2015.

Moreover, in line with the rise of e-commerce, there has been a greater focus on the digitalisation of operational processes and procedures. As e-commerce continues to gain traction over the course of the pandemic, more reforms are needed to keep up with the increased volumes of business. For example, COVID-19 restrictions severed supply chains and placed undue pressure on postal systems.

The global economic and trade recovery will require more resilient and efficient supply chains. The SCFAP II review report highlights several issues moving forward.[14]

First, resiliency is an important component of a stronger recovery. When building and upgrading supply chains, several traits should be prioritised. The supply chains should be robust and can withstand shocks; agile in embracing recovery; flexible and able to leverage alternatives; and able to build surplus capacity.

The rising trade costs (from congestion, delayed shipments, increase in freight costs and border barriers) deserve urgent attention. Promoting stronger border agency cooperation rooted in trust is essential in addressing interoperability issues.

Increasing investment in digital technologies and enhancing the environment for public–private partnerships (PPP) are important to close the digital divide and improve competitiveness. Regulatory reforms affecting the digital economy will contribute to a stronger recovery. Sustainability and inclusiveness in supply-chain trade are also important elements of recovery.

Last but not least, the growth of e-commerce is dependent on reliable and advanced logistics services that address issues of modernisation and development of skills and expertise.

Trends in GVC development

Even before the COVID-19 pandemic, there were already signs that GVC expansion had somewhat stagnated, particularly after the collapse of trade during the 2008–2009 global financial crisis. From 2010 to 2019, the length of GVCs remained more or less constant at around 8.5 stages. For comparison, the number of stages between primary inputs and final consumption was 7.9 in 2000, with virtually all traded sectors seeing their supply chains lengthen from 2000 to 2010. [15] Nevertheless, certain economies like Bangladesh and Viet Nam still experienced an increase in GVC participation.

While GVC participation and expansion appear to be slowing, GVCs are still viewed as an important route for economies to participate in the global economy and pursue their economic development strategy.

Several new trends are emerging in the development of GVCs. First, services and intangibles are gaining in importance. Value added in GVCs is increasingly generated beyond manufacturing as advanced methods of production that involve services and intangible assets are applied. The rising number of services jobs created for manufacturing is driving the growth of services-in-trade shares, in addition to supporting higher GVC participation in certain economies.[16] Intangible assets, such as brands, designs, patented technologies and know-how, serve to distinguish the leading firms in GVC networks from their suppliers.[17]

Second, innovation and knowledge spill-overs are becoming an important element of modern GVCs.

[14] APEC, "Final Review of the APEC Supply-Chain Connectivity Framework Action Plan 2017–2020 (SCFAP-II)."
[15] ADB, "Global Value Chain Development Report 2021."
[16] E. Nano and V. Stolzenburg, "The Role of Global Services Value Chains for Services-Led Development," in ADB, "Global Value Chain Development Report 2021," Ch. 4.
[17] Nano and Stolzenburg, "The Role of Global Services Value Chains."

GVC networks are crucial channels of knowledge transfer and productivity-enhancing innovation. Local firms and suppliers may benefit from GVC participation and interactions by improving their learning capacity, to absorb the new technology or know-how. This may increase domestic innovative capabilities [18] and technological (or economic) upgrading in domestic manufacturing firms.[19]

COVID-19 further put the spotlight on new risks and the transformation of old risks affecting, and caused by, GVC trade and policy responses surrounding the post-pandemic recovery. GVCs characterised by complex, lengthier and concentrated production or distribution are most vulnerable.[20] As a result of a highly integrated global economy, economies are becoming vulnerable to supply chain risks, which may negate the benefits of offshoring production based on cost-related factors.[21]

The World Economic Forum (WEF) Global Risks Report 2021 highlights a range of global risks, among them climate action failure; digital concentration and inequality; cybersecurity failure; infectious diseases; debt crises and breakdown of information technology (IT) infrastructure.[22]

GVCs may be cushioned from future shocks by moving toward sustainable practices, such as adopting reusable packaging. Sustainable GVCs may also contribute in distributing the gains from globalisation more evenly. [23] The impact of sustainable practices is likely greater for products like electronics that have longer supply chains.[24]

New challenges and opportunities in the digital economy

With the experience from implementing SCFAP I and II, APEC economies have developed knowledge on adapting to new challenges and opportunities. In terms of the digital economy, overcoming the digital divide in APEC economies, and achieving balanced and inclusive economic growth, is a major challenge for the region.

Prior to the pandemic, ICT infrastructure had already been identified as one of the major factors in enhancing participation in the global supply chain. COVID-19 has further put ICT infrastructure and supply chain visibility at the heart of economic recovery. Digital technologies had played a crucial role in keeping society functioning during the pandemic, whether by enabling remote working, automating processes or facilitating contactless transactions. Therefore, creating high-functioning ICT infrastructure and robust digital connections across economies is a top priority, so as to improve digital connectivity in the APEC region. However, the availability of financing for infrastructure investments remains constrained, delaying or preventing the development of these projects. Infrastructure projects tend to be debt financed at around 70–80 percent and the financial complexity of digital infrastructure can be relatively high. Governments are still the predominant source of funding for infrastructure projects in many APEC economies.

To overcome the digital divide, economies should consider sharing the burden of financing ICT infrastructure and making the investment climate more attractive. The PPP approach could be more widely introduced to finance ICT infrastructure projects.

The digital economy also brings opportunities for inclusive growth. The rise of digital platforms provides more opportunities for small and medium enterprises (SMEs) and women entrepreneurs from developing economies to participate in GVCs.[25] The ability to explore the potential of digital platforms is, however, constrained by limited digital capacity and poor infrastructure. [26] Digital platforms also allow GVCs to become more resilient as shown by the increased use of such platforms after the initial shock of the pandemic. [27] Investing more in

[18] Gentile et al., "Productivity Growth, Innovation."
[19] M.B. Marcato and C.T. Baltar, "Economic Upgrading in Global Value Chains: Concepts and Measures," *Revista Brasileira de Inovação* 19, e020002 (2020): 1–25, https://doi.org/10.20396/rbi.v19i0.8654359
[20] E. Solingen, B. Meng, and A. Xu, "Rising Risks to Global Value Chains," in ADB, "Global Value Chain Development Report 2021," Ch. 5.
[21] G Talamo and M. Sabatino, "Re-Shoring and Resilience in Italy during and after the Crisis," *American Journal of Industrial and Business Management* 8, no. 5 (2018): 1172–96, DOI:10.4236/ajibm.2018.85081
[22] World Economic Forum (WEF), "The Global Risks Report 2021" (WEF, 2021), https://www.weforum.org/reports/the-global-risks-report-2021
[23] Unsustainable practices have, for example, been implicated in overfishing, which threatens the livelihood of some fishermen. (OECD, "Building More Resilient and Sustainable Global Value Chains through Responsible Business Conduct" (OECD, 2021), https://mneguidelines.oecd.org/rbc-and-trade.htm).
[24] Malk Sustainability Partners, "Sustainable Supply Chain Management in Information Technology" (Malk Sustainability Partners, 2015), https://malk.com/wp-content/uploads/2015/05/MSP-Study-Sustainable-Supply-Chain-Management-in-IT.pdf
[25] P. Antràs, "Conceptual Aspects of Global Value Chains," Working Paper, World Bank, 2020, https://openknowledge.worldbank.org/handle/10986/33228
[26] K. Lundquist and J.W. Kang, "Digital Platforms and Global Value Chains," in ADB, "Global Value Chain Development Report 2021," Ch. 6.
[27] OECD, "The Role of Online Platforms in Weathering the COVID-19 Shock," updated 8 January 2021, https://www.oecd.org/coronavirus/policy-responses/the-role-of-online-platforms-in-weathering-the-covid-19-shock-2a3b8434/

digitalisation and automation may also improve the visibility and flexibility of GVCs.[28]

Way forward

The Aotearoa Plan of Action for implementing Putrajaya Vision 2040, which was endorsed in 2021 by APEC member economies, highlights the importance of promoting resilient supply chains and responsible business conduct; strengthening digital infrastructure; accelerating digital transformation; and narrowing the digital divide.[29] The Plan also signifies collective action by APEC economies to address key infrastructure gaps, improve digital connectivity and promote the use of digital technologies.

APEC has been taking the lead in addressing supply chain chokepoints with the objective of facilitating a regulatory environment for businesses that supports efficiency, connectivity and certainty. In the midst of evolving supply-chain reconfiguration (or rebalancing) and COVID-19 recovery, businesses are pursuing a range of supply chain strategies, including automation, digitalisation, multiple sourcing, redundancy, nearshoring and suppliers mapping. [30] The multidimensional character of the COVID-19 crisis has resulted in a plurality of approaches for recovery.

The following potential chokepoints need to be addressed with the goal of improving the efficiency and reliability of supply chains.

1) **Lack of transparency, cooperation and consistency in trade, transportation and border-related policies.** Earlier SCFAPs have identified the lack of transparency and consistency as a challenge in improving the region's supply-chain connectivity. Efforts such as promoting single window interoperability and the expansion of authorised economic operator (AEO) mutual recognition agreements ensure greater predictability and reduce trade costs. This is important because policy uncertainty may have significantly contributed to the decline in world trade growth, with possible long-term impact on investment.[31]

2) **Lack of resiliency and sustainability in the global supply chain network.** Resiliency can be achieved through several means such as through promoting flexibility[32] and visibility.[33] Supply chain flexibility helps firms respond more quickly to fluctuations, and withstand disruptions. [34] Better visibility and mapping would support the prevention and mitigation of supply chain disruptions; while closer international collaboration, reciprocity and transparency on the preventive measures would allow better handling of GVC-related risks. [35] While longer supply chains may be more susceptible to risks, inward-focused resiliency strategies may be costly and not economically sustainable. Lastly, sustainable supply chain management practices may also contribute to increased resiliency. It goes the other way as well: a resilient (as opposed to fragile) supply chain might be more likely to 'go green'. [36] An eco-friendly supply chain could also enhance business competitiveness through better brand recognition[37] as well as in meeting tighter regulations.[38]

3) **High costs and uncertainty in logistics and supply-chain related services**. Supply chain disruptions and congestion are costly and may entail costly solutions. With the recovery process evolving in an uneven manner, firms would need to adjust to the uncertainties and governments would need to facilitate that process of finding an efficient solution. High logistics cost may also be an obstacle to the development of domestic value chains.

4) **Lack of collaboration and cooperation among supply chain stakeholders**. Collaboration and cooperation among border agencies would allow smoother exchange of information and faster trade processing. Collaboration across firms, customers and logistics operators would also allow for reliable

[28] P. Fortunato, "How COVID-19 is Changing Global Value Chains," UNCTAD, 2 September 2020, https://unctad.org/news/how-covid-19-changing-global-value-chains

[29] APEC, "Aotearoa Plan of Action," accessed 18 December 2021, http://aotearoaplanofaction.apec.org/

[30] Solingen, Meng and Xu, "Rising Risks."

[31] C. Constantinescu, A. Mattoo, and M. Ruta, "Policy Uncertainty, Trade and Global Value Chains: Some Facts, Many Questions," Working Paper, World Bank, 2019, https://openknowledge.worldbank.org/handle/10986/32657

[32] Flexibility can be achieved by having alternative suppliers and routes or maintaining temporary capacity buffers.

[33] Better end-to-end supply chain visibility allows relevant parties to trace individual cartons at each stage of the shipment. This will sustain the growth of e-commerce by ensuring reliability of delivery in the context of the pandemic.

[34] Y. Sheffi, "Building a Resilient Supply Chain," *Harvard Business Review* 1, no. 8 (2005): 1–4, http://web.mit.edu/sheffi/www/selectedMedia/genmedia.buildingresilientsupplychain.pdf".

[35] Solingen, Meng, and Xu, "Rising Risks."

[36] M. Negri et al., "Integrating Sustainability and Resilience in the Supply Chain: A Systematic Literature Review and a Research Agenda," *Business Strategy and the Environment* 30, no. 7 (2021): 2858–86, https://onlinelibrary.wiley.com/doi/full/10.1002/bse.2776

[37] Malk Sustainability Partners, "Sustainable Supply Chain."

[38] B. Sinclair-Desgagné, "Greening Global Value Chains: Some Implementation Challenges," Working Paper, World Bank, 2013, https://openknowledge.worldbank.org/handle/10986/16840?locale-attribute=en

and seamless delivery. Focus should be on the drivers of collaboration; that may include trust, commitment and information sharing.[39]

5) **Digital divide in transportation and connectivity infrastructure facilities**. To narrow the digital divide, APEC economies should enhance the PPP environment to increase investment in digital infrastructure and technologies. Governments also need to facilitate the wide adoption of innovative supply chain practices to improve broad-based productivity. Tackling digital divide issues may facilitate more inclusive and sustainable supply chains (for example, through increasing the utilisation of digital platforms).

6) **Lack of regulatory reforms and cooperation to support the digital economy and digital solutions.** Supply chain networks are evolving to adapt and contribute to the growing digital economy. In this context, APEC economies should implement regulatory reforms, introduce policies to promote data security and privacy, and streamline data flows.

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Figure 1 is constructed using GVC data provided by the Multi-Regional Input-Output team at the ADB. We are especially grateful for the chart provided by Kenneth Anthony Luigi S. Reyes.

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[39] R. Banomyong, "Collaboration in Supply Chain Management: A Resilience Perspective," Discussion Paper, International Transport Forum, Paris, 2018, https://www.itf-oecd.org/sites/default/files/docs/collaboration-supply-chain-management.pdf