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GLOBAL INFLUENCE AND NATIONAL DIVERSITY IN SOCIO-TECHNICAL TRANSITIONS: A SECTORAL TAXONOMY

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Global influence and national diversity in socio-technical transitions: a sectoral taxonomy.

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Abstract

Socio-technical transitions (STTs) are used to analyse radical innovations and their extensive and structural impacts on the society. The spatial articulation of STTs is more and more studied to provide a deeper understanding of horizontal (i.e., between areas at the same scale) and vertical (i.e., between areas at different scales) dynamics. In particular, an increasing attention is given to the global scale.

This paper contributes to the geography of STTs, by studying the connections between the global and the national scale and by aiming at filling two research gaps: the inadequate consideration of both national diversity and sectoral specificities. Starting from five case studies on agrifood, healthcare, logistics, urban mobility and tourism, we build a sectoral taxonomy of STTs focussed on the relation between global influence and national diversity.

Four types of sectors emerge from the analysis: Type 1 sectors with a higher variety of national STTs, mostly depending on no relevant global influence; Type 2 sectors with a typology of national STTs with some (actor-led or discourse-led) global influence; Type 3 sectors with multiscalar STTs and a very limited number of national specifications; Type 4 sectors featuring a global STT and no relevant national diversity.

The taxonomy may be used: a) to represent sectors other than those studied here (e.g., defense, education, energy, internal security, justice, media/entertainment, water, Web/TLC), b) for dynamic analyses, i.e. to study the eventual migration of sectors between Types, and c) to provide useful hints for the design and implementation of policies aiming at pushing STTs in a desired direction.

Keywords: socio-technical transition, scale, globalization.

Jel classification: O3, P5.

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1 Introduction

The supply chain can be defined as the set of vertical (usually inter-industry) relationships, along which production and logistics activities take place to bring a specific product or service to the market. Leading scholars of innovation have shown that the supply chain is also the environment where innovation processes deploy: minor innovations may emerge from the cooperation between suppliers and users of a specific technology (Pavitt, 1984); more relevant innovations may imply that the supply chains must be reorganized in order to integrate a new input (Lundvall, 2010); new general-purpose or enabling technologies may result in one or more brand new supply chains (Teece, 2018).

The literature on socio-technical transitions (STTs) provides a sound and articulated conceptual approach to understand (and possibly influence) large-scale innovations that take place through structural techno-economic and socio-political changes (Kohler et al., 2019).

The geographical dimension of STTs has been thoroughly studied: local, national and global innovation dynamics are explicitly considered, both simultaneously and alternatively; horizontal (i.e. between areas at the same scale) and vertical (i.e. between areas at different scales) connections are a key driver of innovator networks. Multiscalarity is the emerging concept that synthesize the attention of the literature on STTs to phenomena taking place at various scales (Raven et al., 2012; Hansen and Coenen, 2015; Miorner and Binz, 2021).

Notwithstanding the increasing research effort to understand the geography of STTs, two literature gaps are apparent:

1) little attention is given to the national variety of STTs, this is mostly because a too simple representation of the upward and downward relation between the global and the national scale is usually provided;

2) sectoral specificities in the multiscalarity of STTs are not considered, this is because a single sector (or sub-sector) approach is followed in most case studies.

Some research questions emerge from such gaps: which is the influence of the global scale on the generation of a diversity of national STTs? Is this influence sector-specific? And, if yes, why?

To answer to these questions we start from the analysis of the relevant literature on STTs and scale (Section 2), then we provide a multi-scalar analysis of five sectoral STTs (Section 3): Agrifood, Healthcare, Logistics, Tourism, Urban mobility. Case studies focus on the scale articulation of the relevant ST-systems, supporting actors and political discourses of each

sector, looking for the existence of a sector-specific relation between global influence and the national variation of STTs. Starting from these case studies we offer to the reader a sectoral taxonomy of STTs (Section 4) whose analytical and policy implications are presented in the conclusions (Section 5).

2 Socio-technical transitions and scale

2.1 Basic concepts

Following the seminal book of Frank Geels (2005), any societal function (such as the provision of energy, healthcare, feeding, mobility, etc.) is fulfilled by one or more ST systems. A ST system is a configuration of material and immaterial constituents, whose reproduction and change is supported by a network of actors (Smith et al., 2005). Every societal function features a two-level competitive dynamic: between ST systems (e.g., between the car and public transport) and between actors within the same ST system (e.g., between carmakers, such as Toyota and Wolkswagen).

Each societal function features a dominant ST system whose supporting actors are able to influence both the techno-economic and socio-political dimension of the societal function itself. Between the other subaltern ST systems a relevant role is played by ST niches, where both techno-economic and socio-political innovations may emerge from the action of so-called "enactors" (Schot and Geels, 2007; Smith and Raven, 2012). When the ideological dimension of enacting is prevalent, then grassroots innovators (and innovations) are at stake (Hossain, 2016).

A ST transition is nothing but the transformation of a societal function, resulting from two alternative dynamics: the adaptation of the existing dominant ST system as a reaction to internal and external pressures for change, or the emergence of a ST system which is able to leverage such pressures to take over the dominant position (Geels and Schot, 2007; Haxeltine et al., 2008). During a ST transition the competition between dominant and emergent ST systems is based more on alternative "political discourses" about the functioning of the whole societal function, than on different technologies (Hekkert et al., 2007).

As stated in detail in the following, ST systems and their supporting networks feature a scalar dimension: they may take place and reproduce at a single level (local or national or global) or they may be multiscalar (i.e., local and national and global). The same applies to ST transitions.

Tab. 1 – Basic socio-technical (ST) concepts

ST systems	Definition: Configurations of material and immaterial constituents supported by a network of actors, fulfilling a societal function
	Main feature: Structured change: the structure of a ST system is changed by its supporting actors, whose action is in turn conditioned by the structure of the ST system itself
	Typology: Dominant ST system: high levels of both power and stability Subaltern ST system: medium to low level of power, high to medium level of stability ST niche: low levels of both power and stability
Supporting actors	Definition: Agents that reproduce and change a ST system
	Main feature: Coalescence: supporting actors build and develop networks by creating and sharing material and immaterial resources
	Typology: Core actors: performing a more active role to support a ST system Fringe actors: other actors supporting a ST system Enactors: interested in the emergence of a new ST system, usually as the evolution of a ST niche Grassroots innovators: enactors with an ideological motivation
ST transitions	Definition: Transformation of a societal function
	Main feature: Co-evolution: techno-economic and socio-political changes are endogenous to the ST transition and mutually dependent
	Typology: Adaptation: adjustment and maintenance of the dominant ST system (also through the absorption of ST niches) Takover: creation of a new dominant position (also through the empowering and coalescing of ST niches)

Based on Marletto et al., 2016 (ch. 1).

2.2 The issue of scale

Following some seminal criticisms (e.g., Truffer, 2008; Smith et al., 2010), the interest of STTs scholars for the issues of space and scale started some ten years ago when some seminal papers focussed on the intersection between two research fields: geography and STTs. In particular, Bernhard Truffer, and Lars Coenen (and their colleagues) published several papers in journals covering multiple research areas: economic geography, regional studies, planning, innovation, sustainability, etc. All stressed first the need and then the existence of a new research theme: the geography of STTs (see, among the others: Coenen et al., 2012; Truffer and Coenen, 2012, Hansen and Coenen, 2015; Truffer et al., 2015). Also as a result of this starting effort, the issues of space and scale have reached a stable and relevant status in the STT research agenda (Kohler et al. 2019; Binz et al, 2020).

Thanks to such a thorough research acknowledgement, studies on STTs have gone beyond some basic (and somehow obvious) space-based specification of STTs (e.g., the relevance of the local dimension in ST niches and grassroots innovations, or the existence of regional innovation systems) and delivered to the reader a deeper understanding of the spatial dimensions of a STT.

The horizontal spatial dimension of STTs has been unfolded as: translocal interaction and diffusion (Loorbach et al., 2020), transnational linkages (Wieczorek et al, 2015), transnational actors (Bhamidipati et al., 2019), translocal networks (Avelino et al., 2020), multi-space niches (Fontes et al., 2016). Also the vertical spatial dimension of STTs – usually considered as a multiscalar or cross-scale dynamics – has reached centre stage (Raven et al., 2012; Bauer and Fuenfschilling, 2019; Hebinck et al., 2021; Miorner and Binz, 2021) and found a place in most approaches to STT. Thus we now have: multi-scalar technological innovation systems (Dewald and Fromhold-Eisebith, 2015); multiscalar global innovation systems (Heiberg and Truffer, 2021); multi-scalar networks (Sengers and Raven, 2015). The interplay between upward and downward interactions is also part of the vertical dimension of STTs (Skjolsvold and Ryghaug, 2020), in particular between (sectoral) global dynamics, (territorial) local dynamics (Miorner and Binz, 2021) and grassroots innovations (Marletto and Sillig, 2019).

The global level of the multiscalar dynamics of a STT has been thoroughly studied, with a focus on: global actors (Kranke and Quitsch, 2021), global diffusion and global discourses (Miorner et al., 2021), global value chains (Pietrobelli and Rabellotti, 2011; Lema et al, 2018; Mohamad and Songthaveephol, 2020). Almost all alternative conceptualisation of a STT have been adapted consequently to gain such a global flavour: the global regime (Fuenfschilling and Binz, 2018), the global technological innovation system (Binz et al., 2014), the global innovation systems (Binz and Truffer, 2017).

Notwithstanding such a focus on the global dimension of a STT, its influence on lower scales has not reached a specific attention. In particular, the relation between the global dimension of a STT and its diversification at the national level is somehow undervalued: national variety may emerge only if the global dimensions is weak (or absent) (Fuenfschilling and Binz, 2018); the focus is only on the nature of horizontal connections between countries, while the whole global level (and its possible upward and downward connections with countries) remains implicit (Binz et al., 2014). Moreover, studies on STTs and scale usually focus on a single sector (or sub-sector), while multisectoral analyses are an exception (e.g., Binz and Truffer, 2017); as a result it is not possible to understand if and why the multiscalar articulation of a STT differs from sector to sector and in particular if the global influence on the national variety of a STT is sector-specific.

3 Short case studies

3.1 Agri-food

a. Short description

The food societal function is to feed humanity. It is characterized by commercial supply chains that include agriculture and breeding, trade, processing and product distribution. Within the supply chain, power is predominantly in the hands of a few corporations (to the detriment of farmers)(Murphy, 2006).

Agri-food is characterized by the coexistence of multiple ST systems, organized at various scales and that can be grouped into three main types: a) Big agribusiness; b) systems based on traditional agriculture; c) new alternative supply chains (organic, fair trade, regional supply chains) (Green et al., 2003; Goodman et al., 2012).

The sector regulation mainly concerns agricultural and livestock production standards (authorized inputs, sanitary standards), as well as health standards related to distribution. Both public (national) and private (Global G.A.P., organic, etc.) product certification standards are increasingly widespread and varied. In many countries, agricultural policy (e.g. land reforms and subsidies) has a major influence, with implications on the prevailing forms of agriculture. As a general rule, policies favor the development of large agricultural firms with intensive methods, although policies supporting alternative methods such as organic are also being pursued (Sillig, 2022).

b. On-going changes

The societal function evolution depends on tensions both internal and external to the sector.

With regards to internal tensions, although the ST systems other than Big agribusiness exhibit forms of positive contamination (practices) and convergence (advocacy) in opposing Big agribusiness, the latter's dominant position does not appear to be at risk (Marletto and Sillig, 2019). However, awareness of the extent of its negative impacts with regards to environment (soil depletion, water shortages, declining biodiversity) and health (food safety, obesity) is pushing it to reconfigure some practices (toward greater sustainability).

The sector is also characterized by tensions with other societal functions, especially energy and transportation, that compete for the use of land and labor for biofuel production (Al-Riffai et al., 2010).

Finally, the food sector has to deal with the current and future consequences of global warming as well as geopolitical crises and new equilibrium. These elements could lead to a reconfiguration of Big agribusiness network of actors (e.g., greater reference to national supply chains, evolution of supply areas).

c. Notes on sectoral transition and scale

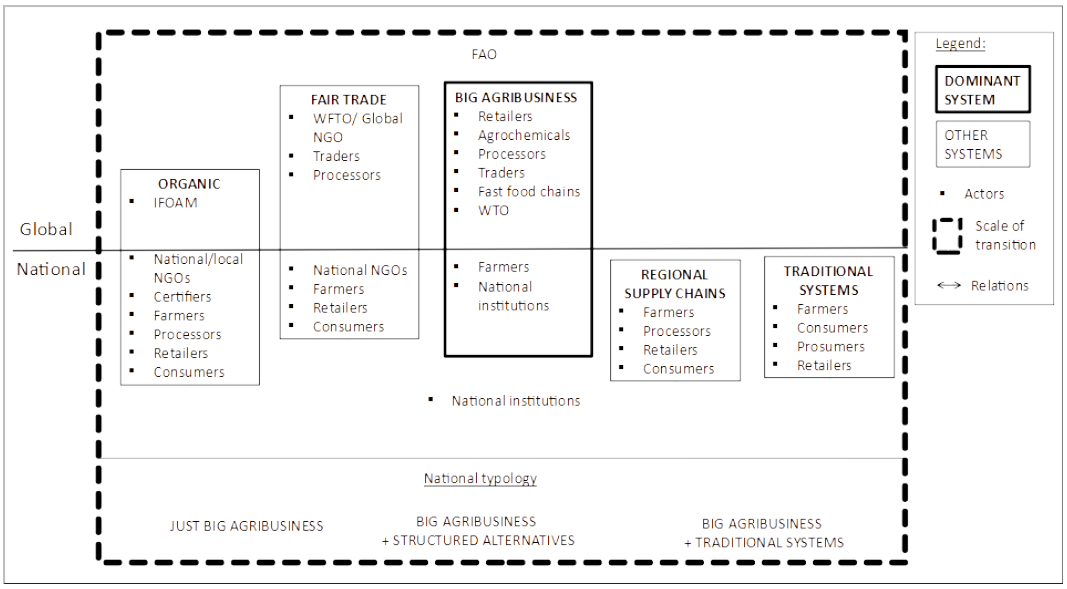
The sector is dominated by the Big agribusiness ST system, which greatly influences the dynamics of the other ST systems. Big agribusiness is organized on a global scale and is characterized by the presence of a few big retailers, food processors, global commodity traders, and agrochemical firms that impose on producers in the global South and North a techno-economic routine aimed at achieving high yields and low prices (food for all) through commercial agriculture, economies of scale, mechanization, and massive use of pesticides and fertilizers. In addition to large private players, this ST system is supported by most governments and the WTO, supporting free international trade and globalization (Marletto et al., 2016).

Although they engage the majority of the world's agricultural workforce, ST systems based on traditional farming methods are today a residual reality, that can be found almost exclusively in the Global South. They are characterized by low complexity supply chains (few intermediaries, unprocessed products) and are dedicated to self-consumption and/or local and national markets. While their organization takes place on a local or national scale, they are also affected by global dynamics, as they are undermined by Big agribusiness, both as a method of organizing the societal function of food and because much farmland is being

taken away from traditional agriculture and switched to intensive agriculture for the global market (land reforms, land grabbing).

ST systems ascribable to the family of new independent alternative supply chains develop as a reaction to Big agribusiness. They include supply chains such as organic, fair trade, and local supply chains that enhance typical products and traditions, especially in the Global North. They propose practices aimed at local development and the sustainable overcoming of the Big agribusiness model. Unlike ST systems based on traditional agriculture, they are institutionally structured and represented by first- and second-level NGOs (IFOAM, WFTO), which codify practices through certification (Marletto and Sillig, 2019). Their dynamic is clearly multiscalar: while they support territorial differentiation of practices (i.e. importance of local and national arenas) they are active in terms of global advocacy. They are also challenged by incorporation from Big agribusiness, which repurpose their practices in a conventionalized form, i.e., with attenuated practices that deviate only slightly from industrial production and supply chains (e.g. Big agribusiness's organic supply chain, that differ from non organic solely by the absence of fertilizers and pesticides) (Guthman, 2004).

Fig. 1 – Agrifood: actors, systems and scale



From a geographical perspective, three national types of ST transitions can be distinguished, that feature different pairings between Big agribusiness and the other ST systems: a) countries with no relevant alternatives to Big agribusiness. This configuration is typically found in countries with large agricultural areas and medium or high levels of industrial development, either from the Global North (e.g., USA, Australia) or the Global South (Brazil, China); b) countries where Big agribusiness dominates but where structured alternatives (organic, regional supply chains, etc.) have developed. This configuration is found in some West European countries, characterized by the historical sedimentation of local productive traditions and civil society movements sufficiently structured to support the development of alternative supply chains; c) Global South countries, where Big agribusiness coexists with traditional local food systems. This configuration is contracting to a few areas of the world, e.g. some sub-Saharan and Asiatic countries, where the penetration of Big agribusiness, and more generally of the global economy, is still contained or patchy.

Summing up, given the weight of Big agribusiness and its influence on the other ST systems, the ST transition of the food sector is dominated by global scale dynamics, but with national/local responses showing some variety. In this regard, the multiple agricultural price crises as well as recent geopolitical crises may push some States to reintroduce protectionist policies, further increasing the variety of national development paths.

3.2 Healthcare

a. Short description

Healthcare systems are put in place to prevent and treat human diseases. The provision of medical services, the construction and management of medical infrastructures (hospitals, outpatient clinics, urgent care facilities, etc.), the production and distribution of drugs, are the main constituents of healthcare systems.

The political debate on healthcare features two alternative discourses: healthcare as a social right or as a set of marketed services. The role of the State is defined consistently: as the guarantor of universal access to infrastructures and services, or as the regulator of a set of liberalized markets.

b. On-going changes

R&D activities for the development of new drugs and medical treatments are key to innovate healthcare, in particular to confront chronic diseases (such as diabetes, heart diseases, cancer), communicable diseases (such as HIV, malaria, tubercolosis) and emerging epidemics (Covid-19, Zika, etc.).

It is debated who is up to decide which diseases are a priority for research: global pharmaceutical companies (the so-called "big pharma"), who invest on the more profitable diseases of the rich, or some Authority which is able to focus on the relevance of the disease (thus including – e.g. – the so-called "neglected tropical diseases") (Stiglitz, 2007; Londeix and Forette, 2014). Even the establishment of powerful global private-public partnerships is under scrutiny (Birn, 2009).

Some new actors are entering healthcare: the increasing role of new technologies (on-line healthcare, I.O.T., A.I.,) has brought along some Internet actors (Verily/Google, Microsoft); Amazon, featuring a leading position with its pharmacy branch, recently widened its positioning into the market of e-health services (Hajli and Featherman, 2018).

c. Notes on sectoral transition and scale

National Healthcare Systems (NHSs) are defined by national norms that – inter alia – define the room for market and non-market activities, thus conditioning the overall transition of this sector.

At the same time, the establishment of a global health system must be acknowledged, whose supporting actors are: the UN World Health Organization (WHO) and other global intergovernmental organizations, the "big pharma" and some (NGOs (such as the Bill & Melinda Gates Foundation) (Nilsson, 2017; McCoy et al., 2009; Ollila, 2005).

Other global elements play a significant role at the global scale:

• the very recent experience of global epidemics has strengthened the demand of a global governance of basic health issues;

• the World Trade Organization (WTO) that is at the heart of the trans-national regulation of the pharmaceutical sub-sector;

• global NGOs (e.g., The Red Cross and Red Crescent organization, Medecins sans frontieres) are relevant for the functioning of healthcare, in particular in poorer countries and in specific conditions (wars, epidemics, disasters, etc.);

• tensions between actors (States, private companies, GOs, NGOs) supporting alternative discourses on healthcare and different visions on more specific issues (e.g., pharmaceutics patents and prices) take place at both the national and the global level.

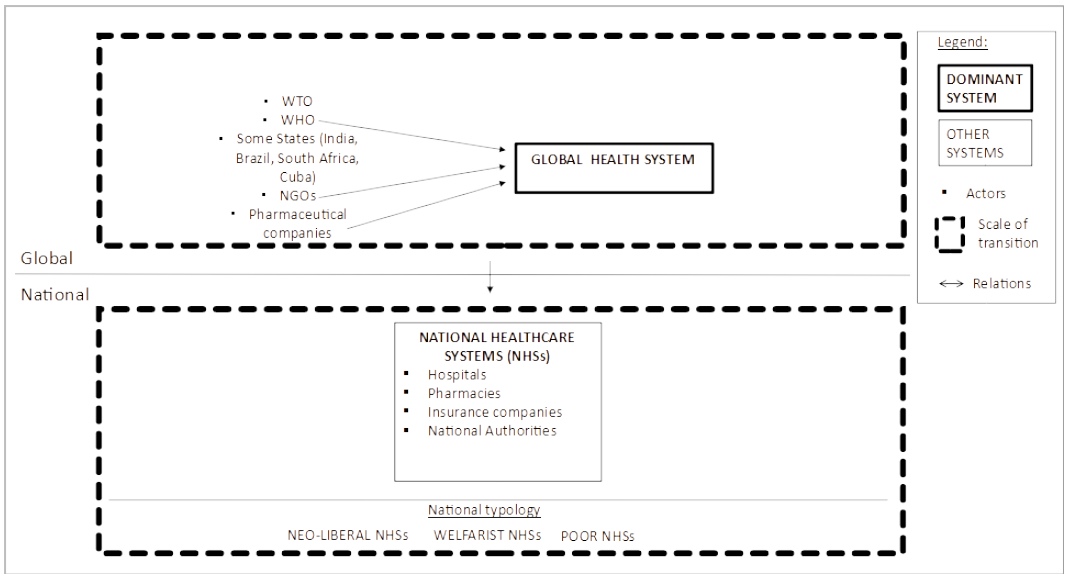
As a result of the combination between national norms and global influence a rough typology of NHSs can be sketched:

• Neo-liberal NHSs (e.g.: USA, Mexico, some South-Eastern Asian countries). In these NHSs private actors (pharma companies, private insurance, private managers of hospitals, pharmacies) play a key role. National States act as regulators and as residual funders or providers of services for the poor. The neo-liberal core discourse of these NHSs is also supported globally by the WTO;

• Welfarist NHSs (e.g. EU countries, Canada, Australia, Japan, India, Cuba, China). In this type of NHSs the State is the core actor, as both regulator and provider of services. Private actors play a more or less minor role, depending on the specific structure of each NHS. Some States (e.g., India and South Africa) also play as global actors against the neo-liberal approach to healthcare (in particular on pharmaceutical patents and prices, orphan diseases and drugs, neglected tropical diseases, etc.) (Gahlot and Krishnan, 2016).

• Poor NHSs (global South countries with weak national political institutions). In these – usually unstable – systems, States and global NGOs co-operate (or just co-exist) to provide some form of medical assistance to the population. Cuba is present in some of these NHSs as a foreign provider of healthcare services and products.

Fig. 2 – Healthcare: actors, systems and scale



3.3 Logistics

a. Short description

Logistics is about organizing and managing the movement of goods along supply chains. It is a derived activity so that its development is highly dependent on that of the geography of production and international trade.

Logistics is characterized by different transport segments, as well as storage and supply chain management activities, which are highly integrated with each other, but also with the production and, recently (e-commerce), consumption phases. Innovations in the sector therefore also have an influence on the organization of production and consumption patterns. In particular, containerization has enabled the development of integrated intermodal transport services and provided a strong boost to the globalization of value chains (reduction of transport costs). The integration of production and logistics is also associated with the development of lean production and just-in-time (stock minimization) (Rodrigue, 2020a).

The logistics sector is dominated by global logistics operators focusing on one or more stages of the supply chain (logistics services providers, shipping companies, port operators, etc.). However, national operators, in particular on specific stages of the supply chain (e.g. road hauliers, terminal operators, railway companies) keep a significant market share.

While containerization has enabled the standardization of transport for most goods, the liquid and solid bulk chains differ partially in terms of actors and techno-economic routines.

In addition to private operators, States play an important role as infrastructure providers and through direct (environment, safety, etc.) and indirect (tariffs and regulation of goods) regulation. Trade agreements within the WTO have greatly contributed to ease free trade and international freight transportation.

The political discourse within the sector is highly consensual and endorses free trade as a tool for economic growth. The sector is refractory to emerging green concerns (low adoption of green technologies, development of high environmental impact strategies).

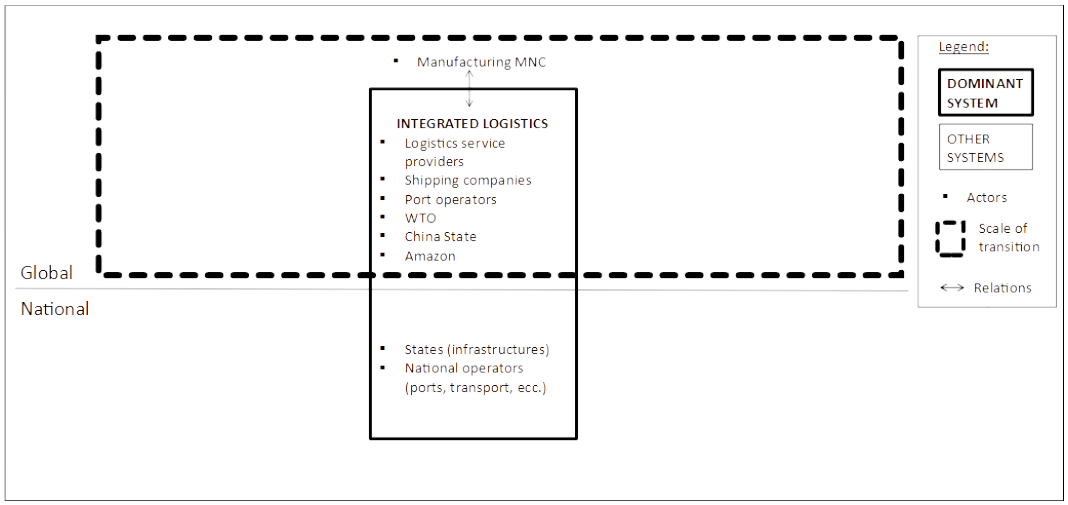
b. On-going changes

In recent years, the development of e-commerce, and in particular the disrupting entry of Amazon, has led to important changes in terms of practices and steering power. The fast delivery strategy developed by the company intensifies already existing trends (transport intensity, logistical sprawl) to unprecedented levels. In addition, Amazon is expanding its business to the transportation stages (Rodrigue, 2020b).

Another important trend is the expansionist policy of the Chinese State in the transport field. It articulates both in the rise to leadership positions of State-controlled shipping companies, terminal operators, etc. and in the development of infrastructure networks around the world as part of the Belt and Roads Initiative (BRI) (Flint and Zhu, 2019).

Finally, the Covid-19 pandemic and geopolitical crises (in particular the Russia-Ukraine war) have highlighted the limits of globalization and just-in-time (supply disruptions). In response, strategies of nearshoring (friendshoring may also develop in the future) and inventory enhancement (just-in-case) are appearing (WTO, 2021).

Fig. 3 – Logistics: actors, systems and scale



c. Note on sectoral transition and scale

Apart from residual forms of poorly integrated transport networks that persist in some Global South areas that are scarcely affected by globalization (Blaszkiewicz, 2021), the sector is characterized by a single multiscalar ST system. The ST transition of the sector is strictly dictated by global logic. Indeed, as far as national players (e.g. States as infrastructure providers) are relevant, they adapt according to a logic of competition within the global economic system (developing their own attractiveness as logistics hubs and industrial locations). Variations in the reproduction of the transport system at the national level are

mainly expressed in the production of intermodal transport systems adapted to geographical specificities (e.g. possibility to exploit inland waterways).

However, some ongoing trends – in particular the mistrust of some States towards the growing power of China and the consideration of the limits of globalization – may lead to an evolution of the international organization of production from global free trade to free trade within macro-regions. This could lead to a shift in transport networks (routes, modal splits) and possibly to diverging paths of development in the different macro-regions.

Currently, the adoption of green technologies or strategies in the sector is underdeveloped, but the deployment of technologies based on renewable energy or the implementation of pricing policies (fuel taxation, application of Emission Trading Schemes to transport) may have a major influence on the organization of the sector.

3.4 Tourism

a. Short description

Tourism can be considered as leisure travelling and – as such – it competes with other sectors (sport, entertainment, media, etc.) to fulfil the societal function of leisure.

With the exceptions of the 2007/2008 financial crisis and the 2020/2021 COVID crisis, tourism has experienced several decades of growth that – following all forecasting – will continue in the future (OECD, 2021).

Tourism is an economic activity realized through a chain of several services (transportation, hospitality, catering, etc.). Air companies and international hotel chains operate in highly concentrated global oligopolies.

The aggregation and brokerage of such services is an important part of the tourism sector and it is provided by specialized operators: tour operators and travel agencies. Tourism aggregation and brokerage are global oligopolies too.

The supply of global operators is complemented by a multitude of smaller national and local operators.

Tourism is also highly segmented: mass products (e.g. the seaside or the cultural tourism) stay together with specialized products (business, religious, wellness, sport, elderly, etc.).

The picture of the today tourism supply is completed by finance operators who are entering the sector, mostly in the hotel and internet-based industries, as majority or minority shareholders, respectively (UNCTAD, 2007).

Regulation – that usually takes place at the national level – has a marginal impact on this sector. Public authorities also contribute to the promotion of specific destinations and their tourism products.

The overall political discourse of environmental sustainability diffused in the tourism sector too, but with very limited impact on both tourism supply and demand (Shanks, 2009). The carrying capacity of destinations – and its regulation with alternative measures (quotas, fees, etc.) – can be considered as a tourism-specific issue of sustainability (Klaric et al., 2003).

b. On-going changes

The tourism sector has been radically changed by the entry of big global internet-based brokers and aggregators (such as Expedia, Booking, AirBnB, Trivago, etc.) who disrupted the traditional vertical relations between – on one side – tour operators and travel agencies, and – on the other side – air companies, hotels, car rental companies and other sellers of single tourism services (Heo, 2016). These new operators are able to integrate all tourism business at all scales:

- by imposing top-down business model that pushes local operators to a subaltern position;
- by importing artificial intelligence (AI) into the tourism sector with its effects in term of big data analytics and machine learning.

Also because of the disrupting entry of web platforms, the Web is nowadays the common technology of all aggregators and single service tourism operators.

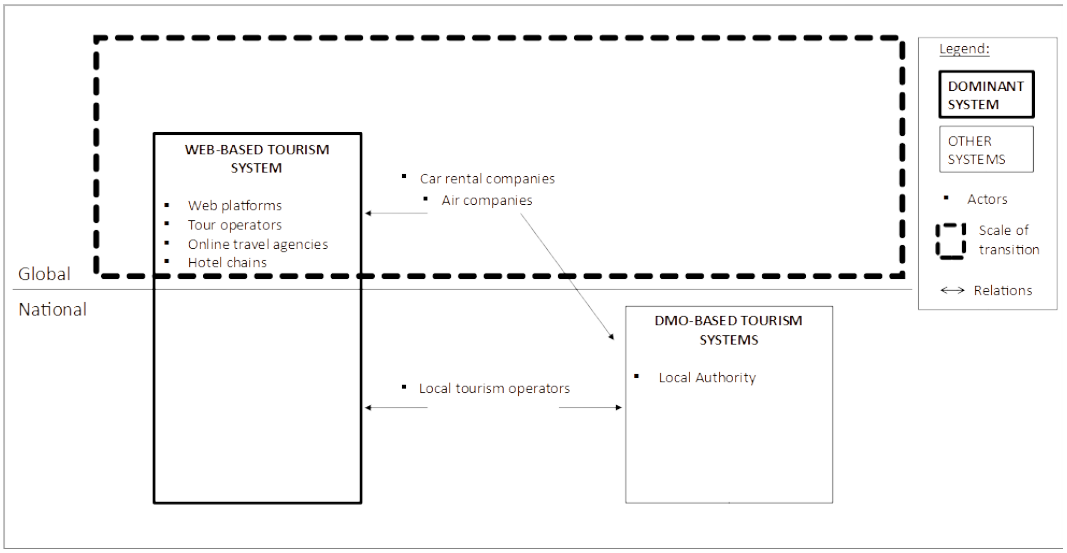
Some limitations to the power of web platforms may come from the stricter regulation of their activity (new global tax rules specifically designed for global internet platforms, national norms to limit their market power, etc.).

As a reaction to the entrance of web platforms, many other tourism operators are innovating their business routines; in particular: tour operators and big hotel chains are increasing their specialization on specific products or destinations; travel agencies are turning into web-based brokers (the so-called online travel agencies: OTAs); single service operators are transforming into web-based aggregators (e.g., the low-cost air companies).

Moreover, a new kind of operator has emerged: the so-called destination manager organization (DMO), which focuses on the creation of a local network of tourism operators, usually supported by some public authority (Volgger and Pechlaner, 2014). DMOs aim at becoming an aggregator and promoter of local tourism services that – through the web – is

able to both cooperate with global players (in particular, air companies and tour operators) and reach global demand.

Fig. 4 – Tourism: actors, systems and scale



c. Notes on sectoral transition and scale

The STT of the tourism sector largely takes place at the global level where most powerful actors operate (web platforms, tour operators, air companies).

Most of the tourism sector can be considered as a single and powerful multiscalar ST system featuring a common techno-economic routine based on the web-based aggregation of tourism services (and on the implicit political discourse of tourism for all) (Marletto and Franceschini, 2019). Even the so-called "alternative" or "sustainable" tourism is served by (specialized) operators that largely follow the same business routines of all other operators, while bringing along a very specific – and very marginal – political discourse (Weaver, 2014).

Such a ST system is led by global web platforms, while some internal defensive competition is acted by traditional tour operators that are trying to keep their position. The whole system easily reproduces at lower scales as no relevant limitation come from national

specificities. The only exception is given by much less powerful DMOs that operate at the local level and try to resist to global power.

Web platform, traditional tour operators and DMOs compete to attract into their commercial network all other tourism operators, in particular: air companies, car rental companies and local operators.

3.5 Urban mobility

a. Short description

Urban mobility is a set of transport services and infrastructures that are used to access urban functions and services. Most of urban mobility is provided by individually owned cars, while road and rail (i.e., tramways, metros, urban trains) collective transport plays a non-marginal role. Sharing schemes – that provide members with access to a vehicle for short-term use – the bicycle and pedestrian movements complete the picture (Marletto, 2014).

The use of urban space by transport activities is regulated by some public Authority. Urban areas can be dedicated to specific forms of mobility: pavements and pedestrian areas, bicycle lanes and paths, taxi and bus lanes, areas reserved for the circulation and parking of residents' cars, etc. Circulation and parking of all transport means is highly regulated too.

Most urban collective transport services are planned by some public Authority, who may also impose subsidized prices.

The reduction of the negative impacts of urban mobility (i.e., air pollution, traffic noise, congestion, etc.) is a shared goal that influence most policies; the reduction of car use and the diffusion of "ecological vehicles" (and in particular electric cars) are the more common actions.

b. On-going changes

Policy pressure in favour of the electric car has led to the entrance of new actors into the sector of urban mobility: producers of batteries, new automotive companies specialized on full electric vehicles, managers of electric grids (Dijk et al., 2013).

Policy pressure to reduce car use gave room to all sort of hard and soft measures of urban planning and transport policy that may ease the integration of all alternatives to the individually owned car: collective transport, sharing schemes and "soft mobility" (that is, bicycles+pedestrians) (Bristow et al., 2008).

Two other innovations with limited impact may be considered: the wide use of several web-based tools (e.g. to buy tickets or to use sharing schemes); the diffusion of automated driving (already used in rail collective transport, but only experimented for shared or owned cars) (Marletto, 2019). Both innovations may bring along the increasing relevance of web platforms into this sector.

c. Notes on sectoral transition and scale

The ST transition of the sector of urban mobility mostly takes place at the national and sub-national level where regulations are put in place. But the genesis of such regulations in turn depends on both:

• global factors, and in particular car companies (with their innovation routines and their ability to influence national agendas and actual policies) and the overall political discourse on sustainability;

• national and sub-national factors, and in particular policy routines (i.e., discourses, agendas, actual norms and policies) and local ST niches and grassroots initiatives.

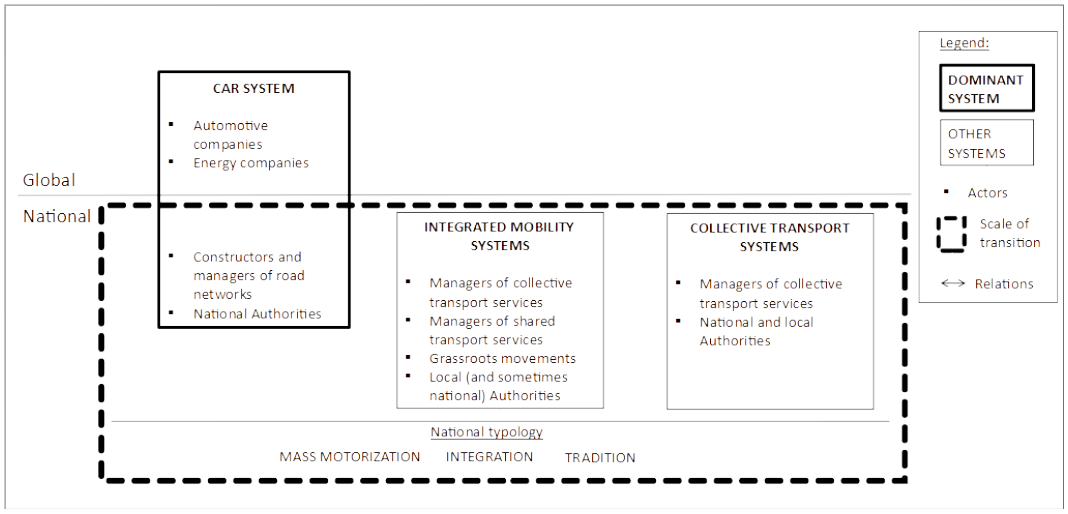
The actual configuration of urban mobility at the national level depends on the competition between three ST systems (Geels et al. 2012; Marx et al. 2015; Marletto et al., 2016, ch. 4):

• the multiscalar car ST system. This is a powerful and stable ST system, whose core actors are global automotive and energy companies (usually supplemented by national builders and managers of road networks) who are able to manage top-down interactions between their global strategies and national specificities. The car ST system is experimenting an internal reorganization to achieve electrification without giving up its traditional political discourse of individual free mobility;

• national ST systems of collective transport. Power and stability of these ST systems depends on the actual configuration of urban mobility at the national level: in most countries it is marginalized by the car ST system, in some other countries it is now a constituent of the wider ST system of integrated mobility (see below). Public or private managers of collective transport services and public authorities are their core actors. National Authorities play a relevant role as both regulators and funders; some managers of services are global companies. Horizontal international interactions are relevant (e.g. between managers of services, cities, etc.). Since its birth this ST system has been able to plug-in vehicles (trolleys, tramways, trains, etc.) to the electric grid, thus covering all propulsion technologies. This system has experimented a shift of its political discourse from the provision of a social service to the reduction of the negative impacts of mass motorization;

• national or sub-national ST systems of integrated mobility. These ST systems are usually enacted by some local network of public authorities, managers of collective and shared services and grassroots movements. The latter have played a relevant role as promoters (and actual actors) of specific transport services (e.g., the bicycle and carsharing schemes) and of new approaches to both transportation and urban planning (Marletto and Sillig, 2019). The power and stability of these ST systems mostly depends on the ability of their supporting networks to upscale from the local to the national level, with the aim of gaining greater political support and wider diffusion. The battle against the car is the core political discourse of these ST systems (usually supplemented by a discourse on urban liveability), making use of any technological or organizational innovation to reach the declared goal. Horizontal international relations are relevant for these ST systems too.

Fig. 5 – Urban mobility: actors, systems and scale



Three alternative national configurations result from the different combination between global, national and sub-national influence.

Type A: Mass motorization (most countries in the world). The car ST system is dominant. The ST system of collective transport features a marginal position as a service for very specific social segments (students, the elderly, immigrants, the poor). The ST system of integrated mobility is not relevant.

Type B: Integration (an increasing number of countries in the world). All alternatives to the individual car, including collective transport services, the bicycle and shared mobility services, are part of a local or national ST system of integrated mobility. In some cases, such ST systems are supported by the integration of transport and urban planning too. The car ST system is powerful but not dominating.

Type C: Tradition (poorer countries of the global South; some communist and post-communist countries). Formal and informal collective transport services serve the majority of the population. The car ST system mostly serves the richest. The ST system of integrated mobility is not relevant.

4 A sectoral taxonomy

Case studies show that in all sectoral ST transitions something relevant is happening at all scales. Then one may conclude that all ST transitions are multiscalar. But it is possible to go beyond such a somehow trivial consideration. To do this one may look at three key factors:

i. <u>At what scale operates the relevant ST systems and actors?</u>

Healthcare is the only studied case where ST systems are only national; that does not imply that there is no global influence, which instead comes from powerful global actors (pharma companies, NGOs and the UN WHO) and alternative global political discourses about healthcare (a social right vs a market).

The logistic sector features just one ST system which is multiscalar (i.e. global and national). Agrifood is the only studied sector where there is more than one multiscalar ST system; that imply that competition between ST systems take place at the global level too. In the two remaining cases (tourism and urban mobility) competition between a multiscalar ST system and some national ST system is apparent.

ii. <u>Multiple political discourses are at stake?</u>

Agrifood, healthcare and urban mobility sectors feature multiple political discourses. In the first two cases, the confrontation between political discourses takes place at both the global and the national level (i.e. it is multiscalar), while in the urban mobility sector it is rooted at the national and sub-national levels.

In the logistics and tourism sectors there is no political contention; even the trans-sectoral discourse on sustainability has marginal – and mostly facade – effects (greenwashing).

iii. Is national regulation relevant?

Urban mobility and healthcare are the two studied cases where national regulation has a relevant impact on the functioning of the sector, also because in both cases a public service logic is in force.

In the other three cases (agrifood, logistics and tourism) the prevailing reference to market and free trade logic led to a globalised sector, where national regulations are of little – when not negligible – relevance.

The joint impact of the sectoral articulation of the above key factors provides the basic blocks of a sectoral taxonomy of the relation between global influence and the national diversity of ST transitions. In particular, a typology of sectors can be built:

- type 2 sectors (such as healthcare and urban mobility, and possibly water provision and education) where the main impact of a limited global influence is the reduction of the national diversity of ST transitions to a typology;

- type 3 sectors (such as agrifood, and possibly energy) where the global scale is relevant as an arena of competition between ST systems and political discourses, but national diversity of ST transitions is still relevant;

- type 4 sectors (such as logistics and tourism, and possibly the Web/TLC and media/entertainment sectors) where any national diversity of ST transitions is almost completely wept out by the prevalence of the global scale and by the absence of political contention.

Moreover, it is possible to add:

- type 1 sectors (covering all core state activities, such as justice, defense, internal security) featuring a negligible level of global influence, and the highest level of national diversity of ST transitions.

Tab. 2 – A sectoral taxonomy of socio-technical transitions (STTs)

Type	Scale of the STTs	National variety of STTs	Stability of relevant ST systems	Power of relevant ST system	International interactions between actors	Sectors
1	National STTs with no relevant global influence	High It depends on national interactions	At the national scale	At the national scale	Mostly horizontal	Defense Justice Internal security
2	National STTs with some global influence	Medium (reduced to a typology) It depends on the combination between global influence and national interactions Global influence can be actor- and/or discourse-led	At the national scale	At both the global and the national scale	Horizontal and vertical	Urban mobility* Healthcare* Water Education
3	Multi-scalar STTs	Medium to low (reduced to a typology) It depends on the different reproduction of multi-scalar ST systems at the national scale, given national specificities	At both the national and the global scale	Mostly at the global scale	Mostly vertical (top-down and bottom-up)	Agrifood* Energy
4	Global STTs	Low It depends only on very specific barriers (e.g., language, geography, strategic issues, etc.)	At the global scale	At the global scale	Vertical (mostly top-down)	Media/Entertainment Web platforms/TLC Tourism* Logistics*

5 Discussion and conclusions

The sectoral taxonomy proposed here goes beyond the consideration of a STT as a multiscalar phenomenon, making explicit that multiscalarity can take multiple forms and that the resulting typology is sector-specific.

As already shown in Table 2 even if the taxonomy was built starting from a number of case studies, it may be easily extended to other sectors. As such, the proposed taxonomy can be considered as a heuristics for more sectoral analysis.

Moreover, the taxonomy may be used for dynamic analyses: the migration of sectors between types may be the specific object of more studies. One may verify if (and why) some sectors (such as healthcare and water) migrated from type 1 to type 2. Scenario analysis of some other sectors may be explicitly based on the taxonomy: the migration from type 3 to type 4 was implicitly considered in our previous study on the futures of the agrifood sector (Marletto et al., 2016); the reshoring option highlighted in the case study on the logistics sector is nothing but a migration from type 4 to type 3 (or even to type 2); the same applies to the (unlikely) structuration of destination manager organizations, as an alternative to dominant web-based tourism platforms. Moreover, one should use the taxonomy to understand if a STT migrate between types during its evolution, thus confirming what other scholars already found by using other multiscalar analytical tools (Dewald and Fromhold-Eisebith, 2015; Binz and Truffer, 2017; Heiberg and Truffer, 2021).

Last but not least, the proposed taxonomy may be used as a policy tool too. First, because it makes clear at which scale one should look for policy design and implementation: in type 1 sectors, policy may focus on the national level only; in type 2 and 3 sectors, the global level must be considered, together with a focus on the typology of national variations; in type 4 sectors, effective policies have to be global. Second, because the migration of sectors between types may be considered a policy goal; that applies to both directions: the increasing consideration of healthcare as a global social right may led to migration of the this sector from type 2 to type 4; the opening to political issues and contestation of logistics and tourism sectors may trigger their migration from type 4 to type 3.

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