



Solving the restructuring problems of (former) old industrial regions with smart specialization? Conceptual thoughts and evidence from the Ruhr

Robert Hassink¹ · Matthias Kiese²

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Abstract (Former) old industrial regions are a specific kind of lagging regions that suffer from long-term restructuring problems and deindustrialization. They are back in the focus of many researchers as well as media observers, because of the rise of populist parties in many of these regions in North America and Europe. Therefore, new policy options are discussed in the literature. In this paper, we critically discuss the effects of smart specialization as the most recent regional policy strategy in Europe on solving the restructuring problems and deindustrialization in (former) old industrial regions and we illustrate our analysis with a view on the Ruhr in Germany. Since smart specialization focuses on existing endogenous potential and entrepreneurial discovery processes from the region, vested interests in (former) old industrial regions might hinder necessary restructuring. Although potentially path transformation might be fostered in some cases, overall, smart specialization is certainly not a quick fix for solving long-term negative effects of restructuring and deindustrialization in (former) old industrial regions.

Keywords Lagging regions · (Former) old industrial regions · Smart specialization · The Ruhr

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✉ Robert Hassink
hassink@geographie.uni-kiel.de

Matthias Kiese
matthias.kiese@rub.de

¹ Dept. of Geography, Kiel University, Kiel, Germany

² Dept. of Geography, Ruhr University Bochum, Bochum, Germany

1 Introduction

We live in times of increasing economic and political instability in large parts of the world. Politically, we can observe a surge of populism in many Western countries (Trump, Brexit, France), with ever-louder anti-establishment, nationalistic voices, particularly from (former) old industrial regions, such as the Rust Belt in the USA and Northern England (Rodrik 2018; Hobor 2013). Media reports show that deindustrialization and uneven development have been recently clearly linked to current times of economic and political instability, both between countries but certainly also between regions within countries (see for instance, Economist 2016). It has certainly led to a reviving interest in the Rust Belt, deindustrialization and its long-term consequences and the geographies of discontent both in the US (see for instance McQuarrie 2017; Trubek 2018) and Europe (Dijkstra et al. 2018; Rodríguez-Pose 2018).

Part of the problem, however, also lies in perceptions: “what arouses popular opposition is not inequality per se, but perceived unfairness” (Rodrik 2018, p. 18). Moreover, Rodríguez-Pose (2018, p. 204, 205) recently stated in this context: “... local inhabitants ... want opportunities rather than assistance and aid; they want a future rather than permanent support. It is in these circumstances when they feel at their most vulnerable ...” and went on that “territorial inequality, persistent lack of opportunities and incapacity and/or unwillingness to move are at the root of a resentment that is lightning the fire of territorially based populism. Withdrawing intervention in these areas will inevitably add fuel to the fire” (ibid., 204).

The restructuring of these (former) old industrial areas/regions and ‘Rust Belt’ economies, as a particular kind of lagging regions, have, in fact, generated much attention in economic geography (Hu and Hassink 2016; Bluestone and Harrison 1982; Martin and Rowthorn 1986). Studying the fall and necessary restructuring and adaptability of regional economies obviously has not only a long tradition in Europe and North America; more recently, we see also more and more studies in East Asia (see Hassink et al. 2018). Old industrial regions can be regarded as geographically concentrated mono-structural agglomerations dominated by either heavy and natural resource-based or light industries that structurally suffer from deindustrialization and high unemployment (Hu and Hassink 2016). The problems and legacies caused by old industrial regions in industrialized countries are persistent and can have long-term effects, even after the industries have largely disappeared, when they could be regarded as former old industrial regions. Some of the latter still suffer from the problems and legacies of the past, illustrated by for instance the impact of Rust Belt voters in the USA on the outcome of the 2017 presidential election, and of voters in former old industrial regions in Northern England on the Brexit referendum (Economist 2016). This voting behavior reflects the variety of economic trajectories that (former) rustbelt regions have taken in different dimensions: the shift of output and employment from mining and manufacturing to services, the transformation into innovation-driven knowledge economies (“structural change 2.0” according to Kiese 2019), and the resulting restoration of prosperity and employment opportunities for broad constituencies. Former rustbelt regions have progressed very differently along these axes. Where regions are situated on this continuum between old industrial

regions, still having a strong but declining old industrial base, and former old industrial regions, which have gone through a successful restructuring process, is thus an empirical question. By using (former) old industrial regions, we indicate that we are dealing with a broad category of regions, of which some can be seen as lagging regions, that is regions with below average economic and innovation indicators. Although the outcomes of restructuring processes in (former) old industrial regions differ strongly from case to case due to spatially specific preconditions, heterogeneous actions of agents and the different historically conditioned national political structures and varieties of capitalism in which these agents are embedded (Hassink 2010), some general theoretical concepts have been developed. In one way or another, many of the recent studies on (former) old industrial regions and their adaptability (for an overview, see Hu and Hassink 2016) point at the evolutionary terms *path dependence* and *lock-ins* as the main internal barriers to industrial restructuring (Grabher 1993; Hassink 2010). *Path dependence* refers to a process or system “whose outcome evolves as a consequence of the process’s or system’s own history” (Martin and Sunley 2006, p. 399). The related *lock-ins* are defined as the “... the idea that the combination of historical contingency and the emergence of self-reinforcing effects steers a technology, industry or regional economy along one ‘path’ rather than another” (Martin 2010, p. 3). Although these definitions are open-ended, as is also indicated by so-called positive and negative path dependence and lock-ins, most studies on old industrial regions and their adaptability refer to the negative ones, stressing lacking capacity of adaptability in regional economies due to their specific history (Hassink 2010). Recently, Blažek et al. (2020) shed new light on path decline by classifying this process according to the main underlying causes into three partly interrelated and overlapping types: path contraction, path downgrading and path delocalization. Particularly path contraction can be observed in deindustrializing old industrial regions.

Path creation, as another evolutionary concept used in relation to regional economic adaptability, can be an option to transform regional economies from a negative path into related but newly created paths (Martin 2010; Hassink et al. 2019). Most recently, *path transformation* is discussed in the context of old industrial regions and mature clusters (Chaminade et al. 2019; Baumgartinger-Seiringer et al. 2021). Baumgartinger-Seiringer et al. (2021, p. 161) define it as “radical, innovation-based forms of path development, where an established path and the regional support structures it is embedded in are undergoing major change”. Whereas path dependence, path creation, lock-in, often focus on those parts of a regional economy with a strong industrial specialization, such as clusters or industrial districts, *related and unrelated variety* is a concept stressing the advantages of specialization vs. diversity for the adaptability of a regional economy as a whole. On the one hand, variety is seen as a source of regional knowledge spillovers, measured by related variety (a high degree of technologically related sectors in a region). On the other hand, in the case of unrelated variety, variety is regarded as a portfolio protecting a region from external shocks (Frenken et al. 2007).

Given the recently changing circumstances, which policy solutions can be thought of to solve the specific problems of this kind of lagging regions and to what theories are they linked? On the one hand, theories stemming from geographical economics

are oriented towards equilibrium-thinking, and develop one-size-fits all, place-neutral (or spatially-blind) policy solutions (Barca et al. 2012). These theories have been criticized for not being sensitive to geographical differences (Martin 2011). Moreover, since they are strongly linked to the neoliberal capitalism that is in crisis, they are not considered to be in a good position to provide alternative models of development (Economist 2016). On the other hand, the above-mentioned evolutionary theories in economic geography, which are often based on heterodox economics, are arguably stronger, leading to tailor-made, place-based policy solutions (Barca et al. 2012; Barca 2019). Smart specialization can be clearly seen as the most recent place-based regional policy strategy that has been popular in Europe. However, apart from some recent papers on old industrial regions and smart specialization in Ukraine or other Eastern European cases without an EU policy (see Amosha et al. 2018; Shevtsova et al. 2020), so far little literature has been published on evaluating the potential impact of this policy strategy on the restructuring of (former) old industrial regions. One clear exception is the Basque Country, which is arguably the best-researched former old industrial region regarding both cluster and smart specialization policy. Following its successful transformation, the Basque Country is now one of the wealthiest regions with above-average innovation performance in Spain (European Commission 2021). Aranguren and Wilson (2013), for instance, focus on learning processes from clusters for the development of regional smart specialization in the Basque Country, whereas Estensoro and Larrea (2016) deal with the implementation of smart specialization. For other work on this region, see Morgan (2016) and Valdaliso et al. (2014), and for a broader discussion on lagging regions and smart specialization, see Barzotto et al. (2020). Surprisingly little has been written on smart specialization in the Ruhr, the largest former old industrial region in Western Europe.

In this paper, we therefore critically discuss the potential of smart specialization to solve restructuring problems of (former) old industrial regions. In Section 2, we will introduce the smart specialization policy strategy further and will also discuss on a conceptual level whether it can tackle the specific problems and issues in (former) old industrial regions. In Section 3, we will elaborate on a typical example of a former old industrial region, namely the Ruhr in Germany, and critically reflect on the contribution of smart specialization to structural change in that region. Section 4 will provide some conclusions and outlook on further research.

2 Smart specialization policy and the restructuring of (former) old industrial regions

2.1 Smart specialization: an introduction

Smart specialization has been receiving strong academic and political attention recently (Radosevic et al. 2017; Fellnhöfer 2018), not only in Europe, but also internationally thanks to support from the OECD (2013) and the World Bank (Aprahamian and Correa 2015). Within a few years, the number of publications has exploded,

both concerning policy reports, white papers with recipes on how to develop a smart specialization strategy, books, as well as journal articles (Fellnhöfer 2018).

Smart specialization has a conceptual and policy strategy meaning. First, its conceptual meaning encompasses “the capacity of an economic system (a region for example) to generate new specialities through the discovery of new domains of opportunity and the local concentration and agglomeration of resources and competences in these domains” (Foray 2015, p. 1). Secondly, it is foremost an influential policy strategy, which emerged due to thoughts developed by the Knowledge for Growth Expert Group (Foray et al. 2009) on how to explain and reduce the productivity gap between the USA and the EU. They identified two main weaknesses in Europe: national-level fragmentation of public research systems and the duplication of knowledge bases, as many regions focus on the same high-tech industries (Foray 2015, p. 10, 11). The rationale of smart specialization is to build on existing industrial structures in regions and to transform them with the help of new, but related explorative research activities (Foray 2015, p. 11). The latter should have the potential to transform existing regional economic structures. That is to say, smart specialization is not about more of the same, but more about R&D and innovation in existing sectors (Foray 2015, p. 11). The strategy is defined as a policy process that should lead to the selection and prioritization of domains (fields or areas) that are part of a cluster in which entrepreneurs play a key role as they are supposed to discover the appropriate domains for the future (Foray et al. 2011, p. 7). In a similar vein, Foray (2015, p. 2) states that well-timed and targeted governmental intervention is key in this process as it is supposed to select the most promising new activities, which should lead to spillovers and structural changes in the regional economy. It is not only about having an important industry in a regional economy (such as alpine industry in a tourism region), but about smart diversification with the help of general-purpose or key enabling technologies, so that existing industries become more competitive (e.g., ICT application in the alpine industry) (Foray 2015).

These strategies, officially called Research and Innovation Strategies for Smart Specialization (RIS3), were introduced as an ex-ante conditionality for receiving support from European Structural and Investment Funds for the 2014–2020 funding period (Landabaso 2014), aiming at a paradigm shift in the structure of regional innovation policies. Each region should “identify transformation priorities that reflect and amplify existing local structures and competences, and thus produce original and unique competitive advantages” (Foray 2015, p. 2). They emerged in the increasingly popular framework of place-based policies (Barca et al. 2012), in which geographical context, consisting of social, cultural and institutional elements, matters and policy intervention should include the participation of a broad group of actors, avoiding social exclusion and unevenness. They potentially can solve the problem of too standardised, one-size-fits-all regional innovation policies (Tödtling and Trippel 2005). They therefore consist of an integrated, place-specific and place-sensitive agenda for economic change, focusing on specific strengths, competitive advantages and the performance potential of a country or region as a starting point, trying to strengthen regional diversity and take into account the differences between “leader” vs. “follower regions” (Foray et al. 2009, p. 27). They are also open to support for all sorts of innovation (beyond just technological) and the involvement of

a broad range of innovation actors in the strategy development and priority setting. The entrepreneurial discovery process is a core element of the strategy.

Entrepreneurial discovery is defined as a process in which entrepreneurial actors (both firms and non-firm actors, such as researchers at universities and public research establishments) in a region explore and discover new and innovative activities. Such a ‘domain’ leads to innovation and transformation of the regional economy in turn. In some cases, this involves strategic interaction between the government and the private sector (Foray et al. 2009, p. 26; Aranguren et al. 2019). Regional actors involved in an entrepreneurial discovery process can stem from a certain cluster or industry, but not necessarily so. Entrepreneurs and researchers, in particular, as the main initiators of the entrepreneurial discovery process, are regarded as the main source of information for the direction of smart specialization, not administrators, politicians and policy-makers (Foray 2015, p. 3). In the next funding period (2021–2027), the ex-ante conditionality will be replaced by a set of more specific fulfillment criteria (Benner 2020) and the focus might be stronger on “the green dimension of Smart Specialisation ... in line with the European Green Deal” (Landabaso 2020; without page number).

2.2 Critical issues around smart specialization for (former) old industrial regions

Recently, Hassink and Gong (2019) asked six critical questions about smart specialization, which provoked reactions by Foray (2019) and Benner (2020). Some of these critical issues, such as the overlap with and recycling and/or relabeling of cluster policy, apply to all kind of regions, but some issues are particularly relevant to (former) old industrial regions. We will refer here only to the latter.

2.2.1 Fuzziness

First, the concept suffers from fuzziness around what is meant by specialization, an issue particularly pertinent in highly specialized old industrial regions. Moreover, such fuzziness is particularly problematic when the concept is put into policy practice. According to several evaluation reports on the early implementation of the smart specialization strategies in regions (Capello and Kroll 2016; Gianelle et al. 2020), many local actors, be they entrepreneurs, policy makers, or opinion leaders, have difficulties in fully understanding the concept. Misinterpreting smart specialization for further specialization in regional economies that so far suffered from it, such as mono-structural old industrial areas and company towns, could lead to the wrong strategies further diminishing the prospects of those economies. Therefore, the plurality of terms used in the literature, and particularly the lacking distinction between specialization and diversification, will only lead to further confusion, as most policy implementers lack the capability to interpret or translate them correctly (Hassink and Lagendijk 2001).

2.2.2 *Entrepreneurial discovery process: a transformative hope or a lock-in trap?*

According to smart specialization, countries and regions should identify strategic ‘domains’ of existing and/or potential competitive advantage, where they can specialize and create capabilities in a different way compared to other countries and regions (Asheim 2019), thus fostering structural change. According to Foray et al. (2011), such structural change takes four forms: transition, modernization, regional diversification, and radical formation. Transition refers to the fact that a new domain can emerge from the existing industrial commons (the collective R&D, engineering, and manufacturing capabilities that sustain innovation). Modernization refers to the development of specific applications of a general-purpose technology that have a significant impact in terms of efficiency and quality in an existing sector. Regional diversification indicates the development of a new line of productive activity based on regional assets. A fourth pattern involves the radical formation of an entirely new and distinct domain within a region. Such radical foundation involves the co-emergence of an R&D/innovation activity and the related business activity. Therefore, transforming the economic structure of a region is one of the key aims of the smart specialization strategy.

The transformative hope of smart specialization, according to Foray (2015), lies in the potential of individual entrepreneurial discovery processes to contribute to the rest of the regional economy with the help of knowledge spillovers. If used properly, the entrepreneurial discovery process is a useful tool for identifying sectoral competitive advantages in regions. In reality, however, such a transformative hope towards a better economic structure is most often turned into a delusion if one considers: 1) the vested interest groups that need to be incorporated in this process, and 2) the geographical diversity of entrepreneurship in many countries and regions (Fritsch and Storey 2014; Stuetzer et al. 2016). According to Sotarauta (2018), selecting entrepreneurial discovery processes is not just a technical process of selecting industries that contain competitive advantages, but a very complicated social and political process, where issues such as power, political and bureaucratic rationality, vested interests of different groups, etc., need to be taken into account (see also Kiese and Wrobel 2011; Magro and Wilson 2019). Similarly, Grillitsch (2016, p. 22) states that “picking winners, rent-seeking behaviour, corruption and lock-ins ... are typically associated with place-based policies, such as smart specialisation”. A lack of hard institutions, good governance and political goodwill will jeopardize the good intention of smart specialization policies (Rodríguez-Pose et al. 2014). Moreover, the presence of regional differences in terms of entrepreneurial culture, as well as the dynamics of new firm formation within Europe and beyond also make the transformation in certain regions with low level of entrepreneurial activities very difficult (see for instance Dodd et al. 2013).

The second critical aspect concerning entrepreneurial discovery process is whether this process will lead regions to lock-out from negative path dependence (Martin and Sunley 2006) or regional lock-ins (Martin 2010; Hassink 2010), phenomena that can be particularly observed in old industrial regions (see Section 1). While RIS3 rests on the assumption that entrepreneurial discovery processes will lead regions to lock out of negative path dependence, the decision-making and do-

main-selection activities of local stakeholders are often influenced by rent-seeking behavior and hence lead to negative lock-ins (Boschma 2014). The latter threat is particularly relevant due to the focus of smart specialization on pre-existing economic structures. There are plenty of examples of old industrial areas, which have been suffering from all kind of lock-ins hindering transformation, diversification and modernization (Hassink 2010). Potentially negative lock-ins might be worsened by local myopia (see Uyarra et al. 2018), and this shows why non-local resources are key to avoid them (Boschma 2014, p. 7). In theory, local stakeholders are supposed to look for resources, technologies and competencies both within and outside of the region. This is also stressed by Rodríguez-Pose et al. (2014, p. 10) as they state that the smart specialization approach is expected to help “inefficient regional administrations become accustomed to external connections and be confronted with practices and experience coming from outside, challenging inertia and clientelism which prevail in locked-in systems”. Even though geographical openness (pipelines) is potentially important for the entrepreneurial discovery process, in practice, however, the geography of smart specialization is still predominantly local. This is because local political stakeholders are supposed to strengthen existing structures and have a strong interest in keeping the money in the region (this is similar to cluster policy, see Schmidt et al. 2018). Moreover, many local political stakeholders lack sufficient knowledge about the international competitive position of local activities, leading to suboptimal decisions from an international, competitive point of view. Recent empirical research confirms the problem of local myopia (Iacobucci and Guzzini 2016; Radosevic and Stancova 2018).

Third, and related to the earlier discussion on lock-outs and lock-ins, it is questionable if structural change should only be achieved by incremental structural change that is related to existing structures. In fact, recent literature on unrelated variety and unrelated knowledge combination both in peripheral and core regions provides some counter evidence (e.g., Asheim 2019; Neffke et al. 2018; Asheim et al. 2017). Neffke et al. (2018), for instance, argue that the unrelated diversification required for structural change mostly originated via new establishments, especially via those with nonlocal roots. Asheim (2019) claims that a long-term perspective is necessary to promote fundamental structural changes in the economy through transformative activities as part of a RIS3 strategy. Only applying a short- and medium-term perspective limits the scope for new policy initiatives. It thus reduces the potential for promoting economic activities that have higher knowledge and technology complexity than previous industries, but are less related to the region’s existing knowledge base. Moreover, the applications of general-purpose technologies, such as artificial intelligence, to (traditional) economic sectors is in many cases still in an embryonic stage, and hence not fully occupied by core regions yet, leaving the windows of opportunity open for all regions. In addition to supporting vertical smart specialization (selecting promising activities in a non-neutral manner), therefore, lagging regions should also have policy portfolios to support their horizontal, broader, non-selective research and innovation capabilities, so that they would not run the risk of further lagging behind in the current and future rounds of the digital and knowledge economy.

While the entrepreneurial discovery process is in principle a suitable tool to select regional sectoral priorities, we expect that the vested interest groups, the related rent-seeking behavior, as well as the strong dependence on pre-existing economic structures and conditions, and the consequential high risk of lock-ins, may render the entrepreneurial discovery process a challenging exercise in old industrial regions.

2.2.3 *Which type of region tends to benefit from smart specialization?*

Smart specialization is claimed to benefit all types of regions (Tödtling and Trippel 2005), be they global metropolitan regions, specialized old industrial areas, or structurally weak peripheral regions. However, most illustrative examples of smart specialization are located in structurally strong regions. Foray (2015), for instance, presents several cases with the typical phenomena of smart specialization, namely entrepreneurial discovery and spillovers, agglomeration effects, leading to structural changes, in economically strong regions in Switzerland or France. This is a little bit like looking at Silicon Valley to learn something about clusters.

Moreover, the successful examples chosen by smart specialization proponents also tend to be located in relatively small regions, which might implicitly indicate that structural change is more possible in relatively small regional economies where a successful entrepreneurial discovery process can really lead to a transformation of an existing cluster. However, in large regional economies, such as Baden-Württemberg or North Rhine-Westphalia, such a process might very likely resemble a drop in the ocean. Therefore, in this sense, size really matters. Moreover, as observed by Trippel et al. (2020), while organizationally thick regions may be better prepared for smart specialization, these regions also face difficulties to make tough choices as regards to whom to include in the smart specialization practice and how to balance the needs and ideas of a large number of capable actors.

Whilst the logic of smart specialization seems to work well in the context of advanced core regions, its application in peripheral regions has proven more challenging, suggesting a persistence of the so-called European regional innovation paradox (Uyarra et al. 2018). The latter refers to the mismatch between the strong need for innovation in structurally weak regions and their limited capacity to absorb innovation funds (Oughton et al. 2002; Marques and Morgan 2018). Therefore, smart specialization might only be successful in regions where the right horizontal, broader, non-selective measures are in place. However, smart specialization is supposed to boost the economy of structurally weak regions, as it is an ex-ante conditionality for receiving support from European Structural and Investment Funds (Landabaso 2014).

The key question, however, is: Do old industrial regions and other structurally weak regions also benefit from smart specialization? There are several reasons why one might be sceptical. First, the existing industrial structures on which smart specialization builds might be too weak in (former) old industrial regions. Therefore, it might be no coincidence that most successful cases presented in the literature introducing the concept of smart specialization are located in structurally strong regions (Foray 2015). Secondly, the strategy puts high demands on the institutional capabilities in regions to select the right entrepreneurial discovery processes (Kroll 2015;

Capello and Kroll 2016), as well as to guarantee that ‘sleeping giants’, ‘excited goblins’ and ‘hungry dwarfs’ are included.¹ However, one might doubt whether one can find these capabilities to a satisfactory extent in structurally weak regions. Moreover, Foray (2015, p. 56) stresses the complementarity between smart specialization strategy and horizontal instruments with the general regional innovation policy that is available in a region. That means, however, that if structurally weak regions have only weakly developed horizontal measures, which is often the case, they will not be able to develop complementary smart specialization strategies. Recent research has shown that institutional and governance capabilities are particularly weak in the structurally weak regions in Southern and Eastern Europe (Rodríguez-Pose and Garcilazo 2015), which casts doubts about their capability to devise a sound smart specialization strategy, thus echoing the innovation paradox mentioned earlier. Capello and Kroll (2016) summarize these obstacles as lack of interest, lack of ability and general politics. However, while in general structurally weak regions are not fully capable of implementing smart specialization as prescribed by the EU, recent evidence has shown that they benefit from policy learning and system building efforts (Tripl et al. 2020). In a similar vein, Kroll (2015) also argues that the main merit of RIS3 processes may lie in their contribution to changing routines and practices of governance. In sum, although smart specialization strategies are supposed to boost the economies of structurally weak regions, we doubt whether they will be able to achieve this aim.

3 Smart specialization in former old industrial regions: the case of the Ruhr

The Ruhr is among the most prominent former old industrial regions in Western Europe. Its structural transformation has been studied in the literature for decades (cf. Hassink 1992; Cooke 1995). How has smart specialization contributed to this structural change in the Ruhr? To address this overall research question, we address both the implementation of smart specialization embedded in the region’s structural policy trajectory, acknowledging the path-dependent nature of policy learning, as well as its embeddedness in the federal country’s multi-level governance architecture (cf. Kiese 2010, 2013; Uyarra and Ramlogan 2017). Against this backdrop, we aim at identifying the relevance of path dependence, transformation and creation, as well as related versus unrelated variety in the region’s strategy. To achieve this objective, we review policy literature and documents, as well as secondary data to link political strategies to the region’s transformation and performance.

The Ruhr is not an administrative entity, but a polycentric urban region of 5.1 million inhabitants at the end of 2019, scattered across eleven cities in the core and four less urbanised counties at the fringes (RVR 2020a). It has a regional planning authority (*Regionalverband Ruhr*, RVR) with limited tasks, including an economic

¹ The regional institutional capacity is influenced by national political-administrative systems, giving regions in federal systems more autonomy and often a stronger capacity than regions in centralized systems (see Baier et al. 2013).

development subsidiary (Business Metropole Ruhr, BMR) seeking to guide and coordinate the various municipalities, which have their own economic development offices and a long tradition of parochial thinking (cf. Rehfeld and Terstriep 2019). The Ruhr is only part of North Rhine-Westphalia (NRW), Germany's most populous federal state with 17.9 million inhabitants (IT.NRW 2021), which is the administrative level in charge of operational programmes for EU structural and investment funds, and hence RIS3. Due to this multi-level governance constellation, we will briefly review the NRW level before turning our focus to the Ruhr.

3.1 North Rhine-Westphalia

Smart specialization in NRW builds on three decades of path-dependent, cumulative policy learning summarised in Table 1. It is worth noting that the regionalization of structural policies in the 1980s bear some resemblance with the entrepreneurial discovery process with the attempt at including all relevant regional stakeholders in the development of consensual regional development strategies. The outcome, however, was not encouraging: Despite some process benefits contributing to the region's organising capacity (van den Berg et al. 1997), conferences resulted in non-binding, very similar mission statements with insufficient consideration of endogenous potential (Goch 2002, p. 437) and predominantly traditional projects in conventional areas. Hampered by large differences between sub-regions in co-ordination capacities and efficiency (cf. Potratz 2000; Rehfeld et al. 2000), regionalised structural policies made only limited contributions to structural change and eventually faded out in the mid-1990s.

Following some experimentation with regional innovation networks in the 1990s, the early 2000s witnessed the introduction of cluster policy for the Ruhr, although

Table 1 NRW Policy Evolution: From Clusters to Lead Markets. (Based on Kiese 2012, p. 140 ff.)

Year(s)	Programme	Policy & Content
1987	<i>Zukunftsinitiative Montanregion (ZIM)</i>	<i>Regionalised structural policy</i> ERDF focus on endogenous potential
1989	<i>Zukunftsinitiative für die Regionen Nordrhein-Westfalens (ZIN)</i>	Consensus-led regional conferences 1991–1993 regional development concepts (Cf. Huggins and Thomalla 1995; Wood 1997; Danielzyk and Wood 2004)
1993–1999	PROFIS	Regional innovation networks Combining regional & sectoral structural policy
2000–2005	<i>Kompetenzfeldpolitik</i>	Implicit cluster policy 12 fields of competence for the Ruhr Focus of ERDF funding (objective 2, cf. Rehfeld 2006)
Since 2007	Cluster Policy	16 ⇒ 14 NRW-clusters defined as managed state-wide networks, grouped into 5 lead markets + open RegioCluster contest (2007–2010) Competitive ERDF funding (cf. Kiese and Kahl 2017) Strategy adapted & refined; € 640 m for cluster contests 2014–2020 (MWIDE-NRW 2020)

the cluster term was avoided for various and mainly political reasons (cf. Kiese 2012, p. 147f.). The attempt at focusing support from the European Regional Development Fund (ERDF) on twelve ‘fields of competence’ assigned to specific places in the Ruhr was driven by very diffuse and usually clearly exaggerated expectations (Rehfeld 2006, p. 251). The selection of fields of competence was largely arbitrary and strongly influenced by political processes and motives of equalization policy. Due to a lack of critical mass and stamina to create sustainable structures (Koschatzky et al. 2004, p. 157), the process once again did not contribute to a discernible economic profile for the Ruhr (Budde et al. 2006). After a change in government and the opening-up of ERDF funding for the entire state, NRW embarked on the state-wide promotion of regional networks of science and industry in its cluster policy for the 2007–2013 funding period.

To fulfil the ex-ante conditionality for 2014–2020, the state government drew on its previous cluster policy by grouping 16 initial clusters (defined as state-wide managed networks of science and industry) into eight so-called lead markets. These are fields of strength in the NRW economy with expected international market growth (MWEBWV 2010, p. 14), developing products that offer solutions to global challenges, such as demography, health, climate and environmental protection, urbanization, mobility, secure energy supplies, and the knowledge and information society (MWIDE-NRW 2020; own translation). The ERDF Operational Programme for 2014–2020 asserts that “the focus of the measures on lead markets meets the requirements of smart specialization and concentration” (EFRE.NRW 2014, p. 7; own translation). One should note that this political use of the term differs from management and innovation studies’ understanding lead markets as technologically sophisticated customers foreshadowing future demand (cf. demand conditions in the diamond model of the business environment; Porter 2008, pp. 190–192), or countries that first adopt an innovation before it spreads globally (Beise 2004). Displayed in

Table 2 Lead markets and state-level cluster initiatives in North Rhine-Westphalia. (Source: Own composition from <http://www.exzellenz.nrw.de> [13.06.2020])

NRW Lead Markets (8)	NRW Cluster Initiatives (15)
Energy & Environment	Competence Network Green Economy
	Cluster Energy Research
	Cluster Energy Region
Health	Medical Cluster NRW
	NRW Centre of Health
ICT	ICT Cluster
Life Sciences	Biotech Cluster NRW
Mechanical, plant & process engineering	Competence Centre for Cyber Physical Systems
	Mechanical Engineering/Production Technology Cluster
	NanoMicroMaterialsPhotonic.NRW
Media & Creative Industries	Competence Centre for Creative Industries
	Media Network NRW
Mobility & Logistics	Competence Network Logistics
New Materials	Chemical Cluster
	Synthetic Materials Cluster

Table 2, these lead markets receive a substantial share of the state's ERDF funding, distributed competitively, a process introduced in the 2007–2013 funding period (cf. Kiese and Kahl 2017).

Following a general understanding that NRW had pursued smart specialization long before the term came up, no serious entrepreneurial discovery process was initiated at the beginning of the 2014–2020 ERDF funding period. Kroll et al. (2016, p. 1462) observed this as a general pattern for German federal states: “While regional innovation strategies nominally existed in many places, they had neither been developed in the manner envisaged by the RIS3 guidelines nor did they explicitly aim to contribute to (...) entrepreneurial discovery, that is, multi-actor inclusive processes of strategy definition. While regional stakeholders had been involved in many cases, this process had more often than not been conducted with the ‘usual suspects’ on an ad hoc, informal basis. Moreover, the lasting institutionalization of discovery processes had so far not been common practice.” This potentially aggravates the danger of rent seeking by vested interests highlighted in our literature review.

The portfolio of NRW lead markets grew out of the state governments' previous cluster policy and did not involve any notable process of entrepreneurial discovery as demanded by the S3 concept. Consequently, continuity prevails over profiling: All important areas that have been supported previously are represented, hence no ‘tough choices’ were made. Reflecting NRW's large and diversified regional economic and technological base, the lead market portfolio does not contribute to carving out a more specific, let alone unique profile. As Kiese (2012, p. 232) states, it strongly overlaps with that of other federal states, such as Bavaria. Furthermore, state-wide cluster initiatives also illustrate bureaucratic competition over responsibilities, leading to splits between healthcare management and medical research, as well as energy industry vs. energy research, ignoring the key principle of clusters linking research and business (ibid., 158).

As far as the RIS3 process is concerned, Kroll et al. (2016, p. 1468f.) assess NRW's approach as a research, lead market and transfer strategy. In formal fulfilment of the EU's ex-ante conditionality, consultation and stakeholder feedback have taken place, but substantive participation was often limited to organizations already involved in earlier processes. In other words, there was only limited mobilization of new stakeholders. Although there was a reorientation from technology fields in the previous cluster policy to lead markets allowing for more cross-cluster interaction, no specific new instruments were introduced, and many activities would have been carried out without RIS3. While they observed an improved integration and co-ordination of the different ministries involved, the evidence base of policies has only partly been improved. As a consequence, prioritization still remains a predominantly political process.

3.2 The Ruhr

Following rapid industrialization around coal and steel in the 19th century, the Ruhr still was Germany's manufacturing heartland after World War II, benefiting from the post-war boom and the need to rebuild a destroyed country. However, structural change started with the coal crisis of 1957 and the ensuing steel crisis.

Table 3 Productivity, income and knowledge economy indicators for major Ruhr cities and benchmarks. (Data: 1–4: BBSR 2020, p. 5; Creditreform 2017; own calculations)

	GDP per capita, 2017 (Germany = 100)	GDP per employee, 2017 (Germany = 100)	Average disposable household income, 2017 (Germany = 100)	Share of university graduates in the workforce, 2017 (%)	Share of employment in creative industries, 2017 (%)	Share of new firm formation in knowledge-intensive manufacturing and services, 2012–2016 (%)
Bochum	81.8	86.1	89.1	16.0	4.19	6.1
Dortmund	94.4	92.4	85.7	16.3	3.85	6.4
Duisburg	89.9	104.3	75.6	12.6	2.00	5.7
Essen	106.6	100.5	90.0	17.9	4.07	5.6
Cologne	150.5	114.2	98.6	23.2	7.85	9.6
Dusseldorf	199.2	123.8	113.9	24.0	5.85	7.5
Berlin	97.7	96.5	89.5	25.1	6.89	9.4
Munich	199.5	139.6	128.5	32.9	9.69	12.0
Germany	100.0	100.0	100.0	15.6	3.63	7.1

After decades of heavily subsidised structural change—the last coal mine only closed in 2018—the regional economy is now dominated by service industries. While the Ruhr is no longer mono-structural and its manufacturing share well below the national average, it still suffers from the effects of deindustrialization, as evident from clearly above-average unemployment and a weak knowledge economy. In October 2020, regional unemployment stood at 10.1% compared to the national average of 6.0%, while the city of Gelsenkirchen even reached 15.6% (BA 2021; RVR 2021). Correspondingly, the region is trailing in GDP per capita and disposable household income, the latter falling behind sharply over the past two decades (cf. Röhl 2019; Seils and Baumann 2019). Table 3 compares the four largest cities in the Ruhr—Bochum, Dortmund, Duisburg and Essen, which also host the region’s major universities—to the national average and leading cities in both NRW (Cologne, Dusseldorf) and Germany (Berlin, Munich). As an indicator of labour productivity, GDP per employee is close to the national average due to the presence of capital-intensive industries, such as steelmaking, chemical industry and energy production. Compared to GDP per capita, it is not distorted by commuter flows, but conceals the Ruhr’s persistent unemployment challenge.

Despite large universities built since the 1960s, the Ruhr still cannot match national averages or the country’s other metropolitan regions in key dimensions of the knowledge economy. While many knowledge-based activities generally tend to concentrate in urban agglomerations, the Ruhr is close to the national average, thus far behind the leading cities. The evidence clearly identifies the Ruhr as a lagging region in Germany’s knowledge-based economy, a picture further confirmed by patent registrations by Rothgang et al. (2020, p. 45; for further discussion see Kiese 2019). Politically, the populist Alternative für Deutschland (AfD) party scored somewhat above the West German average in the Ruhr in the elections for the European Parliament in 2019 (WAZ 2020). However, the measurable level of discontent is still not as pronounced as that observed in US or UK rustbelts, presumably due to the

cushioning of structural change with sustained subsidies and social transfers over many decades in the Ruhr. Following deindustrialization, the economic structure is fragmented both sectorally and spatially, with individual cities developing their specific technological and industry profiles, which are difficult to aggregate into a discernible economic profile for the entire region.

In response to these challenges, BMR defined nine so-called lead markets for the Ruhr responding “to the major challenges and trends in socio-economic development with new offers, services and business models” (Lehner et al. 2015, p. 4; own translation; see also BMR 2020a). This reflects a shift from previous technology-push approaches toward a grouping of industries and technologies around broad societal needs (Nordhause-Janz and Rehfeld 2011a, p. 6). Despite the same name and similar definition, the resulting portfolio is not a subset of NRW’s state-level lead markets (cf. table 2). Furthermore, it obviously represents a different level of aggregation, as the NRW portfolio evolved from its previous cluster policy, while BMR’s portfolio is the outcome of a commissioned report that grouped core industries, materials and processes, engineering services, as well as related manufacturing and services into lead markets.

As at the NRW level, the Ruhr’s lead markets are not the result of a process of entrepreneurial discovery as demanded by the RIS3 concept. In contrast to the NRW level, however, they did not evolve from previous policies either, but were rather identified in an analytical exercise for BMR’s first report on the regional economy (Nordhause-Janz and Rehfeld 2011a). Table 4 reveals that once again, no hard choices were made, as more than 84% of regional employment are covered by the industrial core and lead markets. Furthermore, the region is not at all specialized in these areas overall, as shown by the total LQ close to one. Four lead markets even have employment shares below the national average. The LQ across all fields even

Table 4 Employment in BMR lead markets and development over time. (Data: BMR (unpublished, processed by CIMA Institut für Regionalwirtschaft GmbH, based on Federal Labour Office))

Lead markets	Employment ^a	Regional Share	CAGR	LQ ^b	LQ ^b
	June 2019	June 2019 (%)	2009–2019 (%)	June 2009	June 2019
Healthcare	340,658	19.6	3.25	1.09	1.16
Manufacturing core and business services	330,309	18.4	2.05	1.12	1.11
Urban construction & living	197,689	11.4	1.35	0.98	0.97
Mobility	175,593	10.4	1.26	0.86	0.88
Sustainable consumption	120,790	6.8	-1.25	1.11	0.84
Leisure & events	85,464	4.9	1.02	0.81	0.79
Education & knowledge	82,938	4.8	1.38	0.98	1.11
Resource efficiency	78,835	4.6	-2.08	1.78	1.43
Digital communication	55,533	3.3	2.74	0.80	1.11
<i>Total</i>	<i>1,467,808</i>	<i>84.2</i>	<i>1.45</i>	<i>1.06</i>	<i>1.01</i>

^aCovered by social insurance, Employment in industries shared by two or more lead markets was split to avoid double counting

^bLocation quotient (Germany = 1.00)

Table 5 The Ruhr's lead markets—definition and assessment (sorted by absolute employment, descending order). (Definitions: Nordhause-Janz/Rehfeld 2011b; own translation)

Lead markets	Core areas	Supplementary activities	Assessment	
Healthcare	Inpatient and outpatient care, health-related insurance and administration, pharmaceutical industry	Services in trade, sports, social services and care, other related industries, medical technology manufacturers, dental laboratories	Generic/ local	Path transformation
Manufacturing core and business services	Manufacturing of materials incl. steel, manufacturing (process) technologies and services, business services	–	Traded ^a	Path-dependent lock-in
Urban construction & living	Building and finishing trades, manufacturing of home furnishings	Construction services, rental and housing administration, industrial material and equipment suppliers, machine and tool manufacturers, architectural and engineering services	Generic/ local	–
Mobility	Manufacturing of vehicles and parts, construction and operation of transport infrastructure, logistics and mobility management	Services from the relevant trade, repair trade and agencies, neighbouring industrial sectors (oil, tyres) and engineering services	Generic/ local	–
Sustainable consumption	Trade brokering, wholesale and retail trade	–	Generic/ local	–
Leisure & events	Cultural sector, audio-visual media, events, leisure, sport, tourism	Service providers from retail, publishing, leisure and cultural sectors, individual manufacturers (e.g., musical instruments, sports equipment, toys)	Local & traded	Path creation unrelated variety
Education & knowledge	Pre-school education, schools, universities, research organisations	Other training and educational organisations	Generic/ local	–
Resource efficiency	Energy production and distribution, water management, environmental protection, recycling	Related trading and maintenance services, raw material extraction and processing, mechanical engineering, relevant laboratory, engineering and measurement services	Generic/ local	Path transformation related variety
Digital communication	IT hardware manufacturing, telecommunications and IT services incl. IT consulting and data processing, software development	IT-related services	Traded	Path creation unrelated variety

^aContaining major industries with above-average export ratios at the national level according to IHK Hannover (2020)

declined since these lead markets had been defined. This means that while the total portfolio recorded employment growth of 1.45% per year, this was somewhat lower than for these fields in Germany as a whole. Looking inside the portfolio, we observe only one notable, but declining excess specialization, which is resource efficiency, dominated by the region's large energy providers struggling with the challenges of decarbonization and climate neutrality. This is offset by digital communication recording almost twice the average employment growth and even accelerating in the second half of the decade, thereby moving from a deficient lead market to one with slightly above-average specialization. Together with the healthcare sector, which is also expanding albeit more modestly, and to a lesser extent also education and knowledge, these shifts signal the ongoing dynamics of structural change. The region thus participates in megatrends such as digitalization, academization, demographic change and increasing attention to health issues.

Table 5 provides an overview of lead market definitions and our own assessment regarding their potential contribution to structural change in the Ruhr. This appraisal cannot be anything more than tentative, given the broad definition of lead markets. Most of them predominantly serve regional markets—which can be seen as another consequence of deindustrialization. At 15.1%, the regional share of employment in manufacturing was well below the national average of 20.8% in 2019 (RVR 2020b; StBA 2020) and there are rather few exportable services in the Ruhr. Only two of the lead markets appear to sell substantial portions of their products and services to other regions or internationally in the sense of traded clusters (Delgado et al. 2016). The mobility lead market by definition contains the manufacturing of vehicles and parts as an export-intensive industry (IHK Hannover 2020), but as the region has no automotive OEM and no particular concentration of suppliers, we assume the non-traded industries to provide most of the employment in this lead market, too. For the 'consumption' lead market, the label 'sustainable' appears largely euphemistic, as this contains *all* wholesale and retail trade without qualification.

Two of the lead markets clearly aim at creating new trajectories for the region, most notably the rapidly growing field of digital communications. Drawing on the Technical University of Dortmund with the country's largest IT department and the Ruhr University at Bochum with its emergent IT security cluster, ingredients for a new path are evident here that shows no relatedness to pre-existing specializations. As a general-purpose technology, digital communication bears strong potential to drive the transformation of the manufacturing core, energy efficiency, as well as healthcare, highlighting the need to link these fields in specific projects. Apart from the latter aspect, we would classify the leisure and events lead market accordingly, although specialization failed to catch up in the same way and is still below the national average, i.e. no specialization at all at this high level of aggregation. While this market caters to the rising number of visitors to the Ruhr, too, the region is still no major destination for city tourism, so that much of this field is regional rather than traded.

We identify two further lead markets with distinct processes of path transformation. While the declining resource efficiency lead market suffers from the expiration of coal mining in 2018 and the decarbonization of energy production, major companies are in the process of shifting their focus to technology and service development

(mining) and renewable energies. Environmental engineering and recycling benefit from the region's sophisticated demand caused by the pollutant mining and heavy industries of the past. In a similar fashion, the healthcare sector owes at least some of its capacities and specific competencies to the damaged health of former coal miners and steel workers.

References to smart specialization only appeared in the 2014 regional economic report, i.e. three years after the definition of lead markets for the Ruhr (Lehner et al. 2015). It appeared that the broadly defined lead markets can be seen as search area for more specific challenges and opportunities that may translate into concrete projects for the regional economic development agency, BMR. A survey of recent projects (BMR 2020b) shows that some are clearly targeted at specific lead markets, such as the regional network Greentech.Ruhr or the Ruhr-Israel Cyber Activator and the broader Innovation Bridge Israel linking regional IT start-ups with Tel Aviv's leading cluster (cf. Rohde et al. 2019). By focusing on the nationwide recruitment of (potential) founders from the culture and creative industries and their matching with SMEs and the initiation of new cross-sector collaboration to promote innovation and digital competencies of regional firms, Creative Innovation Ruhr is one project leveraging on the core RIS3 idea of general-purpose technologies. Other projects are more generic, mainly addressing entrepreneurship, innovation or site conversion, partly in a flexible response to external funding opportunities. The impact of such projects is unknown so far, and the integration with the activities of the region's often powerful municipal economic development agencies remains another open question.

Our appraisal of smart specialization in the Ruhr reveals an eclectic and diffuse mix of path dependence, path transformation and path creation with both related and unrelated variety. However, more detailed evidence is obviously hampered by implementation problems. As the Ruhr is neither a powerful administrative unit nor the level in charge of RIS3 formulation, its interpretation of smart specialization as 'lead markets' remains a broad analytical exercise for reporting that makes no hard choices whatsoever and includes more local than traded activities and, in fact, little specialization at all. It rather offers a wide frame for various projects, of which only some focus on particular topics within the broader lead markets. Sandwiched between the NRW state level in charge of EU Operational Programmes on the one hand and powerful local authorities on the other, RIS3 in the Ruhr lacks entrepreneurial discovery processes and falls short of the hard choices required to carve out a clear profile for an increasingly heterogeneous region. This applies to the NRW level, too, while echoing the experiences made with the antecedents of smart specialization since the 1980s. Overall, the region's governance architecture appears like a major impediment to implementing RIS3 in the Ruhr, an issue that deserves further research attention.

4 Conclusions

As stated in the introduction, (former) old industrial regions and their problems are back in focus because of rising populism, although this has been more mod-

erate in the Ruhr than elsewhere so far. In this paper, our aim was to critically analyze whether smart specialization is a potentially successful regional innovation strategy for solving the problems of these (former) old industrial regions. Recently both policy-makers and academics devoted much attention to smart specialization. It represents an explicit, place-based and place-sensitive approach, emphasizing prioritization and selectivity through non-neutral, vertical policies aiming at diversified specialization.

We agree with Boschma (2014) that smart specialization has many positive characteristics as a place-based and place-sensitive regional innovation policy strategy. It focuses on knowledge and innovation and stresses that one-size-fits-all policy and starting-from-scratch are wrong. It also takes region-specific needs and resources into account. Moreover, it emphasizes local demand (needs and potentials) as a potential driver for innovation and expedites agglomeration processes by reducing double investments. It also encourages regional players, particularly regional governments to focus their resources on those areas or activities that are likely to effectively transform the existing economic structure through R&D and innovation. Finally, it encourages the participation of a large group of different regional actors (beyond just firms) in entrepreneurial discovery processes.

However, as we have pointed out in this paper, several critical issues related to smart specialization prevent it from being a promising strategy for (former) old industrial regions. First, particularly, entrepreneurial discovery processes have been questioned as a tool to set in motion structural changes of a regional economy. Can they really lead to structural change, or do they expose regions to various lock-in risks, given the focus on existing structures and the potential influence of vested interests on key decisions about priorities? In addition, which kind of institutional conflicts can emerge because of the tension between locking in and locking out? Secondly, since most (former) old industrial regions lack competitive industrial structures and sufficient institutional capabilities, they might not have enough potential to develop promising entrepreneurial discovery processes. This, in turn, might increase rather than reduce regional economic inequalities. So the key question for future research is: What exactly hinders smart specialization strategies from being successful in (former) old industrial regions?

We confronted these conceptual considerations with the empirical case of the Ruhr, a former old industrial region that managed to overcome its dependence on mining and manufacturing but—unlike the Basque Country—still lags behind other metropolitan regions in Germany in terms of prosperity, employment and innovation performance. The Ruhr's experience partly confirmed critical issues concerning the lacking involvement of entrepreneurs in entrepreneurial discovery processes and the limited focus on promising specialization domains. However, other issues pointed out in the critical literature could not be confirmed, such as the strong role of vested interests prominent in earlier phases of structural change (cf. Grabher 1993)—if at all, they may be working behind the scenes, invisible to our research. Another key finding is that the implementation of RIS3 may not only be hampered by thin institutional structures, but also by a hypercomplex multi-level governance architecture. As a consequence, the Ruhr's lead market approach looks like a paper tiger sandwiched between NRW's non-aligned lead market portfolio, on the one hand, and

powerful municipalities with diverging industry structures and parochial thinking, on the other hand. The main problem that the Ruhr represents, less than a third of NRW, the federal state in charge of ERDF operational programmes and RIS3 strategy formulation, is thus unrelated to its history as an old industrial region. Despite these challenges, some tender attempts have been identified in the Ruhr to foster path creation and path transformation with the help of smart specialization. The Ruhr case has also illustrated that it is not only hard to isolate the effects of smart specialization quantitatively from other effects, but also to assess the qualitative improvements in the organizational capacity of (former) old industrial regions due to the smart specialization strategy. As our research draws on secondary data and desk research only, more in-depth research and (comparative) case studies, also within the Ruhr at the city level, are clearly needed for a closer investigation of what obstacles to effective RIS3 implementation are specific or common across (former) old industrial regions. Overall, we may conclude that smart specialization is certainly not a quick fix to solve the long-term negative effects of restructuring and deindustrialization in (former) old industrial regions.

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