Varieties of innovation and transition pathways in rural areas: A theoretical perspective to technology-, community-, and nature-based development

Markus Grillitsch, Rhiannon Pugh, Michal Miedzinski, Simone Sasso

Paper in Innovation Studies no. 2025/14

Varieties of innovation and transition pathways in rural areas: A theoretical perspective to technology-, community-, and nature-based development

Markus Grillitsch[1,2], Rhiannon Pugh[2,3], Michal Miedzinski[4], Simone Sasso[4]

Abstract:

Rural regions encompass a wide variety of contexts, often facing challenges such as population decline and ageing, or limited infrastructure and services. Yet, rural territories can also be unique places for experimentation and serve as sites of transformative, sustainability-oriented development. We contribute with the development of a theoretical perspective on rural transition pathways that connects rural pre-conditions across industrial, social, and ecological dimensions with distinct varieties of innovation—technological, community-based, and nature-based—and with system effects achieved through two key elements: change agency and rescaling. We identify four archetypes of transition pathways in rural areas: rescaling a rural niche, transforming an existing industry, a community-based pathway, and a nature-based pathway, and provide an empirical illustration for each. The archetypes capture variations of possible transition pathways grounded in theoretical differences in the processes leading to system change. As such, the archetypes are propositions regarding why and how sustainable and inclusive system change can occur in rural regions.

Keywords: rural development; science, technology and innovation; transition pathways; agency; rescaling; place-based policy; foundational economy; nature-based innovation; bioeconomy.

Acknowledgement: This manuscript resulted from work funded within the SINATRA (Sustainable Innovation and Transition pathways in Rural Areas) project of the Joint Research Centre of the European Commission. We thank experts at the JRC and representatives of the regions of Catalunya, Spain and Jämtland Härjedalen, Sweden for their input on draft versions of this paper.

---

[1] Department of Human Geography, Lund University

[2] CIRCLE – Centre for Innovation Research, Lund University

[3] Department of Design Sciences, Lund University

[4] Joint Research Centre of the European Commission, Seville

1 Introduction

Sustainable and inclusive development of rural areas has become a key topic in the public and scientific debate. This has been prompted by the realization that many of the rural regions are becoming increasingly "left behind". Growing socio-economic inequalities and exclusions affecting rural areas lead to profound social and political shake ups including voting for extremist parties, protests, and increasing sentiments of discontent (McCann, 2020, De Ruyter et al., 2021, Dijkstra et al., 2020, Pike et al., 2024, Tomaney et al., 2024, McGuinn et al., 2024). In this discourse, rural is often used interchangeably with peripheral, non-core, lagging, or left behind (Pugh and Dubois, 2021, Nilsen et al., 2023). Yet, in contrast to the notion of "left-behind" and "lagging", some rural regions have successfully developed transformative and sustainability oriented pathways (Chlebna and Mattes, 2020, Morales and Dahlström, 2023, Sotarauta et al., 2023, Suitner et al., 2023, Chaminade and Randelli, 2020, Pinzón-Camargo et al., 2022, Grillitsch et al., 2025). Furthermore, rural regions are not all the same. They display a wide range of differences in terms of their regional profiles, localised challenges, and pioneered solutions. Hence, rural regions are relative, evolving, and diverse (Pugh and Dubois, 2021, Nilsen et al., 2023).

It is this variety of rural contexts this paper steps into and asks: *How can transition pathways in rural areas be conceptualized? Which forms of rural transition pathways exist? Why and how do they differ?*

The notion of "transition pathway" depicts a process characterized by a sequence of events leading up to a system change. The logic of system change is that the complexity of required solutions to grand challenges transcends technological and market-oriented solutions and requires a "co-evolution of technologies, institutions and societal developments as sources for broader socio-economic changes" (Schwaag Serger and Palmberg, 2022, 150). Following this rationale, the focus of innovation and regional development policy is expanding to embrace a new paradigm that promotes green regional development (Tödtling et al., 2020), sustainable inclusive growth (Moujaes, 2023), and socio-technical change for addressing grand challenges through innovation policy (Isaksen et al., 2022). The hope is that transformative innovation will result in green and just regional path development (Eadson and van Veelen, 2023). These optimistic perspectives, however, offer limited insight on challenges faced by many rural areas, including depopulation and "shrinking" (Syssner, 2023) or limited infrastructure and services.

It is important to note also that pathways are increasingly entering the regional development parlance and have a strong precedence in the field of economic geography in a theoretical sense (Henning et al., 2013, Pugh et al., 2024b). The concept of path development is concerned with processes and dynamics surrounding the emergence and growth of new activities and industries at the regional level (MacKinnon et al., 2019). Path dependence has been employed to understand dynamics of lock-in and economic decline (Hassink, 2005), but also renewal (Tödtling and Trippl, 2004). Contemporary work in this area places a focus on change and new paths (Grillitsch et al., 2018), but also on the interdependence between path evolutions (Frangenheim et al., 2020). From its more academic roots, the concept of pathways has been employed in policy terms, for example being used by the Directorate-General for Regional and Urban Policy (DG REGIO) of the European Commission in a toolkit "supporting sustainability transitions under the European Green Deal with Cohesion Policy" (European Commission, 2021). Pathways are herein used instrumentally: nations or regions should formulate a vision,

operationalise a set of goals and then identify pathways to achieve these goals, translating pathways into a set of actions.

Against this backdrop, this paper contributes with a theoretical perspective on rural transition pathways, basing it on varieties of pre-conditions for transition pathways in rural regions, different types of innovation as drivers of change at the micro-level, and mechanisms for contributing to system change at the meso-level. To develop this theoretical perspective, we combine different streams of literature that help to identify broadly the conditions for sustainable development in rural areas drawing on insights from regional industrial path development (Hassink et al., 2019, MacKinnon et al., 2019), the foundational economy providing for the services and infrastructure covering basic human need (Henderson et al., 2024, Foundational Economy Collective, 2022), and literature on ecosystem services to cover the ecological dimension (Hasan et al., 2020, Millennium Ecosystem Assessment, 2005). As regards mechanisms of change, we take a bottom-up perspective introducing a broad view of innovation, including social innovation (Marques et al., 2018, Moulaert et al., 2013) and nature-based innovation, which is based on the literature on nature-based solutions (Seddon, 2022, Cohen-Shacham et al., 2016). We then argue that escalating such innovations to system effects in rural contexts and beyond necessitates a wider perspective on change agency (Grillitsch and Sotarauta, 2020, Kinossian et al., 2024) and rescaling dynamics (Grillitsch et al., 2024, Miorner et al., 2025), including for instance institutional entrepreneurship (Battilana et al., 2009, DiMaggio, 1988) and leadership (Sotarauta and Beer, 2021, Gibney et al., 2009).

The paper then identifies four archetypes of rural transition pathways, which are based on fundamental differences in the characteristics of the pre-conditions, the innovation processes, and the drivers of system change therein. These archetypes have been developed iteratively based on previous theoretical and empirical insights to identify plausible combinations of pre-conditions, innovation processes and drivers of system change. The framework and the archetypes developed were subsequently tested, further developed, and validated in collaboration with two European regions (Catalunya, Spain and Jämtland Härjedalen, Sweden), through a two-step approach. In March 2024, semi-structured interviews were conducted separately with representatives of regional governments and key stakeholders from each region, exploring whether the draft framework aligned, at least in part, with existing policy approaches to identifying rural transition pathways. The second step took place during a joint workshop with the two regions in May 2024, in participatory sessions structured around a canvas tool. The tool guided participants to articulate major sustainability challenges and a long-term vision for the rural areas of their region; to identify system change needed across the industrial, social and environmental dimensions; to specify required innovation activities to achieve these changes; to deliberate possible transition pathways linking these elements; and to define the research and innovation capabilities necessary to implement and sustain the identified pathways. The process situated prospective pathways within broader socio-technical and socio-ecological contexts and encouraged reflection on the place-specific capabilities shaping them.

The paper proceeds with introducing the theoretical building blocks of rural transition pathways in section 2 and continues thereafter with identifying archetypes of transition pathways in section 3. Section 4 provides the conclusion reflecting on the scientific and policy relevance of the paper.

2 Theoretical building blocks of rural transition pathways

This section conceptualises rural transition pathways as theories of system change with three distinct elements that result from i) rural pre-conditions, ii) varieties of innovation, and iii) system effects, each of which will be introduced below.

2.1 Rural pre-conditions for transition pathways

We embark from a broad conceptualisation of sustainability covering the economic, social, and environmental dimensions. However, we adapt this broader perspective of sustainability to better relate it to conditions that matter for transition pathways in rural areas and differentiate between the industrial, social, and ecological dimensions. These dimensions are not isolated and interact and overlap in different ways. Yet, differentiating between the three dimensions conceptually allows us to draw out the contributions on each dimension derived from the different literatures. We will define a spectrum of possible conditions by dimension and discuss challenges as shown in Table 1. On this basis, we will then reflect about possible transition pathways[1].

The industrial dimension encompasses the development of industrial paths in a particular rural context, which could range from manufacturing to service sectors like tourism, or extractive industries such as mining. Industrial paths capture processes of emergence, growth, renewal, and decline of industrial activities in regions (Hassink et al., 2019, Martin and Sunley, 2006, MacKinnon et al., 2019, Grillitsch and Hansen, 2019, Blažek et al., 2020). While covering sectors beyond manufacturing, the notion of industrial activities is here understood more narrowly than economic activities in general. This is to reduce the overlap with the foundational economy, which provides the services and infrastructure essential for the social dimension (see below). Furthermore, with the notion of industry, we also emphasise tradable economic activities, which tend to be embedded in global production networks and exposed to competition (Yeung and Coe, 2015, Henderson et al., 2002). Yet, rural contexts can also create conditions that protect tradable industrial activities from global competition. The latter would refer to a niche were some rural specificities created shielding conditions: for instance, the lack of infrastructure or connectivity can lead to local solutions for energy supply (e.g.: Simmie, 2012).

The social dimension focuses on the wellbeing of people in rural areas. This encompasses the opportunities for jobs and income as well as the provision of foundational infrastructure and services that are important for wellbeing (Hansen, 2022, Martynovich et al., 2021, Bentham et al., 2013). Bernard et al. (2023) suggest that the wellbeing of people depend besides labour market opportunities on the provision of public and private services, the natural and built environment, and opportunities for community and civic engagement. This implies that the social dimension is linked to the presence of industrial activities because industrial activities are providing job and income opportunities, which in turn influence migration patterns and the demography of the place, and thereby also the tax income available to local governance to fund

[1] To be sure, the below discussion refers to rural regions that are not suburban or residential areas of larger cities, this is to say we focus on rural regions that are not within the commuter belts of larger cities and thus lack the benefits (and disadvantages) that come with such proximity. We do this for conceptual reasons to shed light on the particularities of the rural areas.

foundational infrastructure and services. Social conditions also relate to services and amenities provided that ensure health, wellbeing, and community resources to people living in rural areas.

The ecological dimension centres around the land-use in rural contexts and its effect on ecosystem services (Hasan et al., 2020, Angeon et al., 2024, Collins et al., 2011). The ecological dimension relates to the industrial and social dimensions from a land-use and ecosystem services perspective. Ecosystem services have been classified in four types (Millennium Ecosystem Assessment, 2005): i) provisioning services which relates to tangible products such as food, fish, fiber, water, raw materials, minerals, etc. ii) cultural services covering intangible benefits related to for instance recreational, spiritual, or aesthetic experiences and values, iii) supporting services that are underlying functions enabling other services such as primary production (photosynthesis) or soil formation, and iv) regulating services that are important for the long-term functioning such as ecological dynamics, purification, and decomposition, or climate regulation. The ecosystem services are also multi-scalar with trade-offs and synergies where for instance provisioning services can serve a global industry/market at the expense of provisioning services locally.

Having defined the three dimensions of sustainability, we now frame typical rural pre-conditions for regional development in relation to these three dimensions. As we show below, industrial, social and ecological conditions in rural regions will often be interdependent. With an interest on developing productive capabilities in regions, we first zoom in on rural regions that have ceased to have industrial activities, never had industrial activities, or have very marginal and isolated industrial activities. These industrial conditions imply that such regions lack jobs and income opportunities, which tends to lead to depopulation, decline, and a feeling of discontent, being “left behind” and not to matter for the city elites (Economist, 2017, McCann, 2020, Rodríguez-Pose, 2018). The social problems associated with such decline can be severe and aggravated by difficulties to fund the public services needed for an aging population including health and elderly care. In addition, such regions will have low capabilities due to limited educational possibilities, outmigration and a lack of resources. As regards the ecological dimension, such rural areas will tend to have a low ecological impact. As people move out, depleted areas expand in such rural regions, which may lead to a rewilding of the ecological system. Due to the small human land-use impact, there is the potential for a breath of ecosystem services for the benefit of local people, which contributes also to regulating ecosystem services globally.

Second, we find rural areas that have developed a rural niche, related to the rural specificities of place. Hence, we are not talking about any niche but niches that emerge in the context of for instance the lack of connectivity, or specific rural social and ecological conditions. For instance, such niches may address local energy challenges facing a lack of connectivity to grids (e.g., Simmie, 2012) or may involve slow food where local ingredients and practices link local consumers and producers (e.g., Miele and Murdoch, 2002). Here, some local challenges are successfully addressed, and some jobs and income opportunities are created. Such rural regions could have an improved wellbeing as compared to the previous type of regions due to the successes of their developed niches. Industrial activities tend to remain, however, rather small scale and thus have a limited ecological impact both locally and globally. Ecosystem services will be relevant for local people but may also provide unique provisioning services for the niche and contribute to regulating services globally.

Third, there are rural areas that have a heavy industrial profile and are embedded in global production networks. Such regions often (but not always) extract and exploit natural resources

such as in mining, agriculture, fishery, or forestry or are a location of energy plants (e.g. nuclear or renewable energy). These economic activities are often conducted at a large scale and the main companies are often not locally owned. The industry is a source of jobs and income often beyond what the local labour market can provide, necessitating efforts to attract and retain workers. Challenges such as the reliance on a fly-in fly-out workforce or the competition for residential space and local services can emerge (Morales and Atienza, 2022, Stihl, 2022), potentially leading to conflicts with local stakeholders due to factors like rising costs and repercussions on other local activities. However, such industries can also become part of the regional identity. The land-use impact of these activities tends to be large where provisioning services are extracted for global industry/markets at the expense of ecosystem services locally and regulatory services globally.

Table 1: Typology of rural areas in relation to industrial, social, and ecological conditions

	Industrial conditions		
	Absence / very low level of industrial activities	Rural niche specific to a local context	Industry embedded in global production networks
Social conditions	Few jobs and income opportunities, depopulation, decline; often in places with natural attractions opportunities from tourism	Some local challenge successfully addressed, provision of jobs and income opportunities, improved wellbeing for small groups of inhabitants	Source for jobs and income, need for attracting labour, conflict potential with local stakeholders vs non locally owned firms; risk of local dependency on one company for local incomes
Ecological conditions	Low human land-use impact, rewilding, breath of ecosystem services for the benefit of local people, contribution to regulating services globally	Low human land-use, breath of ecosystem services for the benefit of local people, unique provisioning services for the niche and contribution to regulating services globally	Large human land-use impact, provisioning ecosystem services for global use at the expense of ecosystem services locally and regulatory services globally

The conditions in the different dimensions do not necessarily coincide as suggested in the table. For instance, due to automation, it may be the case that a heavy industrial specialisation does not provide many jobs and income opportunities. Similarly, there could be instances of a strong industrial profile with limited ecological impact, or rural areas heavily affected by climate change or pollution without having an industrial profile. Yet, conceptualising the industrial, social, and ecological dimension in this way reflects interlinkages between the dimensions and will become useful to discuss specific types of transition pathways, recognising that in any region combinations of such pathways may be possible.

2.2 Varieties of innovation

The idea that innovation can only strive in knowledge-intensive urban areas has been debunked (Eder, 2018, Shearmur, 2012, Pugh et al., 2024a). Embarking from the position that knowledge is the most fundamental resource and learning therefore the most important process for innovation (paraphrasing Lundvall and Johnson, 1994, p. 107), one of the first questions addressed was how firms located in rural regions could compensate for a lack of local knowledge spillovers (Johansson and Quigley, 2004). One mechanism to do so is to establish linkages outside the region, a mechanism which is accessible particularly for firms with strong in-house knowledge endowments (Grillitsch and Nilsson, 2015). Building such absorptive capacities in rural areas requires both retention and attraction of qualified staff from outside the region (Meili and Shearmur, 2019). Furthermore, in rural areas innovations tend to dominate in domains where information and knowledge decays slower (e.g. in engineering) than in domains where the decay is faster (e.g. in fashion) (Shearmur and Doloreux, 2016). Recent studies have gone beyond the idea of innovation "despite" being located in the periphery (emphasising compensation mechanisms) and suggest that the rural context can also have advantages for innovation (Glückler et al., 2022, Eder and Trippl, 2019). Among the advantages are that rural areas can protect firms from competition on labour markets and from knowledge leakage (Grillitsch and Nilsson, 2017). Yet, rural areas may offer also distinct advantages in terms of natural and cultural resources, giving room for creativity and experimentation (Grabher, 2018). Location in rural areas thus does not necessarily imply isolation as creative actors engage in translocal processes connecting the urban with the rural (Mathisen et al., 2024).

To capture the full potential of innovation in rural development addressing all dimensions of sustainable development, we advocate for a broad conception of innovation. Even though much emphasis has been placed on technological innovations in the last decades, the original use of the term referred to bringing about social and cultural change (Godin, 2012, Moulaert et al., 2017). While any innovation concerns the implementation of new (combinations) of ideas or knowledge leading to improved or new ways of doing things which add (economic or social) value, two necessary features distinguish technological from social innovations: the focus on a human need, and the promotion of inclusive social relations, often in the form of bottom-up collective initiatives. Furthermore, such initiatives often emerge because such needs are not sufficiently addressed by the market or public sector, and yet often addresses public domains concerning health, education, or care (Marques et al., 2018, Galego et al., 2022). Social innovations are considered important for regional development in rural areas (Castro-Arce and Vanclay, 2020). Rural areas provide for specific preconditions for social innovations, which encompass often a larger need due to a relative scarcity of resources, and tighter social relations that may facilitate the mobilisation of collective action and coordination between actor groups (Steiner et al., 2023).

Besides technological and social innovations, we suggest that innovation addressing the ecological dimension needs to be explicitly considered to arrive at a comprehensive understanding of transition pathways in rural areas. The concept of nature-based solutions speaks to this end, defined as "actions that involve people working with nature, as part of nature, to address societal challenges, providing benefits for both human well-being and biodiversity" (Seddon, 2022, 1). It concerns the sustainable protection, management, and restoration of natural and modified ecosystems (Cohen-Shacham et al., 2016, 4). The concept is rooted in the ecosystem approach and operationalises how ecosystem services can be maintained and enhanced through innovative action (Faivre et al., 2017). These actions are thought to be

“inspired by, supported by or copied from nature” (European Commission, 2015, 4). In a rural context, nature-based solutions have the potential to contribute to reducing people’s vulnerability to climate change (Woroniecki et al., 2023), and possibly also to providing sustainable economic opportunities (Maes and Jacobs, 2017). Putting emphasis on agentic processes designed to address societal challenges in rural areas, we slightly reframe the concept to “nature-based innovations”. Thus, while social innovations have the distinguishing features to i) address a human need and ii) entail inclusive social relations, we suggest that nature-based innovations i) positively affect ecosystem services, and ii) involve people engaging directly with nature.

2.3 System effects

In the theory of change proposed in this paper, innovation needs to be paired with other mechanisms to escalate into system change locally and beyond. In the context of local and regional development, Grillitsch and Sotarauta (2020) have argued that besides innovation, institutional entrepreneurship and place-based leadership are relevant types of change agency, which often complement each other. Institutional entrepreneurship is about changing existing or introducing new formal (e.g. laws and regulations) or informal (e.g. conventions and norms) institutions (DiMaggio, 1988, Battilana et al., 2009). It is widely acknowledged that institutions affect regional development processes (Rodríguez-Pose, 2013, Sotarauta and Pulkkinen, 2011) and the creation of new development paths (MacKinnon et al., 2022, Chlebna and and Simmie, 2018). Changing narratives, mindsets and worldviews, and breaking-up old coalitions of power opens the possibility for new directions and momentum in rural development (Rekers and Stihl, 2021, Uyarra and and Flanagan, 2022). Place-based leadership concerns navigating the interests of many actors, identifying and developing joint development objectives, and orchestrating and pooling competencies, resources and power to achieve these objectives (Sotarauta and Beer, 2021, Gibney et al., 2009). Place-based leadership makes collective action possible by bringing together the variety of actors relevant for regional development who operate under different institutional logics, have different interests, and capacities (Beer et al., 2019). The combination of the different types of change agency has turned out effective in a variety of global north and south contexts (Grillitsch et al., 2023, Hutchinson and Eversole, 2023, Pinzón-Camargo et al., 2022).

To capture the mechanisms producing system change beyond the concrete rural context, we suggest using an agentic perspective on the notion of rescaling, where actors engage to change rationales, conditions and relationships beyond the local scale and thereby influence wider systems. Rescaling captures a complex process in which spatio-temporal, socio-institutional, and techno-economic dimensions are entangled (Grillitsch et al., 2024). First, rescaling would entail a diffusion of the rural innovation in time and space, making the spatio-temporal dimension a necessary analytical angle. However, it also situates rescaling processes in a specific spatial and temporal context necessary to understand and explain a specific transition process (Martin and Sunley, 2022, Asheim, 2020). Actors and their possibilities to diffuse innovations are, however, constrained by technologies and institutional architectures (Hägerstrand, 1970), drawing attention to the other two dimensions.

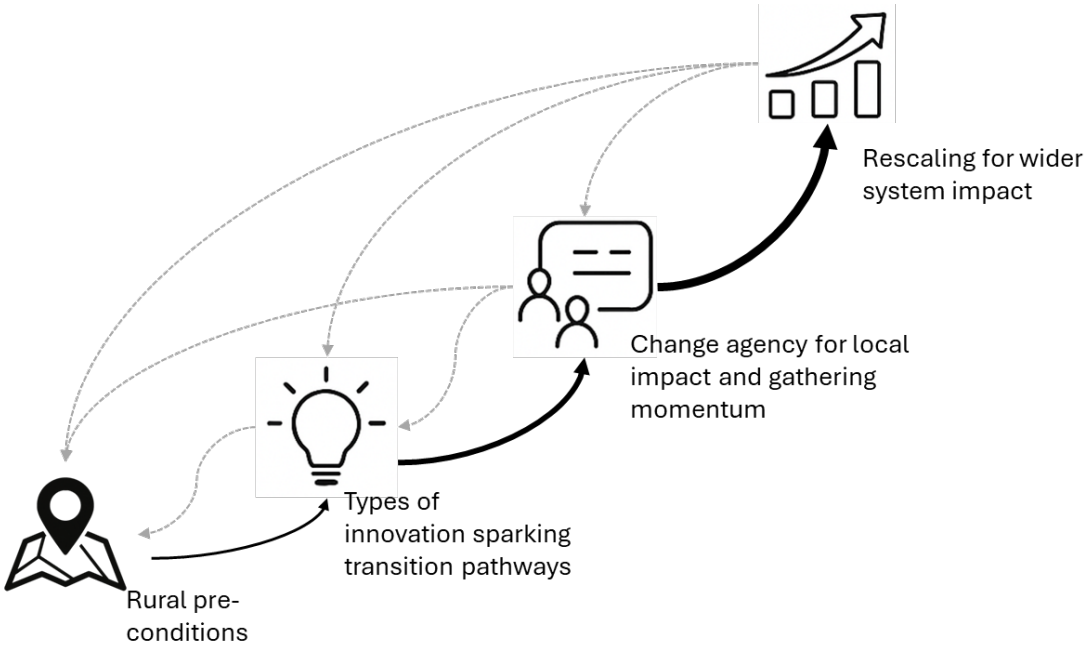
Socio-institutional rescaling concerns the engagement of actors to un(structure) informal and formal institutions and to (dis)integrate social practices (Fuenfschilling and Truffer, 2014). Local actors may engage at different scales to create a more favourable socio-institutional environment for the diffusion of the innovation produced in a local context (Simmie, 2012). In the literature, different mechanisms have been identified such as translating workable solutions in a

(rural) niche to workable solutions in other contexts and other scales (Smith, 2007), establishing conventions and standards based on the configuration that works in a local context (Roebke et al., 2022), or developing configurational templates that could be applied and other contexts (Miorner et al., 2025). However, while we foreground socio-institutional rescaling as agentic process, it is important to remind that external events outside the influence of local actors may shape the possibilities for rural innovations to diffuse (e.g. regulatory change at the EU level) (Coenen et al., 2014). Moreover, institutional change and discourses at or beyond the national scale can influence and actively be integrated by local actors to drive socio-institutional change and affect the direction of development (Roessler et al., 2025).

Techno-economic rescaling concerns changing the scale of economic activities, and economies of scale, which are based on choices of economic actors and the available technologies (Perez, 2009, Nelson, 1980). Relating this to the context of rural innovation, two main scenarios are thinkable: i) that the rather small-scale rural innovation can be upscaled, which would require further innovation in the product design and production process, and ii) that the configurations developed in the rural contexts are small-scale workable alternatives to other existing configurations, which are then replicated in adapted form in other contexts. In both cases, the techno-economic scale and potential rescaling would be a distinguishing feature of the transition pathway.

Figure 1 summarises transition pathways as theories of system change. Accordingly, the starting point for a system change is a specific set of rural pre-conditions. Considering industrial, social and ecological dimensions of rural realities, we argue that different types of innovation can spark a rural transition pathway. From there, we see the necessity of change agency to create system impacts locally, for instance, by coordinating actors, mobilising resources, or legitimizing a certain path. Wider system impacts are then realised through rescaling processes. The arrows from rural pre-conditions to rescaling illustrate transition pathways, acknowledging with the dotted lines that such processes should not be understood in a linear way and involve feedback loops.

Figure 1: Rural transition pathways



3 Rural transition pathway archetypes

We identified four archetypes of rural transition pathways by identifying plausible combinations of industrial, social, and ecological conditions (see section 2.1), different types of innovation (see section 2.2), and mechanisms for driving system change within and beyond the rural context (see section 2.3). Each archetype is based on previous theoretical and empirical research and made tangible with an empirical illustration from the literature. Even though this paper is mainly a theoretical and conceptual contribution, we would like to acknowledge valuable insights we gained from engaging with two regions as explained in the introduction. We claim that the identified archetypes represent plausible theories of system change in rural regions but open up the possibility that there are more variations, especially addressing the social and ecological dimensions where less previous literature exists.

We identify two technology-based transition pathways, one community-based and one nature-based transition pathway. The technology-based transition pathways concern the rescaling of a rural niche and the transformation of an industry. These pathways fit well with the green-growth idea articulated for instance in the European Green Deal. The community-based transition pathway addresses the social dimension and may fill a void where there is a lack of industrial activities, but it could also be conducive for creating viable social spaces more generally in rural areas. The nature-based transition pathway relates to the ecological dimension. Arguably, the largest possibilities for this pathway exist where few industrial activities are present, thus providing possibilities for re-naturalisation and rewilding, strengthening ecosystem services for the local population but also for contributing to global regulating services (see Table 2 for a summary).

3.1 Technology-based transition pathway 1: Rescaling a rural niche

The starting point for this transition pathway is a rural niche (see section 2.1), which is based on a technological innovation tailored to a specific rural context protecting it from global competition. The shielding from global competition can relate for example to shortcomings related to connectivity, infrastructure, or agglomeration economies, or to place-based community-driven dynamics. Rescaling can happen when an institutional change creates a larger market for the locally developed niche activities.

3.1.1 Empirical illustration

A case in point is the introduction of wind power technologies in Denmark (Simmie, 2012). Accordingly, many rural areas in Denmark lacked connection to grid supplied electricity in the beginning of the 20th century, and the supply of diesel for electricity generators was uncertain due to restrictions imposed after the second world war. The lack of connectivity and infrastructure in the rural areas created both a niche and demand for local solutions to energy generation. In the early phases of wind power technology development, innovative entrepreneurs played an important role with a first windmill for electric power generation constructed in 1891. What follows are a series of improvements of the wind power technology by pioneers aiming to develop wind power generators that could provide electricity at a scale and at a price that energy companies utility companies could accept and was commercially viable. In this phase, the pioneers travelled and sought inspiration from outside the region and

had university collaborations. Public funding was also important to realise the early attempts to develop wind power technologies.

For a long time, wind power generators fulfilled a niche function serving, e.g., for farmers and rural co-operatives, with some openings but also setbacks due to national and EU regulations. The barriers for the diffusion of wind power technologies against the dominant regime were formidable but through a combination of social engagement of niche actors and landscape change due to increasing concerns with climate change, the institutional landscape changed incrementally. This included legalizing the grid connection of approved wind turbines, provision of government subsidies, tax reliefs and feed in tariffs, regulation of wind power technologies and the development of complementary technologies. Based on incrementally developed technological advantages and complementary institutional developments, local firms could expand from the niche and become major global players in the emerging wind power industry.

3.1.2 Stylized transition pathway

Innovation
The innovation process is characterised by introducing and improving a technological innovation, which solves a problem in a narrow and small rural niche. The further development to make the innovations viable and competitive on broader markets often requires combinatorial knowledge dynamics where local expertise is complemented with specialized knowledge from outside the region, which increasingly also may include research-based knowledge from, for instance, research institutes and universities. In a later stage, when local actors work on expanding the niche, firms will engage in other innovation processes, for instance, process innovations to scale up production, or market and organisational innovations when accessing new markets. This requires complementary competences that neither exist within the local actors nor within the region.

Change agency
Niche expansion is expected to imply system change locally. Initially it may be a smaller number of inventive, innovative, and entrepreneurial actors who experiment with a local solution to the local challenge. However, very soon this endeavour will entail wider dynamics. This can relate to processes of gaining local legitimacy as well as mobilising resources to develop a local niche. Further, if the local actors are successful, and expand on global markets, this will have profound implications not only on the firms but also the local labour market. It will be one of the key challenges to attract talent to the region and retain it as niche expansion will typically go hand in hand with growing companies. This would often necessitate investments in public services and infrastructure to make it more attractive for workers to move to rural areas. The success of niche actors may be inspiring for others cultivating an entrepreneurial culture, and successful entrepreneurs may reinvest in other local initiatives and support new ventures with their experience and networks, possibly contributing to developing a rural “entrepreneurial eco-system” (Miles and Morrison, 2020). However, this success may also have downsides with rising labour costs and real estate prices. Local communities may feel marginalised and external actors may buy up local firms. External actors may come with fresh investments and new ideas but may also increase the risk of moving activities to other locations.

Rescaling
The rescaling process results from the interplay between local actors engaged in institutional work and a changed macro-institutional and economic context, which changes the conditions for expanding the niche to wider markets. Institutional work may target different actors at the

national and international levels to enhance legitimacy, support the emerging industrial path, remove regulatory barriers, and create a market. With the pace that this is possible, firms will need to engage in scaling up production, possibly establishing new collaboration and sites nationally and internationally. The rescaling process in this later phase will include the imitation of the formally niche solution by other extra-regional players and potentially acquisitions of larger companies with resources for sale-up and distribution. It is worth adding that rescaling would also involve the discontinuation of unsustainable or untenable practices, so it is not simply a case of upscaling a promising niche, but also involves downscaling other activities.

3.2 Technology-based transition pathway 2: Transformation of an industry

The rural preconditions for this transition pathway are established activities in globally connected industries, which are in the case of rural areas often but not necessarily related to natural resources, landscapes, and thereby to local ecosystems (see section 2.1). Examples of such industries are agriculture, forestry, tourism, mining, and fishing. Unlike rural niches that are shielded from global competition, actors in rural areas are in this case part of global production networks. Industry transformation then concerns changing existing industries.

3.2.1 Empirical Illustration

Jolly et al. (2020) provide an example of how and why the pulp and paper industry in Värmland/Sweden transformed towards the bioeconomy. Relatedly, Morales and Dahlström (2023) shed light on innovation processes in this region related to the implementation of regional development strategies (smart specialisation). Benefiting from a combination of forest resources, access to water resources and cheap energy, Värmland has an industrial history developing from sawmills to pulp and paper and recently to bioeconomy products. This industrial transformation resulted from a broader social change process, including institutional changes, efforts to reconfigure the local knowledge infrastructure, and finally rural innovation in new products and processes. The change process started in the late 1990s when local firms came under increasing cost pressure due to globalisation. The first step was a change in mindset from regional competition towards regional collaboration for global competitiveness, which manifested in the establishment of the cluster organisation Paper Province and subsequent initiatives aimed at fostering experimentation and testing. Also, local actors collaborated to strengthen the knowledge base by pooling resources to recruit professors to Karlstad University with the aim to enhance the contribution of higher education institutes to regional development.

This joining of forces enabled the mobilising of long-term funding for new bio-economy activities from the Vinnväxt programme of VINNOVA, the Swedish Innovation Agency. The more collaborative culture coupled with various initiatives such as the establishment of a demonstration plant, the reinforcement of the local university, and the bioeconomy programme stimulated innovation in new products and processes. These innovations contributed to technological upgrading where existing products and processes became more sustainable and diversified based on combinations of related and unrelated knowledge. An example is the large paper and packaging firm BillerudKorsnäv, which developed new renewable materials, semi-chemical fluting, liquid packaging board, and different waste streams to produce new materials. Another is Modvion, a firm that uses wood to build wind turbine towers instead of steel, thus reducing the emissions of new wind power installations.

3.2.2 Stylized transition pathway

Innovation

The innovation process underpinning this transition pathway refers typically to what has been termed combinatorial knowledge dynamics (Asheim et al., 2017). Firms and local industries build on existing capabilities and combine it with knowledge and insights from new domains. In the current transitions towards green and digital industries, this often requires complementing industry-specific knowledge with knowledge about new generic technologies, such as digitalisation, automation, and carbon-neutral production processes. This knowledge often needs to be accessed from outside the region, but local absorptive capacity is required. The innovations in products and processes will then either upgrade existing products and processes or diversify from existing activities towards related and unrelated fields.

Change agency

The pursuit of innovation to change existing industries may need to be accompanied with a shift in mindset about the existing industry, the redesign of practices, and the development of new competences. Firstly, it requires an awareness and acceptance that existing ways of working, which may be deeply rooted in the local identity, are no longer sustainable and need to be changed. Such a change in local mindset is typically resisted and requires institutional work to gain legitimacy. Secondly, to build up knowledge and learn for industrial transformations, it is often required to build new competence bases and create experimental spaces. Thirdly, the possibility recruit and retain a skilled workforce is often dependent on building an attractive living environment and provide some diversity in employment opportunities for men and women.

Rescaling

The rescaling process in this transition pathway relates to the green growth paradigm. Local production processes with a low environmental impact may be a competitive advantage, allowing firms to grow while reducing the industries' environmental impact. Another possibility would be the diffusion of the innovation so that production processes in other locations reduce their environmental impact. A prime example could be basic industries such as steel or chemicals, which are currently highly carbon intensive. Innovation to decarbonise these industries would play an important role in sustainability transitions. Yet, the levelling-up process is dependent on institutional conditions at the national and global scale.

3.3 Community-based transition pathway

The community-based transition pathway entails a social innovation tailored to the specific rural context, often related to the condition of sparsity and peripherality. Sparsity is a central issue in rural areas often leading to thin job markets, depopulation, and an aging population. This makes it difficult to provide for wellbeing and access to public services such as education, health, or elderly care. These challenges are typically exacerbated if there is an absence or low level of industrial activities (see section 2.1). Social innovation, often associated also with the notions of grassroots innovation or frugal innovation (Sheikh et al., 2024) contributes to solving the local challenges.

3.3.1 Empirical illustration

An interesting case of social innovation for rural regional development has recently been presented in the Nordics, where artists co-operatives engaged in change agency to revitalise rural communities. In research presented by Coenen (2023) two projects spearheaded by artists collectives in rural locales - Bromölla, Sweden and Rjukan, Norway – are credited with leveraging

social innovation to enhance environmental sustainability and revitalise place. Coenen couched these transformations in the language of responsible innovation (Schot and Steinmueller, 2018, Uyarra et al., 2019), seeing social transformation as a way in which local actors can take responsibility and take care of their place. Previously, a lot of the research around creativity and place development focused on cities as the nexus (e.g., Florida, 2003), however, what Coenen (2023), similarly to Hautala in the case of Finnish Lapland (2015), reveals is that the creative work of artists in rural areas can lead to profound place-centred development towards reimagined sustainable futures, with responsibility and care for a place at its heart.

In these cases, old industrial sites in areas that have experienced both industrial downturn and population loss are transformed to vibrant artistic and community spaces, breathing a new lease of life into them. Not only being artistic hubs, they also provide education and training, community centres, and suitability education, becoming local engines for different types of activities and knowledge transfer across the community. Partnerships between entrepreneurial actors (in these cases artists cooperatives), the public sector, and communities in rural areas led to transformations of rural areas in a social innovation mode. As Coenen (2023) explains, there are alternative ways in which innovation contributes to sustainable development in rural areas beyond green industrial transformations. Drawing on Morgan (2004), she posits that rural development in this case "can be considered intrinsically significant for place-based sustainability, such as education, well-being, sense of community, and care for environment, in contrast to development outcomes that are instrumentally significant, such as economic growth, business creation, and income".

3.3.2 Stylized transition pathway

Innovation

The community-based transition pathway is based on social innovation, which entails the development of inclusive social relations to address a human need. Inclusive relations typically entails that actors join from different groups within the local community. Local community members are best placed to know what the problems are for their area, and what the possible solutions might be. They might not have the resources to implement these solutions, but they contain the knowledge to find solutions in partnership. For social innovation to occur, there is often an organization (such as a collective, community group, event) to spark this work. This could also be small business collectives, chambers of commerce, local schools and colleges, or any other organization that sees the need to act in an innovative and entrepreneurial manner to improve conditions in the region.

Change agency

The embedding of social innovation in the local context may require developing a sense of responsibility and a change in social practices and mindsets. Mobilising and pooling resources helps to create a wider benefit to the local community, such as improving the local area by renovating and upgrading underused spaces, providing new services and meeting places for the local population, having more events and happenings. There can also be a knock-on effect whereby more people are attracted to come and visit the local area to attend events, exhibitions, frequent local cafes and shops, which spreads the economic benefits to other local businesses who benefit from more footfall and visitors to the area. When local people see that it is indeed possible to get social innovations off the ground, this can create a positive spirit and more impetus to drive further community-based innovation, spreading alternative narratives for rural development.

Rescaling

If we think about these social innovations in the wider geographical sense beyond the region in question, it is not as obvious to see rescaling dynamics as in the industrial paths. Social innovations are revolving around very local needs and networks, and stem from the local space and address the challenges and opportunities therein. Rescaling of social innovation can take the form of social movements, pushing for socio-institutional changes. A fitting illustration is the slow food movement that took of first in Italy and is now popular across Europe with many different local and community-based structures and initiatives to try to support local producers and consumers. Similarly, examples like the one we give here might inspire similar groups in other regions when they see success in one place. There are initiatives, such as the European LEADER programme, which link up smaller scale initiatives in rural regions on a wider European scale, providing funding and cross regional learning. Social innovations could potentially be imitated and adapted in other places.

3.4 Nature-based transition pathway

The nature-based transition pathway aims to deliver positive environmental and social impact, typically also combined with some sort of niche economic activities. Considering the different types of rural areas, those with no industrial activities or where industrial activities have left, and which are faced with depopulation will have abandoned spaces that provide plenty of opportunities for nature-based transition pathways (see section 2.1), potentially leading to re-naturalisation as promoted, for instance, by the recently passed European nature restoration law. We find some illustrative examples where regions have approached development from a strongly ecological perspective, and some of these attempted pathways are quite radical and transformational in nature.

3.4.1 Empirical illustration

A case in point is the rewilding the Southern Carpathian Mountains, Romania. Romania is a country that has been suffering from large gaps between the richer urban core areas (especially the capital regions) and the poorer rural regions. Whilst European membership has been positive for the country's economy overall, the gap between urban and rural has only widened, and there are significant challenges facing rural areas around stagnating economy, out migration, and ageing population. Many smaller settlements are being emptied, and small-scale farms being abandoned as the older generation disappears and the younger generation moves to cities or other countries for better work, study, and lifestyle opportunities, in a familiar process that has been witnessed in rural areas right across Europe (García-Cortijo et al., 2019). An interesting response to these intersecting problems for rural areas has emerged in the Southern Carpathians, hinging around a quite radical ecological approach of rewilding, seeing the abandonment of small farms and rural settlements as an opportunity to return the area to a more natural previous state and centre it in Europe's conservation efforts. As Dunford (2023) explains, the planned new wilderness protected area in the region will be one of Europe's largest, comparing it to Yellowstone in the US. As such the scale of the approach which will cover a significant proportion of the regions Nord Vest and Vest especially (200, 000 hectares).

With support from the EU through the LIFE Re-Bison project (see: https://life-bison.com/life-bison/), bison have been re-introduced to the region, as a keystone species which restores the landscape to a more natural state, thus fighting climate and environmental crisis (Kenny, 2021). In a classic case of change agency, the mayor of the town of Armenis saw an opportunity with the project to reintroduce Bison and a wider ecological approach to regional development to

bring tourism development and new ecologically focussed jobs to the area (Kenny, 2021). An integrated approach was needed because the region did not have a tourism industry and infrastructure previously, so locals needed help setting up accommodations, shops, restaurants etc to serve a touristic population (ibid.). Matei et al (2014) studied tourism in the region and their findings agree: in the post-communist era the demand for tourism businesses in the region has increased, including agritourism, requiring improvements in the quality of services provided there. Looking at the Carpathian Euroregion as a whole, not only Romania, Výrostová et al. (2021) do indeed see a positive economic impact of tourism development, but their data don't cover the recent years of large ecological programmes in the area which are likely to push the industry's development further. Not only local politicians, local residents started acting as philanthropists and set up a not-for-profit organisation (Foundation Conservation Carpathia) and started buying up tracts of lands in the area as part of an approach inspired by the famous Patagonia project of the Tompkins (Dunford, 2023).

3.4.2 Stylized transition pathway

Innovation

Nature-based transition processes entail nature-based innovation, i.e. people working with nature, inspired by nature, and as part of nature to strengthen ecosystem services, and contribute to human wellbeing. While abundant literature focusses on experimentation and participatory governance of nature-based solutions in urban areas, we currently lack a thorough understanding of the processes in rural areas that lead up to nature-based innovations. As compared to the other types of innovation, knowledge about biological processes and ecological systems will be necessary, which need to be combined with other types of knowledge that allow for sustainable local livelihoods. In the process of rescaling nature-based innovations, there might be couplings with other types of innovation, for instance technological innovations may come to use for monitoring and tracking changes in wildlife (e.g. drones and satellite imagery).

Change agency

The nature-based transition pathway will often entail a quite radical change from previous social practices, making it necessary that actors engage as institutional entrepreneurs and develop ecological narratives. It will be necessary to consider interests from different stakeholder groups, considering existing ways to make a living and traditional livelihoods, and coordinate and mobilise for nature-based development. If this is achieved, there is also potential to set up new niches and businesses related to the nature-based innovation, revolving, for instance, around eco-tourism or new nature-based products and services. In areas that have been experiencing out migration of younger populations, farm abandonment etc. there may not be a large entrepreneurial and small business population existing, nor individuals with much experience or orientation towards this. This may make it necessary for the municipality (or other organisations) to step in and offer some training and support to locals to develop nature-based and complementary innovations and businesses.

Rescaling

The rescaling dynamics in the nature-based transition pathway might be quite like the community-based ones we describe above because it also stems from very specific local circumstances, and usually impetus from the local level which initiates the change. However, this is not necessarily the case, and it can be international actors who step in and initiate rewilding process, such as we can see in the Patagonia region where it was American businesspeople buying up large tracts of land that went into creating the largest existing

wilderness protected area. This could cause resistance from local populations if it is felt a development path is being imposed onto the region from outside. There are networks that operate internationally, and on the European level, for nature-based innovations such as rewilding, and funding, expertise, and knowledge often come from global networks when it comes to these very specialist efforts. There is a window of opportunity for regions to establish themselves as experts in the niche and later sell their expertise and solutions to yet more regions who wish to follow a nature-based transition pathway.

4 Conclusion: Building a framework of transition pathways in rural areas

In the light of the pressing need for sustainable and inclusive development in rural areas, this paper contributes with conceptualizing rural transition pathways as theories of system change, which tie into different territorial contexts and reveal the variety and plurality of transition pathways available to different types of rural regions. Thereby, it brings the concept of transition pathway closer to empirical realities in rural regions and helps to strengthen the theoretical foundations for why, how, and under which conditions rural regions may develop in a sustainable and inclusive manner.

The paper is also relevant in the context of the call for a broader perspective for regional development beyond industrial dynamics and growth, to cover social and ecological dimensions (Miedzinski et al., 2022, Grillitsch et al., 2025). The proposed framework captures comprehensively the industrial, social, and ecological dimension and reflects on plausible combinations of pre-conditions rural regions may face along these dimensions. Embarking from such a comprehensive starting point, it becomes clear that transition pathways in rural regions may entail different types of innovation – technological, social and nature-based, as well as different types of mechanisms to rescale innovations to generate local and wider system impacts. The explicit focus on scale and rescaling offers an important lens for thinking about place-based development that connects micro-, meso- and macro-level development dynamics. Moreover, anchoring change and rescaling in an agentic perspective offers a valuable perspective on the role of local capabilities to realise different forms of rural transition pathways. In the paper, we thus explore variations of transition pathways in rural regions and identify four archetypes, which are summarised in Table 2[2].

[2] This paper is mainly a theoretical and conceptual contribution. However, we have also discussed the framework and the four archetypes with practitioners in the field in Catalunya, Spain and Jämtland Härjedalen, Sweden. In Catalunya, discussions underscored the challenge of reconciling territorial cohesion, green industrial transformation and the rural–urban interface, as well as the need to align science, technology and innovation investments with existing industrial strengths while addressing service and infrastructure deficits. In Jämtland Härjedalen, debates focused on the interplay between nature-based tourism, cultural heritage and renewable energy, highlighting the importance of combining technological innovation with the preservation of natural and social capital, and of multi-scalar governance to link local initiatives with national and EU-level resources. Notably, representatives of the local indigenous community questioned the role of innovation in driving sustainable transformation. Across both regions, the framework proved useful for structuring discussions across industrial, social and ecological dimensions, although its usability was seen to depend on adapting terminology to local contexts. The exercises also confirmed the value of starting co-creation from a shared vision and clearly defined challenges, and the necessity of integrating technological and non-technological innovation in rural transition pathways. These insights informed refinements to the framework, including clarifying the varieties of innovation, strengthening the role of governance and agency, and making explicit the sequencing from vision-setting to capability mapping.

Table 2: Archetypes of rural transition pathways

Transition pathway	Rural pre-condition	Innovation	Change Agency	Rescaling
Pathway 1: Rescaling a rural niche	Standard technological solutions inappropriate, creating opportunity and shielding for rural niche innovation	Technological innovation addressing a specific rural niche, broaden applicability over time	Development of local legitimacy and pooling of resources for diffusion	Engage in institutional work at other scales to develop a market, technological change to make upscaling possible
Pathway 2: Transforming an existing industry	Existing industrial activities in rural region, often related to key resources	Process and product upgrading, related or unrelated diversification, green transformation within existing value chains	Coalitions of incumbents, SMEs, HEIs and public intermediaries	Repositioning the cluster in national and global markets via standards, regulation and procurement; extend supplier networks and value-chain functions
Pathway 3: Community-based pathway	Sparse or peripheral areas with weak industrial base, service gaps and underused assets but civic capacity and place attachment	Social innovation in foundational services; cooperative and mission-driven business models	Community-led coalitions with municipalities and anchor organisations as convenors	Replication and diffusion through networks rather than firm scale-up; scale-out via federations, extra-local programmes and knowledge exchange
Pathway 4: Nature-based pathway	Low-intensity land use or land abandonment with high ecological value and amenity assets; limited industrial footprint and potential land-use conflicts	Nature-based innovation for restoration, rewilding, regenerative land use and eco-tourism	Alliances of local communities and authorities, landowners, conservation groups	Landscape-scale coordination; brands and certification

It is important to note that we are neither claiming that these archetypes are exhaustive nor that the suggested differentiation is the only way possible to capture the variety of rural transition pathways. Furthermore, we foresee the possibility, and even consider it likely, that different types of transition pathways co-exist, interrelate or are combined in concrete empirical realities of rural regions. The aim of articulating archetypes is to unfold the variations of possible

transition pathways grounded in theoretical differences in the processes leading to system changes. As such, the archetypes are propositions regarding why and how sustainable and inclusive system change can occur in rural regions. Our framework provides the opportunity to think about transitions regardless the normative or factual position of actors in concrete contexts. For instance, the industrial transition pathways tend to be aligned with green growth rationales, while the community-based and nature-based pathways are also in tune with de-growth rationales. Furthermore, we acknowledge the fact that many rural regions experience shrinking and must cope with the consequences of such a development (e.g. reduced tax base and possibilities to provide welfare services) (Syssner, 2023). In such cases, where there are few opportunities for industrial transition pathways, community- and nature-based pathways may contribute to enhanced wellbeing of the local population. The paper is thus a point of departure for future theoretical and empirical studies that can validate, reject, develop, or identify other varieties of transition pathways in rural areas.

From a societal perspective, the paper is relevant for policy actors in rural areas as it increases awareness about the different possibilities how system changes can be achieved for the benefit of people and planet. It helps regional stakeholders focused on rural development to consider alternative rural transition pathways mobilising often unappreciated opportunities and address context-specific challenges. Including industrial, social and ecological dimensions helps regional stakeholders to think about transition pathways in a systematic and comprehensive way (considering cross-sectoral links and wider implications of different paths). It helps demonstrate how different pathways can create different value streams for rural places, and through which mechanisms local and wider system impacts can be achieved. The approach does not predetermine a desirable pathway but rather invites a critical reflection on what is desirable by different groups and why. It helps create stronger shared understanding of rural development potentials and alternatives.

References:

ANGEON, V., CASAGRANDE, M., NAVARRETE, M. & SABATIER, R. 2024. A conceptual framework linking ecosystem services, socio-ecological systems and socio-technical systems to understand the relational and spatial dynamics of the reduction of pesticide use in agrifood systems. *Agricultural Systems,* 213**,** 103810.

ASHEIM, B. T. 2020. Economic geography as regional contexts' reconsidered – implications for disciplinary division of labour, research focus and societal relevance. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography,* 74**,** 25-34.

ASHEIM, B. T., GRILLITSCH, M. & TRIPPL, M. 2017. Introduction: Combinatorial Knowledge Bases, Regional Innovation, and Development Dynamics. *Economic Geography,* 93**,** 429-435.

BATTILANA, J., LECA, B. & BOXENBAUM, E. 2009. How Actors Change Institutions: Towards a Theory of Institutional Entrepreneurship. *The Academy of Management Annals,* 3**,** 65-107.

BEER, A., SARAH, A., TERRY, C., FABIAN, F., ALESSANDRO, S. & AND SOTARAUTA, M. 2019. Place leadership and regional economic development: a framework for cross-regional analysis. *Regional Studies,* 53**,** 171-182.

BENTHAM, J., BOWMAN, A., DE LA CUESTA, M., ENGELEN, E., ERTÜRK, I., FOLKMAN, P., FROUD, J., JOHAL, S., LAW, J., LEAVER, A., MORAN, M. & WILLIAMS, K. 2013. *Manifesto for the foundational economy,* Manchester, Centre for Research on Socio-Cultural Change.

BERNARD, J., STEINFÜHRER, A., KLÄRNER, A. & KEIM-KLÄRNER, S. 2023. Regional opportunity structures: A research agenda to link spatial and social inequalities in rural areas. *Progress in Human Geography,* 47**,** 103-123.

BLAŽEK, J., KVĚTOŇ, V., BAUMGARTINGER-SEIRINGER, S. & TRIPPL, M. 2020. The dark side of regional industrial path development: towards a typology of trajectories of decline. *European Planning Studies,* 28**,** 1455-1473.

CASTRO-ARCE, K. & VANCLAY, F. 2020. Transformative social innovation for sustainable rural development: An analytical framework to assist community-based initiatives. *Journal of Rural Studies,* 74**,** 45-54.

CHAMINADE, C. & RANDELLI, F. 2020. The Role of Territorially Embedded Innovation Ecosystems Accelerating Sustainability Transformations: A Case Study of the Transformation to Organic Wine Production in Tuscany (Italy). *Sustainability,* 12**,** 4621.

CHLEBNA, C. & AND SIMMIE, J. 2018. New technological path creation and the role of institutions in different geo-political spaces. *European Planning Studies,* 26**,** 969-987.

CHLEBNA, C. & MATTES, J. 2020. The fragility of regional energy transitions. *Environmental Innovation and Societal Transitions,* 37**,** 66-78.

COENEN, K. 2023. Creatively transforming periphery? Artists' initiatives, social innovation, and responsibility for place. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography,* 77**,** 47-61.

COENEN, L., MOODYSSON, J. & MARTIN, H. 2014. Path Renewal in Old Industrial Regions: Possibilities and Limitations for Regional Innovation Policy. *Regional Studies***,** 1-16.

COHEN-SHACHAM, E., WALTERS, G., JANZEN, C. & MAGINNIS, S. (eds.) 2016. *Nature-based solutions to address global societal challenges,* Gland, Switzerland: IUCN.

COLLINS, S. L., CARPENTER, S. R., SWINTON, S. M., ORENSTEIN, D. E., CHILDERS, D. L., GRAGSON, T. L., GRIMM, N. B., GROVE, J. M., HARLAN, S. L., KAYE, J. P., KNAPP, A. K., KOFINAS, G. P., MAGNUSON, J. J., MCDOWELL, W. H., MELACK, J. M., OGDEN, L. A., ROBERTSON, G. P., SMITH, M. D. & WHITMER, A. C. 2011. An integrated conceptual framework for long-term social–ecological research. *Frontiers in Ecology and the Environment,* 9**,** 351-357.

DE RUYTER, A., MARTIN, R. & TYLER, P. 2021. Geographies of discontent: sources, manifestations and consequences. *Cambridge Journal of Regions, Economy and Society,* 14**,** 381-393.

DIJKSTRA, L., POELMAN, H. & RODRÍGUEZ-POSE, A. 2020. The geography of EU discontent. *Regional Studies,* 54**,** 737-753.

DIMAGGIO, P. J. 1988. Interest and agency in institutional theory. *In:* ZUCKER, L. G. (ed.) *Institutional patterns and organizations: Culture and environment*. Cambridge, MA: Ballinger.

DUNFORD, J. 2023. 'A Yellowstone for Europe': Romania's ambition for a vast new wilderness reserve. *The Guardian*, 22.10.2023.

EADSON, W. & VAN VEELEN, B. 2023. Green and just regional path development. *Regional Studies, Regional Science,* 10**,** 218-233.

ECONOMIST, T. 2017. Left behind. How to help places hurt by globalisation. *The Economist.*

EDER, J. 2018. Innovation in the Periphery: A Critical Survey and Research Agenda. *International Regional Science Review,* 42**,** 119-146.

EDER, J. & TRIPPL, M. 2019. Innovation in the periphery: Compensation and exploitation strategies. *Growth and Change,* 50**,** 1511-1531.

EUROPEAN COMMISSION 2015. *Towards an EU research and innovation policy agenda for nature-based solutions & re-naturing cities – Final report of the Horizon 2020 expert*

group on 'Nature-based solutions and re-naturing cities', Publications Office of the European Union.
EUROPEAN COMMISSION 2021. Supporting Sustainability Transitions Under The European Green Deal With Cohesion Policy Toolkit for national and regional decision-makers. Luxembourg: Publications Office of the European Union.
FAIVRE, N., FRITZ, M., FREITAS, T., DE BOISSEZON, B. & VANDEWOESTIJNE, S. 2017. Nature-Based Solutions in the EU: Innovating with nature to address social, economic and environmental challenges. *Environmental Research,* 159**,** 509-518.
FLORIDA, R. 2003. Cities and the Creative Class. *City & Community,* 2**,** 3-19.
FOUNDATIONAL ECONOMY COLLECTIVE 2022. Foundational Economy: The infrastructure of everyday life, new edition. Manchester University Press.
FRANGENHEIM, A., TRIPPL, M. & CHLEBNA, C. 2020. Beyond the Single Path View: Interpath Dynamics in Regional Contexts. *Economic Geography,* 96**,** 31-51.
FUENFSCHILLING, L. & TRUFFER, B. 2014. The structuration of socio-technical regimes—Conceptual foundations from institutional theory. *Research Policy,* 43**,** 772-791.
GALEGO, D., FRANK, M., MARLEEN, B. & AND SANTINHA, G. 2022. Social innovation & governance: a scoping review. *Innovation: The European Journal of Social Science Research,* 35**,** 265-290.
GARCÍA-CORTIJO, M. C., CASTILLO-VALERO, J. S. & CARRASCO, I. 2019. Innovation in rural Spain. What drives innovation in the rural-peripheral areas of southern Europe? *Journal of Rural Studies,* 71**,** 114-124.
GIBNEY, J., COPELAND, S. & MURIE, A. 2009. Toward a `New' Strategic Leadership of Place for the Knowledge-based Economy. *Leadership,* 5**,** 5-23.
GLÜCKLER, J., SHEARMUR, R. & MARTINUS, K. 2022. Liability or opportunity? Reconceptualizing the periphery and its role in innovation. *Journal of Economic Geography,* 23**,** 231-249.
GODIN, B. 2012. Social Innovation: Utopias of Innovation from c. 1830 to the Present. *Project on the Intellectual History of Innovation, working paper 11* [Online].
GRABHER, G. 2018. Marginality as strategy: Leveraging peripherality for creativity. *Environment and Planning A: Economy and Space,* 50**,** 1785-1794.
GRILLITSCH, M., ASHEIM, B., LOWE, N., KELMENSON, S., FÜNFSCHILLING, L., LUNDQUIST, K.-J., MAHMOUD, Y., MARTYNOVICH, M., MATTSSON, P., NILSSON, M., MIÖRNER, J. & SCHUBERT, T. 2024. Rescaling: Change agency and the emerging geography of economic relationships. *Progress in Human Geography,* 49**,** 4-26.
GRILLITSCH, M., ASHEIM, B. T. & TRIPPL, M. 2018. Unrelated knowledge combinations: the unexplored potential for regional industrial path development. *Cambridge Journal of Regions, Economy and Society,* 11**,** 257-274.
GRILLITSCH, M. & HANSEN, T. 2019. Green industry development in different types of regions. *European Planning Studies,* 27**,** 2163-2183.
GRILLITSCH, M., LARS, C. & AND MORGAN, K. 2025. Directionality and subsidiarity: sustainability challenges in regional development policy. *Regional Studies,* 59**,** 1-13.
GRILLITSCH, M. & NILSSON, M. 2015. Innovation in peripheral regions: Do collaborations compensate for a lack of local knowledge spillovers? *The Annals of Regional Science,* 54**,** 299-321.
GRILLITSCH, M. & NILSSON, M. 2017. Firm performance in the periphery: on the relation between firm-internal knowledge and local knowledge spillovers. *Regional Studies,* 51**,** 1219-1231.
GRILLITSCH, M. & SOTARAUTA, M. 2020. Trinity of change agency, regional development paths and opportunity spaces. *Progress in Human Geography,* 44**,** 704-723.
GRILLITSCH, M., SOTARAUTA, M., ASHEIM, B., FITJAR, R. D., HAUS-REVE, S., KOLEHMAINEN, J., KURIKKA, H., LUNDQUIST, K.-J., MARTYNOVICH, M., MONTEILHET, S., NIELSEN, H., NILSSON, M., REKERS, J., SOPANEN, S. & STIHL, L. 2023. Agency and economic change

in regions: identifying routes to new path development using qualitative comparative analysis. *Regional Studies,* 57**,** 1453-1468.
HANSEN, T. 2022. The foundational economy and regional development. *Regional Studies,* 56**,** 1033-1042.
HASAN, S. S., ZHEN, L., MIAH, M. G., AHAMED, T. & SAMIE, A. 2020. Impact of land use change on ecosystem services: A review. *Environmental Development,* 34**,** 100527.
HASSINK, R. 2005. How to unlock regional economies from path dependency? From learning region to learning cluster. *European Planning Studies,* 13**,** 521-535.
HASSINK, R., ISAKSEN, A. & TRIPPL, M. 2019. Towards a comprehensive understanding of new regional industrial path development. *Regional Studies,* 53**,** 1636-1645.
HAUTALA, J. 2015. Interaction in the artistic knowledge creation process: The case of artists in Finnish Lapland. *Geoforum,* 65**,** 351-362.
HENDERSON, D., MORGAN, K. & DELBRIDGE, R. 2024. Mundane innovation in the periphery: the foundational economy in a less developed region. *Regional Studies,* 58**,** 2146-2157.
HENDERSON, J., DICKEN, P., HESS, M., COE, N. & YEUNG, H. W.-C. 2002. Global production networks and the analysis of economic development. *Review of International Political Economy,* 9**,** 436-464.
HENNING, M., STAM, E. & WENTING, R. 2013. Path Dependence Research in Regional Economic Development: Cacophony or Knowledge Accumulation? *Regional Studies,* 47**,** 1348-1362.
HUTCHINSON, D. & EVERSOLE, R. 2023. Local agency and development trajectories in a rural region. *Regional Studies,* 57**,** 1428-1439.
HÄGERSTRAND, T. 1970. What about people in regional science? *Papers of Regional Science Association,* 24**,** 7-21.
ISAKSEN, A., TRIPPL, M. & MAYER, H. 2022. Regional innovation systems in an era of grand societal challenges: reorientation versus transformation. *European Planning Studies,* 30**,** 2125-2138.
JOHANSSON, B. & QUIGLEY, J. M. 2004. Agglomeration and networks in spatial economies. *Papers in Regional Science,* 83**,** 165-176.
JOLLY, S., GRILLITSCH, M. & HANSEN, T. 2020. Agency and actors in regional industrial path development. A framework and longitudinal analysis. *Geoforum,* 111**,** 176-188.
KENNY, S. 2021. Where the wild things are: a trip to Romania's southern moutnains. *The Guardian*, 4.11.2021.
KINOSSIAN, N., GRILLITSCH, M. & NAGY, E. 2024. Agents of change in old-industrial and non-metropolitan regions of Europe. *European Planning Studies***,** 1-10.
LUNDVALL, B.-A. & JOHNSON, B. 1994. The Learning Economy. *Journal of Industry Studies,* 1**,** 23-42.
MACKINNON, D., ASBJØRN, K., STUART, D., MARKUS, S., SAMSON, A. & AND KENZHEGALIYEVA, A. 2022. Legitimation, institutions and regional path creation: a cross-national study of offshore wind. *Regional Studies,* 56**,** 644-655.
MACKINNON, D., DAWLEY, S., PIKE, A. & CUMBERS, A. 2019. Rethinking Path Creation: A Geographical Political Economy Approach. *Economic Geography,* 95**,** 113-135.
MAES, J. & JACOBS, S. 2017. Nature-Based Solutions for Europe's Sustainable Development. *Conservation Letters,* 10**,** 121-124.
MARQUES, P., MORGAN, K. & RICHARDSON, R. 2018. Social innovation in question: The theoretical and practical implications of a contested concept. *Environment and Planning C: Politics and Space,* 36**,** 496-512.
MARTIN, R. & SUNLEY, P. 2006. Path dependence and regional economic evolution. *Journal of Economic Geography,* 6**,** 395-437.
MARTIN, R. & SUNLEY, P. 2022. Making history matter more in evolutionary economic geography. *ZFW – Advances in Economic Geography,* 66**,** 65-80.

MARTYNOVICH, M., HANSEN, T. & LUNDQUIST, K.-J. 2021. Can Foundational Economy Save Regions in Crisis? *Papers in Evolutionary Economic Geography* [Online].
MATHISEN, T., JANSSON, J. & POWER, D. 2024. Female artists work and creativity in the rural: Beyond core and periphery. *Journal of Rural Studies,* 111**,** 103427.
MCCANN, P. 2020. Perceptions of regional inequality and the geography of discontent: insights from the UK. *Regional Studies,* 54**,** 256-267.
MCGUINN, J., CANTARELLI, A., KULESA, A., CARLETTI, G., LICHNER, I., TRUC, M., MÜLLER, M., HUDCOVSKY, M. & GLINIECKA, M. 2024. Rural areas and the geography of discontent. Brussels: European Committee of the Regions, Commission for Natural Resources.
MEILI, R. & SHEARMUR, R. 2019. Diverse diversities—Open innovation in small towns and rural areas. 50**,** 492-514.
MIEDZINSKI, M., COENEN, L., LARSEN, H., MATUSIAK, M. & SARCINA, A. 2022. Enhancing sustainability dimension in Smart Specialisation strategies: a framework for reflection. Luxembourg: Publication Office of the European Union.
MIELE, M. & MURDOCH, J. 2002. The Practical Aesthetics of Traditional Cuisines: Slow Food in Tuscany. *Sociologia Ruralis,* 42**,** 312-328.
MILES, M. P. & MORRISON, M. 2020. An effectual leadership perspective for developing rural entrepreneurial ecosystems. *Small Business Economics,* 54**,** 933-949.
MILLENNIUM ECOSYSTEM ASSESSMENT 2005. Ecosystems and Human Well-Being. Washington, DC: Island Press.
MIORNER, J., VASCO, S. & AND BINZ, C. 2025. How Transformative Innovations Travel: Tracing the Diffusion of Circular District-Scale Sanitation Systems in Europe. *Economic Geography,* 101**,** 93-121.
MORALES, D. & DAHLSTRÖM, M. 2023. Smart specialization and participatory processes in green path renewal. Analysis of the forest-based bioeconomy in sparsely populated regions in the Nordics. *European Planning Studies,* 31**,** 1734-1753.
MORALES, H. & ATIENZA, M. 2022. New path capture. Insights from the diversification process in mining regions. *The Extractive Industries and Society,* 11**,** 101091.
MOUJAES, G. 2023. Moving to Smart Specialization for sustainability: the implications on the design of monitoring indicators. *Science and Public Policy,* 51**,** 127-143.
MOULAERT, F., MACCALLUM, D., MEHMOOD, A. & HAMDOUCH, A. (eds.) 2013. *The international handbook on social innovation: collective action, social learning and transdisciplinary research,* Cheltenham, UK: Edward Elgar Publishing.
MOULAERT, F., MEHMOOD, A., MACCALLUM, D. & LEUBOLD, B. 2017. *Social innovation as a trigger for transformations – The role of research,* Brussels, European Commission Publications Office.
NELSON, R. R. 1980. Production sets, technological knowledge, and R & D: Fragile and overworked constructs for analysis of productivity growth? *The American Economic Review,* 70**,** 62-67.
NILSEN, T., GRILLITSCH, M. & HAUGE, A. 2023. Varieties of periphery and local agency in regional development. *Regional Studies,* 57**,** 749-762.
PEREZ, C. 2009. Technological revolutions and techno-economic paradigms. *Cambridge Journal of Economics,* 34**,** 185-202.
PIKE, A., BÉAL, V., CAUCHI-DUVAL, N., FRANKLIN, R., KINOSSIAN, N., LANG, T., LEIBERT, T., MACKINNON, D., ROUSSEAU, M., ROYER, J., SERVILLO, L., TOMANEY, J. & VELTHUIS, S. 2024. 'Left behind places': a geographical etymology. *Regional Studies,* 58**,** 1167-1179.
PINZÓN-CAMARGO, M. A., ORDOÑEZ-MATAMOROS, G. & KUHLMANN, S. 2022. Towards a path-transformative heuristic in inclusive innovation initiatives: an exploratory case in rural communities in Colombia. *Innovation and Development,* 12**,** 135-154.
PUGH, R. & DUBOIS, A. 2021. Peripheries within economic geography: Four "problems" and the road ahead of us. *Journal of Rural Studies,* 87**,** 267-275.

PUGH, R., FIL, K. I. & AND DUBOIS, A. 2024a. Innovation in the periphery: refresh! *Geografiska Annaler: Series B, Human Geography,* 106**,** 1-9.
PUGH, R., VAN VEELEN, B., LUNDMARK, M. & MARQUES, P. 2024b. At the intersection of economic history and contemporary regional development: insights from a Swedish 'bruksort'. *European Planning Studies***,** 1-18.
REKERS, J. V. & STIHL, L. 2021. One crisis, one region, two municipalities: The geography of institutions and change agency in regional development paths. *Geoforum,* 124**,** 89-98.
RODRÍGUEZ-POSE, A. 2013. Do Institutions Matter for Regional Development? *Regional Studies,* 47**,** 1034-1047.
RODRÍGUEZ-POSE, A. 2018. The revenge of the places that don't matter (and what to do about it). *Cambridge Journal of Regions, Economy and Society,* 11**,** 189-209.
ROEBKE, L., GRILLITSCH, M. & COENEN, L. 2022. Assessing Change Agency in Urban Experiments for Sustainability Transitions. *Environmental Innovation and Societal Transitions,* 45**,** 214-227.
ROESSLER, M., MARKUS, G., JOHAN, M. & AND SCHILLER, D. 2025. Shaping opportunity spaces: the role of narratives in place leadership. *Regional Studies,* online first**,** 1-15.
SCHOT, J. & STEINMUELLER, W. E. 2018. Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy,* 47**,** 1554-1567.
SCHWAAG SERGER, S. & PALMBERG, C. 2022. Towards transformative policy in Finland and Sweden: some viewpoints from practice. *In:* BENNER, M., MARKLUND, G. & SCHWAAG SERGER, S. (eds.) *Smart Policies for Societies in Transition*

Smart Policies for Societies in Transition: The Innovation Challenge of Inclusion, Resilience and Sustainability. Cheltenham: Edward Elgar Publishing.
SEDDON, N. 2022. Harnessing the potential of nature-based solutions for mitigating and adapting to climate change. *Science,* 376**,** 1410-1416.
SHEARMUR, R. 2012. Are cities the font of innovation? A critical review of the literature on cities and innovation. *Cities,* 29**,** S9-S18.
SHEARMUR, R. & DOLOREUX, D. 2016. How open innovation processes vary between urban and remote environments: slow innovators, market-sourced information and frequency of interaction. *Entrepreneurship & Regional Development,* 28**,** 337-357.
SHEIKH, F. A., RHIANNON, P., XIAOBO, W. & AND SARKAR, S. 2024. Regional studies and frugal innovation: a missing link? *Regional Studies,* 58**,** 893-905.
SIMMIE, J. 2012. Path Dependence and New Technological Path Creation in the Danish Wind Power Industry. *European Planning Studies,* 20**,** 753-772.
SMITH, A. 2007. Translating Sustainabilities between Green Niches and Socio-Technical Regimes. *Technology Analysis & Strategic Management,* 19**,** 427-450.
SOTARAUTA, M. & BEER, A. (eds.) 2021. *Handbook on City and Regional Leadership,* Cheltenham: Edward Elgar.
SOTARAUTA, M., KURIKKA, H. & KOLEHMAINEN, J. 2023. Change agency and path development in peripheral regions: from pulp production towards eco-industry in Lapland. *European Planning Studies,* 31**,** 348-371.
SOTARAUTA, M. & PULKKINEN, R. 2011. Institutional Entrepreneurship for Knowledge Regions: In Search of a Fresh Set of Questions for Regional Innovation Studies. *Environment and Planning C: Government and Policy,* 29**,** 96-112.
STEINER, A., CALÒ, F. & SHUCKSMITH, M. 2023. Rurality and social innovation processes and outcomes: A realist evaluation of rural social enterprise activities. *Journal of Rural Studies,* 99**,** 284-292.
STIHL, L. 2022. Challenging the set mining path: Agency and diversification in the case of Kiruna. *The Extractive Industries and Society,* 11**,** 101064.

SUITNER, J., HAIDER, W. & PHILIPP, S. 2023. Social innovation for regional energy transition? An agency perspective on transformative change in non-core regions. *Regional Studies,* 57**,** 1498-1510.

SYSSNER, J. 2023. What can geographers do for shrinking geographies? *Fennia - International Journal of Geography,* 200**,** 98–119.

TOMANEY, J., BLACKMAN, M., NATARAJAN, L., PANAYOTOPOULOS-TSIROS, D., SUTCLIFFE-BRAITHWAITE, F. & TAYLOR, M. 2024. Social infrastructure and 'left-behind places'. *Regional Studies,* 58**,** 1237-1250.

TÖDTLING, F. & TRIPPL, M. 2004. Like Phoenix from the Ashes? The Renewal of Clusters in Old Industrial Areas. *Urban Studies,* 41**,** 1175-1195.

TÖDTLING, F., TRIPPL, M. & FRANGENHEIM, A. 2020. Policy options for green regional development: Adopting a production and application perspective. *Science and Public Policy,* 47**,** 865-875.

UYARRA, E. & AND FLANAGAN, K. 2022. Going beyond the line of sight: institutional entrepreneurship and system agency in regional path creation. *Regional Studies,* 56**,** 536-547.

UYARRA, E., RIBEIRO, B. & DALE-CLOUGH, L. 2019. Exploring the normative turn in regional innovation policy: responsibility and the quest for public value. *European Planning Studies,* 27**,** 2359-2375.

VÝROSTOVÁ, E., HRABOVSKÁ, Z. & DIOBA, A. 2021. Tourism and regional growth in the Carpathian Euroregion – a panel data approach. *European Journal of Tourism Research,* 29**,** 2911.

WORONIECKI, S., A., S. F., ALEXANDRE, C., BETH, T., ISABEL, K., HASEEB, M. I. & AND SEDDON, N. 2023. Contributions of nature-based solutions to reducing people's vulnerabilities to climate change across the rural Global South. *Climate and Development,* 15**,** 590-607.

YEUNG, H. W.-C. & COE, N. M. 2015. Toward a Dynamic Theory of Global Production Networks. *Economic Geography,* 91**,** 29-58.