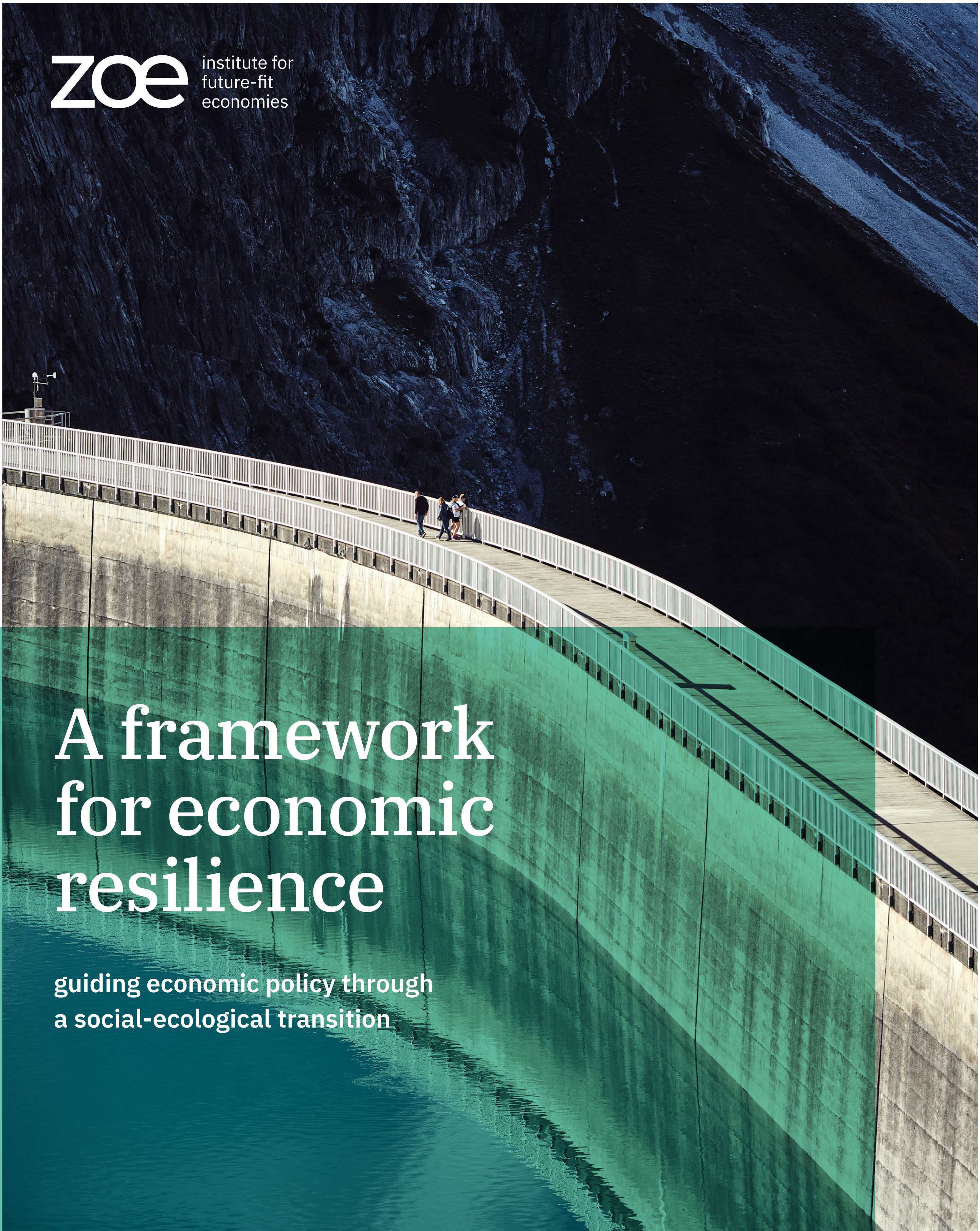

ZOE institute for future-fit economies

A framework for economic resilience

guiding economic policy through a social-ecological transition

ZOE Institute for Future-fit Economies
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1. Introduction

The COVID-19 pandemic has made governments and businesses alike understand the critical importance of economies' capacity to react to disturbances. With the ongoing war in Ukraine and the energy price shocks that followed, new challenges loom on the horizon. Amidst a crisis-ridden world, economic resilience has gained considerable momentum in policymaking (IMF, 2022; Manca et al., 2017; OECD, 2021). The European Commission states resilience as a primary policy objective for the European economy, while international organisations such as the UN, G20, or the OECD have been calling for a step-change in global economic governance to increase resilience from economic shocks (OECD, 2021).

A common approach to economic resilience is however missing. While there exist common understandings of resilience in psychology (Johnson and Wiechelt, 2004; Wright et al., 2013), engineering (National Academy of Engineering, 1996; Woods, 2015), or ecological science (Batabyal, 1998; Holling, 1973;), understanding resilience in dynamic socio-economic systems remains subject to controversies (Martin and Sunley, 2015). For instance, resilience can either refer to the capacity of a system to withstand, recover from, and bounce back to a pre-shock state (Martin and Sunley, 2015), or also consider the capacity to improve the system and bounce forward to a new state (Alessi et al., 2020).

Given the plethora of work on economic resilience (Hallegatte, 2014; Sánchez and Röhn, 2016), it is confounding why the term remains subject to debate. Following Manca et al. (2017), we argue this is because the existing literature lacks a consistent definition of the system that needs to be resilient. Economic resilience scholars use economic variables as reference for their resilience analysis. For instance, economic resilience is often equated to the measurement of the Gross Domestic Product (GDP) (Briguglio et al., 2009; Oprea et al., 2020; Pontarollo and Serpieri, 2020). By using GDP as the indicator for economic performance against which to assess resilience, the scholars implicitly assume that GDP is the primary goal of an economic system. Considering the various critiques of using GPD as a measure of economic performance (Costanza et al., 2009; Raworth, 2017; Stiglitz et al., 2009), this understanding of economic resilience misses a deeper analysis that reflects on the broader context of the economic system in relation to other systems such as society and the environment.

This paper contributes to the debate on economic resilience-enhancing policy interventions in its aim to derive a consistent framework to assess economic resilience (alongside Alessi et al. (2020), Manca et al. (2017), and Hynes et al. 2022)). Similar to Manca et al. (2017) but focusing on the economic system instead of society as a whole, our target variables against which to assess economic resilience go beyond a narrow focus on GDP and are determined based on a social-ecological approach to defining the economic system. This paper is organised as follows: in the first section, we focus on what we are trying to make resilient – the economic system. We determine the target variables for economic resilience by contextualising and defining the economic system. Applying a "system of systems" approach, we first define the purpose of the economic system. We then assess which elements and activities play a crucial role for the economy to fulfil this defined purpose.

The second section focuses on how the economic system can be resilient to shocks. We determine three capacities that are essential for resilience: absorb, recover, and adapt. We then derive resilience characteristics of the economic system that enable these capacities. The third section discusses the inevitable limits of this paper's conceptualisation and their consequences for policymakers. We then provide some concluding remarks.

2. The resilience of what: defining the economic system

To study economic resilience, we first need to define the economic system. Given the complexity in understanding the economic system, we use a system's perspective to organise the complexity of the economy in manageable parts that do justice to the system's core dynamics. This section will first formulate our understanding of systems. We will then apply this understanding of systems to guide our definition of the economic system.

2.1 Defining "systems"

We study economic resilience through the paradigm of systems thinking. Adopting a systemic lens is important because it ensures we consider crises as a whole, rather than as a series of partial events (Cavallo and Ireland, 2014). Indeed, crises are not simply the sum of their component parts but involve different systems which are all dependent on one another (Cavallo and Ireland, 2014).

A system is defined as "an interconnected set of elements that is coherently organised in a way that achieves something" (Meadows, 2009). This definition underlines that systems must consist of three kinds of things: a purpose, elements, and interconnections (Meadows, 2009).

Relevant for our subsequent definition of the economic system, we focus on a specific strand of systems called "complex" systems (Meadows, 2009; Levin et al., 2013). Systems are complex when they are composed of many elements and interactions which gives rise to rich behaviour that is impossible to be understood in terms of an individual factor (Meadows et al., 1982). For instance, an ecosystem, or social and economic organisations are complex systems (Arthur, 2015; Eidelson, 1997; Levin et al., 2013) because they are composed full of balancing feedback loops with delays and they are inherently oscillatory (Meadows, 2009). A feedback loop occurs when a variable is affected by something it influences (Meadows, 2009). Additionally, complex systems often have the feature of being adaptive (Levin et al., 2013; Berkes et al., 2000) in that individual elements are able to change and/or learn from experiences.

Furthermore, a complex system does not only exhibit interconnections between its own elements but also with those of other systems. The term "system of systems" captures the fact that complex systems are built from components which are large-scale systems in their own rights (Cavallo and Ireland, 2014). For example, the Earth itself is a system which is embedded in the solar system, which is yet embedded in the galaxy (Meadows, 2009). This approach reveals two important considerations. First, when analysing a system, it is important to not only reduce it to the properties of its elements but to locate it within other systems and understand the relationships that connect systems to one another. Second, it is important to set boundaries to the system subject to analysis, because it can otherwise have an infinity of elements (Midgley, 2015; Urquiza et al., 2021).

Figure 1 represents our understanding of complex systems. The inner circle represents system 1 composed of its elements and its purpose. For example, using the analogy of Meadows (2009)'s, one might imagine system 1 as football team. In this light, the elements composing system 1 are the football team's players, organised around the common purpose of winning games (Meadows, 2009). The elements of system 1, the players, are interconnected by the rules of the game or the players' communication (Meadows, 2009). We define the interconnections of elements as flows (Phelan, 1999) which we will elaborate on in the next section. Additionally, system 1 is a sub-system of system 2. That means that system 1 is built from components of other large-scale systems, which are systems in their own rights. For example, the football team is a sub-system of the Earth system whereby laws of physics govern the motion of players and the ball.

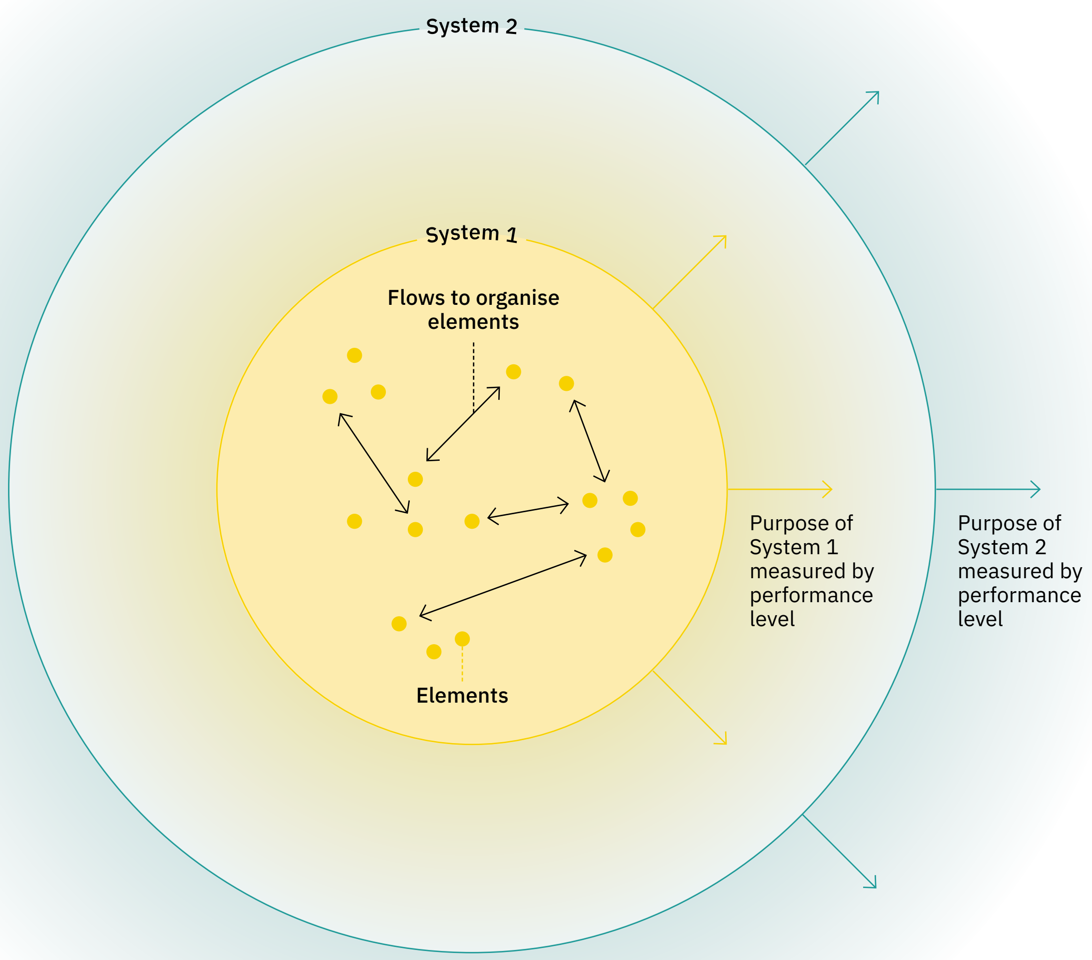

Figure 1: Definition of a system which consists of three components: a purpose, elements, and interconnections between its elements (graph based on Urquiza et al. (2021) and adapted for our definitions).

2.2 Defining the economy and the elements needed for assessing its resilience

In the following, we apply this "system of systems" approach to the economic system by way of analysing the economy as a system embedded within the societal and Earth systems. We draw on ecological economics to analyse the complex system of systems constituted by the interdependencies between the economic system, the social sphere,the social sphere and the environment (Spash, 2012). The economic system is not an isolated system in which neither matter nor energy enters or exists – it is a system that has relations to its broader environment (Daly, 1993). Crucially, the interdependent dynamics of social-ecological systems entail nonlinear feedback loops (Fanning et al., 2020; Preiser et al., 2018). As such, this system's approach is crucial to reconcile the processes in the economic system with the requirements of the societal and environmental sphere.

2.2.1 Understanding the economy as a system of systems

Being embedded into the Earth system, the economy is characterised by a bi-directional relationship with the environment. On the one hand, economic processes depend on the manifold services ecosystems provide. In essence, these ecosystem services can be defined as "the benefits people obtain from ecosystems" (Millennium Ecosystem Assessment, 2005, p. v) and comprise four broad aspects: (i) the provisioning of physical goods such as food and raw materials, (ii) regulating functions comprising, for instance, climate regulation or processes of water purification, (iii) immaterial benefits derived from nature, such as aesthetics or recreation, and lastly (iv) the supporting core functions of the Earth, for instance nutrient cycling (Gómez-Baggethun, 2017; Millennium Ecosystem Assessment, 2005).

On the other hand, economic processes affect the Earth system and thus constitute drivers of environmental changes. To conceptualise and measure the carrying capacity of the Earth system, the concept of planetary boundaries has been introduced (Rockström et al., 2009). Planetary boundaries aim to define biophysical limits within which humanity can safely operate (Steffen et al., 2015). At present, six of the nine planetary boundaries have been transgressed due to the environmental pressures emanating from human activities: biosphere integrity, climate change, land-system change, biogeochemical flows (Steffen et al., 2015), novel entities (Persson et al., 2022) and freshwater change (Wang-Erlandsson et al., 2022). Crucially, the continued transgression of planetary boundaries increases the risk of triggering tipping points (Steffen et al., 2015), which results in large-scale shifts in environmental systems with potentially deleterious consequences for human societies (Lenton, 2013).[1]

Moreover, the economy is embedded in the societal system.[2] On the one hand, the societal system is in many ways the precondition for a functioning economic system. For instance, human relations, creativity, skills, knowledge, social institutions all play an important role in shaping how provisioning takes place in the economy (Hadad, 2017; Hodgson, 2006). On the other hand, the economy provides for society by, for example, making available goods and services.

Figure 2 depicts the embedded nature of the economic system in its interrelation with both the societal and the Earth systems. The bi-directional feedback loops between these spheres are indicated by the arrows.

2.2.2 Defining the purpose of the economic system: providing goods and services at appropriate quantity and quality for society

Having elaborated on the interdependencies in social-ecological systems, we now narrow our attention to the economic system. We will construe the economic system by defining its purpose, its elements its interconnections (following Meadows' (2009) three-part definition of "systems" in section 2.2.1).

A functional economic system must be able to achieve social-ecological goals. The purpose of such an economic system is noticeable in its interrelation with the whole societal system: to provide for society through the provision of goods and services at appropriate

1 For instance, recent research suggests that the Greenland Ice Sheet may be close to reaching its tipping point due to on-going global warming (Boers and Rypdal, 2021). A complete melting of the Greenland Ice Sheet is expected to result in a seven-meter rise of global sea levels (Aschwanden et al., 2019; Gregory et al., 2004), threatening the livelihoods of millions of people living in coastal regions (Nicholls, 2011).

2 The traditional understanding of economics concerns the allocation of scarce resources in line with Robbins (2007). In this view, economics deals with aspects of production, exchange, allocation, and consumption of commodities and services. While these aspects are important in an economy, this perspective lacks a proper consideration of interactions between the societal and economic system.

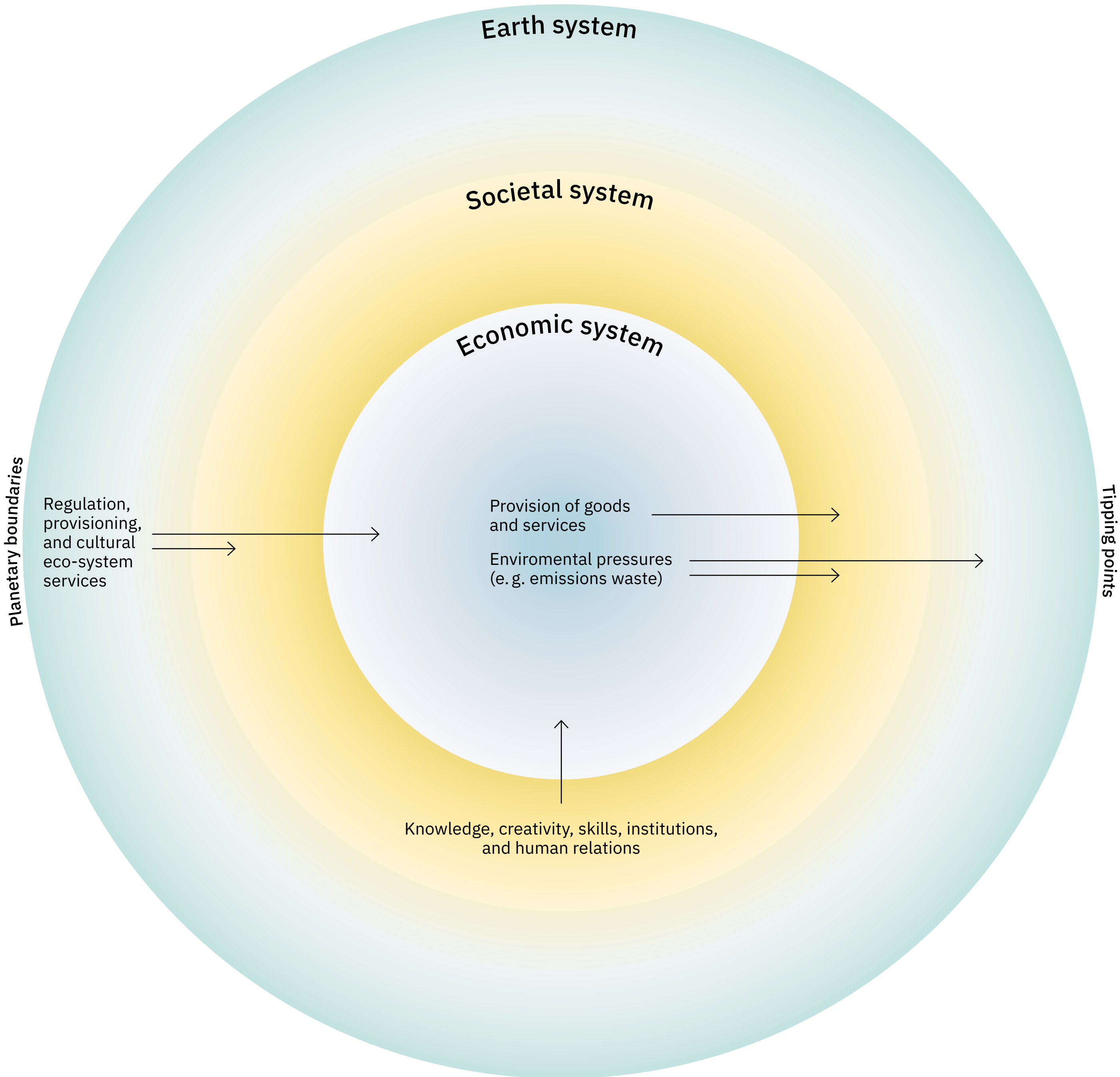

Figure 2: The economic system as a "system of systems": the various feedback loops between the economic system, the societal system, and the Earth system (Graph based on Raworth et al. (2017) and adapted for our definitions)

quantity and quality.[3,4] In that regard, it is crucial to delineate which goods and services are essential and critical for society to then prioritise their resilience. As such, we draw a distinction between necessities and luxuries (Gough, 2020).

3 We use the term "provision" here in an all-encompassing way, i.e., dealing with aspects of production, exchange, and allocation.

4 Following Lee (2005), we understand economics as the science of social provisioning. This perspective constitutes an analytical frame which perceives the economy as an intermediary between the biosphere and societal needs and wants. The economy holds a mediating role between specific types of resource use and needs satisfaction while fundamentally depending on healthy ecosystems and the resources they provide (Fanning et al., 2020).

First, the economy provides essential goods and services. These so-called necessities comprise need satisfiers[5] which are required for a person to maintain an acceptable minimum standard of living in a particular socio-cultural context (Deeming, 2011; Gough, 2020; Niemietz, 2010). These include food and water, housing, healthcare, security, education (Doyal and Gough, 1984; Stratford and O'Neill, 2020; Wiens et al., 2017).

Second, drawing on the security policy discourse dealing with critical infrastructure (Alcaraz and Zeadally, 2015; Osei-Kyei et al., 2021), the economy is further concerned with the provision of critical goods and services. These include, among others, the provision of energy, information and communication technology, transportation systems, chemicals, and a defense industrial base (Leibovici, 2021). Crucially, these critical goods and services are often involved in the provision of essential goods.

Third, the provision of the economy does not only include paid goods and services but also unpaid ones. Unpaid goods and services include caring activities, education of family members, cooking, maintenance of living spaces and domestic goods, volunteering, community service and the cultivation of social relationships (Nierling, 2012; Picchio, 2003; van de Ven et al., 2018). Such activities are often directly concerned with the satisfaction of essential human needs (Pietilä, 1997). Here, care and reproductive work, which is predominantly performed by women, is of particular importance for the functional workings of the economy, as it ultimately ensures the social reproduction of the population and is thus prerequisite to wage labour and societies' productive activities (Federici, 2014; Picchio, 2003; Spencer et al., 2018). The acknowledgment of unpaid labour as fundamental to the economic system is pivotal when thinking about the purpose of the economic system (Power, 2004).

2.2.3 Defining the high-level purpose of the Earth, societal, and economic systems: providing wellbeing for present and future generations within the planetary boundaries

Furthermore, we need to understand how the purpose of the economic system connects to its encompassing systems – the societal and Earth systems.

To do so, we define a high-level purpose which envelops the economic, societal, and Earth systems. The high-level purpose is "providing wellbeing for current and future generations while staying within planetary boundaries".[6] Wellbeing refers first and foremost to the satisfaction of universal basic needs (Büchs and Koch, 2019; Doyal and Gough, 1984; Max-Neef et al., 1991). Since basic needs can be met through different needs satisfiers (Gough, 2020), wellbeing can be generated from both material and non-material sources (Ferriss, 2002; Karacaoglu et al., 2019; Trainer, 2020), as well as from environmental sources (Kumar, 2012). Material sources are the physical prerequisites necessary to support life (i.e. nutrition, shelter, basic healthcare, etc.) as well as the means to acquire those (i.e. income, assets and education) (Ferriss, 2002; Karacaoglu et al., 2019). Conversely, non-material sources include social, cultural, and psychological factors fundamental to how people live and the ways in which they pursue their wellbeing goals (White, 2010). Lastly, the environment provides wellbeing through its myriad of ecosystem services which provide

5 According to Gough (2020), "needs satisfiers comprise the goods, services, activities, and relationships that contribute to need satisfaction in any particular context".

6 This definition builds on a traditional understanding of the purpose of the economy, which has been associated with maximising welfare (material resources) (Hicks, 1939). It adds an intertemporal dimension by highlighting the importance to balance the welfare of current generations with the welfare of future generations (Büchs and Koch, 2017; Gough, 2015; Rauschmayer and Omann, 2017; World Commission on Environment and Development, 1987). At the same time, this definition links the achievement of intertemporal welfare to the concept of planetary boundaries. These put a limit to the impacts that can be absorbed by nature in the process of welfare generation (Fanning et al., 2022; Gough, 2021).

intangible wellbeing benefits, such as recreation (Millennium Ecosystem Assessment, 2005).

The need to harmonise the purpose of the economic system with the high-level objective, places two vital constraints on the purpose of the economic system. The provision of goods and services needs to 1) minimise negative social consequences that deteriorate wellbeing and 2) respect the hard environmental limits on economic activities imposed by planetary boundaries. In other words, the social-ecological goal of the economy is to contribute to the provision of intergenerational wellbeing, by providing goods and services in a way which minimises negative social consequences and remains within planetary boundaries.

The first constraint relates to the processes involved in the provisioning of goods and services, be they material or non-material. The aim is to minimise the *negative impacts of these provisioning processes* on wellbeing. For example, production processes can either be detrimental to wellbeing (e.g., through poor or exploitative working conditions, high levels of stress) or beneficial (e.g., through a pleasant and safe working environment, fair and adequate remuneration) (Gurtoo, 2016; Lee et al., 2014; Ravalier et al., 2022, 2021). As such, the quality of the provisioning process can be assessed by indicators such as the degree of non-hazardous work and physical environment, material equity, equitable participation in the system, decent work, and autonomy or leisure.[7]

The latter constraint, *respecting and staying within planetary boundaries,* refers to reducing anthropogenic environmental pressures[8] (e.g., emissions, waste, resource use) and hence the negative consequences for the state of the biosphere (e.g., climate change, biodiversity loss) (EEA, 1999; Gari et al., 2015). To avoid further transgression of the planetary boundaries, it is thus imperative to minimise environmental pressures by way of altering the scale as well as resource- and carbon- intensity of the economy's provisioning processes.

Figure 3 pictures the two additional constraints the economic system must adhere to in its provision of goods and services for society. These two constraints shed light on the level of goods and services that should be provided.[9] As stated above, the provision of goods and services needs to be at *appropriate quantity* for wellbeing. On the lower end, an appropriate quantity can be determined because needs are satiable. Satiability implies that certain thresholds can be identified at which needs can be satisfied and beyond the employment of additional resources does not substantially add to needs satisfaction (Gough, 2015; Lamb and Steinberger, 2017; Witt, 2011). On the upper end, planetary boundaries pose a hard limit to the quantity that is provided. The causal relationship between the provision of goods and services with environmental pressures depends on the overall quantity of goods in the economy and the technology involved in their production and allocation (Fanning et al., 2020). Depending on this level, Gough (2020) argues that ensuring a satisfactory life for everyone may imply to place a limit on every individual's use of natural resources to guarantee wellbeing for others at present and in the future.

7 One may argue that provision of freedom of choice and action are important for human wellbeing but are not included in our conceptualisation. This is because we are placing a system boundary between the economy and the societal system, whereas political questions of freedom are situated in the societal system.

8 To differentiate between the causal relations between drivers, pressures, states, and impacts involved in environmental change we refer to the DPSIR framework (EEA, 1999).

9 This is based on the framework of consumption corridors (Fuchs et al., 2021). Consumption corridors relate to sustainable wellbeing by recognising the highly problematic nature of current consumption patterns (Fuchs et al., 2021). Consumption corridors delineate minimum consumption standards, but also maximum consumption standards. It allows for people to live a satisfactory life without impeding on the ability of others to do the same across the globe and for future generations.

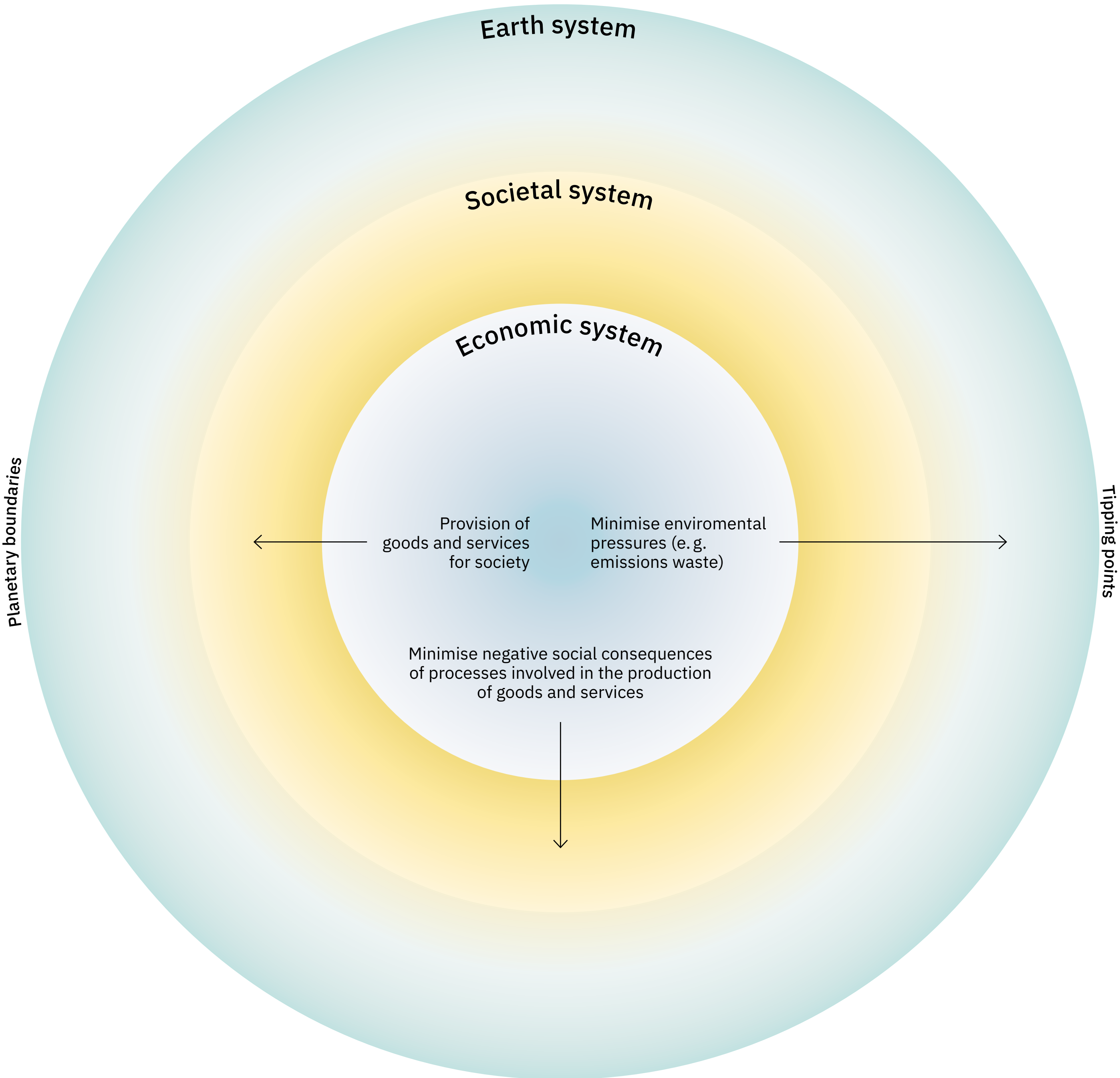

Figure 3: Defining the purpose of the economic system in relation to the societal and Earth system

2.2.4 The elements of the economic system: provisioning actors

As previously mentioned in section 2.2, systems consist of three components: a purpose, elements, and interconnections between the elements (Meadows, 2009). Having clarity on the purpose of the economic system, we will now discern how the economy provides goods and services at appropriate quantity and quality for society. First, this section will characterise the elements that play a role for the economy to achieve its purpose. It will then analyse the ways in which these elements interact for the economic system to fulfil its purpose.

Building on works such as Raworth (2017) and Fanning et al. (2020) we identify four elements involved in the provision of goods and services: households, communities, businesses, and the state.[10] We call them provisioning actors because we understand them as intermediaries that moderate the relationship between the economy and needs satisfiers as part of a provisioning system (following Fanning et al. (2020)[11]). Drawing on ideas from institutional economics (Veblen, 1994; Polanyi, 2002), we understand the elements of the economic system as conditioning the provision of goods and services. Together, the provisioning actors make up the institutional structures of the economy which ensure the provision of goods and services at appropriate quantity and quality for society.

The four provisioning actors are defined as follows: The first provisioning actor are households. Following the statistical definition of the OECD, households are "people residing together, often – but not always – as a family unit, who have shared resources and an inter-dependent standard of living" (OECD, 2002). First, households play a consumer role in the economy in that their role centres around labour supply decisions and consumption of goods and services (Wheelock and Oughton, 1996). Second, households also play a producer role in the economy. Indeed, households' institutional relations can be divided between intra-household work and inter-household work (Wheelock and Oughton, 1996). On one hand, intra-household work can refer to domestic provision of goods and services, consisting for instance of caring and housework (van de Ven et al., 2018; Wheelock and Oughton, 1996). On the other hand, inter-household work can refer to voluntary work between households (Abrams and Bulmer, 1986).

The second provisioning actor are communities. Communities can be broadly defined as forms of collective life, in which people are tied together through tradition and informal relationships (Storper, 2005). Communities play a substantial role in the economy. For instance, they manage "common-pool resources" such as forests, pasture lands, and irrigation systems (Ascher, 1995; Bromley, 1992). Additionally, they contribute to the provision of public goods and services by organising collective actions and voluntary cooperation based on mutual trust (Ostrom, 2000).

The third provisioning actor are businesses. Businesses are designed to produce goods and services that societal members need and want, and are understood to be driven by profit (Carroll, 1991). Indeed, production is usually defined in terms of business activities associated with organising and executing the transformation of matter to produce goods and services (Boons, 2021). Furthermore, businesses are a key source of innovation and technological progress in the economy. Indeed, businesses can invest in research and development as a way to develop new processes and goods (Chesbrough, 2010).

The fourth provisioning actor is the state. The state is an economic partner that can support households, communities, and businesses in provisioning goods and services (Raworth, 2017). The state supports provisioning actors in a variety of ways. For instance, for non-private goods, the state imposes rules and taxes to ensure individuals contribute necessary resources and refrain from self-seeking activities (Ostrom, 2010). Additionally, without the state inducing compliance, self-interested individuals could fail to generate necessary levels of

10 One may argue that provision of freedom of choice and action are important for human wellbeing but are not included in our conceptualisation. This is because we are placing a system boundary between the economy and the societal system, whereas political questions of freedom are situated in the societal system.

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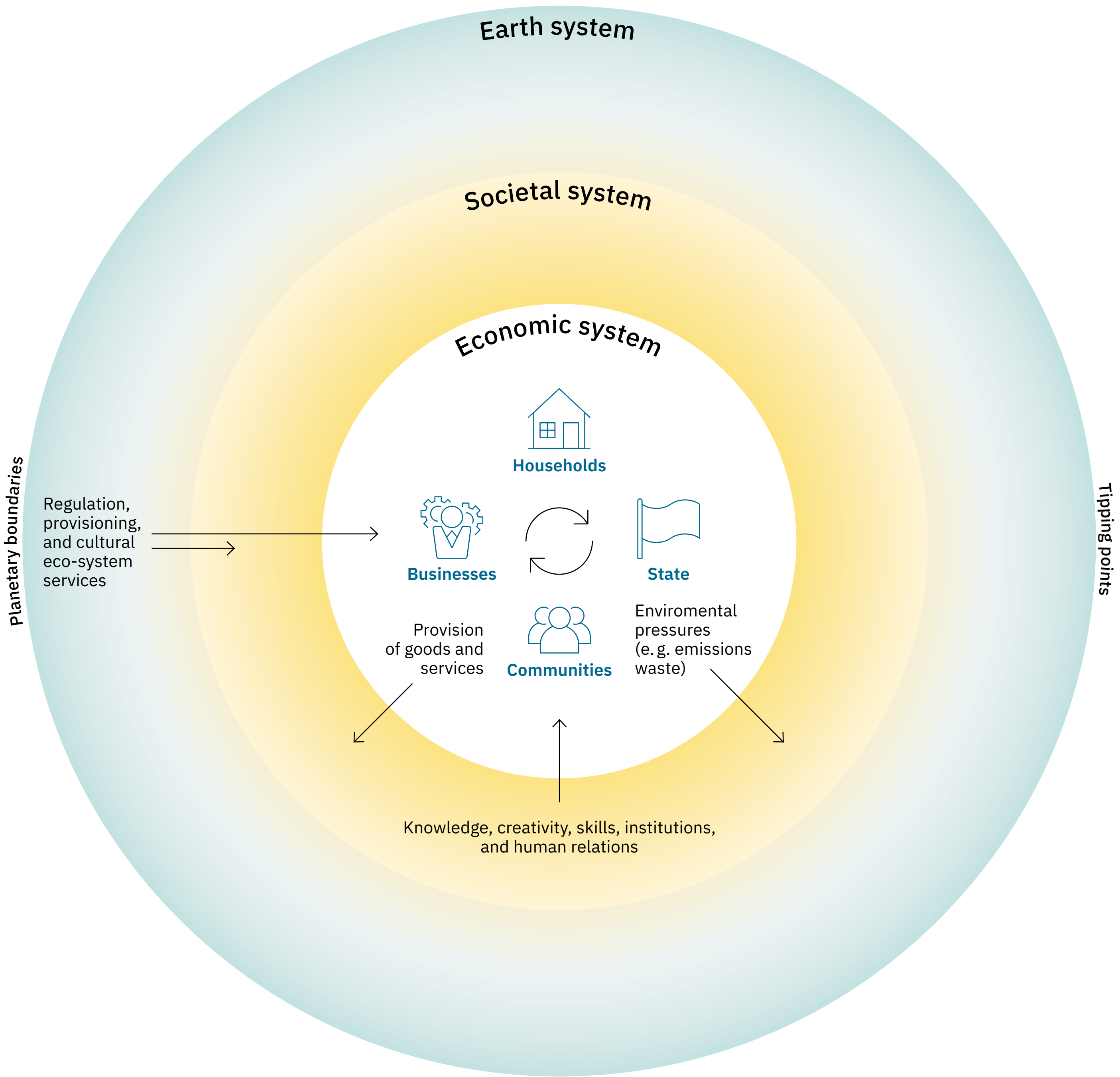

Figure 4: Elements (households, communities, businesses, and state) of the economic system working together in the provision of goods and services at appropriate quantity and quality for society.

public goods (Hobbes, 1894). Additionally, the state can also play a key role in taking entrepreneurial risks when businesses or communities are unable to (Mazzucato, 2013). The state can also play a direct role in the provision of goods and services. Indeed, the state has historically had an important role in making decisions about public goods, such as defence, education, or healthcare, in addition to financing and producing them (Kaul et al., 2003).

Figure 4 portrays the four elements of the economic system.

2.2.5 Flows and flow conditions in the economic system

Provisioning actors play deeply interconnected roles in the provision of goods and services. Drawing on system theory, we define the interactions between provisioning actors as "flows" (Phelan, 1999). Flows can be monetary or non-monetary such as unpaid or voluntary activities (van de Ven et al., 2018; Wheelock and Oughton, 1996). Furthermore, these can be bidirectional (e.g., exchange of a good for money) or unidirectional (e.g., gift giving) in nature (Duffy and Puzzello, 2014; Yan, 2012).

Additionally, various conditions need to be met by the whole economic system to ensure well-functioning flows between provisioning actors. We define these as "flow conditions". The fact that broader flow conditions need to be met is revealed when we analyse macroeconomic developments such as current accounts, or trade agreements. Together, any fluctuations in these "flow conditions" can have a dramatic impact on provisioning actors. The impact is amplified by the interconnection of all provisioning actors. Figure 5 portrays the flows between provisioning actors and the flow conditions which ensure these flows can occur.

We argue that flow conditions differ based on the characteristic of the flow (monetary, non-monetary). First, for monetary flows, we identify three exemplary sets of flow conditions.[12]

1. The first flow condition is macroeconomic balances. For instance, the importance of macroeconomic balance is highlighted when we consider current accounts, which are tracking a country's value of imports and exports and, thus, inter-country capital flows (OECD, 2022). The world's current account is, by definition, zero (the sum of all capital in- and outflows). Consequently, one country's current account surplus is a deficit for others and can contribute to financial instability.[13]

2. The second flow condition is price stability. Fundamentally, price stability preserves the purchasing power of a nation's money (Bernanke, 2006). When prices are stable, people can hold money for transactions without fear that inflation may decrease the real value of their money balances. Price instability, on the other hand, induces uncertainty, distorts firms' investment decisions, and produces losers and winners among households through (re-)distributive effects (Schwartz, 1998).

3. The third flow condition is functioning trade institutions. Trade institutions help stabilise policy and trade as well as investment flows within global markets (Easterly and Kraay, 2000; Rodrik, 1998). Also, because market actors prefer price stability, trade institutions may stabilise foreign commerce by reducing the economy's exposure to terms of trade shocks (Mansfield and Reinhardt, 2008).

Second, for non-monetary flows, we identify one exemplary set of flow conditions:

1. The flow condition we define for non-monetary flows is reciprocity. Reciprocity can be achieved through various ways. Ostrom (1990) collected a couple of conditions for the case of governing common-pool resources which ensure reciprocity: rights and ability to organize, congruent

12 This list is non-exhaustive. Several other flow conditions can be defined, such as property rights, basic social protection, social cohesion, or international competition.

13 Inter-country capital flows can be influenced through different channels (see BIS (2021) for an overview). Taking a closer look at global interest rates, for instance, makes clear why some countries are more exposed to economic crises than others. While domestic factors (e.g., domestic debt levels or monetary sovereignty) play a crucial role for sparking financial crises as well, global interest rate hikes indicate such crises in emerging market economies quite precisely (Guénette et al., 2022). This is essentially true for countries facing limited fiscal and monetary opportunities (Gourinchas and Obstfeld, 2012).

rules, monitoring of contributions to the community, graduated sanctions for free riders, collective choice arenas and conflict resolution mechanisms.[14,15] These non-monetary flows are guided by the principle of supportive transactions, such as sharing (Belk, 2010; Price, 1975), or commodity exchange (Ruskola, 2004) leading to the development of a social network and to the sense of belonging to a community.

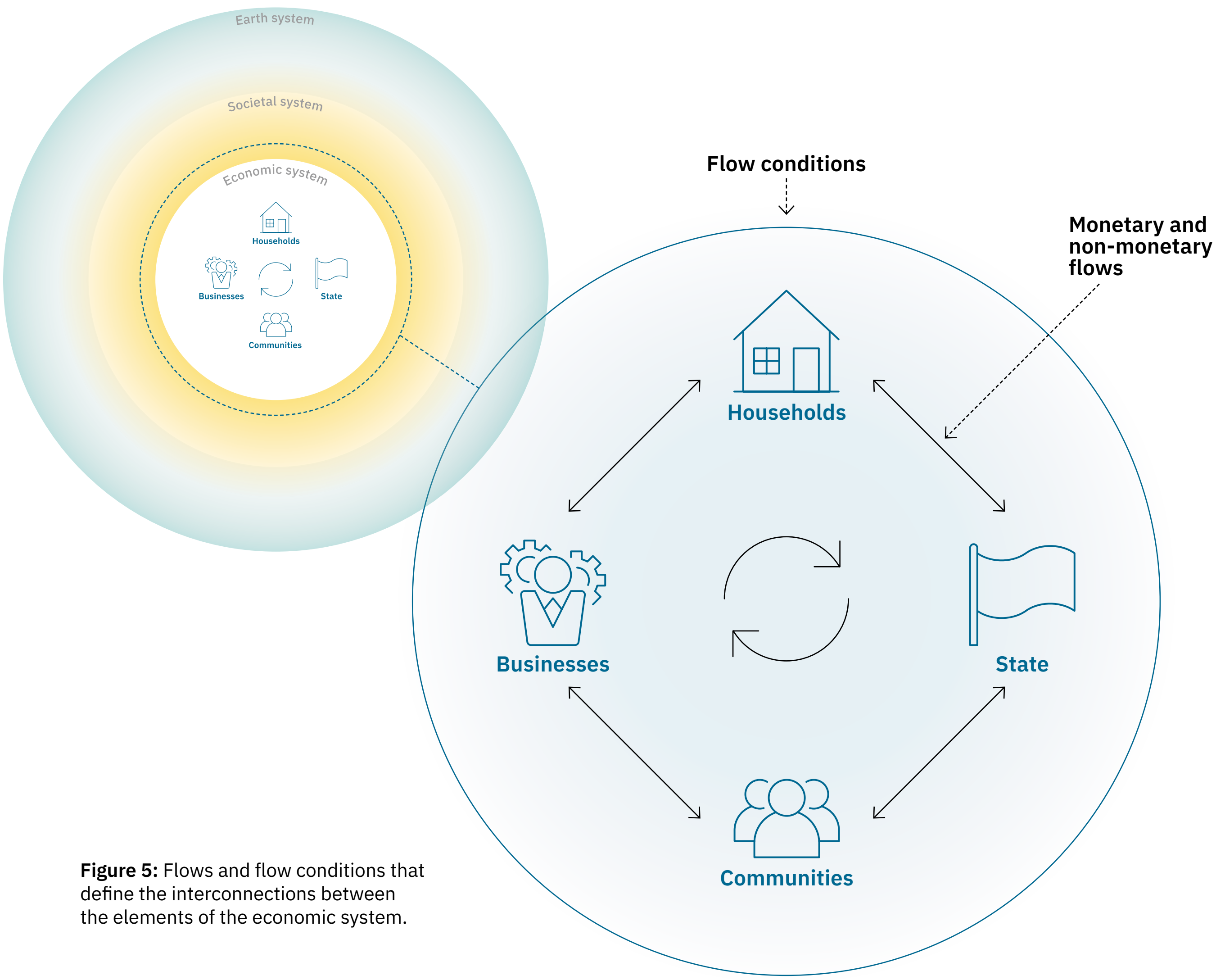

Figure 5: Flows and flow conditions that define the interconnections between the elements of the economic system.

14 Different scholars have analysed the functioning of economies that are not mediated by monetary exchanges, Ostrom (1990) and Graeber (2013) among the most prominent.

15 This framing disrupts the utilitarian way of explaining economic actions based on individual and rational behaviour and, instead, points towards the embeddedness of economic actors (Beckert, 2003; Granovetter, 1985). We understand the economic system in a way which uses social bonding and collaboration based on reciprocal relationships between provisioning actors to ensure the provision of goods and services.

2.2.6 Abilities of provisioning actors to provide goods and services

Finally, provisioning actors need a distinct set of "abilities" to enable them to use what is provided by society (skills, knowledge, creativity, relationships, etc.), and the environment (ecosystem services) to provide goods and services to society, which in doing so minimises social impacts on wellbeing and environmental pressures.

There are various frameworks that discuss the inputs required by the provisioning actors to provide goods and services. We build on the capital framework, whereby capital is understood as a stock or resource from which resources or yield can be extracted (Goodwin, 2003; UNECE, 2009). The capital framework distinguishes between five types of capital which are collectively needed to produce goods and services: human capital (Becker, 1964), social capital, natural capital, produced capital, and financial capital.

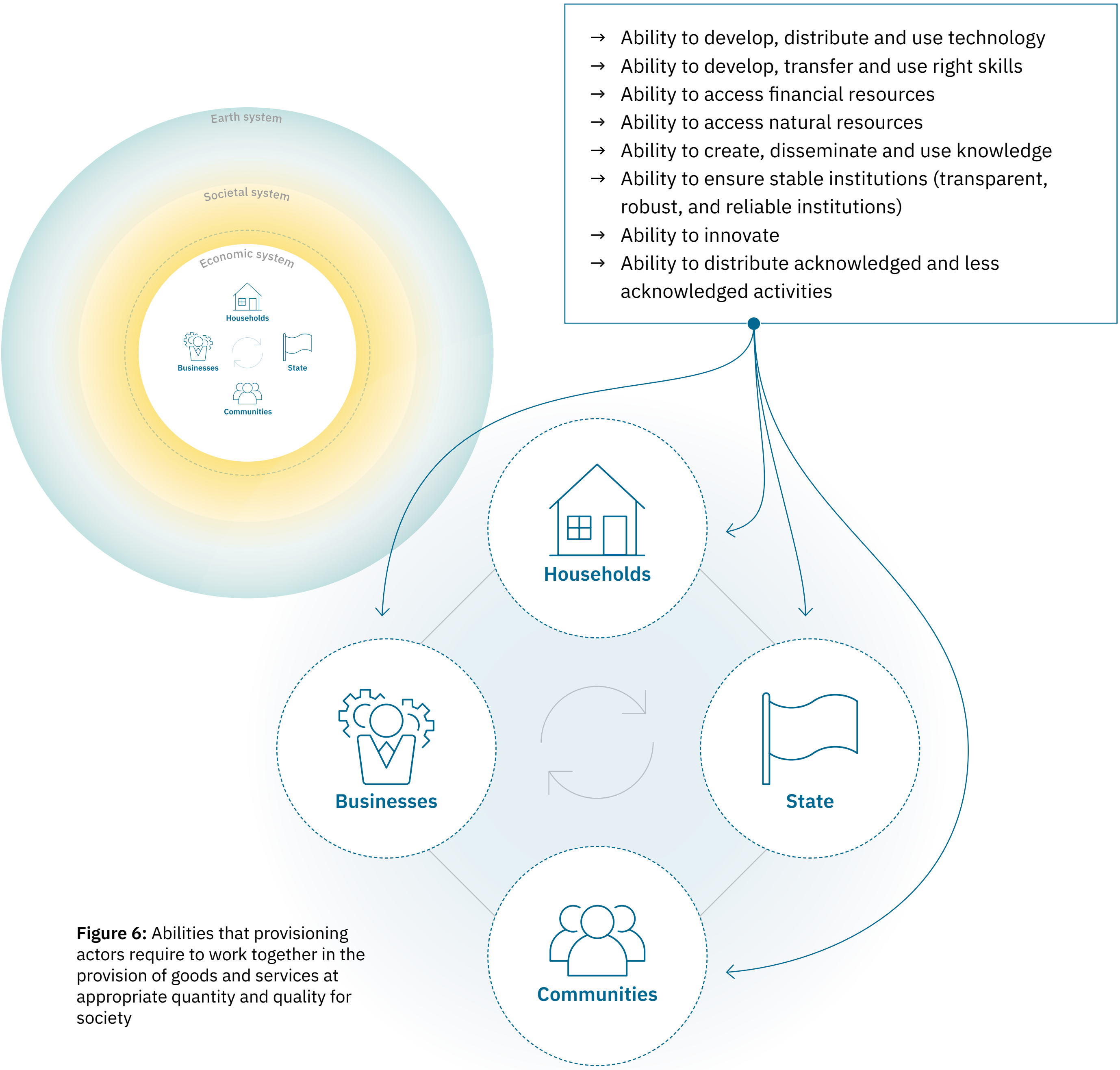

Figure 6: Abilities that provisioning actors require to work together in the provision of goods and services at appropriate quantity and quality for society

First, provisioning actors require “natural capital” to fulfil their economic activities. Natural capital refers to stocks of clean water and air, as well as forests, fisheries, and the systems that support them (Goodwin, 2003). We derive one ability that we deem key for provisioning actors to conduct their economic activities from “natural capital”:

1. Ability to access natural resources.

Second, provisioning actors need “human capital”. Human capital refers to individual productive capabilities (Goodwin, 2003). Individual agents can invest in their human capital through, for instance, education and training (Spulber, 2009). It is by applying their human capital that humans are then able to engage in scientific research or to develop new products and technology (Spulber, 2009). As such, we derive four abilities from “human capital”:

2. Ability to develop, distribute and use technology.
3. Ability to develop, transfer, and use suitable skills.
4. Ability to innovate.
5. Ability to create, disseminate and use knowledge.

Third, provisioning actors require “social capital”. Social capital refers to a cohesive social system characterised by normative consensus, social control, and connectedness (Furstenberg and Kaplan, 2004). Social capital is often used to refer to characteristics of a society that encourage cooperation among groups of people whose interconnected efforts are needed to achieve the production of goods and services (Goodwin, 2003). We derive two abilities from “social capital”:

6. Ability to ensure stable institutions.
7. Ability to distribute paid and unpaid activities.

Fourth, provisioning actors need “produced capital”, which refers to physical assets that are generated by applying human productive capabilities to natural capital (Goodwin, 2003). For instance, produced capital can refer to machinery in production processes. We derive one ability from the need of “produced capital” (which is also contingent on “human capital”):

8. Ability to develop, distribute and use technology.

Lastly, provisioning actors require “financial capital”. Financial capital refers to money which will be invested in an economic activity. For instance, it is common to have to pay for inputs in production processes (Goodwin, 2003). We determine one ability from the need of “financial capital”:

9. Ability to access financial resources.

2.2.7 Summary

This section focused on defining the economic system to establish the target performance of economic resilience. The definition of the economic system was three-fold: first, it determined the purpose of the economy, second, it defined the elements in the economic system, and third, it analysed how these elements are interconnected. We defined the purpose of the economic system as providing goods and services at appropriate quantity and quality for society. Additionally, given the economic system’s place within the societal and Earth systems, two further constraints were established which this purpose must adhere to: the need to 1) minimise negative social consequences that deteriorate wellbeing and 2) respect the hard environmental limits on economic activities implied by planetary boundaries. The constraints were determined based on a wider purpose which transcends the economic, societal, and Earth system, which we defined as “providing wellbeing for present and future generations while remaining within the planetary boundaries”. As such, the social-ecological goal of the economy is to contribute to the provision of intergenerational wellbeing by providing goods and services in a way which minimises social consequences and remains within planetary boundaries.

Having defined the purpose of the economic system, we then defined its elements and how they are interconnected. We determined four elements in the economy, defined as provisioning actors: households, communities, businesses, and the state. Provisioning actors are intermediaries that moderate the relationship between the economic and needs satisfiers (following Fanning et al. (2020)). Additionally, provisioning actors play an interconnected role in the provision of goods and services and therefore their monetary or non-monetary interactions are named 'flows'. We further established that a broader set of "flow conditions", such as functioning trade institutions, were required to enable flows. Lastly, we determined a set of abilities that each provisioning actors distinctly needs to be able to fulfil in its role within the economic system. This conceptualisation of the economic system together ensures that the economy achieves its purpose. Having understood the system that needs to be made resilient, the next section will analyse how the economic system can be resilient to various shocks and crises.

3. How can the economic system be resilient to shocks?

Throughout the literature, the resilience of a system is always assessed with respect to a reference value. We understand the reference value as the performance of the system. The performance level is a time-varying measure of how well a system is achieving its purpose over time. This is in line with the work of numerous other resilience scholars. For example, Vugrin et al.'s (2010) resilience assessment framework focuses on time averaged effects of a shock on system performance. Francis and Bekera (2014) use a framework that measures single resilience value from performance data for a system facing a shock, and Henry and Emmanuel Ramirez-Marquez (2012) use a metric that converts the ratio of current system performance to last performance at a given time when a system is hit by a shock.

Building on the definition of Vugrin et al. (2010), we understand resilience as "the magnitude and duration of the deviation from the targeted system performance level". A system with strong resilience capacities minimises the time-aggregated deviation from the targeted system performance.

Two targeted performance levels can be determined when measuring resilience. First, there is systems resilience. This refers to the high-level purpose of the economic, societal and Earth system, defined as providing wellbeing for present and future generations within the planetary boundaries (see section 2.2.2). Exemplary indicators to measure this system can be "perceived life satisfaction" or "life expectancy", in combination with environmental indicators that measure the extent to which planetary boundaries have been transgressed, such as the planetary boundaries framework which quantifies the safe operating space for humanity with respect to the Earth system and the planet's biophysical subsystems or processes (Rockström et al., 2021).

Second, there is economic resilience. In line with our argumentation above, this refers to the purpose of the economic system, providing goods and services in a way which minimises negative social consequences and environmental pressures and respects planetary boundaries. There are different ways for measuring the performance of the economy in line with this definition. Exemplary indicators, dashboards or indices include the Happy Planet Index (Simms et al., 2006), the OECD Better Life Index (OECD, 2022), or the Ecological Footprint (Wackernagel and Rees, 1996). In this light, when a shock translates into a sudden deterioration of one of these indicators, economic resilience is defined as the capacity to recover to the pre-shock level of this indicator value.[16]

16 These exemplary indicators do not capture the means used to achieve these end goals.

3.1 The relation of Resilience to Vulnerability, Exposure and Robustness

A system can only be considered resilient when its performance has been negatively impacted. This happens when a system is both *exposed* and *vulnerable* to a shock. Following the definition of the IPCC, exposure is defined as the "inventory of elements in an area in which hazard events may occur" (IPCC, 2022). To adapt the IPCC's definition to our economic context, exposure is defined as the inventory of stocks (resources, built infrastructure, people) and flows (monetary, non-monetary, material, immaterial) in a geographical area (local, national, international) in which a shock may occur.

Continuing to follow the IPCC, vulnerability is the predisposition to be adversely affected by a shock (IPCC, 2022).[17] Vulnerability can be interpreted as the level of loss in performance experienced after a shock before any reaction by the system takes place (Gitz and Meybeck, 2012; Haimes, 2009).[18] The opposite of vulnerability is robustness, whereby the system is exposed to the shock but its performance is not impacted (Btandon-Jones et al., 2014; Haimes, 2009; Woods, 2015). Figure 7 shows the difference between vulnerability and robustness.

When analysing system exposure and vulnerability, it is important to distinguish between resilience and risk. Risk is an integrated measure to assess the likelihood of specific outcomes (Galaitsi et al., 2021). Risk assessment aims to prevent or defuse threats before they can cause damage by decreasing the system's exposure and vulnerability or increasing its robustness. Resilience focuses on system reaction once the damage has already occurred (Galaitsi et al., 2021; Linkov and Trump, 2019), which we define as resilience assessment.[19] This distinction is highlighted in Figure 7. Additionally, if the system's performance is impacted by a shock, and the system's performance is never able to recover from that shock then the system collapses.

3.2 Resilience capacities that make a system resilient

Resilience capacities make a system resilient (Linkov and Trump, 2019). Following the work of numerous resilience scholars (see Manca et al., 2017; Martin and Sunley, 2015; Pontarollo and Serpieri, 2020; Vugrin et al., 2010; Walker et al., 2004), we argue that economic resilience is achieved by the capacity of a system to absorb, recover, adapt, and/or transform amidst crises.

17 The debate on the relation between vulnerability and resilience has a long-standing history, as discussed by Noy and Yonson (2018). In earlier years vulnerability was defined as the "flipside of resilience", capturing both the level of potential loss by a shock and the adaptive capacities. In the meanwhile, the most common definition as agreed between both the climate change and the disaster risk reduction communities understands vulnerability "as propensity or predisposition to be adversely affected" (IPCC, 2014) with a clear distinction from adaptive capacities (resilience) and exposure.

18 Other terms in the debate are "robustness" or "resistance". In most cases these refer to systems whose functions are not affected by a shock and as such are not of importance for analyzing resilience.

19 Some scholars define resilience as the ability to anticipate, and prepare for a disruption, in addition to responding to a shock (Linkov et al., 2014). In this sense, the difference between risk management and resilience becomes blurred. We argue that resilience can include anticipation, and preparation towards future shocks, but as a response to the system performance being impacted by a current or past shock. As such, resilience only comes to be when a system has already been hit, whereas risk management refers to actions taken before the system is hit by a shock.

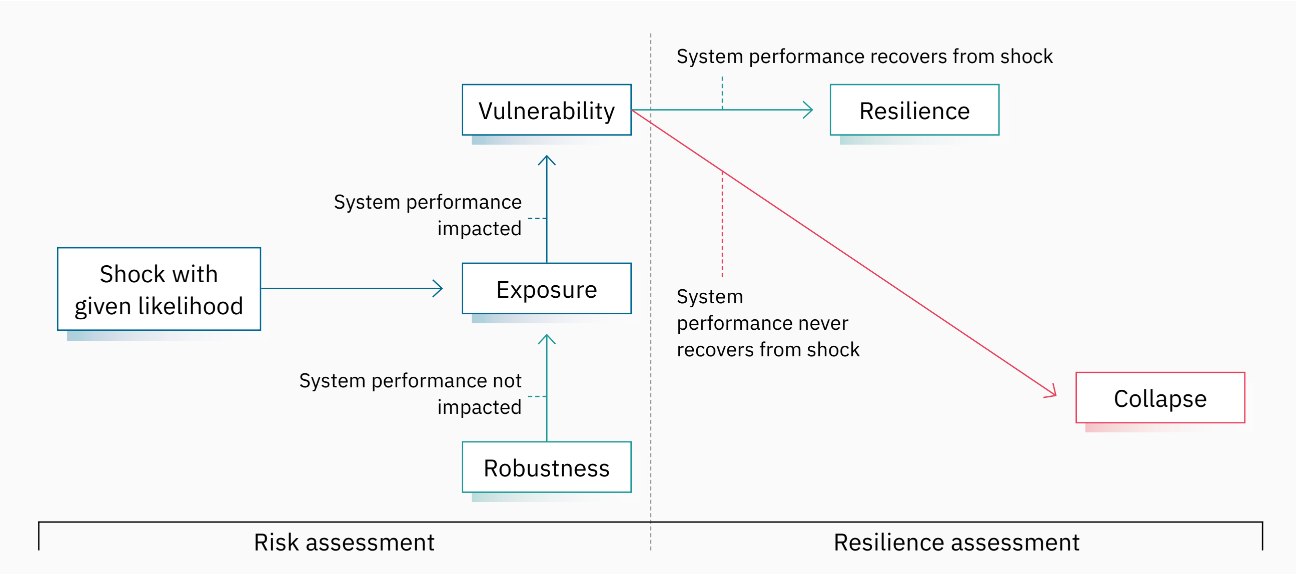

Figure 7: Differentiating between risk assessment and resilience assessment.

These capacities can be differentiated between two dimensions. The first dimension is the interaction between the time of exposure to the shock, the intensity of its disturbance, and the associated duration of the response (Alessi et al., 2020). Depending on these factors, the capacity the system will evoke will be different.

The second dimension is the shock's consequence for the system's structure and the associated performance level. We differentiate resilience capacities between two categories: persistence and change.[20] These categories refer to the degree of structural change they bring about. Persistence means that the ways in which the performance of a system is achieved remain static (Daly, 1993) . That is, the purpose of the economy is achieved with constant processes of production. Conversely, change means that the ways in which the performance of a system is achieved is dynamic (Fiksel, 2003; Guzman and Stiglitz, 2020). That is, the ways in which the economy achieves its purpose are constantly evolving. Distinguishing between persistence and change adds an intertemporal dimension to the analysis, which has an impact on the likelihood of future shocks. Change implies that the way in which the purpose of the economy is achieved can be improved, i.e., by decreasing pressures on the environment. As such, whereas persistence is static, change can alter the likelihood of future shocks (Hewitt, 1983).

In line with these distinctions, we define resilience capacities as follows. When the time of exposure is not too long, and the intensity not extensive, then the best way for the system to react might be through the absorptive capacity (Alessi et al., 2020).

The capacity to absorb a shock implies resistance because it denotes a short-term bounce back to a past target performance level without sustaining

20 Our categorisation follows that of other scholars such as Walker et al., (2004) which categorise capacities between persistence and adaptability. We use change rather than adaptability to not confuse the terms adaptation and adaptability. Additionally, other scholars such as Guzman and Stiglitz, (2020) refer to static or dynamic equilibrium thinking, which are terms that also categorise capacities between persistence and change. We have however not introduced the term equilibrium in our framework.

permanent damage (Manca et al., 2017). By creating redundancy and buffers in the current system, shocks can be absorbed more easily. The capacity for a system to absorb a shock is different than the system being robust to that same shock (Woods, 2015). This is because robustness is the ability for a system to maintain performance during a crisis (Brandon-Jones et al., 2014). Conversely, absorption means that the system performance has been affected by the shock and refers to the ability to return to normal operations in the short-term. Additionally, absorption does not imply structural changes to the way in which the systems achieve their performance level and can therefore be categorised as persistence.

If the shock is not able to be absorbed by the system because it is too long, and/or too intense, then the system can be resilient either by recovering or by adapting to the shock in the medium- to long-run.

The capacity to recover from a shock denotes the efforts to regain lost system function in the medium- to long-run (Linkov and Trump, 2019). Recovery implies system persistence (Walker et al. 2004) and refers to the system 'bouncing back' to the past-shock equilibrium upon disturbance (Alexander, 2013).[21] The capacity to recover and the capacity to absorb a shock are similar in that for both the system "bounces back" to pre-shock performance level. They are different in that recovery implies that the shock was too big, and too intense, to be absorbed, and that the system performance level is therefore drastically impacted. Recovery is evoked in the medium- to long-term.

The capacity to adapt to a shock denotes efforts to change the system in the aim of better dealing with future threats of similar nature (Linkov and Trump, 2019). Adaptability links resilience to the existence of multiple equilibria and refers to the propensity of a system to shift from one equilibrium to another in the face of a shock by "bouncing forward" through adaptation (Chapin et al., 2009) – it can therefore be categorised as change. Change represents a system's ability to learn from past experiences, anticipate future risks, and adjust accordingly (Pereirinha and Pereira, 2021). The capacity to adapt can infer different scale of changes. From one end of the spectrum, it can denote small changes to the system's past equilibrium while on the other end of the spectrum it can refer to transformation. Transformation denotes a fundamental change of structure, which breaks with the status quo. We categorise the capacity transformation as a part of adaptation and do not keep them distinct. This is because whereas the distinction between absorption and recover is the time-dimension and the distinction between adaptation and recovery is the system's structure post-shock (static or change), the same distinctions can't be applied between adaptation and transformation. This is because the latter both occur in the medium to long run, and both consist of change. As such, to not add a layer of distinction, we categorise them together.

It is important to note that these capacities are not mutually exclusive (Alessi et al., 2020). There is a time dimension in the reaction of complex systems to shocks, i.e., it is possible for a system to undergo absorptive capacities in the short-term, adaptive capacities in the medium-term, and transformation in the long-term (Pereirinha and Pereira, 2021).

Figure 8 portrays the process of resilience in response to a shock. In the short-term, once the system performance is impacted by a shock, it will first try to absorb it. If the shock is not prolonged nor intense, then the system will return to its pre-shock system performance in the short run (i.e., it will completely absorb the shock). However, if the shock is sustained and too intense then the system will not be able to completely absorb it. In that scenario, to be

21 Drawing on concepts of game theory, bounce back can be seen as the result of a finite game mindset, in which the response to one shock is seen in isolation and no anticipation of the future takes place. Bounce forward relates to an infinite game. One considers consequences of the response on the future course of events.

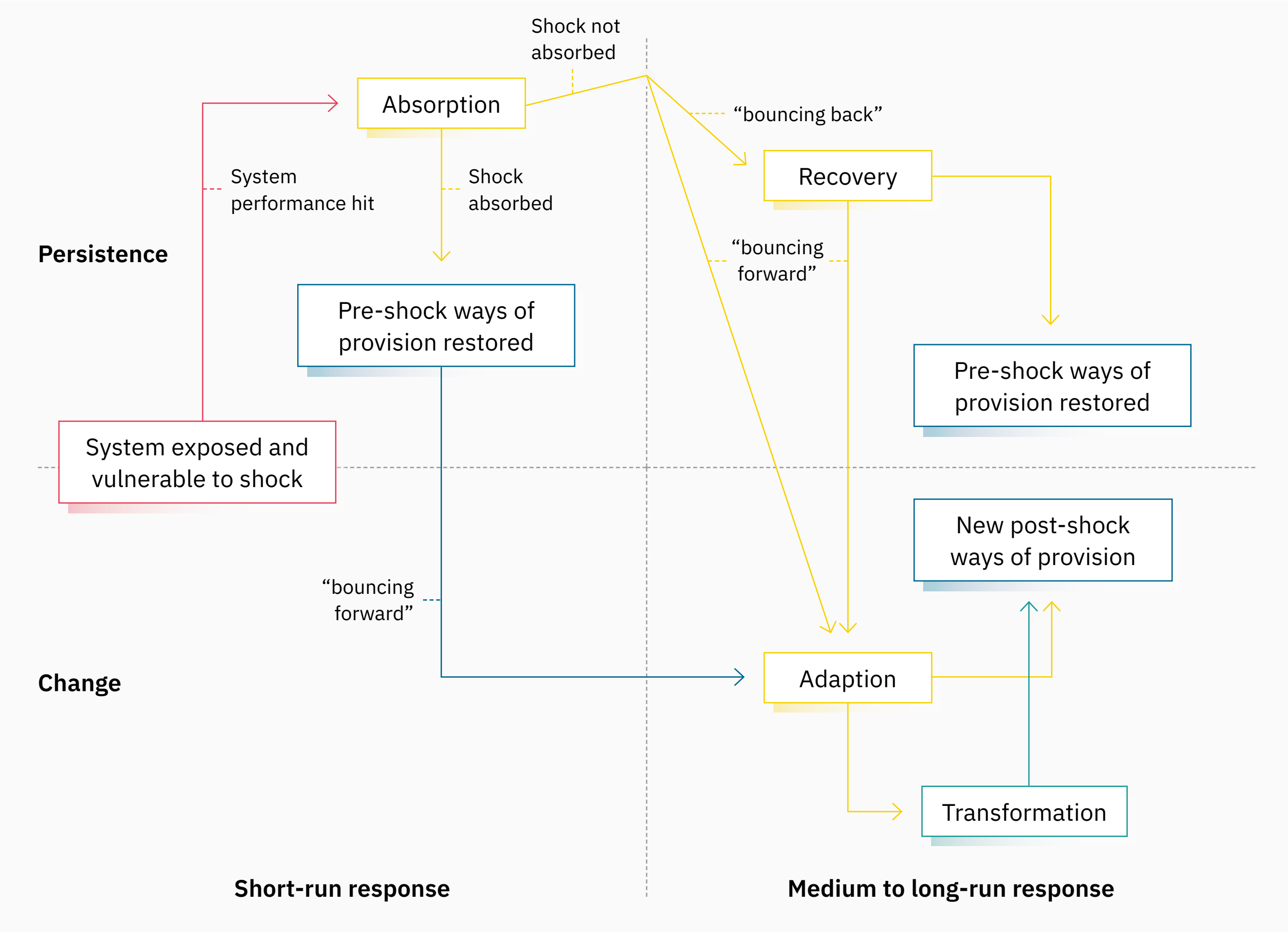

Figure 8: Understanding resilience capacities: absorption, recovery, and adaption

considered resilient, the system can either recover or adapt in the medium- to long-run. Additionally, it is not because the system first absorbed the shock or recovered from it (i.e., returning to its pre-shock performance level), that it cannot further 'bounce forward' and adapt to reduce vulnerability to future shocks. This is also highlighted in Figure 8.[22]

3.3 Resilience characteristics that generate resilience capacities

Furthermore, a system needs resilience characteristics to enable its resilience capacities. Resilience characteristics are underlying features that explain why certain systems are better at absorbing, recovering, and adapting relative to others. For instance, resilience characteristics include variables linked to institutional features, the ability of governments to spend money, and trust. Resilience characteristics are variables of the economy that prove to be robust, significant, and meaningful predictors of countries' resilient capacities (Alessi et al., 2020). While we are not providing a list of characteristics on empirical grounds, we will present a list of variables that could be tested in future research. They serve as important measurement tools for gauging and assessing

22 Note that in Figure 8 the categorisation of capacities regarding the interaction between the time of exposure to the shock, the intensity of its disturbance, and the associated duration of the response and the shock's consequence

the resilience of economies. It is important to note that these resilience characteristics do not necessarily correspond to policies to be used in times of crisis (Alessi et al., 2020) but capture underlying features of countries that enable them to act resilient when a shock hits.

We differentiate between a macroeconomic and microeconomic lens to determine resilience characteristics. This is because while adopting a microeconomic focus on resilience characteristics could miss critical system features (Florin and Linkov, 2016), a macroeconomic focus could also fall short of adequately enhancing individual recovery and adaptation. As such, both the resilience of all system components and the resilience of specific individual system components will be considered in our analysis of economic resilience characteristics.

First, on a macroeconomic level we determine four broad characteristics which stimulate resilience: diversity, redundancy, adaptability, and cohesion. We define them as macro-level patterns. The selection of these characteristics was guided by the works of Rose and Krausmann (2013) on their economic resilience index developed for businesses and the work of Fiskel (2003) on system resilience. The four macro-level patterns are defined as follows.

Diversity refers to the existence of multiple forms and behaviours (Fiksel, 2003). Adopting an economic lens, it can refer to trade diversity. For example, while a lack of diversification in trade partners may be beneficial because countries only trade with partners which offer the most competitive goods, it also decreases resilience. Indeed, being dependent on a few partners for the import of critical goods or for export sources increases the chances of being adversely affected. Trade diversification therefore makes for strong supply chains that can overcome shortages during shocks (Jayasinghe et al., 2022).

Redundancy refers to keeping some resources in reserve to be used in case of a disruption (Sheffi and Rice, 2005). Unlike diversity which focuses on flows, it refers to redundancy in economic stocks. It ensures the system minimises losses in the event of shock and, at the extreme, does not face collapse. For instance, having an excess of face masks or hospital beds prior to the COVID-19 pandemic would have increased resilience to the crisis.

Adaptability refers to the flexibility to change face to a present or future shock (Fiksel, 2003). For instance, adaptability can refer to innovation and creativity. Innovation allows businesses to change their business structure and adapt to a shock. During the COVID-19 pandemic, in-person restaurants were shut down. The innovation and deployment of services such as take-away services enabled restaurants to continue functioning. Additionally, adaptability can refer to efficiency - being able to attain similar levels of performance with less resources (Brand-Correa and Steinberger, 2017). Increasing efficiency can materialise as adapting to a current shock which decreases availability of resources, andequally, adapting to prevent vulnerability and exposure to future shocks.

Cohesion refers to the existence of unifying forces or linkages (Fiksel, 2003). Cohesion is both vertical and horizontal (UNDP, 2020). First, vertical cohesion represents vertical relationships that have power differences, for example relationships between the state and citizens (UNDP, 2020; Jayasinghe et al., 2022). For instance, during the COVID-19 pandemic, cohesion between citizens and the state, ensured rule abidance for recommended mask-wearing. Vertical cohesion enables efficient decision-making and law implementation, which can be crucial when dealing with the impacts of a shock. Second, horizontal cohesion refers to social networks, whether informal or formal (UNDP, 2020). Horizontal cohesion refers to collaboration and cooperation. An economic system that exhibits both horizontal and vertical cohesion is more resilient and better equipped to deal with shocks.

Second, on microeconomic level, we argue that macro-level patterns translate into different resilience characteristics dependent on the respective provisioning actors (households, communities, businesses, and state) and their respective abilities. For example, Table 1 expands on the resilience characteristics of businesses in function of businesses' abilities and resilience capacities.

For instance, the capacity for businesses to 'absorb' a shock relates to the characteristic of 'redundancy'. When pondering on businesses' specific ability to "develop, distribute, and use technology" for example, 'redundancy' can be defined in various manners. First, it can mean having spare technologies that can directly replace the ones that are affected by the shock. Second, it can mean having spare capacities to produce new technologies, when others are shut off due to a hazard. Similar reasoning applies to all the other abilities, such as access to skills, natural or financial resources, etc. (see Table 1).

The capacity for businesses to recover from a shock relates to the characteristics of 'diversity' and 'cohesion'. Using the same example, when investigating businesses' specific ability to 'develop, distribute, and use technology '', diversity can be defined in various ways. For instance, the diversity of supply chains can help to substitute imports or exports of products with others. For example, if the supply of a product A by country Y is disrupted, but a supply chain for the same product exists with country Z, the economy could quickly replace the imports from Y by imports from Z.

The capacity for businesses to adapt to shocks relates to characteristics of 'adaptability', "cohesion" or "diversity". When pondering on businesses' specific ability to 'develop, distribute, and use technology' for example, 'adaptability', 'cohesion' or 'diversity' can be defined in various manners. For instance, adapting to a shock can refer to substituting one technology with another, which both contribute to the same provisioning of businesses. This in turn may require innovation if the substitute isn't available yet. Additionally, cohesion can refer to the sharing of technologies across businesses. Sharing technologies enables businesses to pool resources and drive innovation which can enhance efficiency.

Table 1 is as an incomplete example of possible resilience characteristics for the provisioning actor 'businesses'. To limit the scope of the paper, we only give an indication of what this can look like for the other three provisioning actors (more details on each provisioning actor can be found in the annex). For example, the capacity for households to 'absorb' a shock relates to the characteristic 'redundancy'. Households' ability to 'develop, distribute, and use technology' can be achieved by making redundant facilities and capacities for developing and using technology. Additionally, for households to 'recover' from a shock, they require characteristics relating to diversity. For example, to ensure the ability to 'develop, transfer, and use suitable skills', households need to be equipped with diverse skills and training opportunities.

Additionally, the process of 'adaptation' from a shock is closely linked to the system anticipating future shocks and adjusting its processes accordingly. As such, anticipating future shocks can infer the characteristics imposed in the process of adaptation. For example, for 'businesses' to ensure their 'access to financial resources', adaptation can mean anticipating the impacts of revenue streams on other provisioning actors, society, and the environment. Additionally, for businesses to ensure the adequate 'distribution of paid and unpaid work', adaptation can mean anticipating the impact of unfair distribution for society and the environment.

Abilities for provisioning actors to work together in the provision of goods and services at appropriate quantity and quality for society.

Resilience capacities			
	Absorption	Recover	Adaptation
Macro-level patterns	Redundancy	Forecasting Methodology	Adaptability, Diversity, Cohesion
Develop, distribute, and use technology	Redundant technological capacities, spare production capacities.	Flexibility in changing what technologies can produce; diverse trade network for critical technologies, diverse set of technologies used in production. Cohesion: benefits of technologies are widely shared; level of market concentration; income and wealth concentration.	All characteristics under "recover" + adaptability: knowledge what and how technologies create risks of shocks. Ability to use techno-logies that are less prone to shocks and are future-fit. Cohesion: benefits of techno-logies are widely shared.
Develop, transfer, and use suitable skills	Spare workforce with skills for relevant businesses.	People are equipped with diverse skill sets; diverse training opportunities; strong job-matching institutions; short time working schemes, flexible working contracts. Cohesion: satisfaction with work overall.	All characteristics under "repair" + adaptability: knowing what kind of skills will be needed in the future; compensation, transition, and acknowledgement. Schemes for skills that become less important.
Access financial resources	Financial savings and equity, above average profit margin, above average credit rating.	Diverse financing models and revenue streams; multiple different consumer groups or clients. Cohesion: efficiency in how financial resources is used (investment decisions); low market concentration in banking.	Adaptability: anticipating impacts of revenue streams on other provisioning actors, society, and environment. Benefits of financial revenues are widely shared.
Access natural resources	Stocks of relevant resources, spare trade, and transmission capacities for resources.	Diverse supply networks for resources and energy. Cohesion: efficiency in how natural resources are used (investment decisions); regional concentration of environmental impacts.	Adaptability: anticipating impacts of resource extraction and waste on other provisioning actors, society, and environment. Benefits of natural resource and energy use are widely shared.
Create, disseminate, and use knowledge	National server and data capacities, intranets independent from global internet structure, number of libraries, national providers for critical data like navigation data.	Multiple knowledge providers; access to different kinds of knowledge; ability of teams to easily shift between topics; multi-disciplinary teams. Cohesion: incubation processes, co-creative research networks.	Adaptability: anticipating impacts of applying certain types of knowledge on other provisioning actors, society, and environment. Open access to knowledge.
Ensure stable institutions	Redundant leadership positions, multiple ways of storing contractual information.	Diverse leadership styles; multiple ways of staff acknowledgement; strong identification of team members with the organi-sation. Cohesion: above average team culture, trust in public institutions, reliability of contracting law.	Adaptability: anticipation of impacts of corruption on institutional quality.
Innovate	Contingency plans embedded in the business structures (organisational development plan).	Diversified (regionally and thematically) innovation clusters. Cohesion: research networks, degree of creativity of workers, trust in science.	Adaptability: innovative-thinking, entrepreneurial thinking. Diversity: different backgrounds in researchers, corporate culture. Cohesion: research networks.
Distribute paid and unpaid work	Large labour force, inflation adjusted minimum wage, strong welfare institutions and state support mechanism, strengthening the access to safe and secure public transportation.	Narrowing the gender wage gap, equality at workplace, infrastructure support for non-market household production. Cohesion: non-exploitative workplace.	Adaptability: anticipation of impact of unfair distribution of paid and unpaid work. Understanding the impacts of macroeconomic policy on paid and unpaid work.

Table 1: Exemplary characteristics for the provisioning actor "businesses"

4. Discussion

Resilience has become one of the major concepts for dealing with uncertainty in times of crisis. This paper's understanding of economic resilience depends heavily on the geographic dimension of scale, pattern, integration, and interaction. When tasked with strengthening economic resilience, policy-makers will have to make important political choices. In this discussion section, four non-exhaustive emerging political choices and tensions will be presented.

First, it is crucial to consider resilience for whom. While we have discussed resilience of what, important questions remain as to the equitable and fair access to resources. This raises questions on the current underlying structural inequalities which drive the socio-economic system. These inequalities are further exacerbated in times of shock. Resilience for whom can be divided into different parts: international, national, local, formal, or informal. The international aspect of resilience for whom can refer to the structural inequality in the global economic system leading to uneven structural access to financial capital in times of crisis. Thinking through questions of resilience for whom entails considering potential trade-offs between stakeholders (Fabinyi, 2009). Additionally, the informal aspect of resilience for whom can refer to different lived experiences in times of crisis. For instance, during the COVID-19 pandemic, numerous countries imposed strict stay at home lockdowns to stop the spread of the virus. Albeit this policy enhanced national resilience to the pandemic, it also saw a drastic increase in domestic violence, particularly towards women in the informal sphere. Once again, this example highlights how pre-existing structural inequalities in the socio-economic system are exacerbated in times of crisis. As such, when designing policies to build economic resilience, it is crucial to consider who will benefit, and who will be left vulnerable (Jackson et al., 2022). Resilience for some populations or systems can be a source of disturbance and risk for others (Hahn and Nykvist, 2017). This question is crucial to consider the associated cost of implementing economic resilience policies and defining the resulting distribution of costs, benefits, and negative externalities.

Second, tensions exist between risk and resilience, especially when it comes to the resilience characteristic of diversity. While resilience increases with diversity by increasing the capacity to adapt, diversity can also increase the exposure of the system to shocks and as such the risk to be hit by a shock. For instance, a country with multiple trade partners will have greater chance of exposure to a shock if one trade partner is affected by a shock. In contrast, it increases that country's capacity to recover or adapt because of a high degree of network diversity in trade networks make it easy to substitute trade streams with one another.

Third, there are tensions between resilience characteristics and the performance of the economy (providing goods and services in a way which minimises negative social consequences and environmental pressures). For example, adaptability (a resilience characteristic) can refer to market flexibility. Market flexibility has seen a steady move towards the expansion of the gig economy in which workers are independent contractors who are paid to take on tasks by those who require their services (Jackson et al., 2022). In numerous countries, social protection such as unemployment benefits, healthcare coverage, do not apply to gig economy workers. As such, even though the market is adaptable, it has also left a considerable part of the workforce with little access to financial services. This has resulted in declining wages, inadequate health outcomes, eroding benefits, and widening income inequality within society (Jackson et al., 2022). In sum, increasing resilience through market flexibility may have negative effects on the performance of the economy when it comes to minimising its negative social consequences.

Fourth, there are tensions in the political choice to evoke persistence (absorb, recover) or change (adaptation) capacities. Persistence capacities require lower energy and resources than change capacities in the short-run (Hynes et al., 2022). This is because adaptation revisits the organisation of the system by re-organising relationships and dependencies (Hynes et al., 2022). As such, adaptation policies may be difficult to implement in the short run because the costs could outweigh the willingness (Jackson et al., 2022). However, even though adaptation may be more costly in the short run, it can have lasting benefits in the long run to both national and international economic resilience (Hynes et al., 2022). Overall, it is important to determine the favourable outcome between persistence and change not only in the short-term, but also in the long-term.

5. Conclusion

To conclude, this paper contributed to the literature by providing a consistent framework to understand economic resilience. Resilience is always assessed against a reference value. To determine the reference value of economic resilience, we need to understand the economic system. Indeed, if we are to grasp how to make economies resilient amidst a crisis-ridden world, it is needed to first understand what we are trying to make resilient. For this reason, we dedicated the first section of this paper to discerning the economic system's core dynamics and its purpose. Given the complexity in understanding the economic system, we used a social-ecological system's perspective to organise the complexity in manageable parts. In particular, our system's definition of the economic system was three-fold: first, we determined the purpose of the economy, second, we defined its elements, and third, we analysed how these elements are interconnected.

Applying a "system of systems" approach by way of viewing the economy as a sub-system of the societal and Earth systems, we defined the purpose of the economic system as providing goods and services at appropriate quantity and quality for society. Given the economic system's place within the societal and Earth systems, we established two further constraints which this purpose must adhere to: the need to 1) minimise negative social consequences that deteriorate wellbeing and 2) respect the hard environmental limits on economic activities to a level respecting planetary boundaries. The constraints were established based on a wider purpose which transcends the economic, societal, and Earth system, which we defined as "providing wellbeing for present and future generations while remaining within the planetary boundaries". The purpose of the economic system then guided our definition of the key elements involved in this provision (the provisioning actors) and how their interconnections materialise.

In this light, we defined the reference value for assessing economic resilience as the performance level of the economy. In other words, how well the economy is achieving its purpose over time. As such, economic resilience is the magnitude and duration of deviation from the targeted performance level during a shock. To assess economic resilience, we first determined three capacities systems need to be resilient: absorb, recover, and adapt. From this, we then derived resilience characteristics, specific to the economic system, that would enable these systemic capacities amidst a crisis. The latter provides the basis for our framework which assesses economic resilience. The framework connects resilience capacities and characteristics to the provisioning actors' abilities in the economy. The next step will then be to empirically test and quantify these specific characteristics, distinct for each provisioning actor, into a country-level index. Through this resilience framework, we aim to enhance economic resilience by guiding economic policy towards a future-fit, improved steady state.

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