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Rescaling: An Analytical Lense to Study Economic and Industrial Shifts

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Abstract

Rescaling as a concept has been used to investigate and explain shifting patterns in economic and industrial development. This ranges from processes explaining the shift towards globalisation in the 1980s to current calls for shifts towards decarbonisation, national security, and more even development, which profoundly affect the organisation of economies and industries. This paper aims to unpack the notion of rescaling, identify and elaborate on different dimensions of rescaling, and use rescaling as conceptual and analytical lens to discuss and understand shifting patterns in economic and industrial development. We explore the potential of rescaling to capture the complex processes underpinning such shifts in patterns with a unifying language that connects multiple disciplinary perspectives. It is also relevant from a societal perspective as rescaling has been used as a strategy to affect the patterns in economic and industrial development.

Keywords: economic development, industrial dynamics, globalisation, technological regimes, industrial policy, sustainable development

JEL Codes: F02, F50, F60, L50, L60, O10, O30,

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1 Introduction

The notion of rescaling is frequently used to describe and analyse shifts in patterns of economic and industrial development. A debate on rescaling as a concept surfaced in the backwaters of the shift towards neoliberal globalisation (Swyngedouw, 2000, Mansfield, 2005). Nowadays, it plays a role in relation to the post-neoliberal restructuring implied in the revival of new industrial policies, which call for a rescaling of governance with an increased importance of the national scale, aiming to affect the geographic spread and integration of economic activities (Aiginger and Rodrik, 2020, Krugman, 2022). Relatedly, concepts with an inherent rescaling dimension such as friend-shoring and back-shoring are discussed in response to supply chain and national security concerns (Feroz, 2022b, Stentoft et al., 2016). Rescaling has also been identified as a relevant dimension for governing sustainability transitions (Madsen, 2022, Bouzarovski and Haarstad, 2019). Furthermore, rescaling of actor, network, and institutional configurations affects innovation processes (Grillitsch et al., 2019b) and is essentially related to the geography of economic activities (Krugman, 2009). Rescaling thus features in a broad range of academic disciplines and theoretical traditions, which leads to the overall question if rescaling could serve as an integrative conceptual and analytical framework to study shifts in patterns of economic and industrial development.

The objective of the paper is therefore to discuss the relevance of rescaling for studying shifts in the patterns of economic and industrial development. Rescaling is a complex concept, and this opens the question of how to account for the various dimensions of rescaling and the theoretical and empirical insights from a variety of different literatures. From a geographic perspective, rescaling refers to the changes in the spread of economic and industrial activities in time and space. Relatedly but conceptually different, rescaling has been used from a governance and institutional angle to capture shifts between levels of governance from local to global. From the economic and business perspective, rescaling refers to the scale and scope of activities and how these are organised and distributed within and between organisation and relate to the technologies used. Building on the different strands of literature, the paper thus differentiates between spatio-temporal, socio-institutional, and techno-economic rescaling. The paper discusses the relevance and nature of these different types of rescaling processes, and thus aims at enhancing analytical value of using the term rescaling. Furthermore, the paper shows how the dimensions of rescaling are not only analytical categories but also used as agentic strategies to influence the patterns of development.

The other question is if and how the three different dimensions of rescaling processes interact and explain shifting patterns of economic and industrial development. The paper proposes an integrative conceptual and analytical framework, which is then used to discuss theoretically i) the shift towards neoliberal globalisation, ii) the post-neoliberal restructuring, and iii) two industrial illustrations using the examples of the maritime industry and the textile industry. Despite the contingent character of these concrete cases, the paper shows that shifting patterns of economic and industrial development (or the absence of such shifts) can be theoretically linked to sets of rescaling processes, and the extent to which they align or misalign. Overall, there is still little understanding how different rescaling processes are linked together and produce shifts in patterns of development. To advance on this front, it is necessary for analytical purposes to define and distinguish the different rescaling dimensions, which then allows to investigate their interplay. The critical assessment advanced in this paper suggests that rescaling as a concept holds the potential of capturing the complex processes underpinning shifts in patterns of economic and industrial development with a unifying language that connects multiple disciplinary perspectives. It is also relevant from a societal perspective as rescaling has been used as a strategy to affect the patterns in economic and industrial development.

Section 2 is dedicated to assessing the concept of rescaling and to discussing the three dimensions of rescaling. Section 3 brings the three dimensions together and analyses shifts in patterns of development using an integrative conceptual and analytical framework combining the three dimensions of rescaling. Section 4 offers conclusions including a number of propositions how rescaling relates to shifts in the patterns of economic and industrial development.

2 Rescaling: An assessment of the concept

The aim of this section is to review and assess the concept of rescaling. We organise this assessment in three main themes: Spatio-temporal rescaling, socio-institutional rescaling, and techno-economic rescaling. Spatio-temporal rescaling captures the expansion or contraction of economic activities and processes in space and time. Socio-institutional rescaling is concerned with the shifts in power between different governance levels. Techno-economic rescaling refers to changes in scale economies based on the choices made by and available to economic actors and the direction of technological development.

2.1 Spatio-temporal rescaling

The nature and consequences of any economic or industrial process relate to and depend on the nature of the social world and historical context in which it occurs (Martin and Sunley, 2022). Positioning economic and industrial processes in a specific time and place is therefore key to understanding in the globalized world (Asheim, 2020), and, consequently, analyzing shifts of economic or industrial development requires a fine-tuned analytical lens of these spatio-temporal relations¹. Spatio-temporal rescaling captures how the multiple social, institutional, economic, or technological processes associated with global change are nested in constitutive spatial hierarchies (Gibson et al., 2000). Economic agents are contained in neighborhoods/clusters, which are contained in cities, which are contained in regions, which are contained in nations, which are contained in the global economy (Brenner, 2005).

In such complex, constitutive hierarchies, larger units are not simply the aggregation of smaller units. Spatial scales evolve relationally within tangled vertical hierarchies of territorial units that are linked to the horizontal networks, where other processes are operating (Brenner, 2005). Thus, the meaning of any geographical scale can only be grasped relationally, in terms of upwards, downwards, and sideways linkages to other geographical scales. Processes occurring at any spatial level are affected by mechanisms occurring at the same level, and by levels below and above. Moreover, patterns that appear to be ordered at one level may appear random at another (Gibson et al., 2000). Thus, there is no single 'correct' level to study rescaling; rather it should be examined from a multi-level spatial perspective.

At the same time, embracing the spatial context of rescaling is not possible without explicitly referring to the specific temporalities by which it is produced (Martin and Sunley, 2022). Each geographical scale is constituted through its *historically* evolving positionality within a larger relations' grid of vertically 'stretched' and horizontally 'dispersed' economic or industrial processes (Brenner, 2001). Geographical scales may be ruptured and rewoven through the very processes they enable. Thus, rescaling should be understood not only through interacting multiple spatialities (local, regional, national, and global), but also through interacting temporal modalities that characterize and define it – (historical) time

¹ It is important to note that space and time should not be the subject for analysis *per se*, but rather are the intrinsic properties the study object ASHEIM, B. T. 2020. Economic geography as regional contexts' reconsidered – implications for disciplinary division of labour, research focus and societal relevance. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography*, 74, 25-34. or a kind of boundary conditions MARTIN, R. & SUNLEY, P. 2022. Making history matter more in evolutionary economic geography. *ZFW – Advances in Economic Geography*, 66, 65-80..

frame, tempo, duration, and sequence (Martin and Sunley, 2022). Time, acceleration and urgency are, for instance, part of the rationale of the green transitions, and at the same contested with democratic and justice implications (Skjølsvold and Coenen, 2021). These temporal modalities not only interact with each other, but also operate differently at different spatial scales and in different places (Massey, 1992). From this perspective, rescaling can also be conceptualized as a means and agentic strategy through which various actor groups attempt to reorganize the balance of power and manage the contradictory relations of capitalism (Brenner, 2009).

Overall, understanding rescaling requires a willingness to engage with the spatial and historical context in which economic agents make decisions, and to track the multi-scalar and multi-temporal generative processes and sequences involved. This makes it important to dig into the long-term changes in the very nature of capitalism, and relate rescaling process to the political, economic and financial regimes that enable or constrain it (MacKinnon et al., 2009). Here, spatio-temporal rescaling should not be analyzed *per se* but rather in relation to socio-institutional and techno-economic rescaling. Spatio-temporal rescaling is an analytical lens through which shifts in economic and industrial development can be studied but also relates, in real world terms, to boundary conditions which determine what kind of rescaling is possible, where, and when.

2.2 Socio-institutional rescaling

A range of contributions has zoomed in on the “rescaling of governance” or “rescaling of state” (Swyngedouw, 2000, 70) in relation to globalisation processes. The argument was that globalisation entailed a shifting of power relations from the nation state on the one hand to the global scale represented by actors such as the World Trade Organisation or the International Monetary Fund, but also the European Union, for example, and on the other hand to the local or regional scale. This latter process refers for instance to a disempowerment of national unions and consequently labour negotiations at a more local scale. Mansfield (2005), however, criticises that the rescaling argument at that time was too simplistic, being rather ignorant about the multi-scalar relations and the continuous importance of the nation state. Hence, rather than arguing with a broad brush that one level (e.g., the nation) increases in importance compared to another scale, a more detailed investigation of sets of interrelated processes in context is required, which may exhibit contradictions in socio-institutional rescaling patterns.

More broadly, the notion of socio-institutional rescaling relates to the (un)structuration of informal and formal institutions and the (dis)integration of social practices. The institutionalization of the globalised world has brought about a range of dominant actors and networks (e.g. transnational companies and global value chains); practices, rules and regulations (e.g. intellectual property rights, taxes, duties); technological standards (e.g. ISO norms) and cultural expectations (e.g. low prices). All these elements have co-evolved into a ‘configuration that works’ (Rip and Kemp, 1998) and maintains status quo. Rescaling implies a reconfiguration of established patterns and relations across different socio-institutional scales (Geels and Turnheim, 2022) through processes of (de-)institutionalization (Barley and Tolbert, 1997, Berger and Luckman, 1966).

The concerted/distributed responses by governments and communities to recurring ecological, economic, and geopolitical crises may drive rescaling in the socio-institutional dimension. For example, recent studies have shown how new types of policy has increased the relevance of local urban experimentation for sustainable innovation vis-à-vis in-house R&D by large firms (Sengers et al., 2021). Similarly, activities by international organizations (e.g. the World Bank, WHO, ISO) at the sectoral level increasingly shape development and diffusion trajectories of sustainable technologies globally, while some argue that national efforts, industrial policies and incentive structures appear to decline in

importance (Fuenfschilling and Binz, 2018, Miörner and Binz, 2021). On the other hand, the revival of industrial policy in the US and Europe, and the debate about de-coupling or de-risking of value chains suggest a shift in scale from global to trading blocs or nations (Krugman, 2022, Aiginger and Rodrik, 2020, Foroohar, 2022a). At the nexus of industries and organizations, incumbent organizations may drive (de-)institutionalization processes from within the industry (Turnheim and Geels, 2019) that changes established modes of production and consumption in (sustainable or unsustainable) ways that brings about important questions regarding social cohesion, re-skilling of workers, adequate policies and practices of unlearning and unmaking (Feola et al., 2021, Rogge and Johnstone, 2017). These insights from the literature show that socio-institutional rescaling is not a single process from one scale to another but rather captures a multitude of processes, which may reinforce or contradict each other.

Moreover, core value propositions often differ across societal, sectoral, industrial and organizational scales (Jeannerat and Crevoisier, 2022). These range from economic growth as the overarching rationale for actors' activities, to societal and environmental value orientations that provide a broader frame of incentives for actors to innovate (Yap et al., 2022). Recently, sustainability has arguably been established as a core value at the level of society, but its influence permeates unevenly across sectors, industries and organizations, sometimes being adopted solely on a symbolic or discursive basis (Stål and Corvellec, 2018, Bauer and Fuenfschilling, 2019). Diverging value orientations between scales may create frictions and institutional complexity that drives rescaling between scales that are characterized by different sources and degrees of path-dependencies and lock-ins (Simoens et al., 2022).

Institutional rescaling may be an active strategy as literature on institutional work and institutional entrepreneurship illustrates (Fuenfschilling, 2019, Lesch et al., 2022). Actors engage in activities to (de-)legitimize narratives, develop value propositions and establish new institutional infrastructures (Heiberg and Truffer, 2022, Jeannerat and Kebir, 2016, Baumgartinger-Seiringer et al., 2022) that alters the relationship between activities taking place at the scale of society, sectors, industries and organizations. For instance, in a recent article Madsen (2022, 349) shows that rescaling away from subnational to national decision-making in the Danish waste management systems has been conceived because municipalities acted as incumbents holding back a transformation. As such rescaling "opens opportunities for transformative change by altering power relationships between actors in a socio-technical system and thus may have the potential to both destabilize actors in the regime and empower niche actors". The challenge is that institutional work may also be used to safeguard or promote the uptake of more unsustainable technologies or the de-legitimation of potentially more sustainable innovation (Fuenfschilling and Truffer, 2014). Also, in the wake of the platform economy (e.g. Uber, AirBnB), we also see tensions between firms and states when it comes to the negotiation of labor laws and the provision of health care and insurances (Frenken and Fuenfschilling, 2021). Hence, it is important to recognize the strategic importance of socio-institutional rescaling in the current reconfiguration of the economy and its global relations.

2.3 Techno-economic rescaling

The techno-economic dimension is highly "scale-dependent" where notions of economies of scale and increased productivity, for instance in relation to the division of labour, specialisation, or technology development are fundamentals of economic thought that can be traced back to Smith's (1776) work of "The Wealth of Nations". Furthermore, technological revolutions and techno-economic paradigm shifts reshape the possible scope and scale of economic activities (Perez, 2009, Dosi et al., 1988, Dosi, 1982). Such paradigm shifts often relate to the introduction and diffusion of general purpose technologies (Bresnahan and Trajtenberg, 1995, Lipsey et al., 2005), which over time diffuse in the economy and trigger new industrial configurations through industrial interactions, demand pressures and technological competition (Cantner and Vannuccini, 2012). Techno-economic rescaling is unlike some

simple production function frameworks not a matter of arbitrarily scaling inputs. Scale economies depend on the technology used, and changing scales may need different technologies, which causes substantial frictions. An approach that emphasizes the frictions related to rescaling treat technologies as recipes (Nelson, 1980, Auerswald et al., 2000, Nelson, 2003). Changes to the direction of technological change and the employed recipes result from a combination of supply-side changes to innovation processes, networks undergirding the economy, demand-side changes, and exogenous shocks to the economy such as the recent Covid-19 health crisis. In the past, emphasis was given to greater efficiency by reaping the benefits of returns to scale in production, and consequently employed technological recipes displayed a tendency towards massification and homogenization.

On an international scale this was accompanied by a trend towards the cost-minimizing types of specialization exploiting labour cost advantages (Azmeah and Nadvi, 2014) and increasing returns to scale (Krugman, 2009) by for example offshoring simpler production tasks to developing or catch-up countries and concentrating high-value knowledge activities in advanced economies' chains (Ambos et al., 2021). This set-up of fine-slicing global value chains led to short-term gains in cost-efficiency. Yet, they also made them vulnerable. First, the increasing geopolitical tensions pose considerable problems for the reliability of global value chains. On the policy-side, this has already led to an increased emphasis of industrial policies and the call for technological sovereignty (Edler et al., 2023, March and Schieferdecker, 2023). This will also affect the shape and the *modi-operandi* of international knowledge networks, which have become a driving force of technology development. Second, the pandemic has also caused major disruptions leading Kano and Hoon Oh (2020) to argue for a need for a governance of reliability on global value chains, which may also imply a partial renationalization. Third, pressures towards more sustainable production systems. In this context, the development of the circular economy becomes pivotal because it simultaneously holds the promise of reducing negative environmental impact and can make production systems more resilient (Kennedy and Linnenluecke, 2022).

The forces driving techno-economic rescaling both with respect to the change processes/networks and the direction of technological change are multifaceted and will play out dependent on the context. However, a general feature is that they are tied together by changes to scale and scope of technology development and innovation. Because globalization tends to favour international exchange of knowledge, productivity, economies of scale and mass production (Schubert et al., 2018), shocks leading to a more disintegrated economy – irrespective of whether they are induced by geopolitical tensions, the need to respond to societal challenges or crisis-like events such as a pandemic - will imply a loss of market and knowledge integration causing technological shifts to smaller and more nationalized potentially even localized scales or regional clusters (cf. Chaminade and Plechero, 2015). Firms often try to deal with such pressures by following trodden paths but just at a smaller scale. This strategy often fails because of the loss of economies of scale, which will very often just amplify the problems (Dewitt, 1998), which can give rise to self-enforcing downward spirals (Tao et al., 2020). Moreover, because technologies are recipes, they are not arbitrarily scalable in terms of its input factors (Dosi and Nelson, 2010), simply downscaling activities by using less input will often not even be possible. Instead, techno-economic rescaling may require a shift from one technology to another, which will deeply change the organisation of economic activities and the direction of technological development. These required changes will thus be highly disruptive potentially creating a techno-economic tipping point and thus will bring great challenges in adaptation.

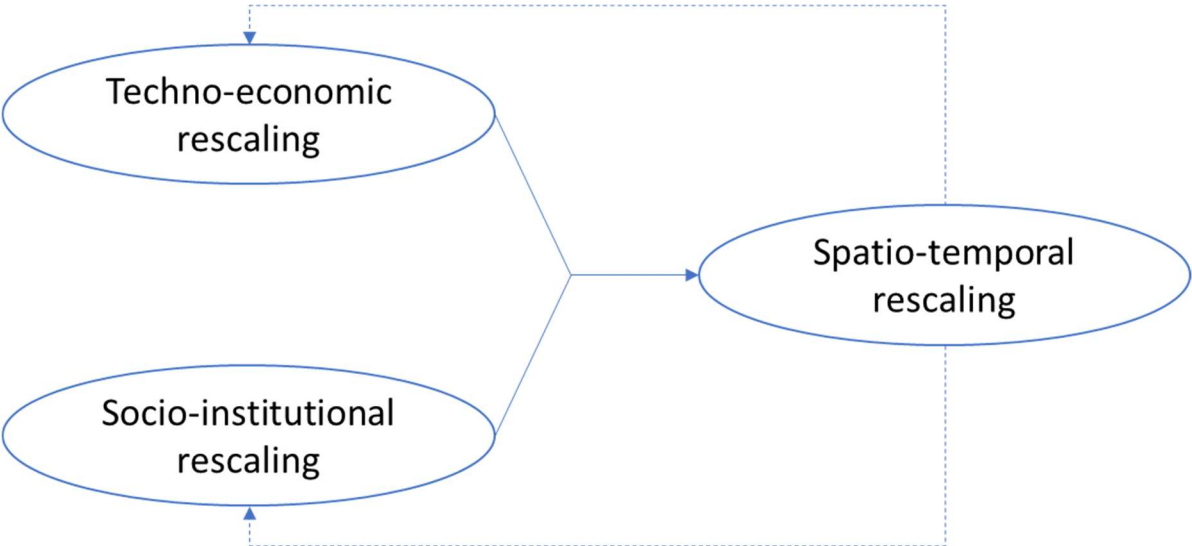
An active coping strategy thus requires disrupting trodden technological paths, which will imply changing technological recipes. Because of the disruptive potential of changing recipes, for firms this will imply changes in the specialization of production, alteration of supplier relationships, realignment

of managerial responsibilities and internationalization (Rico et al., 2021). Firms engaging in such active adaption strategies often show a much better ability to cope with crises and sometimes even leave them behind more competitive than before (Dewitt, 1998). For example, industry 4.0 holds potential for techno-economic rescaling as automation reduces the dependency on cheap labour (exploitation of people) and digitalisation allows for more flexible production, possibly making smaller scale production economically viable (Brettel et al., 2016, Enrique et al., 2022). An example of the latter is the transition from fordism to postfordism in the 1970s and –80s, where the use of computer aided machinery achieved the same productivity in SMEs in industrial districts in the Third Italy as in mass producing large firms, exploiting economies of scope (Asheim, 2000). In that respect, changes in the technological direction following the changes in the pattern of the knowledge economy represent a need in adaptation, but they also open-up economic opportunities, which are more in line with the needs for transformation resulting from e.g., the disruption in global value chains, weakening international institutions or climate change.

3 A conceptual and analytical framework for rescaling

This section elaborates how the three dimensions of rescaling interlink in a conceptual and analytical framework for rescaling, which allows to describe, study, and explain shifts in the patterns economic and industrial development. The proposed framework suggests that the interplay between the sets of socio-institutional and techno-economic rescaling processes result in the expansion or contraction of economic activities and flows in space and time, i.e. spatio-temporal rescaling (see Figure 1). The consequences of spatio-temporal rescaling may then trigger further techno-economic and/or socio-institutional rescaling in positive or negative feedback cycles. For instance, economic inequalities arising because of the concentration of high-value knowledge intensive activities to serve markets globally may receive a push back through a call for increased protectionism. We would argue that this framework is useful to understand and study major shifts in world economies such as the ones associated with neoliberal globalisation as well as the current processes of post-neoliberal restructuring, as well as for the study of concrete industries as illustrated below.

Figure 1: Conceptual and analytical framework for rescaling



3.1 Neoliberal globalization: A rescaling process with consequences

Globalization as a process of increasing spread and functional integration of economic activities emerged in the 70s and 80s related to a socio-economic paradigm shift typically associated with neoliberalism, which promoted deregulation, financialization, free trade, reduction of progressive taxation, and a slim government (Naidu et al., 2020). These neoliberal ideas implied a socio-institutional rescaling where the power of the nation state tended to be hollowed out in the favor of international regulations governed by international organizations (Swyngedouw, 2000, 70). Over many decades, there seemed no end to the expansion of economic activities in space and time, measured on various dimensions such as the movement of capital, products, labor, and knowledge (Dicken, 2015).

Globalization, however, differs from internationalization, which was not a new phenomenon, in its extensive geographical spread and high functional integration in global value chains (Dicken, 2015). Global value chains can be defined as “nexus of interconnected functions and operations through which goods and services are produced, distributed, and consumed on a global basis” (Kano et al., 2020, 579). Nowadays, approximately 50% of world trade is organized in global value chains (World Bank, 2020). The success of global value chains can be explained by the economic scale and cost advantages made possible by the spatial flexibility (Gereffi, 2020). On the one hand, global value chains are a possible channel for international collaboration and knowledge sharing, increased productivity due to specialization and economics of scale, and for smaller firms and emerging economies to integrate in the global economy without mastering the whole production process (OECD, 2021). On the other hand, global value chains are a source for global inequalities and power struggles because they are hierarchical and orchestrated by dominant transnational cooperations (Kano et al., 2020). Most value and power are captured through knowledge-intensive activities such as research and development, headquarter activities, finance, etc. Competition in global value chains is then a struggle about upgrading from simple to knowledge-intensive activities through learning processes, conditioned among others by the governance of global value chains and the strength of regional and national innovation systems (Lema et al., 2018, Hobday and Rush, 2007).

While the dependency relationships, the unequal distribution of value in global value chains, and the barriers for upgrading and development have been extensively discussed in the literature, the main issue at stake in this paper is the main organizing principle, which in a liberal market economy like US, where most transnational cooperations controlling global value chains are located, is to maximize shareholder’s value through cost reductions and profit maximization. This meant that “in the past two decades, the US economy has been bullied into following a path of offshoring , driven by an ideology celebrating short-term financial gains above everything else” (Breznitz and Adler, 2021). Furthermore, due to the increasing power of transnational cooperations, it has become increasingly difficult for nation states to govern global value chains giving transnational cooperations more possibilities to exploit weak labor and environmental standards, and differences in tax regimes. So that “... the current grand challenges are related in a non-trivial way to companies’ wrongful business conduct, especially that of large multinational corporations which have grown to rival governments in size, and have proven to be powerful agents capable of shaping the global governance agenda” (Giuliani, 2018, 1577).

Ignoring a broader perspective of development, which goes beyond a short-term cost and profit perspective and integrates other dimensions such as environmental and social harm at a global scale (within and beyond global value chains) as well as security concerns and geopolitics, there is no question that the last decades of economic development also produced a highly unequal world, a planet that is heating up and loses biodiversity at a rapid speed, and economic dependencies on countries that lack stable governance. Furthermore, even though lead firms in global value chains, including tech-giants such as Apple, Google, or Amazon control the most valuable knowledge,

intellectual property, and financial resources, there have been productivity gain problems associated with deindustrialization (i.e. the outsourcing of production in global value chains) (Capello and Cerisola, 2022). As regards social impacts, Bachelet (2022), UN High Commissioner for Human Rights, says “[t]he human rights impacts of global supply chains are clear: the use of precarious and informal employment is expanding at a rapid rate. Workers, especially migrant workers, are becoming ever more vulnerable, subject to a raft of human rights violations at the hands of their employers” and this share is expected to grow considering the expected increase in climate migrants. Moreover, geopolitical frictions such as the Ukraine war or the rivalries between US and China for technological supremacy are another source of pressure affecting globalisation (Krugman, 2022).

3.2 Towards post-neoliberal restructuring of world economies

It is the response to this set of largely unintended consequences of neoliberal globalization that recent commentators proclaim a post-neoliberal area. Geopolitical tensions, climate change, uneven development coupled with a series of crises such as the Ukraine war, Covid-19, or the financial crisis has been driving the post-neoliberal restructuring of world economies, which manifests in reshoring, new industrial policies, policies addressing technological sovereignty and system transformation, as well as social movements.

Industrial policy has been practiced for decades as a means to promote a country’s industrial and economic growth by a pro-active government through tax incentives, regulations and R&D support. Earlier examples are Japan, Taiwan and South-Korea’s industrial development in the 1970s and 1980s (Senghaas, 1985). Often industrial policy builds on a combination of import substitution in the earlier phase, supported by infant industry protection to build competitive advantage, and export orientation in later phases when competitive advantage has been achieved (Nam & Li, 2012). The new phase of industrial policy in the post-neoliberalist era is driven by three specific factors, viz. geopolitics and security risks, sustainable transition, and rising inequalities caused by deindustrialisation and offshoring of manufacturing jobs.

This translates in changes in the overall geopolitical landscape, which was in the post Bretton-Woods era characterized by the free-trade agenda safeguarded by a series of international WTO agreements such as GATT about the trade of goods, GATS about the trade of services and TRIPS about the protection of intellectual property. Moreover, cross-national trade agreements (e.g. EU common market, CETA, NAFTA, EU-Japan Trade Agreement) had institutionalized such a rule-based free-trade system. Yet, these institutions are increasingly challenged following a call to adapt international relations towards new reality where economic policies are not limited to economic goals but may also reflect national strategic interests, the resurrection of industrial policy and the emphasis on technology sovereignty being clear signals (Aiginger and Rodrik, 2020, Criscuolo et al., 2022, Bassens and Hendrikse, 2022). While these policy approaches make sure to differentiate themselves from calls for autarky, they do have in common that they put weight on the notion that blind trust on rule-based free-trade and free-knowledge approaches may turn against countries if their trading partners do not respect these rules anymore (Edler et al., 2023, March and Schieferdecker, 2023).

This is demonstrated by the industrial policy initiatives of the US (IRA and chips act) and the EU (EU Chip Act). In the US strategic sectors for US security, such as semiconductors, is targeted as well as EV, batteries and clean technology to achieve environmental sustainability. In the latter industries China has a very dominating position, which adds to the geopolitical rivalry. And the location of these manufacturing industries in previous deindustrialised areas is an important factor in reducing regional and social inequality. These industrial policies may result in a rescaling (downscaling) of global value chains through spatio-temporal rescaling such as the reshoring of production and manufacturing jobs, techno-economic rescaling using and further developing enabling technologies such as industry 4.0,

and socio-institutional rescaling with regulations and policy reforms shifting power away from global governing frameworks.

Furthermore, it is widely acknowledged that pressing environmental and societal challenges requires deep transformative changes in sectors as diverse as energy, mobility, healthcare, agri-food, or water and sanitation (Geels, 2002, Markard et al., 2012). Targeting socio-technical system transformation is increasingly seen as an integral part of STI- and industrial policies, as well as becoming a pronounced policy domain in its own right (Loorbach et al., 2017, Kivimaa and Kern, 2016, Grillitsch et al., 2019a). System transformation is intimately associated with rescaling dynamics, which are expected to differ across different sectors (Miörner and Binz, 2021, Madsen, 2022). For example, policies targeting transitions in grid-based urban infrastructure systems such as energy, water and transport, may result in techno-economic rescaling to modular infrastructure solutions and standardised household appliances, fuelled by a socio-institutional rescaling which on the one hand favours international standardization in a more complex technology space, but on the other hand shifts normative directionality from the logic of national 'efficiency' towards urban 'resilience'. Taken together, this leads to a spatio-temporal rescaling of urban infrastructure in which the global 'gold standards' of urban infrastructure are increasingly challenged by alternatives that emerge in urban experimentation settings and diffuse in small networks of cities with similar preconditions.

Hence, transformative change generally results from the interplay of top-down interventions, such as policies and regulations, as well as bottom-up processes like social movements. The latter has been shown to be particularly relevant for sustainable development overall, including efforts to increase democratization, inclusivity, accountability, justice, or equity (Seyfang and Smith, 2007, Avelino et al., 2016). The recent years have seen a considerable increase of global social movements whose visibility has been amplified by social media, such as the #metoo-movement, Fridays for Future, Extinction Rebellion, or Black Lives Matter. While these types of social movements are discursively very global, action is often local with people gathering for local demonstration and civil unrest actions. In general, one can observe a tendency for many sustainability movements – social and environmental – to call for a fundamental rescaling of the economy that changes the ways in which civil society, the state, and industry relate to each other (Hess, 2018). Oftentimes, social movements call for smaller, more local, and more inclusive structures (Fischer et al., 2017, Schmid et al., 2021). This has, for instance, been seen in the de-growth movements (Demaria et al., 2013), in research on urban living labs (Voytenko et al., 2016), or in many community-oriented initiatives aiming at the 'unmaking' of capitalistic structures (Feola et al., 2021).

Even though the above drivers tend to promote spatio-temporal rescaling, the outcomes need to be critically assessed. The desired outcomes tend to emphasize national security, reindustrialization, new job and income opportunities in places left-behind by globalization, and a reduction of carbon emissions. However, there are also critical voices suggesting that there will be unintended negative outcomes. For instance, The Economist (2023b) argues that even though US trade relations with China have significantly been reduced with the new industrial policies put into place, the trade partners that increased their exchange with the US are also those most interwoven in value chains with China. The argument is that China's produce has only been rerouted through third countries, giving China a stronger leverage and importance in these third countries, while the US leverage on China has decreased. Also, The Economist (2023a) shows that unlike in previous technological revolutions, the large corporations in the US have rather strengthened their position. This is because of their resources to develop and integrate new technologies, and catch-up even though they might have been late in adopting new technologies. For instance, even though Walmart's mortar and bricks business model

was seen as outdated, it is now the company with the highest turnover on digital platforms behind Amazon in the US.

At the end of the day, as Sabel and Zeitlin argued in their seminal article from 1985 on historical alternatives to mass production, it is politics and policy and not specific features of technologies that determines the direction in which economies are moving, which they call '*the world of many possible worlds*' (p. 162) and '*the many worlds view*' (p. 164). This points to the importance of agency and agentic actions to carry out socio-institutional rescaling in realizing framing transformative policies. Such policies are not mainly dependent on the capacity of technologies (techno-economic rescaling), as we already have the technological capacity that is needed for a green transition, but on policy, on the capacity of the political system and politicians to implement the necessary policies, regulations, and policy reforms, including to obtain legitimacy and support in and from the public.

3.3 Illustrative examples for studying industry dynamics through a rescaling lens

Rescaling as a conceptual and analytical framework is not only useful to discuss the shifts patterns in the world economy but also to investigate the dynamics of specific industries, which relates to the larger processes discussed above. This paper uses the shipbuilding and textile industries as examples. The aim here is to illustrate the value of rescaling as an analytical lens but not to be conclusive about the current and expected outcomes of the interplay between sets of rescaling processes, which needs to be the focus of future research.

3.3.1 Shipbuilding

One example is shipbuilding, one of humankind's oldest industries which is closely related to global economic development (United Nations, 2022). Broadly, the shipbuilding industry includes design, manufacturing and maintenance activities and is embedded in an ecosystem composed of, among others, shipowners serving a variety of industries from tourism to logistics and energy, financial institutions, and the innovation and knowledge infrastructure. The shipbuilding industry can also be differentiated in labour intense manufacturing activities with relatively low skill requirements (e.g. construction of hulls) and more knowledge-intensive activities like ship design, project management, and design of specialised equipment. Neoliberal globalisation entailed a spatio-temporal rescaling where labour intense manufacturing activities were outsourced so that today 44% of newbuilt ships are constructed in China, 32% in the Republic of Korea, and 18% in Japan (with a diminishing market share of Japan) (United Nations, 2022). This led to the end of industrial paths in formally leading shipbuilding regions such as in Malmö in Sweden hosting once the world's largest crane, which was sold, dismantled, and moved to South Korea in 2002. Some shipbuilding locations in high-income countries survived, however, by focussing on knowledge intensive activities and complex ships such as in Denmark or Norway (Caniëls et al., 2016) and still creating approximately half a million direct jobs in the European Union (European Commission, 2022a). Over time, countries, which were able to attract the low-skill manufacturing work, could upgrade and enhance their knowledge-intensity challenging the remaining shipbuilding activities in the higher cost countries.

The development of the shipbuilding industry in the last decades can thus be described as a rescaling process. However, the diffusion of automation technology, robotics, and computer-integrated manufacturing related to Industry 4.0 could drive a new process of techno-economic rescaling. The use of robotics has been shown to decrease the human hazard rate, which remained relatively high in shipbuilding (Lee, 2014). Automation and robotisation reduce labour intensity, and thus the reliance on cheap labour, which has been accessed through offshoring or guest labour. This technological change coincides with increasing difficulties to attract cheap labour from abroad and the labour costs were also increasing in some of the countries to which production was outsourced (Grillitsch and

Asheim, 2023). In addition, it was recognised that due to outsourcing, firms faced quality issues and were losing innovation and manufacturing capabilities and thus competitive advantage in the long run (Grillitsch and Asheim, 2023). This shift to automated production constitutes a techno-economic rescaling, which decreases labour intensity and in particular the demand for low-skill and low-wage labour while increasing the need for highly specialised skills. In addition, it leads to an integration of knowledge-intensive activities with manufacturing in which shipyards play an important role whereas in dispersed global value chain, these became increasingly separated. It also leads to the building of new capabilities and business models.

Socio-institutional rescaling plays an important role for such an alternative approach to shipbuilding. This relates first and foremost to a broader perspective on development outcomes where not only minimum cost counts but also environmental and social harm in the whole value chain. This is important because the separation of the knowledge-intensive activities from low-cost manufacturing has a strong environmental footprint where long-haul transport of steel constructions is difficult to decarbonise, despite new regulations coming into effect in 2023 aiming at reducing the environmental impact of shipping (United Nations, 2022). Taking the environmental harm into account would substantially alter the playing field making techno-economic rescaling towards automatised production closer to the market, closer to green energy, and with minimised transport related emissions possible. Furthermore, shipbuilding is a strategic industry in several European countries and shipyards – thus the ability to manufacture and assemble ships – contributes to national security interests (European Commission, 2022a). Drivers for levelling the playing field are a change in trade policy considering the environmental footprint in the cost, which is a goal of the European Commission (2022b). This includes plans of the European Commission where carbon credits would need to be bought for voyages starting or arriving in the EU for large ships (United Nations, 2022). Relatedly, public procurement can play an important role by including environmental and social aspects in the evaluation criteria, and by breaking down procurements in smaller tenders providing openings for smaller, more specialised, and potentially more local suppliers. Another driver is a new type of industrial policy, which shifts attention from mainly focussing on knowledge-intensive business services to building the capabilities for advanced manufacturing using new technologies associated with industry 4.0.

Such a techno-economic and socio-institutional rescaling has a spatial footprint where the location of production is determined more by access to specialised skills, green energy, job provision, and optimisation of transportation, and less by access to cheap labour, material, and energy regardless the environmental and social cost. As the European Commission's (2022a) Blue Economy Report shows, the shipbuilding industry in Europe developed positively from 2013 to the Covid-19 crisis, largely by positioning in high-end niche markets. To what extent the geography of shipbuilding will rescale beyond the more knowledge-intensive activities is at this stage uncertain and will depend on the developments in the techno-economic dimension such as diffusion of Industry 4.0 and automation and changing labour or energy costs and the socio-institutional dimension related to efforts for levelling the playing field as regards environmental and social harm, and potential security concerns. Such a rescaled version of the shipbuilding industry would be more knowledge-intensive but less resource-, energy-, and carbon-intensive. It would tend to have more knowledge and production locations with optimised and shorter value-chains, holding potential to reduce regional and social inequalities. However, to what extent and how different locations in the global north and global south would be affected by such rescaling processes would need to be assessed. For instance, a higher knowledge intensity through automation might exclude some locations from development who lack the required knowledge infrastructure.

3.3.2 Textile Industry

The US textile and apparel industry provides yet another example of rescaling, this one with connections to a growing social movement in support of better, more environmentally responsible working conditions. In the early 20th century, the US was an international leader in textile and apparel manufacturing. That changed over the course of a century, as the nation became a net importer of manufactured textile and fibre-based products, especially from low and middle-income nations, including China.

This national trend, however, obscures considerable intra-national regional variation and with it an opportunity to learn from *efforts to rescale to smaller spatio-temporal geographies*. In the early-1900s, the center of textile and apparel manufacturing shifted from the US Northeast to the US southeast, lured by lower regional labor costs and anemic rates of unionization—the latter kept at bay by coordinated (and at times violent actions) taken by local government and industry leaders to suppress worker organizing. By the 1950s, roughly half of all U.S.-based textile and apparel manufacturing was concentrated in three southeastern states: North Carolina, South Carolina and Georgia (U.S. Department of Labor, 1969, Minchin, 2012). While the pressures of deindustrialization were initially confined to the mid-west and Northeast of the U.S., southeastern states began to feel the squeeze from low-cost imports in the late 1970s. The textile industry was especially vulnerable, as were other traditional manufacturing industries like furniture and tobacco-processing. The 1994 North American Free Trade Agreement between the US, Canada and Mexico intensified the pressure on the domestic textile and apparel-making industry, as did the end to international quotas with the expiration of the international Multi-Fiber Agreement in 2005, resulting in a flood of Chinese-made imports. In light of the flood of Chinese imports, US firms attempted to rescale again, this time by leveraging high levels of debt throughout the 1990s, often to fuel corporate expansions through mergers and acquisitions. By the late 1990s and early 2000s, many of these overleveraged firms were forced into bankruptcy, the most notable of which was Pillowtex. In 2001 the company shuttered all of its U.S. and Canadian manufacturing plants resulting in one of the largest single day manufacturing layoffs in US history. Around 7000 workers lost their jobs on July 30th 2003, with 4000 based in North Carolina alone (StarNews Online, 2003, Minchin, 2009).

Some southern states responded to these reinforcing challenges by transitioning away from textile manufacturing entirely. Not North Carolina—it followed a different course, with state-level institutions doubling down on effort to drive industry regeneration through technological innovation. The textile college at North Carolina State University, the Textile Technology Center at Gaston Community College, and the Hosiery Technology Center (now called the Manufacturing Solutions centers) have been most active in this on-going effort—all long-established industry support institutions, some with over 70 years of experience servicing manufacturers in the region. Through a series of coordinated initiatives, these institutions and other critical partners like the National Science Foundation have repositioned North Carolina as the national center for non-woven textile innovation. These efforts in turn have led dozens of international firms from as far as Denmark, Italy, and Israel to set up state-of-the-art manufacturing and research facilities in North Carolina. As a result of this continued technology-centered approach to rescaling, North Carolina has the nation's largest non-woven textile workforce, with 30 percent of the world's top 40 nonwoven companies operating in the state (Economic Development Partnership of North Carolina, 2020).

But other concurrent rescaling efforts are equally notable, especially as they are helping to shore up more labor-intensive parts of the industry by responding to calls for socially and environmentally-responsible manufacturing alternatives. Core to this effort is a coalition called The Industrial Commons and its sister organization, the Carolina Textile District (CTD). Formed in 2013, the CTD is a novel value-

chain initiative that helps North Carolina textile and apparel manufacturers connect with textile designers making sewn goods in the United States (Lowe et al., 2018). Since its start, CTD has helped hundreds of small and medium-sized firms secure production contracts from a new generation of textile designers and makers. Most of these clients are based in large- and mid-size metropolitan regions, including Los Angeles and New York, as well as urban centers closer to the CTD's rural North Carolina base. During the pandemic, CTD expanded their clientele further, connecting smaller networks of manufacturers with neighboring health and childcare facilities to produce protective masks and gowns (Lowe and Vinodrai, 2020b).

In this regard, the CTD is rescaling production by strengthening place-based and place-connecting relationships between legacy manufacturing regions and dynamic urban and institutional centers (Lowe and Vinodrai, 2020a). At a basic level, the CTD enables textile and apparel manufacturers throughout the southern region of the US to reduce their dependence on global product lines that are volatile, price sensitive, and standardized by competing for smaller batch, design-intensive orders. To augment this strategy, they pull together institutional supports around product design and prototyping to attract the attention of thousands of domestic designers. But CTD offers much more than a means to stabilize textile establishments and employment. They center their rescaling efforts on social and environmental concerns. Initially this involved educating smaller manufacturers about the desires of newer designers to offer living wage jobs and environmentally-accountable forms of manufacturing. From there, CTD took steps to help manufacturers improve working conditions and reduce wasteful and environmentally damaging practices.

Within these socially and environmentally-minded efforts we find evidence of further rescaling. The Industrial Commons launched a new initiative in 2021 called Material Return, which enables “custom circularity” by turning textile waste into recycled yarn. Material Return is a worker-owned cooperative that leverages North Carolina's robust network of textile engineering firms and institutions to create novel and scalable options for turning industrial and post-consumer textile waste into high-quality fiber and yarn products. The organization aligns a regional commitment to reducing environmental impact with actions designed to benefit the local economy, especially frontline manufacturing workers within it. They work with local manufacturers in the region—initially in textiles, but with expansion opportunities in upholstered furniture— to create new revenue streams from waste reclamation while stabilizing jobs and livelihoods for frontline manufacturing workers. While still in its early stages, Material Return, and the larger network of textile firms it engages and supports, is an illustration of how local resources, institutions and industrial traditions can be recombined, enabling regions to reposition themselves in response to fast changing social, technological and ecological demands. Furthermore, it remains to be investigated how rescaling processes towards a more sustainable textile industry relates to, competes with, is challenged by and challenges ongoing unsustainable practices such as ultra fast fashion (Sharpe et al., 2022). Also, rescaling processes and their impacts need to be investigated in those places and countries that currently account for the bulk of low-cost production, making fashion and clothing affordable for the masses.

4 Conclusions

This paper assessed the relevance of the notion of rescaling to capture fundamental shifts in the economy and industries. It posits a) that the expansion or contraction of economic activities and flows in time and space (spatio-temporal rescaling) can be described and explained by a set of techno-economic and socio-institutional rescaling processes, b) that a multitude of rescaling processes continuously unfold, c) that shifts in overall patterns of development occur when the directionality of techno-economic and socio-institutional rescaling processes align, and that d) the combination of human agency at different scales and across sectors shapes the directionality of rescaling processes.

Rescaling is proposed as a conceptual and analytical framework to investigate the interplay of multi-scalar change processes that explain shifting patterns of development. This paper applies the rescaling framework to explain the shift to neoliberal globalisation as well as the current post-neoliberal restructuring in the backwaters of national security concerns, climate change, inequalities, and human rights issues. Overall, it shows that shifting patterns of economic development can be both described and explained by the alignment of sets of rescaling processes. The directionality of these processes is heavily influenced by political agency about which type of development, and development rationales are pursued. This sets the framework for techno-economic rescaling influencing the direction of technological development and relatedly the configuration of value chains, and the geography of economic activities and flows.

Zooming in on the level of industries, this paper illustrates that different sets of rescaling processes operate depending on the context. In the maritime industry, for instance, advanced manufacturing and digitalisation was perceived by some actors as way to rescale and backshore production activities because of the reduced need for relatively low skill but cheap labour. Such rescaling is thought to contribute to regenerative local development through innovation and reduced environmental impact because of lower transport-generated carbon emissions, more efficient production methods, and use of green energy. Yet, the socio-institutional realm is still favouring production in global value chains with cost as main determinant and too limited attention to social and environmental harm. In contrast, the textile industry illustrates the possibility of rescaling processes driven by social movements with an increased interest in local and ecologically sound products. This type of socio-institutional rescaling was a driver for the development of new organisational forms, and local production, again with the perspective of enabling regenerative local development and lower environmental impact.

The two illustrations show that shifts in the pattern of development of industries and the economy can result from different combinations of rescaling processes. The illustrations also show that even though shifting patterns of industrial development relate to the macro-institutional framework conditions described as neoliberal globalisation versus post-neoliberal restructuring, rescaling may also be driven by bottom-up processes through for instance innovative actions of firms, or social movements. The illustrations foreground that shifts in the pattern of development depend on the extent to which rescaling processes align and level-up or contradict and oppose restructuring processes. Rescaling as a conceptual and analytical framework allows to cumulate knowledge about which sets of rescaling processes are at play and explain the patterns of development in different contexts. This is relevant to identify policy intervention points that would make possible or accelerate shifts in development patterns.

Rescaling as a conceptual and analytical framework is useful to investigate processes at play, and this without the necessity of a normative starting point about the desirable outcomes. To the contrary, the rescaling framework invites to investigate the normative claims underlying many of the current megatrends, for instance, what are the economic, social, and environmental outcomes of the new industrial policies, which are often propagated in the interest of society. Furthermore, the rescaling framework would call for research on the conditionalities under which outcomes are achieved, and more precisely investigate the interplays between techno-economic, socio-institutional, and spatio-temporal rescaling processes. The discussion of shifting patterns of economic and industrial development also brings several questions to the fore, which call for theoretical development and empirical investigations, for instance: How do coexisting but conflicting rescaling processes interact and affect the patterns of development, such as slow and sustainable fashion versus ultra-fast fashion? How does the alignment between rescaling processes manifest (or fails to manifest)? Which conditions promote or hinder alignment, and how does alignment diffuse in time and space? What is the role of

learning and knowledge in rescaling processes? What rescaling strategies are applied by different sets of actors? To what extent, for whom, and in which contexts does rescaling represent an immanent development process to which actors need to react? How do actors respond to and navigate diverse rescaling processes? Who are the winners and losers from rescaling processes, why, how, and under what conditions? How does rescaling relate to social challenges, economic development, and poverty reduction in the Global South? Under what conditions is rescaling result or cause of evolutionary, devolutionary, or revolutionary processes?

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