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## Global value chains and regional systems of innovation: Towards a critical juncture?

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### ABSTRACT

Over recent years, the world has witnessed unexpected challenges - including the COVID-19 pandemic and significant geopolitical tensions. These events have had substantial impacts on both Global Value Chains and Regional Innovation Systems – two complementary analytical scopes that compose the complex geography of innovation. This has led governments to take drastic measures on different fronts and scholars to argue about the surging of a phase of de-globalization in which Global Value Chains are being transformed and restructured, potentially altering the geography of economic activity that has been forged over the last decades. It is uncertain how countries, regions, firms and individuals will respond to multifaceted crises and productive rearrangements, which ones will be more resilient and better capable of doing so than others. In this introduction to the Special Issue “Global Value Chains and Regional Systems of Innovation: Towards a Critical Juncture?” we discuss the local-global dynamics of innovation and propose a critical appraisal on how key contextual parameters have changed, on the one hand, and the potential outcomes of these shifts, on the other. We outline pressing issues for debate among scholars, policymakers and practitioners as well as offer elements to begin a discussion on the critical junctures that lay ahead. We also present the insightful articles that compose this Special Issue.

### 1. Introduction

In complex systems, even small changes in contextual parameters may lead to dramatic shifts in trajectories (Thom, 1975). Literature has long recognized that this corollary remains valid for organizational and economic systems (e.g. Mathews et al., 1999; Wilson, 1981; Varian, 1979). The beginning of the 2020s, however, has brought more than minor transformations to economies worldwide. In fact, the world is in turbulence caused by several events occurring simultaneously. Among these events, the COVID-19 pandemic has evolved into a global health crisis that – considering the levels of global socioeconomic integration - is unprecedented in modern history. This has led governments to take drastic measures which impact social life but also economy and global value chains (Kuckertz et al., 2020). Some have referred to this confluence of frictions as a post-pandemic polycrisis (Leyshon, 2023).

These crises have triggered economic turbulences that hit hard many countries and regions (Donthu and Gustafsson, 2020). Scholars have argued about the surging of a phase of de-globalization in which Global Value Chains are being transformed and restructured (Lee et al., 2021; Sharma et al., 2020; Petricevic and Teece, 2019). This happens amidst increasing trade tensions between the US, Europe and China that already started before the COVID-19 pandemic but which have been accelerating since (Evenett, 2020). On top of that, accelerating shifts associated with Industry 4.0 and artificial intelligence are also shaping the reorganization of the global economy (Strange and Zucchella, 2017; Schwab, 2016; Laffi and Boschma, 2022). Lundvall (2023) identified in these dynamics a severe limitation to national governance of innovation systems. He goes as far as calling for a transition towards a notion of a

Global Innovation System.

From a complementary perspective, innovative activities also rely on local hotspots of technological capabilities, i.e., ecosystems that connect myriad agents to create efficient knowledge networks. This double-sided feature of productive structures (global and local) towards innovation (WIPO, 2019) generates dense interactions – a pivotal element of competitiveness at the micro, meso and macro-levels. Notwithstanding, prospective trends of disruption represent substantial risks for relationships involving organizations and innovation systems (Oldekop et al., 2020), potentially altering the geography of economic activity that has been forged over the last decades.

Following this background, there is massive uncertainty in how countries, regions, firms and individuals will respond to multifaceted crises and productive rearrangements, which ones will be more resilient and better capable of doing so than others, and why that will be the case. Considering the pivotal role played by GVCs in shaping and integrating technological capabilities at the micro, meso and macro-levels worldwide (Ge et al., 2018; Kergroach, 2019; Yoruk, 2019), understanding these conditions becomes key to properly address how economic and innovation systems will absorb impacts associated with these events (Mitroff, 2020). In this introduction to the Special Issue “Global Value Chains and Regional Systems of Innovation: Towards a Critical Juncture?” we discuss the local-global dynamics of innovation in order to propose a critical appraisal on how key contextual parameters have changed – and the potential outcomes of these shifts. We do so by articulating a thorough literature review based on recent contributions associated with topics related to the interplay between Global Value Chains, Regional Systems of Innovations and the recent systemic crises.

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From this background we outline pressing issues for debate among scholars, policymakers and practitioners. A series of articles pertaining to this Special Issue are introduced. They offer insightful elements to start the discussion on the critical junctures that lay ahead.

## 2. The current state of global value chains

International integration of economic systems during the pandemic led to increased negative effects associated with the disruption of GVCs. As a result, the COVID-19 spread generated debates about whether GVCs were adequate productive structures *vis-à-vis* challenges to meet demand in times of crises. In fact, a significant share of economic downturns arising from the COVID-19 pandemic can be traced back to disruption in Global Value Chains (Bonadio et al., 2020). This situation proved particularly harmful for countries that do not possess diversified networks of international collaborations (Pahl et al., 2022), thus augmenting the risk exposure of their economic systems. From a macro viewpoint, although the market value of companies involved in GVCs was severely damaged by the pandemic, leading firms in these international networks exhibited remarkable resilience (Yu et al., 2022).

There is no agreement in the literature regarding the outcomes of this extreme event. Contractor (2022, p. 164) argues that “after the pandemic, the ‘new normal’ may be marginally different, but globalization in its various manifestations will continue, and global coordination will be even more important for collective intergovernmental action”. From this optimist perspective, ongoing crises will have marginal effects on the way GVCs are structured – and they shall not last for long. Yet, one should consider that GVCs are not purely economic phenomena. As Dallas et al. (2021) point out, the spatial distribution of GVC structure is also shaped by country-level policies. A similar argument is laid out by Meng and Ye (2022). In the political and institutional spheres, many things have changed – and it is unlikely that they will return to what they were before the pandemic any time soon. Ciravegna and Michailova (2022) claim that Contractor’s (2022) perspective neglects the socioeconomic impacts of the Covid-19 pandemic, including rising inequality across and within countries, increased senses of nationalism, rising protectionism, and undermined multilateral institutions. In this case, systemic conditions will likely lead to reconfiguration in GVCs, generating more fragmented international markets.

The main issue here is that the Critical Juncture outlined in this article is not a representation of isolated events that will eventually fade into history books. Rather, it is about how these specific occurrences solidify trends that had already been going on for a while. For instance, over the last decades, integration of international markets has been shifting from multilateral agreements to regional and ‘megaregional’ agreements (Pomfret, 2021). This goes beyond the geopolitics of trade, affecting how economic efficiency can be achieved by geographical spread of productive activities. In turn, firm-level responses to these challenges will inevitably lead to GVC reconfiguration due to systemic changes in the parameters that define strategic options for microeconomic agents (Mukherjee et al., 2023; Pahl et al., 2022).

Calls for strategic nationalization of critical industries in order to reduce vulnerabilities have proliferated (Ngo and Dang, 2023). There seems to be a trade-off between efficiency and resilience in the way GVCs are geographically configured (Ayadi et al., 2022; Pahl et al., 2022). This is a compelling argument following the morbid events associated with the pandemic and the lack of protective equipment for all. Nonetheless, it fails to incorporate the notion that nationalization (or even regionalization) of production also implies risks in terms of value chain disruption. OECD simulations indicate that more localized trade regimes would lead to decreased economic activity and higher vulnerability to international and domestic shocks (OECD, 2020).

A critical concept in these discussions is that of “technological sovereignty”. As Edler et al. (2023) argue, technology-based competition has exceeded the economic sphere to encompass disputes among political and value systems – issues that were intensified by recent

geopolitical events. In this respect, technological sovereignty has become an important element of innovation policy debates worldwide due to fears of lagging behind in key technologies (March and Schieferdecker, 2023; Kroll and Frietsch, 2022). This brings us to a delicate boundary between sovereignty and autarky, a situation which can easily lead to protectionist policies that can cause socioeconomic losses in the long term by excluding countries from global networks of innovation (Edler et al., 2023; March and Schieferdecker, 2023). Embedded in this discussion is the notion of ‘resilience’ as a driving factor of GVC structure. Following Gereffi et al. (2022), resilience has different meanings at the levels of firms (operational efficiency), GVCs (governance structure), and countries (national security). Addressing the case of medical supplies, they identify the potential conflicts that can arise among these dimensions, a situation that generates a complex picture for policymakers.

Another feature of critical interest in the debate of GVCs concerns the rapid process of technology upgrading observed in China over recent periods. This has been a major driver of the trade conflict involving that country and the United States (Meng and Ye, 2022; Malkin, 2022) which has led to a rising sense of techno-nationalism expressed in policies from both sides (Luo and Van Assche, 2023). This has far-reaching negative impacts that involve third-party countries due to direct and indirect tariff effects (Wu et al., 2021) which carry the potential of generating significant modifications in the dynamics of trade. Catching-up countries can be particularly impacted by such trade modifications. In the short term, those developing nations that heavily rely on GVCs are exposed to high levels of risk if the international networks in which they are embedded change their geographical structure (Pietrobelli et al., 2022). On the other hand, over the long term, some windows of opportunity might open up.

For instance, Botchie et al. (2022) address the case of China expanding its ICT operations in Sub-Saharan Africa. Contrary to the long trajectory of technological backwardness in this region, the approximation with Chinese companies and institutions promoted intense technological upgrading. Of course, there remains the challenge for developing countries to establish conditions for climbing up the value-added ladder in terms of their participation in GVCs (Islam and Chadee, 2023). The linkage between GVC participation and gains in terms of technological capabilities in these countries is mediated by the quality of institutions, availability of qualified labor, intellectual property agreements, competition policy and trade policy, thus highlighting the complexity involved in actually turning GVC integration into a source of valuable spillovers (Eissa and Zaki, 2022).

In this respect, we also ought to identify leapfrogging opportunities for firms in developing countries, i.e. windows of opportunity that allow latecomers to catch-up with industry leaders at the international level (Pinheiro et al., 2022; Kopka and Fornahl, 2024). Beyond a solely micro phenomenon, leapfrogging creates the chance to shape the development dynamics of regions and countries (Killmer, 2023). Again, the case of China is representative. Altenburg et al. (2022), for instance, identify policy efforts in this country to take advantage of the paradigmatic shift towards electric vehicles to become a global market leader. To do so, the Chinese government fostered the accumulation of technological capabilities in its leading firms. Some strategies to foster leapfrogging, however, are hard to differentiate from protectionist approaches that negatively affect knowledge and resource flows in GVCs. Illustratively, Yu et al. (2023) address “Country Strategic Patent Policies”, a mechanism that creates barriers for the inflow of foreign technologies that compete with local firms – which seems to be the case especially in high-tech and medium-high-tech sectors.

In a different direction, advances in Industry 4.0 have demonstrated impacts on the way GVCs are organized and distributed internationally, concentrating value creation activities in home countries of leading companies (Lee et al., 2023). This is yet another driving force towards ‘nearshoring’ trends (Ayadi et al., 2022). Increasing adoption of Industry 4.0 technologies have the potential to shift the geography of innovation

in Global Value Chains. Such conditions seem to have been intensified by the rapid advances and adoption of artificial intelligence as a strategic technology, having widespread effects on the structure of competition and on job markets in developed and developing countries alike (Lundvall, 2023; Meltzer, 2023; Butollo et al., 2022; Foster-McGregor et al., 2021). If this happens at a significant scale, it might reduce the amount of learning opportunities and knowledge spillovers taking place particularly in emerging markets. This will pose severe challenges for these countries to tap into international sources of capabilities that are required for technology upgrading process – at least in initial stages (Boschma, 2022). At the same time, it might disrupt local clusters of production that gravitate around multinational firms. Job losses and reconfiguration of economic systems are likely to follow.

Yet another layer of complexity in this debate reflects the emergence of armed conflicts between nations which – besides the obvious humanitarian calamities – create massive economic impacts of economic sanctions and relocation of multinational corporations (Du and Wang, 2022) and potentially nudge a redesign in the configuration of GVCs. What is more, these effects generate negative shocks that spread well beyond the countries involved (Gaio et al., 2022). If conflicts escalate or are followed by other localized initiatives, we will likely be experiencing a much more challenging background for GVC operations in the coming future.

### 3. Regional embeddedness of innovation: where do we stand?

Economic geography has a long tradition in assessing the spatial dynamics of innovation. The main issue of interest concerns how interactions and collective learning involving firms, research institutions and government are embedded in specific regions or cities (Doloreux, 2002). From a relational viewpoint, geographical proximity reduces transaction costs in business relationships while expanding the possibilities for technological learning (Storper, 1997). These learning processes are related to the spatial stickiness of knowledge (especially tacit knowledge) and the correspondent interactions that emerge and evolve due to these flows (Amin and Cohendet, 2004; Maskell, 2001).

These elements help explaining the localized nature of the emergence, sharing, distribution and diffusion of knowledge as a vector of agglomeration economies (Krugman, 1991; Jaffe et al., 1993). Ultimately, these features are self-reinforcing and promote the territorial concentration of knowledge networks (Audretsch, 1998; Ellison and Glaeser, 1997; Innocenti et al., 2020; Balland et al., 2013; Giuliani, 2013; Huggins and Thompson, 2013). Such dynamics have evolved to create a context in which knowledge and innovation capabilities are increasingly concentrated in specific regions across the globe (Bathelt and Li, 2022; Crescenzi et al., 2020; Tóth et al., 2021).

The geography of innovation naturally evolves over long periods of time as the location and spatial concentration of economic activity changes. Critical junctures in associated parameters are likely to accelerate the emergence of impacts in the topology of innovative activity. For instance, protectionist policies and effects during the pandemic impacted the location strategies of firms (Bathelt and Li, 2022). Changes in conditions for people to gather in specific locations alter the capacity of places to attract talent and produce innovation (Doehne and Rost, 2021). Accordingly, shifts in migration flows – which can be driven by many of the aspects discussed in Section 2 – can have pervasive impacts on the configurations of Regional Systems of Innovation. Particularly for the case of skilled immigrants, associated effects of labor mobility on innovation and productivity have been identified (e.g. Bongers et al., 2022; Han et al., 2015). Yet, over recent years, nationalist policies led to the creation of significant barriers to the international flow of people across nations (WEF, 2022), a situation that can likely harm the dynamics of technological activity (Han et al., 2015). The case of the US has received increasing attention (e.g. Agarwal et al., 2021; Lowe, 2020). Taking into account the new wave of nationalism that has imposed barriers to migration, we might expect geographical shifts in

innovative regions that can unfold in the coming decades.

Impacts of the growing adoption of Industry 4.0 technologies on the geography of innovation have not yet been adequately captured by the literature (Fraske, 2022). Moreover, the significant emergence of remote workers after the pandemic can also have a role to play in affecting the dynamism of regional innovation systems (Althoff et al., 2022). Even more so considering that remote work has involved primarily highly qualified people (Shearmur et al., 2022). If planned linkages can be somewhat sustained in digital platforms, serendipitous encounters – a fundamental driver of knowledge flows in places (Florida, 1995) – are much less likely to occur. In this case, digitalization trends triggered by the COVID-19 pandemic may have deleterious effects on random encounters that sustain informal exchanges of information. Geographical distancing between peers can also drive down ties that go well beyond work-related content. This is where the social nature of interaction comes in and it should not be downplayed *vis-à-vis* its contributions to invigorating technological capabilities.

On the other hand, from a health-oriented perspective, such geographical spread might be efficient in reducing transmission of future pandemics. Ascani et al. (2021) identified an association between the spatial concentration of economic activity and the rapid spread of COVID-19, a finding in line with epidemiological research on the role of crowded spaces in driving transmissions of respiratory diseases (Tarwater and Martin, 2001; Meyer and Held, 2017). Since new pandemics are not unlikely to occur within this century, inclination towards remote working might be detrimental to innovation dynamics (Lin et al., 2023), but might provide a new social paradigm that enhances flexible responses to extreme events.

### 4. Innovation as a multiscale phenomenon: future challenges

Although in Sections 2 and 3 we have addressed GVCs and Regional Systems of Innovation separately, innovation cannot be captured effectively without considering the inherent complementarities between the local and global levels of analysis. This means that the governance of innovation is of a ‘multiscale’ nature (Coenen and Morgan, 2020). While geographical proximity can be an enabler of linkages for innovation, it is neither a necessary nor a sufficient condition for the formation of such networks (Balland et al., 2022).

Knowledge itself is largely an outcome of interactions. These linkages lead up to knowledge co-creation, interpretation, integration and transformation (Bathelt and Glückler, 2003). In this respect, the geography of innovation can be understood as a geography of connections that emerge with the goal of generating new products, processes or services. Ties among agents do not appear to have evolved towards ‘islands’ of innovation. Considering that the territorial reach of innovation is defined by the structure of networks, it can be argued that the spatiality of industrial systems is seldomly constrained to local or regional boundaries (Dicken and Malmberg, 2001). Consequently, the actual geography of innovation can be defined more accurately by the flows of resources (Amin, 2004).

These arguments open up room for a diversity of innovation networks’ topologies across regions and countries (Amin, 2004). Importantly, the local-global structure of connections also changes across industries and technological domains (Ascani et al., 2020; Faggio et al., 2020; Neuländtner and Schergell, 2020; He and Fallah, 2009). Hence, Regional Systems of Innovation ‘differ in terms of their dynamism, degree of maturity, spatial extension, and local embeddedness’ (Dicken and Malmberg, 2001, p. 357). Within this context, we ought to highlight the existing complementarities between local and exogenous capabilities (Ascani et al., 2020; Bianchi et al., 2020). This provides incentives for innovative firms to search and integrate spatially dispersed competences (Frigon and Rigby, 2021), ultimately leading to strategic approaches that expand the territorial frontiers of innovation. Accordingly, focusing solely on regional agglomeration trends falls short in explaining knowledge exchanges that have an intrinsic international character

(Carayannis et al., 2016). It is the combination of local and global collaborations that drive superior innovation capabilities in firms (De Noni et al., 2017). As it turns out, the literature recognizes that wider inter-regional networks appear to lead to better technological performance than locally embedded networks (Yao et al., 2020; De Noni et al., 2018). Such practices not only provide access to more diversified knowledge bases; they also reduce risks of lock-in related to technological endogeneity in regions (Balland and Boschma, 2021).

This background provides robust explanations for the emergence of Regional Systems of Innovation with remarkable levels of global connections (Crescenzi et al., 2020; WIPO, 2019). Thus, innovation is increasingly understood as a ‘glocal’ phenomenon (Ghazinoory et al., 2021). Regional economies are often embedded in international networks of production, i.e., Global Value Chains. GVCs stand for complex international networks of production that can have varying degrees of coordination and power asymmetries (Gereffi et al., 2005). These elements are shaped by the complexity of transactions involved, the capabilities of agents, and the ability to codify transactions. This background largely affects the levels of knowledge flows that take place as a function of firms’ participation in GVCs. Local clusters can offer inputs in this process that allow firms to integrate in GVCs and upgrade their technological capabilities, although these dynamics are moderated by sectoral characteristics affecting the governance mode of international linkages (Giuliani et al., 2005). Moreover, as technologies mature, collaborative networks tend to disperse across the globe (Bloom et al., 2021), i.e., they become more flexible from a spatial viewpoint. Finally, another evolutionary phenomenon affecting local-global connections concerns how firms operate. As companies grow and expand their operations, so does their complexity in terms of international embeddedness (Dicken and Malmberg, 2001). It is thus impossible to think of the geography of innovation as something stable (Glückler, 2007). Rather, endogenous and exogenous shocks compose an intricate background that affects the trajectories of places. The critical junctures outlined in these articles are clear examples of such shocks – and their long term effects on the geography of innovation represent an exciting field for future research.

The governance structure of these GVCs has significant impacts on the way the innovation dynamics of participating regions is organized (Humphrey and Schmitz, 2002). As the argument goes, the opportunities for technological upgrading are enabled (or constrained) by the way these local-global linkages are managed. This means that different regions also have heterogeneous possibilities attached to GVC insertion. It is not just an in-or-out debate, but rather an appraisal of how firms and regions participate in these international linkages. Of course, potential deglobalization trends do not affect all regions similarly. While some may benefit from a less integrated world, others can suffer negative economic impacts (Giammetti et al., 2022). We can add that such conditions also affect the degree of dependence of regions – particularly those located in catching-up economies – to foreign actors. These elements also demonstrate the level of exposure to risks of potential geographic reorganization of GVCs in regional innovation systems. For instance, multinationals’ R&D have played a pivotal role in creating and strengthening regional clusters of innovation through knowledge spillovers and attraction of other firms (Crescenzi et al., 2022).

If current challenges for GVC structure (as discussed in Section 2) lead up to relocation of these firms, this might dismantle entire local networks of innovation in specific regions. This is critical for those countries and locations in initial stages of technology upgrading since these firms stand up as pillars for their respective Regional Systems of Innovation. But even mature ecosystems can suffer from disarticulation related to outflow of large multinationals. These firms often function as connectivity platforms between these regions and GVCs. As a result, changes in their geographical location can set apart some of these regions from global connections. To that we can add ongoing topics of debate concerning paradigmatic shifts. For instance, technological transitions required for the upgrade towards Industry 4.0 are likely to

alter the geographical distribution of economic activity (De Propriis and Bailey, 2021). There seems to be a need to integrate these emerging technologies with the existing industrial structure (principle of relatedness) (Hidalgo et al., 2018) in order to create synergies (Buarque et al., 2020) – and this creates even more extreme challenges for laggard regions.

On the other hand, such systemic crises create windows of opportunity for leapfrogging based on verticalization of ‘national champions’. An interesting example is that of VinFast (Thoburn and Natsuda, 2023), a flagship car manufacturer from Vietnam founded in 2019 that recently began exporting their electric vehicles under their own brand to the US, also planning to set up a production plant in North Carolina in 2025.<sup>1</sup> Also, effects associated with the Covid-19 pandemic created windows of opportunity for digital industries, a context that China took advantage of (Xiong et al., 2023). Yet, such examples cannot necessarily be transferred to any given developing market. First, because exploiting windows of opportunity requires structural transformations that allow capability accumulation in firms associated with specific industries (Yoruk et al., 2023a, 2023b). Second, because the size and scale of leapfrogging firms seems to matter, as demonstrated by Kopka and Fornahl (2024) for the case of technologies related to artificial intelligence. Third, because capability accumulation must go beyond individual players and involve the broader innovation ecosystem in which these firms are embedded (Chen and Sun, 2023). Hence, for leapfrogging to take place, an inherent interplay between GVCs and Regional Systems of Innovation lies at the core of innovation policy. It remains an open debate whether surging initiatives to deal with the pandemic will enable, hinder or be neutral towards the promotion of leapfrogging – and, ultimately, economic convergence.

## 5. Major findings of the special issue

In this Special Issue, we have a collection of six articles dealing with the ongoing challenges taking place in the interplay between local-global connections. Each of these research articles helps to shed light on the challenges laying ahead for policymakers, practitioners, and scholars. The first three contributions look closely to firm-level dynamics while the remaining articles take a macro-oriented stance. Taken together, this set of papers represent an important step forward in comprehending systemic shifts that will likely affect how innovation networks are configured across regions and countries in the coming decades.

### 5.1. Micro-oriented perspectives

Liu et al. (2022) build upon resource dependency theory to offer an analytical framework that allows examining the mechanisms through which latecomer firms can reap benefits from local and global interactions. Drawing from a multiple case study with three firms headquartered in the Chinese region of Pearl River Delta, they have underlined the critical role of the Regional System of Innovation in shaping the capabilities of these firms. In turn, these local features affect how these firms participate in GVCs, thus creating further opportunities for learning in international markets – instead of simply supplying low value-added components. From this assessment, the region is shown to function as a platform for knowledge integration.

Gomes et al. (2022) address four focal firms participating in Global Innovation Ecosystems (GIEs). Their goal is to move forward with a theoretical contribution on how uncertainty can be managed when local and global sources of instability are at play. As the authors demonstrate, GIEs combine local and global uncertainties, thus creating substantial challenges for network-level strategic management. They conclude that

<sup>1</sup> <https://www.reuters.com/business/autos-transportation/vinfast-ships-2nd-batch-longer-range-electric-suvs-north-america-2023-04-17/>

these multiscale sources of uncertainty require proper rules and mechanisms that are not part of traditional innovation management practices. Hence, they explore new ways to structure ‘uncertainty governance’ in GIEs in a way to minimize vulnerabilities and sustain knowledge flows.

Afrifa et al. (2022) approach the drivers of financial performance in 339 internationalized service firms from the UK. They look specifically into the effects of the geographic scope of internationalization, the strength of innovation systems in host markets, and the R&D intensity of firms. Their findings highlight that firm-level R&D intensity is a pivotal element in establishing the conditions for knowledge absorption in foreign markets, an argument in line with typical discussion on absorptive capacity. On the other hand, they add novel contributions by identifying that firms that spread their international activities across a larger number of foreign markets can not only spread the risks of investments abroad, but also tap into more diverse sources of knowledge. These are interesting discussions that illustrate how Regional Systems of Innovation represent sources of competitiveness also to foreign firms. Of course, as exposed in Section 4, foreign firms will also bring assets to host regions, thus creating a beneficial sense of synergy in the local-global dynamics.

## 5.2. Macro-oriented perspectives

Kim and Lee (2022) analyze how – and why – economic performance and growth trajectories differ in the Asian regions of Taipei, Shenzhen, and Penang. Taking a Schumpeterian perspective, the authors address divergences in Regional Systems of Innovation in terms of their local-global interfaces. Their findings present rich insights on the role of developing local capabilities after regions begin learning from international interactions. That is, intense focus in GVC integration without a proper regional strategy to set up technology upgrading does not represent an adequate strategy to increase capabilities in indigenous agents. Ultimately, strengthening Regional Systems of Innovation is a requisite to define prosperous evolutionary trajectories *vis-à-vis* global markets.

Botchie et al. (2022) draw on technical change and technology transfer theories to explore the role of Chinese investments in ICT industries in sub-Saharan Africa (SSA), where China has become a dominant player. As the authors demonstrate, Chinese firms and institutions have established strategies to gain legitimacy in these markets, transferring knowledge and technologies that allowed SSA countries to achieve rapid capability upgrading. Ultimately, these dynamics underscore how China has gained ground in peripheral markets while promoting initiatives that generate catching-up in the host economies.

Yoruk et al. (2023a, 2023b) investigate how interorganizational learning through network embeddedness and global value chains affected resilience in Poland’s food processing and clothing industries. The article specifically develops a network-oriented framework of sectoral resilience that accounts for network evolution, inter-organizational learning in networks, and evolutionary trajectories. Their findings outline how learning through interactions with foreign systems with advanced science and technology capabilities has promoted technological upgrading in Polish food-processing firms, thus generating economic resilience that allows local players to better navigate through downturns and competition from foreign markets.

## 6. Concluding remarks

In this article we have discussed the interplay between Global Value Chains and Regional Systems of Innovation *vis-à-vis* the extreme events that are taking place in these early 2020’s. We have also presented the set of papers that compose the Special Issue on these current challenges. There are important elements associated with the local-global debate on the geography of innovation that deserve careful attention and scrutiny from scholars, practitioners and policymakers. Economic geography and

international trade are highly sensitive to changes in contextual conditions – a property inherent to system dynamics. Right now, we are facing several challenges at once – and these will likely trigger changes in the dispersion of innovative activity across the globe.

Current sources of uncertainty for GVCs and Regional Systems of Innovation are multifaceted. They can be traced back to effects of the pandemic, trade conflicts, geopolitical tensions, technological changes, and social behavior. Of course, these dimensions are not independent from each other. It is impossible to consider the trade conflict between the US and China without addressing broader geopolitical issues. But technology upgrading in China also plays a big part in these events. Remote working has arisen mainly as an ‘inheritance’ of the COVID-19 pandemic, but it is enabled by digital technologies, and it spurred new social habits. We claim that, taken together, all of these aspects have defined a Critical Juncture for shaping the future of GVCs and Regional Systems of Innovation.

It currently appears that we are heading to a more fragmented geography of innovation. This will have positive and negative effects depending on the strategies of firms, regions, and countries. Even if some windows of opportunity emerge, a key to seize them lies in developing the required set of capabilities to thrive in a changing context. The topology of GVCs and Regional Systems of Innovation is bound to change (it has changed already in many instances). But the importance of innovation itself for prosperity of socioeconomic systems will remain.

## CRedit authorship contribution statement

**Bruno Fischer:** Conceptualization, Writing – original draft, Writing – review & editing. **Dirk Meissner:** Conceptualization, Writing – original draft, Writing – review & editing. **Ron Boschma:** Conceptualization, Writing – original draft, Writing – review & editing. **Nicholas Vonortas:** Conceptualization, Writing – original draft, Writing – review & editing.

## Data availability

No data was used for the research described in the article.

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Innovation Studies at Lund University where he was also director of the Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE). He is member of the Executive Board of the International Regional Studies Association. Boschma has published on Evolutionary Economic Geography, the spatial evolution of industries, geography of innovation, regional resilience, regional diversification, and Smart Specialization policy. Boschma has been ranked by Thomson Reuters among the top 1 % of cited researchers worldwide in all scientific fields in all years since 2014.

**Nick Vonortas** is Professor of Economics and International Affairs at The George Washington University. He is the Associate Dean for Research at GW's Elliott School of International Affairs. Nick concurrently holds a 'São Paulo Excellence Chair' in Technology and Innovation Policy at the University of Campinas, São Paulo, Brazil. His teaching and research interests are in industrial organization, in the economics of technological change, and in technology and innovation policy and strategy. He specializes on strategic partnerships/innovation networks, investment under uncertainty, technology transfer,

knowledge-intensive entrepreneurship, and R&D program evaluation. Nick is editor of the peer-reviewed journal 'Science and Public Policy'.

Bruno Fischer<sup>a</sup>, Dirk Meissner<sup>b</sup>, Ron Boschma<sup>c,d,\*</sup>, Nicholas Vonortas<sup>e</sup>  
<sup>a</sup> University of Campinas, HSE University, Russia  
<sup>b</sup> HSE University, Russia  
<sup>c</sup> Utrecht University, the Netherlands  
<sup>d</sup> Stavanger University, Norway  
<sup>e</sup> George Washington University, USA

\* Corresponding author.

E-mail address: [r.a.boschma@uu.nl](mailto:r.a.boschma@uu.nl) (R. Boschma).