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Reconciling industrial policy and disaster risk management in the context of extreme events

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**Reconciling industrial policy and disaster risk
management in the context of extreme events**

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Abstract

Prevailing frameworks used for industrial policy design provide decision-makers with limited advice on how to appreciate and incorporate elements of disaster management into their practice. Hence, the role of manufacturing, and by extension industrial policies, in dealing with extreme events remains an underdeveloped area of research. The recent coronavirus outbreak has brought attention to the importance of filling this void. Drawing on the literature on industrial policy and disaster risk response and management, this paper presents an analysis and discussion of several key issues that will need to be addressed to adapt industrial policies to improve disaster preparedness and build resilience, while not losing sight of promoting inclusive and sustainable industrial development. We provide a foundation to support the design and implementation of industrial policies in the context of extreme events; further research is needed to develop a more comprehensive framework. We argue that by acknowledging the interconnectedness of different components of the economic, social and environmental systems, the use of industrial policies is justified in the pursuit of high order goals, namely ensuring the provision of essential goods and services during extreme events and to secure society's long-term viability and survival.

JEL codes: *H84, I15, O25, Q01*

Keywords: *COVID-19, industrial policy, disaster risk management, Sendai framework, resilience*

1 Introduction

Economies and societies across the world are facing complex challenges – from climate change and natural disasters to poverty and infectious diseases. With governments under increasing pressure to address these issues, there is growing interest in learning how properly designed policies can lead to enhanced development outcomes. Within the scope of industrial policies, prevailing frameworks have proved limited guides to the promotion of potential gains in productivity, social well-being and sustainability that industrial development may offer. The ability of established frameworks to inform responses to safeguard industry against contemporary global hazards has also been limited, becoming apparent during the pandemic of COVID-19. If disaster-aware policies had been in place, it is very likely that the ensuing disruptions in production and the shortages of critical supplies could have been minimized, if not avoided altogether.

Against this background, this paper discusses industrial policy in the context of disasters or extreme events,¹ whether these relate to health, the environment or other natural or human-induced sources (UNDRR, 2015). Adoption of such a perspective for our analysis is in line with recent contributions to the literature. It acknowledges the growing interest in using industrial policy to address climate change and natural disasters, and to build a culture of resilience (Djalant, Shaw and DeWit, 2020; Ruiz Durán, 2019). The significance of manufacturing for the functioning of the complex economic system reinforces the view that modern approaches to industrial policy should rebalance customary economic targets with more systematic contributions to build social and environmental resilience in times of extreme events (Ferrannini et al., 2021).

Similarly, this approach expands commonly agreed notions of risk and risk management strategies, where industrial activities are perceived as sources of risk (Steyer and Gilbert, 2013).² Extreme events in the past, such as the floods in Thailand (Haraguchi and Lall, 2015; Marks and Thomalla, 2017), or the Great East Japan Earthquake (GEJE) of 2011, and even the COVID-19

¹ According to the UN Office for Disaster Risk Reduction, UNDRR, a disaster is:

“A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts” (UNDRR, 2020a).

In this paper, we prefer the term “extreme event”, as it is consistent with broader definitions of the sources of hazardous events to include geopolitical conflicts or financial shocks (Aitsi-Selmi, Blanchard and Murray, 2016).

² UNIDO, (2019) offers a discussion of frameworks applicable to the specific issue of industrial safety. For example, regulations, standards and the adoption of new technologies are needed to enhance industrial safety and to minimize societal losses resulting from industrial disasters.

pandemic,³ indicate that the manufacturing sector is greatly exposed to risks. This conceptual shift of the manufacturing sector from being a source of risk to being placed at risk has led to a rethinking of its role in addressing global threats. Hence, examining how to improve coordinated action to protect and ensure the continuity of manufacturing operations and how to leverage manufacturing capabilities to manage extreme events and support post-crisis recovery is of particular relevance.

How, then, can we reconcile industrial policy with risk and disaster management considerations? This is the question we aim to explore in this paper. We do so by reviewing contemporary industrial policy debates and emergency and disaster risk response (DRR) literature. More specifically, we examine to what extent the Sendai Framework for Disaster Risk Reduction 2015–2030 (Sendai Framework), which serves to guide international practice in the face of extreme events, can also inform industrial policy targets. The intention is not to provide a definite or comprehensive answer, but rather to offer a foundation for a more open and fruitful debate on the policy-related problem of building industrial capabilities to deal with extreme events. Two complementary dimensions are considered in the analysis. First, industrial policy interventions can be linked to different phases of an extreme event, namely prevention, preparedness, response and recovery. Second, and because extreme events have the potential of causing severe structural, multi-level and long-lasting social and economic consequences, industrial policy responses should entail different levels, namely the firm, national, regional, and even the global level. Our focus, however, lies on the former dimension, which comprises responses to extreme events.

This paper aims to contribute to the literature at the intersection between the fields of industrial policy and disaster risk management and, in particular, to the discussion on the nexus between industry resilience and broader economic, environmental and social resilience. Disaster risk management can provide industrial policymakers with an understanding of priorities, actions needed and policy challenges that may arise and cause major disruptions or global emergencies. At the same time, the disaster risk management literature can benefit from an improved understanding of the strategic role of policies focused on manufacturing activities as tools for building resilient societies. Such an understanding is also relevant for developing countries in that it points to a potential direction for policy learning – even in cases in which the direct contribution

³ The experience of the COVID-19 pandemic has revealed the significant negative impacts emerging disasters can have on industrial activities, leading to one of the sharpest contractions ever recorded in manufacturing activity at the global level (UNIDO, 2020b). In the third quarter of 2020, global manufacturing output had declined by 1.1 per cent in a year-over-year comparison, following a drop of 11.1 per cent in the second quarter of 2020. Manufacturing output was expected to fall by around 8.7 per cent globally in 2020.

of manufacturing to aggregate economic activity, as measured by GDP and employment, is currently lower than that of other sectors, notably tourism or agriculture.

The theoretical and practical insights from this paper can support the design, implementation and assessment of industrial policies in the context of extreme events at various levels. Thereby, our study contributes to the efforts to promote policy actions guided by the general principles and recommendations contained in the Sendai Framework for Disaster Risk Reduction (Sendai Framework) 2015–2030, which aims to build collective resilience (see for instance, Haraguchi, Lall and Watanabe (2016) and Aitsi-Selmi, Blanchard, and Murray (2016)). Some international organizations, for example, the Global Facility for Disaster Reduction and Recovery (GFDRR), in partnership with the United Nations Development Programme (UNDP), the European Union (EU) and other partners, are conducting consultations to inform the preparation of thematic guidance notes on disaster recovery that focus on the manufacturing sector (GFDRR, 2019). Similarly, the World Bank is pursuing efforts to improve our understanding of industry resilience as a nascent discipline (World Bank, 2020), including frameworks for its application and operation. This paper takes a step in this direction.

The paper is structured as follows. Section 2 takes stock of recent contributions to the literature on both industrial policy and resilience, with emphasis being placed on industry resilience. Section 3 bridges the literature on industrial policy and disaster risk management and response. Section 4 discusses how industrial policy interventions can be mobilized at the firm and national level to reflect different stages of disaster risk management. The section is divided into two subsections. The first subsection presents the main tenets of the Sendai Framework, highlighting the elements that support the need to build strategies into industrial policy design to anticipate, prevent, manage and recover from extreme events at different levels of intervention. In the second subsection, we identify potential industrial policy targets by distinguishing between different stages of disaster risk management and levels of intervention. The experience of the COVID-19 pandemic is used to illustrate these stages. Section 4 sheds some light on emerging lessons we have gleaned from the pandemic, arguing that the debate on industrial policy and industry resilience beyond the customary national level needs to be expanded. Enhanced international policy coordination and collaboration is necessary to manage extreme events at the global level and to avoid some of the observed pitfalls in the management of the ongoing crisis. Finally, Section 6 concludes.

2 Linking resilience to policies to promote inclusive and sustainable industrial development

This section addresses the emergence of industrial resilience-building as an additional component of industrial policy as a consequence of the COVID-19 experience. The literature offers a wealth of definitions and specific approaches to industrial policy.⁴ This paper uses the definition proposed by Warwick, (2013), which merges several definitions from previous contributions to the literature:

“Industrial policy is any type of intervention or government policy that attempts to improve the business conditions or to alter the structure of economic activity toward sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention.”
(Warwick, 2013:16).

A key element in this definition, which is reflected in the Sendai Framework, is the central role the government plays in determining economic dynamics by supporting specific sectors and technologies or even by implementing concrete activities expected to have a significant impact on growth and societal progress. Based on the discussion in our introductory section about the role of industrial policy in addressing environmental sustainability, this definition can be aligned more closely with the three key elements of inclusive and sustainable development (ISID) (UNIDO, 2013), which are also fundamental from a resilience perspective (The Economist Intelligence Unit, 2016). First, more broadly defined, long-term sustained industrialization drives economic diversification and development; second, socially inclusive industrial development promotes equal opportunities and an equitable distribution of benefits; and the third component is environmental sustainability, which is understood as the decoupling of industrial activities from energy and other natural resources and mitigating negative environmental impacts (UNIDO, 2016).

Moreover, Warwick, (2013)’s explicit recognition of industrial policy as interventions that target or seek to improve the environment within which industrial activities take place, invites reflection about risks and hazards as substantive components of business environments (World Bank, 2020; UNIDO, 2019), and by extension, of sustainable industrial development. Risk and risk management are two key elements of resilience, which is broadly defined by UNDRR as:

⁴ For an overview, see Aiginger, (2007), White, (2008) and Warwick, (2013).

*“The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.”*⁵ (UNDRR, 2020a).

Building largely on the Sendai Framework, World Bank, (2020) takes a few steps forward towards integrating resilience and industrial development. It advances a definition of industry resilience as:

“The ability of firms, industrial parks, and manufacturing sectors to increase competitiveness by minimizing losses and damages, and by achieving continuity and growth in the face of more frequent and intensifying disasters” (World Bank, 2020: xiv).

According to World Bank, (2020), disasters can affect competitiveness through two main channels: the direct channel, namely physical damage to a firm’s assets and infrastructure involving subsequent repair and reconstruction costs; disruption to supply chains and production networks; or disruptions to basic services such as power, water, transportation or telecommunications; and the indirect channel, involving the loss of production capacity and market demand, reputational risk and loss of investors or job losses with detrimental effects on industrial performance, which can affect competitiveness over long periods (World Bank, 2020). Policies, infrastructure and finance are instrumental to ameliorate the risk environment within which firms operate and to better inform competitiveness strategies while setting the *“groundwork for attractive investment returns, and social and environmental co-benefits”* (World Bank, 2020:xxiv).

The link between industrial resilience and competitiveness is consistent with the use of the latter concept as a proxy for industrial performance (UNIDO, 2020a; 2002). Several aspects of industrial competitiveness, such as innovativeness, close customer relationships, the ability to penetrate or expand market presence and the extent of connectedness to the territory and society also contribute to underpinning industrial resilience (Pike, Dawley and Tomaney, 2013). Moreover, it reminds us of the role of industrial policy and the building of underlying productive and technological capabilities in explaining the differences in terms of both competitiveness and

⁵<https://www.undrr.org/terminology/resilience#:~:text=The%20ability%20of%20a%20system,and%20functions%20through%20risk%20management.>

long-term industrial performance across countries (UNIDO, 2002; Oqubay et al., 2020). The Economist Intelligence Unit, (2016) acknowledges that disaster risk is highest in countries characterized by vulnerable societies and a high exposure to natural hazards. Accordingly, industrialization becomes a means to enhance economic resilience by promoting structural change and diversification away from activities with an extensive exposure to environmental and other sources of risks.

The proposal to establish such a link also seems to be present, albeit implicitly, in recent debates about the relevance of industrial policy and the scope of government intervention in the economy. For example, (Aiginger and Rodrik, 2020) advocate industrial policies that are future- and welfare-oriented, in the sense that they combine traditional market failures and contribute to addressing social and environmental challenges. At the same time, novel approaches to industrial policy should maintain a balance between national and global interests, thereby avoiding misguided protectionist, interventionist and statism characteristic of industrial policies from the past (Aiginger and Rodrik, 2020). The response to the COVID-19 pandemic and the associated global supply chain disruptions illustrate how restrictive trade measures to safeguard domestic supplies of COVID-19-related essentials have only exacerbated the situation, creating unnecessary tensions and disrupting the scope for coordinated interventions across countries.

Ferrannini et al., (2021) expand the discussion by introducing industrial policy as a key component of post-COVID-19 recovery. They assert that industrial policy, as a specific form of government intervention, is necessary to meet the exceptional challenges the pandemic has imposed on all key dimensions of the functioning of the global society. They conclude that the current state of emergency is an opportunity to introduce social resilience and environmental considerations more consciously in industrial policymaking processes, “and to redefine the paradigm on the connection between production dynamics, wellbeing and sustainability” (Ferrannini et al., 2021:137).

The interconnection of industrial policy with resilience and sustainability likewise has its place in the wider scholarship on resilience. For example, Haraguchi, Lall and Watanabe, (2016) and The Economist Intelligence Unit, (2016) suggest that introducing more systematic risk analyses in economic policymaking is necessary to ensure that investment decisions—including foreign direct investment—and the promotion of productive activities can anticipate emergencies, contribute to managing the effects of unexpected shocks and support recovery post-crisis. By making the need explicit to anticipate and deal with extreme events, industrial policy could expand its traditional role of underpinning structural change, fostering job creation, catalysing investments and innovation, and driving economic growth. It could become an essential part of

institutional frameworks on risk prevention and risk management, which ultimately contribute to the three pillars of social, economic and environmental resilience – the same pillars that drive ISID.

The COVID-19 experience suggests that keeping industrial activities—at least some of them—operational is fundamental to respond to emerging disasters, protect lives and incomes, while securing livelihood sustainability in developed and developing countries alike (OECD, 2020a). The Economist Intelligence Unit, (2016) asserts that because the conditions necessary for disasters to occur are man-made, investments in resilient infrastructure, capability building and the introduction of measures to address exposure, preparedness, response and post-disaster recovery are crucial. The tension between building long-term resilience and short-term economic, political and commercial considerations is also acknowledged.

In this context, World Bank, (2020) acknowledges that industry resilience, as a global discourse and practical discipline, is still in its infancy; its application and operation remain limited despite growing threats industrial activities face. Advancing the development of suitable analytical and policy frameworks should help strengthen competitiveness through building back better initiatives, and adaptation to long-term climate change and disaster risks. The report advocates explicit policy actions, investments in infrastructure and the development of dedicated finance mechanisms to enable industries to prepare for, respond to and recover from extreme events. These three elements can guide the identification of strategies to “*mainstream disaster and climate change considerations into industrial development plans and investments*” in advance of disasters (World Bank, 2020:xvi). The challenge is to reappraise our understanding of industrial policy and its many contributions to job creation, investment and innovation, and to more explicitly incorporate the notion of industrial resilience as part of industrial policy targets.

3. Towards disaster management-friendly industrial policies

3.1 A global framework to understand risk management and resilience

Various internationally agreed frameworks to manage extreme events and to guide the response to multiple technological, biological and environmental hazards are already in place; they emphasize prevention and/or containing negative impacts on human health (UNDRR, 2015; WHO, 2019). National guidelines for disaster risk management draw inspiration from such frameworks, more specifically, from the Sendai Framework, adopted at the Third UN World Conference on Disaster Risk Reduction held in Sendai, Japan, on 18 March 2015 (UNDRR, 2015).⁶

The Sendai Framework is the current gold standard of efforts to create a global reference to coordinate international responses to disaster risk management, with an emphasis on new risk prevention, reduction of existing risks and the strengthening of resilience. The document adopts a broad scope, targeting “*both natural and man-made hazards and related environmental, technological and biological hazards and risks*” (UNDRR, 2015:Foreword); it also promotes health resilience as a global priority. The Sendai Framework is a voluntary, non-binding agreement; it invites national and local level authorities to invest in disaster risk reduction by fostering business resilience and the protection of livelihoods and productive assets throughout supply chains.

The Sendai Framework acknowledges that the primary responsibility to prevent and reduce disaster risk lies with States; they are responsible for ensuring the continuity of service provision and for integrating disaster risk management into business models and practices. At the same time, it recognizes the roles and responsibilities of other stakeholders, which is consistent with all-of-society and all-of-State institutions engagement in disaster risk management (UNDRR, 2020b; Steyer and Gilbert, 2013). The framework also serves as a reference for enhanced international cooperation, global partnership and regional-level action on these topics.

The Sendai Framework pursues seven global targets towards 2030. Four of them are particularly relevant from an industrial policy perspective in the COVID-19 context, but also due to their immediate relevance for Sustainable Development Goal (SDG) 9 and SDG-17. These include: (i) reducing direct economic losses due to the disaster, in GDP terms; (ii) increasing resilience and substantially diminishing damage from the disaster to critical infrastructure and the disruption of basic services; (iii) fostering a larger adoption of national and local disaster risk reduction

⁶ Aitsi-Selmi, Blanchard and Murray, (2016) view the Sendai Framework as one of the landmark agreements adopted by the UN in 2015, together with the SDGs and the Climate Change Agreements.

strategies by 2020; and (iv) enhancing international cooperation with developing countries to complement their efforts to implement the Sendai Framework by 2030 (UNDRR, 2015).⁷

Linked to these goals, the Sendai Framework proposes 13 guiding principles, of which two are directly relevant for industrial development. Managing the risk of disasters should, on the one hand, aim at protecting persons and their property, health, livelihoods and productive assets; on the other hand, addressing underlying disaster risk factors, including through private investments, is more cost-effective than post-disaster response and recovery, while its contribution to sustainable development is also stronger (UNDRR, 2015). Investments targeting risk prevention and post-crisis recovery may positively influence the overall business environment, triggering additional investments in infrastructure and economic activities, while boosting confidence to attract or retain investors, including foreign ones, even in disaster-prone areas (World Bank, 2020).

The implementation of the Sendai Framework comprises four priority areas, from improving the understanding of disaster risk and strengthening disaster risk governance and management, to investing in resilience and disaster preparedness for an effective response as part of recovery, rehabilitation and reconstruction. In addition to the contributions of these priority areas to disaster risk reduction, the associated investments have the strong potential of driving innovation, fostering growth and creating jobs, which lie at the basis of development (Christensen, Ojomo and Dillon, 2019). Furthermore, the Sendai Framework draws attention to health-related implications of risk, with an emphasis on reducing the number of deaths or injuries from disasters, early warning systems and the safety of critical infrastructure.

3.2 Industrial policy meets industry resilience: Identifying policy targets

Building on UNDRR, (2015) and The Economist Intelligence Unit, (2016), industrial policy targets connected to different phases in the cycle of an extreme event can be identified. Looking at the experience of the COVID-19 outbreak, we identify the following focal areas:

(1) *Prevention* emphasizes the need to include elements of hazard- and vulnerability reduction in industrial policy design to anticipate, prevent and mitigate risks that could affect industrial activities at the local, regional and global levels. Efforts to underpin prevention against emerging

⁷ The three other goals include two that focus on health concerns: (i) Substantially reducing global disaster mortality by 2030; and (ii) Substantially reducing the number of affected people globally by 2030. In both cases, the aim is to lower the average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015. Finally, it includes the goal to enhance preventive actions by (iii) increasing the availability of and access to multi-hazard early warning systems and disaster risk information and assessments by 2030 (UNDRR, 2015).

disasters include connecting research, policy and practice through actions for awareness building, fostering knowledge creation about new and existing risks while facilitating knowledge exchanges among multiple stakeholders.

(2) *Preparedness* in the sense of creating institutional and operational structures required to address emerging threats. While this is often interpreted at the community level, it can also be expanded to the level of industrial activities and their role in ensuring the smooth supply of essentials to protect health and livelihoods at different levels. Aitsi-Selmi, Blanchard and Murray, (2016) call for policy to foster translations of research and improved hazard monitoring into people-centred early warning systems that integrate vulnerability data, monitoring and evaluation mechanisms to ensure legitimacy and buy-ins by different stakeholders.

(3) *Response* to emerging events at different levels and, to the extent possible, for multiple sources of hazards, which implies multi-stakeholder governance structures that can organize, coordinate, follow up and assess the contribution of industrial activities to the management of extreme events, including through whole of government or whole of sector approaches and public-private partnerships (PPPs) (World Bank, 2020); and

(4) *Recovery* measures at different levels that reconcile national priorities with the requirements of a complex network of global economic interdependencies. Recovery should promote the continuity of all organizational actors in the economy to prevent, or to at least minimize the likelihood of new supply chain disruptions with the potential of diminishing or interrupting the provision of crucial services for society (Steyer and Gilbert, 2013; OECD, 2020a). Moreover, during the recovery phase, disruptions should be turned into new growth opportunities. For example, as many have argued, the COVID-19 outbreak demonstrates the potential to turn investments in more resilient health systems into industrialization opportunities by enhancing self-sufficiency in medical and pharmaceutical production, particularly in developing countries (Santiago, 2020). However, as discussed in Santiago et al., (2020), the many dimensions of human activity affected by the pandemic suggest industrial development opportunities beyond the health sector may be available.

Table 1 summarizes the preceding discussion. It distinguishes between industrial policy responses according to the stage in the cycle of an extreme event, and the level of response required, whether at the firm-, national-, regional- or global level. Table 1 can also be viewed as fleshing out the building blocks of policy actions aimed at building manufacturing resilience at different levels, aligned with Haraguchi, Lall and Watanabe, (2016), who propose that resilience builds on cumulative staggered layers, starting at the plant level, building up through the organizational,

supply chain and community resilience levels, up to the highest level of societal resilience. Societal resilience thus builds up from the national to the regional to the global levels.

Table 1: Proposed framework to inform risk management-friendly industrial policymaking.

Stage of extreme event/level of response	Firm	National	Regional	Global
Prevention				
Preparedness				
Response				
Recovery				

In what follows, we develop the different dimensions proposed in Table 1 further. The discussion builds on secondary literature and is non-exhaustive.

4. Risk and disaster management to inform industrial policy design

Contingency planning for disasters, hazard monitoring and the presence of early warning systems to enable effective disaster response reflect a national government’s disaster preparedness and response capabilities. In this context, the literature suggests that policies that contribute to enhanced industrial resilience and post-crisis recovery include the preparation of business continuity plans (BCPs), policies that favour economic diversification in terms of trade and investment, innovation and the development of increasingly sophisticated, accessible and affordable insurance services, among others. Moreover, regulatory efforts contribute to converting disaster risk considerations into a stronger driver of investment.

The above notwithstanding, as discussed in our introductory section, the implications of introducing risk and risk management considerations into industrial policy remain greenfield, but academic and policy debates are increasingly converging on the potential and essential role of industrial policy in fighting global challenges such as climate change, food security and other emerging threats. Systematic efforts towards addressing these challenges would help us move forward in the implementation of the Sendai Framework. The latest available review concludes that the world is lagging behind in achieving the targets for the adoption of disaster risk reduction strategies aligned with the Sendai Framework by 2020⁸ (UNDRR, 2019). We argue that better linking industrial policy with industrial resilience considerations can contribute to meeting this

⁸ One example is Target E of the Sendai Framework, which proposes the adoption of national—even sub-national—policies for disaster risk reduction, preparedness and response. This target helps assess the extent to which national development plans and other policies incorporate disaster risk considerations (UNDRR, 2015).

challenge. The following sections take stock of some emerging areas, aligned with the said stages of disaster events, which require further research and considerations from an industrial policy perspective.

4.1 Prevention

The growing frequency of disasters and their substantial social and economic impacts call for policies to enhance economic and social resilience, such as compelling firms to accept disaster risk as a core component of their business strategies (The Economist Intelligence Unit, 2016). Policy interventions are necessary, particularly in disaster-prone zones, to promote strategies to anticipate and regulate risks, and to increase the transparency of efforts to build preparedness, ensure rapid responses and a smooth recovery. To the extent possible, the design of such policies should include collaboration with and inputs from the private sector.

Because of their ability to autonomously manage risk, to mobilize resources and competencies in the aftermath of disasters—for which they may bear no responsibility—firms are indispensable partners in preparing and implementing risk responses (Steyer and Gilbert, 2013). However, World Bank, (2020) acknowledges that short-term economic incentives for disaster mitigation and preparedness are weak. Due to insufficient information, competition and power imbalances, firms lack incentives for collective action to prepare for supply chain disruptions or shocks to production networks before extreme events occur. The situation is even more precarious given the fact that funding priorities remain on post-event response and recovery rather than prevention, particularly in developing countries (The Economist Intelligence Unit, 2016; UNDRR, 2019). The COVID-19 pandemic has shown that this situation is untenable for countries that are in a severely restrained fiscal position and highly indebted. Fiscal prudence, including the allocation of dedicated budgets for disaster risk, is key to building preparedness against risk. Ideally, fiscal assets should be supplemented by private insurance mechanisms to boost the available resources to cover for the potentially sizable financial losses resulting from major disasters (Haraguchi, Lall and Watanabe, 2016). However, when available, insurance mechanisms provide little if any coverage for these risks, while the expectation is that without proper regulation and coordination between multiple stakeholders, novel insurance instruments and policies may introduce stricter exclusions and tighter conditions (FERMA, 2020b).

While the relevance of industrial policy to address some of these funding gaps may not be immediately obvious, the strength of industrial activities is fundamental to the extent that some countries target industry to levy taxes to finance contingent disaster management budgets (The Economist Intelligence Unit, 2016) (see Box 1).

Box 1. Tajikistan: Taxing industrial activities to foster disaster preparedness

The Committee for Emergency Situations and Civil Defence is the national-level institution mandated to deal with disaster risk management, including by issuing and implementing legal regulations in distinct areas related to civil defence. The Committee operates under the overall oversight of the Government of the Republic of Tajikistan. The Committee is financed from the Fund for the Liquidation of the Consequences of Emergency Situations, which was created from a tax on certain types of industries.

Source: The Economist Intelligence Unit (2016)

Extending collaboration to other market players and consumers to plan ways to minimize supply chain disruptions and to share resources could enhance willingness to collaborate and build greater collective resilience (World Bank, 2020). UNDRR (2015) highlights the fundamental role of research organizations in the identification of and better understanding of risk and its sources, and in informing DRR strategies. Awareness helps improve alertness, preparedness and response (UNIDO, 2019), while it is important to supplement knowledge with technological capabilities and regulatory frameworks to guide action and ensure adequate compliance with agreed guidelines and procedures to address risk and disasters. According to UNIDO, (2019), industrial activities are exposed to risk resulting from natural and biological hazards, political instability and, increasingly, cybersecurity, which may lead to events that have a major impact on people, industrial assets and the environment. The extent of exposure varies across industries and regions. Industrial policy could motivate firms to prioritize disaster risk in business planning, and to introduce incentives for collaboration with research organizations to inform decision making around risk prevention and risk-sensitive investments. Awareness building through publicly sponsored training sessions, events and consultations are some of the initiatives that governments could take to foster a culture of industrial resilience (American Planning Association, 2014).

4.2 Preparedness

Initiatives to promote preparedness at the firm level are described in the disaster management literature. Several initiatives have been launched in the current COVID-19 environment and are of direct relevance for industrial policy design. One example are discussions around resilience built on *redundant vs flexible* systems (Haraguchi, Lall and Watanabe, 2016). The first option involves increasing inventory, finding alternative suppliers for the same parts and components, or duplicating production and IT systems, which may be costly to maintain in the long run. In the context of COVID-19, this discussion has fuelled debates around initiatives to link production sites to their surrounding territories, which implies retaining at least a certain amount of

production locally, even if this is seemingly uneconomical; from a company's perspective, this could help, at least partially, to offset exposure and dependence on a limited number of production sites (Laidi, 2020). By contrast, flexibility compels companies to find alternatives to ensure smooth operations in any given situation. Haraguchi, Lall and Watanabe, (2016) draw attention to standardization and interchangeability of parts and production systems, which can grant firms both the flexibility to respond to emerging disruptions and a competitive edge in the market, as standardization helps reduce costs. Flexibility requires a thorough understanding of the production system's key elements and components to ensure the dynamics of specific supply chains.

The literature offers practical tools that would be worth exploring through the lens of industrial policy.

Haraguchi, Lall and Watanabe, (2016) identify business continuity plans and the more structured and demanding business continuity management (BCM) as practices that contribute significantly to conventional disaster planning in firms. BCM helps firms identify a crisis, generate flexible mechanisms to manage it, while keeping the critical knowledge components within and under the organization's control. For example, when the earthquake and tsunami hit Japan in 2011, affecting Epson's production sites, the company had some arrangements in place, including supply chain maps. These arrangements were found to be particularly helpful when efforts towards restoring production started; however, additional measures were necessary to improve readiness for future disasters (Epson Group, 2012). Planning was particularly relevant: "preparing, updating, and improving our own business continuity plans (BCPs) for each business (identifying and managing our procurement risks, developing alternative suppliers and components, and keeping strategic inventory, etc.) and periodically auditing the BCPs of suppliers in the supply chain" (Epson Group, 2012:18). Looking to enhance readiness for future disasters, governments could more actively promote the development and diffusion of BCPs among manufacturing firms. This can be achieved by establishing enabling legal and policy frameworks, guidelines and resources (i.e. knowledge and funding).

The caveat of BCM is that while intended to be a holistic management process, it tends to be designed and implemented selectively, and considering the continuous requirement for inputs from management resources, the practice would be particularly deficient in small and medium enterprises (SMEs) than in larger firms due to their more limited access to necessary resources.

Haraguchi, Lall and Watanabe, (2016) acknowledge that SMEs are particularly vulnerable in manufacturing supply chains. Borrowing from information systems terminology, the authors identify SMEs as a single point of failure (SPOF), which when failing, renders an entire system inoperable. SMEs become critical nodes whose adequate operation influences the overall performance of a supply chain network. Like failure in critical infrastructure, disruptions in SME operations can induce significant losses in the entire supply chain network. (Haraguchi, Lall and Watanabe, 2016) mention the GEJE experience in 2011. Several SMEs in the lower-tier supply segments became SPOFs because of their relatively high market share in a highly specialized market; inability to replace ailing firms quickly enough led to a situation in which up to 70 per cent of bankrupt companies resulting from the Japanese earthquake in 2011 were SMEs. Dedicated policies should assist SMEs in building the necessary preparedness against disaster risk, including through improved access to specialized insurance (Haraguchi, Lall and Watanabe, 2016).

4.3 Response

The importance of industrial policies increases during and after a disaster event. It is useful to differentiate between two distinct time horizons, namely the short- to the medium- to long term, as the goals may also differ. In the short-term, the aim is to address the immediate emergency situation, to safeguard income-generating opportunities and to sustain the operation of critical supply chains (i.e. essentials and health supplies) (UNIDO, 2020c). Industrial policies implemented in such contexts are thus elements of governments' emergency response to minimize disruptions and losses. As the situation evolves, policy targets may gradually shift to restore supply chains, recover demand and incentivize productive investments (UNIDO, 2020c). During this subsequent stage, the role of government can be described as laying the grounds for industrial recovery. Our focus in this section is on emergency response.

Once a disaster strikes, a swift and well-managed response is necessary to provide immediate relief. Looking at early responses to COVID-19, two policy areas seem to stand out amidst emergencies. They are (i) safeguarding continued manufacturing, and (ii) mobilizing production towards critical supplies. The strategies, approaches and tools may differ in each case, as may the challenges faced.

In relation to safeguarding the continuity of industry, the emphasis of policy measures should be placed on the supply side. Concrete actions may include, but are not limited to, providing differentiated support measures depending on the specific needs resulting from the major event, which would help a greater number of firms cope with the ensuing crisis and preserve

employment: provision of financial and fiscal support to underpin firms' survival; efforts to ensure continued supply of production inputs and managing supply chain disruptions; and designation of critical sectors and workers (Policy Links, 2020). Ensuring that those who most need it can access government support—typically micro-enterprises and SMEs—is a key challenge for all nations, especially developing countries, where this problem is compounded by high levels of informality. The provision of technical assistance to help manufacturers identify supply chain disruptions involving vendors, suppliers or customers and adequately addressing these is also important.

The mobilization of production capacities, in turn, may be necessary because emergency situations can trigger massive increases in demand for certain products and goods, which can lead to shortages, speculation or predatory behaviour by major supplier firms or even countries. The latter behaviour, as evinced by the coronavirus pandemic, is particularly problematic. As such, scaling up technologies, ramping up production and reorienting productive activities to meet essential needs become key issues for immediate response. The distinctive element for policymakers who must deal with these issues in the context of extreme events (as opposed to “non-crisis” times) is the necessary speed for success (Gross and Sampat, 2020), besides the highly uncertain and rapidly changing context (OECD, 2020b). This calls for proactive and innovative solutions.

To this end, a wide range of measures can be used to reach both the supply- and demand sides. On the supply side, the following non-mutually exclusive alternatives exist (Policy Links, 2020): supporting business efforts to repurpose factories so that traditional production lines can incorporate products for which unmet demand is pressing; incentivizing industry-research consortia to produce critical supplies; designating critical supplies; easing regulations; export control and import facilitation; and direct government involvement in production and distribution. Policymakers seeking to stimulate manufacturing repurposing must overcome challenges such as developing intelligence on the available supply sources, setting robust but sufficiently flexible standards and adapting to a fast-moving environment (Minshall, 2020).

On the demand side, the use of emergency public procurement, which typically plays a pivotal function during crisis situations (OECD, 2020b), should also deserve special attention within industrial policies. As the pandemic has also shown, the lack of within- and cross-government coordination to procure critical products exacerbates risks countries are exposed to, most notably developing and vulnerable countries. Therefore, more systematic and focused efforts at various levels are needed to shift emergency supply and demand in the right direction and at the appropriate speed.

Framework conditions and institutional capacities are crucial for the success of emergency responses – it is no different for ‘emergency’ industrial policies. Within the disaster management literature, this point is clear. From this perspective, it is recommended that governments develop and implement formal disaster response plans to assist manufacturers and to effectively communicate the strategy to businesses (American Planning Association, 2014; World Bank, 2020). These plans may include information on emergency aid and on the procedures to access available resources. Aside from being essential in terms of informing businesses, making formal disaster plans accessible helps align public and private actors’ responses. Similarly, activating emergency procurement frameworks, providing public purchases under flexible and agile conditions while ensuring transparency and possible guarantees that contracts agreed upon will continue to be honoured, serve as key enablers of public-private collaborations during crises (López-Gómez et al., 2020; OECD, 2020b).

Before transitioning from the emergency to the recovery stage, a detailed re-assessment of industry’s situation is necessary. This may capture the consequences and impact of the disaster on the respective industry; at the same time, such a reappraisal provides an opportunity to adapt policy responses to the evolving circumstances. If the industrial policy response is well-designed and managed from the start and throughout the disaster, it is more likely that industry will successfully recover from it.

4.4 Recovery

The role of industry as a driver of long-term growth and as supporting the achievement of a country’s socio-economic and environmental objectives, implies that the industrial sector plays a central role in post-disaster recovery. Similarly, how quickly businesses can rebuild capacity and resume operations may determine the pace and extent of the recovery (Make UK and Santander, 2020; Stella and Woo, 2020). Moreover, differences in the strength of the manufacturing sector across countries helps explain differences in the depth of the contraction of manufacturing and, eventually, in the speed and sustainability of the various paths to recovery post-disaster. If, in addition, the opportunity is seized to innovate, accelerate the development of new and greener production technologies, and to strengthen the resilience of manufacturing industries, the strategic value of industrial policies to deliver the manufacturing sector’s prosperity potential in the aftermath of a disaster is beyond doubt.

China's experience with the COVID-19 pandemic illustrates the importance of a strong manufacturing base for economic resilience (Yao and Crossley, 2020; Stella and Woo, 2020). Despite weaknesses in demand and fears of a deteriorating relationship with the United States, recovery in manufacturing has helped China's economy bounce back strongly after the first COVID-19 shock on the economy (The Economist, 2020). Following the adoption of strict lockdown measures in early 2020, manufacturing registered a severe plunge of -15.9 per cent, during the first quarter of 2020. However, as social distancing measures began being eased, manufacturing quickly bounced back with subsequent expansions of 2.8 per cent and 8.2 per cent in the second and third quarters, respectively. By June 2020, manufacturing production had returned to a path of stable growth, even exceeding pre-crisis production levels (UNIDO, 2020b).

Based on the above, two broad targets for policy can be distinguished. One is the support of business resumption; the other is the support of post-crisis manufacturing growth and reorientation (UNIDO, 2020d). Here, once again, alternative paths, approaches and instruments may underpin the state's involvement.

At the outset, establishing proximity and dialogue between the various stakeholders in the public and private sectors as well as in the community, represents a fundamental basis for action. Governments play an essential role in providing clear and timely guidance for business resumption, including workers' health and safety. Firms, on the other hand, will also have to conduct an assessment of their individual situation to restart operations. This appraisal should examine and quantify any damages or vulnerabilities in infrastructure, factories, inventory or equipment that must be mitigated; it should also identify any business adaptations or changes needed to minimize the exposure to risk (Thompson, 2018).⁹ Insofar as not all companies are equally equipped to do so, especially smaller enterprises, the state could support this assessment exercise and help businesses identify and prioritize their actions. The support could take the form of grants or governments could act as facilitators, fostering new market creation, linking businesses with other partners who can assist in this type of assessment exercise.

In parallel with adequate planning and policies, recovery packages can proactively promote post-disaster manufacturing growth in the medium- to long term. Recovery plans can target and direct investments towards strategic areas to improve pre-existing vulnerabilities, as those revealed during the COVID-19 crisis, namely essential medical supplies and pharmaceuticals, but also more broadly products that are strongly tied to national security.¹⁰ Where such plans also entail

⁹ <https://www.nist.gov/blogs/manufacturing-innovation-blog/nist-awards-emergency-funding-help-manufacturers-hurricane>

¹⁰ Jayant Rajgopal, PhD, PE, Professor of Industrial Engineering, University of Pittsburgh (UNIDO 2020e).

changes in policies and financial investments intended to prevent a return to the ‘normal’ status quo (Sarkis et al., 2020), the chance of reconciling economic revival, social inclusion and environmental sustainability may increase. Doing so would imply the adoption of ‘21st century industrial policy in the sense of seeking to align the promotion of structural change with intended, socially desirable outcomes (Aiginger and Rodrik, 2020; Chang and Andreoni, 2020).

As the ongoing pandemic has already shown, the tremendous amounts of public spending needed to recover from a global shock confer the possibility for governments to structure their support in ways that favour a more sustainable economic future (Scott and Locke, 2020; Stiglitz, 2020). This may entail strategic allocation of financial support—focusing on those industries that are to be strengthened—attaching conditions to any financial support and broader incentives for businesses to invest in renewable energy, sustainable infrastructure, energy-efficient buildings and practices (Stiglitz, 2020). Indeed, the use of conditionalities could play a much broader role if understood as a means to ensure productive, value-creating uses rather than short-term profits (Mazzucato and Andreoni, 2020). At the same time, there is recognition that a green and sustainable recovery requires far more, such as using the tax system to discourage firms from using certain materials, introducing job guarantees and reorienting corporate governance, among other measures, that could help ensure that future economic growth is also inclusive (Mazzucato, 2020).

How to finance reconstruction efforts, especially in the context of developing and least developed countries, is a central question. The answer largely depends on the ability of a network of actors—including local authorities and governments, non-governmental organizations (NGOs), finance institutions, international donor agencies, the private sector and academia—to mobilize and adequately channel the full range of available resources. Analyses of previous disaster management experiences, in particular the Indian Ocean Tsunami that occurred in 2004, draw attention to the importance of ensuring that the increased scale of post-disaster finance does not crowd-out support usually directed to other areas, i.e. health and food supplies (Athukorala, 2012). Yet previous experiences also indicate that the mere availability of funds is far from sufficient for a successful outcome.

A speedy and well-managed industrial recovery means setting up adequate institutional mechanisms to implement a recovery plan. This, in turn, cannot be achieved without intense stakeholder engagement throughout the process – from devising the recovery plan and the required implementation processes to its actual execution. In their review of the disaster management literature, Athukorala and Resosudarmo, (2005) document common shortcomings in the implementation of recovery plans. Among these are the failure to follow original initial time schedules, duplication of tasks, mismatch between the support provided with the recipients’

actual needs, and failure to engage local communities in the process. Such limitations, albeit not exclusive to post-disaster contexts or policies geared towards diversifying and upgrading economies, should be the foundation of systematic learning that can lead to better outcomes (Stiglitz, 2016). And so should other successful experiences. Given that the inherently uncertain nature of structural change policies is magnified following an extreme shock, the state will need to realize this learning and adaptive function along the way, through experimentation in a learning-by-doing fashion.

Beyond this need to develop proper learning mechanisms, supporting investments in innovation and local production becomes even more important at this stage (UNIDO, 2020d). Any investment in a new industry or in the transformation of an existing industry entails high risks. History shows that it is only when the state acts as a lead capital provider, a co-investor and coordinator, that market creation can flourish and lead to economic development (Johnson, 1982; Amsden, 1989; Wade, 1990). Thus, building state capacities to take and share the risks of innovation and laying the foundations for “entrepreneurial states” to emerge (Mazzucato, 2013) is an indispensable ingredient in industrial recovery strategies. This may include supporting the identification of future technological and market opportunities as well as sale channels.

Last but not least, strong coordination is necessary throughout the entire post-disaster phase. Successful alignment of public and private interests, as well as the targeting and orientation of investments in production and innovation can only occur if structures are in place that enable a high degree of coordination. Coherent coordination among industrial policy, competition, regional, trade and other growth policies is just as important (Aiginger and Rodrik, 2020).

5. Going beyond national boundaries

So far, the discussion has followed the agreed understanding of the different phases of a disaster, trying to identify the space for industrial policy interventions. The narrative may seem well attuned to inform national perspectives on industrial policy and resilience (UNDRR, 2015); after all, the national dimension tends to circumscribe the bulk of state interventions. For example, (World Bank, 2020) acknowledges that the optimal arena of influence for policies intended to foster industry resilience is at the national and industrial park level. This finding is in line with the leading understanding of the role industry ought to play during the response and recovery stages. However, (UNDRR, 2020a)¹¹ acknowledges that the effects of a disaster “*may test or exceed the capacity of a community or society to cope using its own resources, and therefore may*

¹¹<https://www.undrr.org/terminology/resilience#:~:text=The%20ability%20of%20a%20system,and%20functions%20through%20risk%20management.>

require assistance from external sources, which could include neighbouring jurisdictions, or those at the national or international levels”.

Hence, the strong focus on the national level does not rule out the importance of policy coordination beyond national boundaries, as stipulated in the Sendai Framework and supported by other contributions to the relevant literature. For example, (UNIDO, 2019) asserts that there is significant room to improve risk management across boundaries to ensure adequate compliance with international conventions and regulations around industrial safety. Djalante, Shaw and DeWit, (2020) suggest that despite national differences in terms of culture, acceptance and interpretation of risk, preparedness and so on, the increasingly interconnected world has made the adoption of global standards and protocols for regional and national response more convenient. Disasters that occur in one part of the world may also have an impact on other distant locations (OECD, 2020a). Moreover, there is recognition that while current risk management institutions and approaches can adequately deal with individual hazards, they are unfit to address systemic risk on the scale expected to result from climate change-related disaster events (UNDRR, 2020b).

In the light of the events that followed the COVID-19 outbreak, the scope to discuss the centrality of manufacturing in a coordinated response beyond national borders, including the regional and global levels, is evident. The COVID-19 outbreak demonstrates that the implications of a global pandemic go far beyond health issues; there are significant consequences for the global economy; moreover, we have witnessed that uncoordinated, science-driven and consensual responses amplify the negative, mutually reinforcing, impacts on both people’s health and the economy. Notable in this context is that existing frameworks and mechanisms to guide manufacturing’s response during emerging global disasters remain underdeveloped. The lessons emerging from COVID-19 suggest a need for improved mechanisms to foster collaboration and capacity-building to protect and mobilize productive assets as global assets against extreme events.

The evidence suggests that at least at the regional level, there is room for further research and efforts to learn from the current pandemic and its possible implications for risk management, and to build on public-private partnerships to inform industrial policy design and to achieve intended development goals (FERMA, 2020b; 2020a; Djalante, Shaw and DeWit, 2020). Similarly, lessons should be drawn for the governance of value chains and industrial development initiatives, as the pandemic has considerably challenged global dynamics, making regional connections and collaboration increasingly relevant.

A comprehensive and consolidated system to identify, prevent and/or manage risks seem difficult to come by due to highly heterogeneous productive systems at the national level, and the need to incorporate specific industry characteristics and degrees of risk exposure.¹² However, it should be possible to develop a minimum standard for different states to agree, coordinate and deploy interventions to protect industrial infrastructure and mobilize industrial activities to address emerging crises with potentially pernicious global implications.

Regional economic commissions could play a coordinating role in managing risks in collaboration with the UNDRR. This is similar to the proposal of the European Union, acting as a supranational entity responsible for coordinating national governments' compliance with a Resilience Framework for Catastrophic Risks (RFCR) (FERMA, 2020a). Beyond this, several risk prevention initiatives have already been proposed that acknowledge the transnational nature of risk. For instance, UNIDO, (2019) calls for internationally coordinated action in applying best practices and available technologies to industrial safety and to reduce damage arising from natural and human-caused disasters. It proposes the creation of a platform to facilitate the collection and analysis of risk data; to map hazardous areas; develop core indicators; and use advanced digital technologies for data analysis. This platform could leverage existing initiatives at the regional level and facilitate knowledge sharing and communication among different stakeholders.

In this regard, international organizations should intensify their support for institutional capacity-building. They could also help government agencies responsible for risk management in introducing innovative approaches to their regulatory and monitoring functions. The international community could moreover also contribute to enhanced implementation of existing legal policy instruments and standards, and foster the discussion and development of additional international standards and good practices in fields such as industrial safety, occupational health and safety, and environmental protection (UNIDO, 2019). Initiatives already under way include the UNDRR's Private Sector Alliance for Disaster Resilient Societies (ARISE), which brings together different private sector entities to foster multi-stakeholder efforts aimed to create "risk-resilient societies" (The Economist Intelligence Unit, 2016; ARISE, 2020). A priority of ARISE is to facilitate multi-stakeholder initiatives that make investments risk-sensitive, leveraging six communities: (i) business, (ii) investors, (iii) insurance, (iv) civil society, (v) education, and (vi) the public sector, and several activity streams, of which those related to strategies for global business, industrial sector certification and insurance seem particularly relevant from an industrial policy perspective.

¹² See, for example, FERMA, (2020a) for a discussion on the implications for insurance activities.

Based on the above, there is significant scope for cooperation and action at the regional and global levels to strengthen the functioning of existing frameworks to help manufacturing manage and respond to catastrophic risks. The argument for improved trans-border collaboration acknowledges the highly interconnected and networked socioeconomic structures that characterize manufacturing. This characteristic magnifies the potential scope, coverage and speed of transmission of shocks and disruptions, increasing the likelihood of chain failures; firms located in a safe area, which would otherwise be fully viable, may be adversely affected by failures of other companies in an area hit by a disaster (Haraguchi, Lall and Watanabe, 2016). Because the complexity of the interconnected chains constrain a firm's ability to identify and anticipate sources of vulnerability, the economic damage caused by unexpected incidents have increased over time (UNIDO, 2019; Ivanov and Dolgui, 2020). Several experiences illustrate the long-lasting impacts that can arise from localized shocks, from flooding in Thailand to earthquakes in Japan.

In summary, the COVID-19 outbreak has demonstrated that when international solidarity falters, the effectiveness of individual national responses becomes diluted, while the potentially damaging impacts on society and the global economy intensify. As the world debates the post-COVID-19 recovery, the urgency to undertake further efforts in risk and disaster management, and the need to enhance international cooperation and policy coordination are evident (Hanif, 2020). Coordinated efforts at the global level are needed to improve the likelihood that global value chain (GVC) restructuring post-COVID-19 contributes to reducing the exposure, dependency and vulnerability of manufacturing, as a sector that provides basic goods and services in times of crisis.

Moving forward, Aiginger and Rodrik, (2020) propose the creation of an annual International Forum for Industrial Policy Shaping Responsible Globalization for political leaders, civic organizations and industry to discuss industrial policy. While acknowledging differences in industrial policy approaches across countries on different continents and in different stages of development, the Forum could facilitate mutual learning on a wide range of issues, including trade and investment regulations, secure property rights, social standards and the promotion of energy efficiency and renewable energy. The Forum would enhance coordination on sensitive issues such as national strategies around subsidies for fossil energy and large-scale agriculture, or mechanisms to assist those countries that are failing to meet the challenges of globalization and rapid technological change. This and other innovative ideas need to be carefully analysed if we want the global manufacturing industry to be better prepared for future emergencies.

6. Conclusions

As the world continues to fight the COVID-19 pandemic, manufacturing is poised to remain at the frontline. The sector has experienced significant disruptions due to the pandemic, yet it also contributes to the management of the related health and economic crises. Beyond these immediate considerations, however, the COVID-19 pandemic has prompted debates around the key issues that decision makers will need to address to make public policies in different domains work effectively in the context of extreme events. In this paper, we argue that this debate resonates with ongoing not yet articulated efforts by two different but complementary streams of work. On the one hand is the ambition to equip industrial policy design and practice with the necessary tools to address pressing development challenges beyond traditional economic targets. The issues of inclusiveness and environmental sustainability place prominently on the agenda. On the other hand, there is the perception that unless elements of disaster risk management and resilience are better integrated into industrial policies, industrial development is unlikely to be sustainable: years of progress can be wiped out by the strike of a single major disaster. Hence, while not losing sight of the pending tasks to achieve ISID, industrial policy faces the challenge of enhancing manufacturing's contribution to the different pillars of resilience—economic, social and environmental—in the long run.

In moving forward towards developing more resilience-aware industrial policies, this paper proposes a two-pronged strategy. First, as illustrated in Section 4, drawing on the Sendai Framework, the definition of industrial policy targets should be consistent with the challenges imposed by different phases or stages of an extreme event, from prevention and preparedness to management of the emergency to recovery. Second, efforts should be carried out to learn from the experiences of previous disasters, as documented in the disaster management literature, as well as from the ongoing coronavirus pandemic. Systematic analyses should illustrate possible areas of intervention and single out those policy responses with the highest chance of contributing to better outcomes in terms of industrial resilience building, mitigation of impact on employment, competitiveness and even the attractiveness for investment. Key lessons should be gleaned in ways consistent with the specific conditions faced by developing and least developed economies. The preliminary evidence presented in this paper highlights the need for approaches that favour multiple stakeholder cooperation and coordination, along with institution building and learning by doing to develop industrial strategies aimed at tackling global challenges.

The interconnectedness of different components of the economic, social and environmental systems UNIDO, (2016) invites reflection on the role of industrial policy in the pursuit of high order goals, namely to ensure the provision of goods and services society needs to manage extreme events and to secure its long-term viability and survival (Ivanov and Dolgui, 2020). OECD's, (2020a) discussion on the effects of COVID-19 on the operation of GVCs, including the supply of essential products, further illustrates this point.

Our paper offers some insights into the relevance of industrial policy as an area for enhanced international policy cooperation and coordination. In the face of an emerging extreme event with global implications, national level responses should be commensurate with the emerging challenges. There is room to improve coordination mechanisms to foster the creation of synergies, while establishing appropriate frameworks to address controversies and to mobilize existing production and distribution capacities at the global level. Advocacy for enhanced international coordination and collaboration is consistent with the UN General Assembly's urgent warning to Member States to prevent national-level responses to fight the COVID-19 outbreak from becoming a justification to promulgate and apply "unilateral economic, financial or trade measures not in accordance with international law and the United Nations Charter that impede the full achievement of economic and social development, particularly in developing countries" (United Nations, 2020).¹³

Future research could integrate disaster risk management concepts into a more comprehensive analytical framework to inform industrial policy responses in the face of extreme events. Such a framework could then be used in case studies and in-depth empirical studies to shed additional light on the theory and practice of disaster risk management-friendly industrial policies. Only with more systematic efforts to create an evidence-base to guide government policies can better outcomes in terms of industrial resilience be achieved. Equally important, however, is understanding the extent to which culture and tradition influence risk perception, awareness and response, which draw direct links to socio-economic structures of countries and communities (Djalante, Shaw and, DeWit 2020).

¹³ <https://www.un.org/press/en/2020/ga12262.doc.htm>

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