

**An exploration of industrial agglomeration, regional  
trajectories and regional inter-industry labour flows in  
Germany**

Kumulative Habilitationsschrift  
zur Erlangung der *venia legendi*  
für das Fachgebiet  
*Geographie*

an der Naturwissenschaftlichen Fakultät  
der Gottfried Wilhelm Leibniz Universität Hannover

vorgelegt im Januar 2021  
von Dr. rer. nat. Anne Otto

**An exploration of industrial agglomeration, regional trajectories and regional inter-industry labour flows in Germany**

cumulative habilitation dissertation  
to obtain authorisation to teach in the field of  
*Geography*

at the Faculty of Natural Sciences  
of the Gottfried Wilhelm Leibniz Universität Hannover

submitted in January 2021  
by Dr. rer. nat. Anne Otto

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## 1. Introduction

Most recently, lagging regions, in particular Old Industrial Areas (OIAs) and the „Rustbelt economies“, have attracted increased attention in political and scientific debates (Evenhuis, 2016; Hassink et al., 2018). Case study research on the trajectories of OIAs has shown a great discrepancy between those lagging-behind and still locked in decline on one side and better performing places on the other. The geography of discontent mirrors the situation of people in such deindustrialized regions still lagging behind as problems have persisted over time. Rodriguez-Posé (2017) stresses that people in these regions often are missing realistic opportunities instead of receiving merely public support. Those lagging regions were particularly affected in the financial crisis 2008/09, while such structurally weak regions appear to be struck also more seriously during the COVID-19 pandemic (Böhme et al., 2020). In Germany, for instance, the national government decided to phase out the lignite industry to reduce carbon dioxide emissions. This decision has given rise to intense political discussion on adequate strategies for the transformation of lignite mining areas. A core question of this debate is whether the workers from the lignite industry could find suitable jobs in other economic sectors in the regions concerned, and which existing or new economic sectors could be promoted accordingly. The Institute of Employment Research (IAB) and the author were involved in this debate (Seibert et al., 2018) and detected that opportunities for lignite workers to switch to other jobs in the region are limited as this industry is only related with a very few other industries in terms of skill content. The limited absorptive capability of the regional industry structure in the lignite areas will be a potential obstacle for the later placement of the lignite workers. This debate is driven by the overall goal for regional policy makers to provide equal living conditions throughout Germany. For this reason, regional economic, labour market and innovation policies aimed at providing special support for lagging regions and OIAs in previous decades. Nonetheless, regional labour market disparities are still pronounced and have persisted in Germany (Niebuhr, 2019). There are still manifold challenges for lagging OIAs to master structural renewal and economic recovery. The effects of previous severe crises of the former predominant industries often persisted for many decades (Evenhuis., 2016), and in addition to sectoral change, these regions need to adapt to demographic change, shortages of skilled labour, trends towards higher skill requirements, the digitization of the world of work, and ecological transformation. The COVID-19 crisis will even accelerate some of these processes (Fitzenberger, 2020). All in all, a central challenge for OIAs consists of retaining a considerable reservoir of highly skilled labour and to develop a coherent industrial portfolio and skill base to be able to adapt dynamically to these changes.

These current topics have been perennial issues that scholars in economic geography have addressed in the past four decades. There are long traditions in exploring the development trajectories of OIAs, labour market transitions of displaced workers after plant-closures in mature, highly localized industries and the migration behavior of highly skilled labour. These different strands of research may provide valuable insights for deriving place-sensitive prospective regional policy strategies for lagging regions and OIAs to face these various structural change processes.

First, an ongoing engagement in economic geography can be observed in studying the problems, challenges and strategies for renewal and adaptation of OIAs (e.g., Birch et al., 2010; Evenhuis, 2016; Hamm/Wiener, 1990). The OIA literature stresses the importance of long-lasting effects of industrial legacy for regional trajectories, although in most OIAs there are left either none at all or only fragments of the former predominant industries. The OIA literature employs mainly concepts from evolutionary economic geography (EEG) such as regional lock-in, path dependency and resilience and has contributed thereby to a detailed understanding of economic-structural and political-institutional factors either facilitating or hindering economic adaptability and renewal of these regions. While earlier OIA studies focus specifically on identifying different types of lock-ins, deficiencies in regional

innovation systems (RIS), and recovery brought about by diversification into different industrial clusters, more recent studies focus, for instance, on new strategies to overcome lock-in with improving the coherence of the industrial portfolio and generating opportunities for knowledge-spillovers by diversifying into related industries and technologies (Coenen et al., 2015).

Second, OIAs experienced at least for certain periods severe decline characterized by various plant closures in mature industries and high unemployment. In past decades, numerous studies focused therefore on shut-downs and worker displacement in these highly localized mature industries. This literature provides robust evidence that individual characteristics affect re-employment probabilities after dismissal (Fallick, 1996). Bluestone (1984) highlights the importance of the ability for a region to master redundancies by re-employing displaced workers. Recent studies highlight the relationship between the qualitative features of this absorptive capacity and individuals' re-employment probabilities after shut-downs (e.g., Hane-Weijman et al., 2018; Nyström, 2018). These works find some indication that the chance to get a job, but also in which industry and region, depends on the presence of related and unrelated industries in terms of skill content to the pre-displacement industry. Hence, the quality of the matching process after displacement seems to matter for retaining acquired skills and knowledge of workers within the region.

Third, higher education institutions (HEI) may contribute to human capital accumulation in regions only significantly when a considerable share of their graduates enter the labour market in the higher education region (Haapanen/Tervo, 2012). An extensive empirical literature studied the migration of university graduates. Many of these works address the interregional migration behavior of graduates in distinct countries and analyse migration related to labour market entry (Haapanen/Tervo, 2012; Krabel/Flöther, 2014). The graduate migration literature provides sound evidence on the importance of individual, study-related and regional factors for migration decisions after graduation (Buenstorf et al., 2016).

This compilation of papers contributes to these three strands of literature in economic geography in several ways. In the first part of this compilation (Papers 1-4) a long-term exploration on industrial agglomeration provides insights about trends on concentration and dispersion of economic activities. Three case study analyses on factors sustaining or hampering economic recovery and renewal in OIAs contribute to a better understanding in which ways structural renewal can be brought about in deindustrialized regions. The second part of this compilation (Papers 5-8) comprises first of all comprehensive analyses on (regional) inter-industry labour flows to provide more detailed insights on the concept of skill-relatedness. Then, this concept is employed in two empirical studies to examine whether regions hosting skill-related industries benefit from a higher likelihood of improved matching quality when dismissed workers seek for new jobs. A further study highlights the role of local labour market knowledge and social networks gained through previous work experience of higher education graduates for their propensity to enter the labour market inside the region of study or beyond.

The contributions of the papers assembled in this compilation to the related literature are summarized as follows:

#### ***Industrial agglomeration and regional trajectories of Old Industrial Areas (OIAs) (Papers 1-4)***

First, Paper 1 shows that a secular, but slow decline of agglomerative forces in Germany took place over the past 30 years. Despite this shift towards more dispersed economic activities, spatial concentration of industries is found to be rather persistent pointing to path dependence of industrial agglomerations. In particular, the degree of spatial concentration remained sizeable in mature manufacturing industries, although most of these industries experienced decline (Paper 1).

Second, the three case study analyses on OIAs detect impact factors either supporting or hampering economic recovery in these regions and which regional strategies can be derived to support structural renewal.

- The comparative study between the Saarland and the Ruhr area (Germany) in Paper 2 shows that the composition of the industry mix negatively affects local employment growth in each region during the 1990s. In addition, it is evidenced that the adverse impact of the industrial portfolio also implicitly intensifies detrimental effects of other structural labour market determinants, firm size and qualification structure, on local growth. The positive impact of the relatively low wage level can turn in case of a wage increase into a pitfall for precarious trajectories in both regions. These findings suggest, in line with Martin et al. (2016), that these industry-related structural determinants are to some extent themselves 'functions' of a region's industrial portfolio and appear to have persisted, in a path-dependent manner, in both regions despite of past decline of mature industries.
- The comparative analysis of economic recovery in the OIAs Saarland (Germany) and Styria (Austria) in Paper 3 highlights two prerequisites for successful economic recovery. The capacity of a region to transform the whole RIS and cluster-based renewal - innovation-based modernization of existing mature industries and establishment of new industry clusters - to overcome the pitfalls of industry specialization. For Styria, the reconstruction of the entire RIS towards industrial clusters enabled economic revitalization. Conversely, in Saarland positive effects of knowledge-spillovers on innovation and growth were found to be limited because of a mono-orientation of the RIS towards new established knowledge-intensive industries, and an 'underdeveloped' knowledge infrastructure for the mature manufacturing cluster.
- The fourth paper in this compilation introduces a tool box which relies on the network of inter-industry skill-relatedness encompassing the entire regional industrial portfolio. This toolbox enables to identify potential barriers and opportunities for structural renewal of OIAs because existing (missing) relatedness links for knowledge spillovers within clusters, but also across the boundaries of clusters/RIS can be detected. This toolbox is employed in a SWOT-analysis on Saarland's industry space and identifies limited opportunities for knowledge-spillovers between old and new industry clusters and it is discussed in which ways region-specific strategies might contribute to build on existing regional industrial activities, but also which additional resources might be untapped by creating new links within or between Saarland and its regional neighbours.

### ***Regional inter-industry labour flows (Papers 5-8)***

In the general context, comprehensive analyses in Paper 5 on the structure, flexibility, and stability on inter-industry labour flows in Germany provide insights on the regularities underlying job switches between industries having similar human capital requirements (skill-relatedness). Evidence suggests that these flows concentrate in a narrow set of industry pairs, thus labour flows connect industries in a sparse network (industry space). This inter-industry skill-relatedness network (industry space) is stable over time, similar for different worker types and independent of whether workers switch jobs locally or over greater distances. In the regional context, an application of the labour-flow based measure of skill-relatedness confirms the predictive quality of the skill-relatedness indicator for local industry growth and shows that local growth patterns of skill-related industries are uncorrelated. Both findings may contribute to design more place-sensitive strategies for supporting the structural renewal and the resilience of lagging regions and OIAs.

Paper 6 and Paper 7 highlight the importance of the regional industrial portfolio for the quality of the regional matching process for dismissed workers. Both studies employ the skill-relatedness concept and examine whether dismissed workers have a higher likelihood to take up a job in regions specialized in industries being skill-related with the pre-displacement industry. Hence, empirical evidence of both papers suggests that shifting released human capital towards related economic activities appears to be a prospective strategy to sustain regional resilience.

- Paper 6 provides insights on the quality of the regional matching process of former exiting shipyard workers in Germany and Sweden when looking for new jobs. A strong regional specialization in such a mature manufacturing industry is related with a higher likelihood of workers staying in this industry irrespective of its decline in both countries. In the West German case, the regional specialization in industries being skill-related with shipbuilding was important in providing job offers with a high matching quality for exiting shipyard workers. In contrast, the absorptive quality deteriorated in Sweden due to decline of both shipbuilding and related industries.
- A key mechanism driving Marshallian externalities is that workers find easier jobs in industrial agglomerations if they were to lose their job. Paper 7 assesses empirically whether Marshallian externalities in industrial agglomerations (core industry and related industries) play a role in moderating the effects of establishment closures and thus for the labour market outcomes of displaced workers. This study reveals that a strong local presence of the pre-displacement industry decreases the likelihood to switch to other industries and regions. In contrast, high shares of local employment in industries skill-related to the pre-displacement industry increase industry switching rates substantially, but do not prevent that workers leave the region.

In this compilation, the findings of the final Paper 8 stress the importance of knowledge about local labour markets and social networks for graduates' migration decision at the start of their career. Previous work experience gained in the university region reduces the likelihood of German higher education graduates outmigrating, while extra-regional work activity enhances the probability of labour market entry outside the region of study. The size of the effect depends on the type of job. To retain highly skilled young workers in lagging regions a possible strategy is to provide opportunities for graduates to establish labour market contacts via employment.

The remainder of this compilation is structured as follows. The next section introduces the conceptual framework while the main findings of the eight papers are presented in section 3. A summary is provided in section 4 and the conclusions are derived in the final section.

## 2. Conceptual framework

### *Industrial agglomerations and regional trajectories of Old Industrial Areas (OIAs)*

Since the beginning 1990s, there is a continuous research interest of scholars in economic geography in examining the problems, challenges and strategies for renewal and adaptation of OIAs and „Rustbelt economies“ (e.g., Evenhuis, 2016). Economic geographers have shown a long-run engagement in these research topics so far - particularly in Europe and North America. These issues have recently received also considerable attention by scholars in East Asia (Hassink et al., 2018). OIAs are usually considered as industrial agglomerations that are overspecialized in mature industries being either heavy, resource-based or light industries. These regions experience at least for certain periods severe decline characterized by deindustrialization and serious labour market problems. There is a coexistence of successful OIAs having managed to overcome the crisis on one side and worse performing OIAs still locked in decline and having difficulties to adapt on the other. Pittsburgh is, for instance, a case in point for a region having mastered the evolution from a region relying on steel production to a related steel technology and service center (Treado, 2010). In contrast, an underdeveloped RIS and the establishment of new technologies being unrelated to the mature, but modernized and diversified manufacturing sector have prolonged economic recovery in Saarland, with this process even worsening after the financial crisis 2008/09 (Evenhuis, 2016).

An important overall objective of OIA studies is to provide an understanding for the causes and mechanisms driving the divergent trajectories and thus consequences for these regions. This literature sought also to identify the barriers of renewal and adaptability. Besides, analyses aimed particularly at uncovering characteristic problems and obstacles in the innovation system of OIAs, which are in turn linked to path dependency and lock-ins (Coenen et al., 2015). Evidence on these issues may sustain regional policy makers in mastering the great challenge to develop strategies enabling such industries and regions to de-lock from declining paths by providing support for industrial renewal as well as for innovation activities and new technologies.

Since the literature on OIAs aims at detecting the causes for severe decline, barriers to renewal and adaptability and the varying paths of how OIAs evolved over time, a qualitative case-study design is applied in most empirical analyses enabling comprehensive in-depth empirical work. In most empirical works single and two case studies are conducted whereas multi-regional comparisons have been carried out much less frequently so far (Birch et al., 2010; Evenhuis, 2016; Hassink et al., 2018). This case study research relies mainly on a combination of qualitative methods such as personal interviews with stakeholders, firms etc. and systematic analyses of documented material and previous evidence. Yet, there are much less studies following a quantitative research strategy with multivariate regression analysis in order to evaluate more thoroughly the determinants of trajectories in OIAs.

The OIA literature resorts to a broad spectrum of conceptual and theoretical approaches to provide a comprehensive understanding of the causes for divergent trajectories. In their seminal review, Hu/Hassink (2015) assign these approaches to two distinct groups. The first group relates to economic and structural causes, the second one to political-institutional ones. Political approaches for OIA research are discussed, for instance, by Birch et al. (2010). As the Papers 1 to 4 in this compilation resort mainly on economic-structural determinants, the focus in this section is on respective approaches and related empirical evidence.

The pace at which OIAs were able to catch up to the growth dynamics of ‚normal‘ regions was usually and is still evaluated with the extent to which the industrial portfolio is still overspecialized in mature industries and diversified into other economic activities. To substantiate uneven economic growth among OIAs the related literature highlights the importance of industry and product life cycle approaches the elasticity of sector-specific demand for goods and technical progress thereby explaining changes in sector-specific labour demand (e.g., Hamm/Wiener, 1990). Accordingly, if young (old) industries in early (later) life cycle stages are predominant in a region, sector-specific labour demand increases (stagnates/declines) (Applebaum/Schettkat, 1999; Amend/Otto, 2006). For instance, studies for a range of OIAs in Germany - Ruhr area, Saarland (Paper 2) and Westpfalz (Ludewig et al., 2007) - show that the still strong specialization in mature industries, but also other structural determinants linked to the industrial portfolio such as wage level, firm size and qualification structure, impact decisively on regional employment growth and provide evidence for long-lasting effects of industrial historical legacy (Martin/Sunley, 2006).

Since the 1990s much effort has been spent in economic geography to explore the success of industrial clusters. In contrast, Grabher (1993) introduced in his seminal work two evolutionary economic concepts - path dependence and multi-dimensional regional lock-in (functional, cognitive, political) - to explain the negative effects of industrial clusters. Regional path dependence is characterized as „the combination of historical contingency and the emergence of self-reinforcing effects steer a regional economy along one „path“ rather than another“ (Martin, 2010, p. 3). The former successful clusters of predominant industries in OIAs can be thought of as industrial districts (Hu/Hassink, 2015). „The initial strengths of the industrial districts of the past – their industrial atmosphere, highly developed and specialized infrastructure, the close interim linkages, and strong political support by regional institutions – turned into stubborn obstacles to innovation‘ (the „rigid specialization“ trap)“ (Grabher, 1993, p. 256). Since then, both concepts were widely used in case-study research in EEG. For instance, regional settings, contingent path dependence and other context specific factors were found to be responsible for differences in the intensity of lock-in between former textile and shipbuilding OIAs in Germany and South-Korea (Eichborn/Hassink, 2005; Hassink, 2007). These findings corroborate that regional lock-in is highly place-based and multiscalar (Martin/Sunley, 2006). Although, some OIAs brought about a successful recovery, Hassink (2010) states that the core problem of OIAs remains nevertheless a negative lock-in as numerous studies have evidenced the missing capacity of adaptability due to the specific history.

Scholars have added further concepts of regional path development originating from EEG to the debate on OIAs. The evolutionary reaction and response to changes in a complex economic system is described with the notion of adaptability to study development paths of OIAs. This notion illustrates the capacity to master exogenous shocks and incidents as well as the dynamic ability to de-lock from persistent barriers to regional development (Dawley et al., 2014; Hassink, 2010). Path creation, as another evolutionary concept used in relation to regional economic adaptability, is considered to be an option to transform regional economies from a negative path into related, but newly created paths (Martin, 2010; Hassink et al., 2018). Boschma (2015) considers regional resilience as the broadest concept linked to regional economic adaptability. Blazek et al. (2020) conceptualize three types of path decline (contraction, downgrading, delocalization). The trajectories of OIAs are associated with a path contraction due to deindustrialization. In contrast, the concept of path creation describes, with respect to regional adaptability, a region’s opportunity to shift from a negative path to a new, but related path (Martin, 2010). Most recently, Baumgartinger-Seiringer et al. (2020) develop an understanding of path

transformation as a trajectory emerging from radical innovation, but not as new industrial path, instead occurring within existing paths.

Tödtling/Trippel (2005) combine in a framework the RIS and cluster approach. Interrelationships between industrial clusters on one side and between clusters and the regional knowledge infrastructure on the other are considered to be crucial to sustain regional innovation activities. Three types of RIS failures are identified by Tödtling/Trippel (2005): organizational thinness, fragmentation and functional, cognitive and political lock-in. A range of comparative case studies shows that OIAs with a thick, less-fragmented RIS with more dense relationships between mature and modern industry clusters on one side and the knowledge infrastructure on the other like in Styria and Upper Austria were better able to master industrial renewal and diversification than the Saarland with a less well-developed RIS and less dynamic restructuring related to lock-in (Tödtling/Trippel 2004; Paper 3). The OIA literature provides sound evidence that development trajectories and the pace of adaptation are impacted by the prerequisites for cooperations between universities, research institutes and firms, the composition of inter-industry linkages and the density of supportive institutions, and the type of RIS.

The introduction of the relatedness concept from EEG into the debate in which ways OIAs could unlock or rejuvenate has shifted the role of agglomeration economies away from a strong focus on specialization within clusters towards diversification of regional industrial structures into related economic activities (Martin/Sunley, 2006; Coenen et al., 2015). A great number of recent studies have widely evidenced that a strategy of diversification into industries (regional branching) being related to a region's core activities improves the coherence of the industrial portfolio of a regional economy and sustains its economic and innovative performance (see for review Hidalgo et al., 2018). The underlying rationale is that the exchange of knowledge between different industries is facilitated because these are linked by cognitive and technological proximity. Knowledge spillovers emerge between related industries, these positive synergies are supposed to foster innovation and growth (Neffke/Martin, 2013; Paper 5). In the literature, different types of relatednesses are discussed such as technological relatedness, skill-relatedness etc. The relatedness concept from EEG is also an important component of clusters (Porter, 2003) and RIS. In a cluster, there are many links between firms of certain sectors and local institutions. However, there may be cross-links between sectors from different clusters, because both sectors are somehow related. Hence, the concept of relatedness encompasses the entire regional industry mix when designing new developing strategies instead of focussing merely on a selected number of industrial clusters.

An important critique in the seminal review of Hu/Hassink (2015) is that these approaches from EEG as well as the RIS and the cluster approach focus altogether too strongly on endogenous industrial systemness for regional innovation activities and renewal while other external factors were shown to be crucial for improved access to external knowledge, too. The local university, for instance, is found in the case of the old-industrialized town Twente (Netherlands) to be crucial to attract external-investments to promote regional innovation (Benneworth/Hospers, 2007) whereas external mobile investments could not be effectively employed to create synergies with local existing industries in old industrial districts in Northern England (Phelps, 2009).

To summarize, OIA research has used a great range of concepts from economic geography, particularly from EEG, in order to explain in which ways different factors, sustain or hamper the economic recovery in OIAs in the long-run. The concepts such as clusters, RIS, lock-in, path dependence, relatedness and resilience, lack a clearer conceptualization in OIA research. A more detailed operationalization of these

approaches in empirical studies might contribute to a more differentiated understanding of factors impacting the divergent trajectories of OIAs. From a methodological perspective, most empirical analyses on OIAs are single or two case studies. Cross-regional comparative studies are rather descriptive using more ‚simple‘ secondary statistics. However, the use of comprehensive administrative micro data, for instance on employment and firm biographies, may enable more sophisticated quantitative methods and provide, also in combination with qualitative methods, more systematic insights in the determinants and mechanisms driving the development trajectories of OIAs.

### ***Regional inter-industry labour flows***

If plants shut down or reduce their workforce, dismissed workers need to find new jobs to prevent a downturn of the regional economy. The analysis of the regional and industrial labour mobility of redundant workers when moving to new employment after plant closures and their labour market outcomes have been longstanding issues in economic geography. The variation of theoretical and empirical approaches to examining the topic can be exemplified by a set of more general studies (Davis/Haltiwanger, 1999; Fredriksen/Westergaard-Nielsen, 2007; Nyström, 2018; Hane-Weijman et al., 2018), numerous investigations on plant closures in mature industries (Pinch/Mason, 1991; Bailey et al., 2012; Holm et al., 2017), and studies of modern services (Dawley et al., 2014; Pike, 2005).

The objective of many case studies on plant closures has been to study the characteristics and success of matching the process of redundant workers' transition to other economic activities using indicators such as re-employment rates or early retirement quotas (Fredriksen/Westergaard-Nielsen, 2007; Oesch/Baumann, 2015; Tomaney et al., 1999). In the literature dealing with displaced workers, individual factors such as tenure, age, education and occupation have repeatedly been found to affect the likelihood of being displaced, while non-employment after displacement is primarily experienced by workers with longer tenures and higher wages (Fallick, 1996). Moreover, the displacement process itself is often found to come with earning losses. For mature industries, the interacting specialization and age effects among redundant workers are particularly interesting. Previous studies highlight that an aging workforce is a typical feature of declining industries (Andersson/Lindmark, 2008). The fact that longer tenured workers are less likely to leave their job may partly be explained by the legal structures of some labour markets, and by the fact that older workers have accumulated sector-specific human capital that becomes a sunk cost if they exit (Eriksson et al., 2008).

Some scholars have emphasized the gender perspective in displacements (Pinch/Mason, 1991), for example noting that women have a greater risk of withdrawing from the labour market in cases of lay-offs and are more inclined to take up just any job due to the gender relations in the household. Institutional arrangements underlying industrial downsizing and plant closures, and how mature industries are considered in policy, often differ between countries and regions. This can also be expected to affect the labour market outcomes of large-scale displacements and the pace of structural change. Holm et al. (2017) argue that the organization of the redundancy process itself is highly important for the labour market outcomes of redundant workers.

In the displacement literature, conditions of the regional economic environment, such as employment rates and unemployment, have been considered as important factors determining the outcomes of worker displacements when moving to new jobs (Fallick, 1996). Primarily in the labour geography literature, more detailed accounts of the role of the regional economic environments have been developed, especially in studies dealing with displacements from particular plants (Shuttleworth et al., 2005; Bailey et al., 2012) and the regional impacts of large-scale closures (Chapain/Murie, 2008).

However, the literature within EEG enables to qualify the notion of the ‘absorptive capacity’ of the regional labour market (Bluestone, 1984). The absorptive capacity of the local labour market is highly important to the outcome of redundancy processes, because the geographical movement of individuals on the labour market and during industrial restructuring processes is constrained by place (regional) concerns due to economic, social and institutional reasons. It is widely acknowledged established that searching for and finding a new job in other regions is time-consuming, and carries monetary and social costs (Sjaastad, 1962). Moreover, Rigby/Essletzbichler (2006) demonstrated that the same industry may have significant and persistent differences in production techniques across regions. When an individual thus moves and becomes detached from the regional knowledge structure and routines, parts of the human capital may be lost, and will have to be built up again in a costly process (Fischer et al., 1998).

Given this constrained mobility of individuals in geographical space, the qualitative dimensions of the regional industry structure might have an important impact on the processes of labour reallocation. A highly specialized regional economy runs the risk of limiting the number of potential employers. Frenken et al. (2007) found that regional industrial diversity is shock-absorbing and protects from unemployment due to portfolio effects. Similarly, thick urban labour markets are generally associated with an increase in the chances for workers to find new employment (Puga, 2010). Nevertheless, changing jobs between different industries often involves a certain degree of human capital destruction. This consequence of job switching is less prevalent when the skill distance between the old and new job is lower. Job moves between skill-related industries enable individuals to use parts of their acquired human capital in their new job as well (Neffke/Henning, 2013). The theoretical reasoning is that workers can at least partially re-use previously acquired skills when switching between industries related due to similar knowledge bases and technological capabilities (see the box below).

***Concept of (skill-)relatedness between industries***

Workers normally strive to minimise the destruction of human capital when they change jobs, and seek to use their previously acquired skills and experience in their new position as well. Neffke/Henning (2013) argue that labour flows between industries, arising from job switches, are a clear indication of the degree to which industries are dependent on the same types of skills. They devise a quantitative strategy to derive the skill-relatedness between industries in the economy by observing the flows of (skilled) labour between these industries as people change jobs. Importantly, though, the observed flow needs to be compared to a baseline of expected flows to adjust for other factors besides relatedness that will obviously impact the size of the flows, for example the size of industries. Excessive labour flows between two industries which exceed the baseline indicate that workers can easily change jobs due to similar skill requirements between industries. Apart from the concept of skill-relatedness various approaches to capture the relatedness between economic and technological activities were introduced in economic geography, particularly in EEG, and widely employed in empirical analyses in economic geography at the individual, firm and regional level (for an overview see Hidalgo et al., 2018).

Recent works (e.g., Dawley et al., 2014; Diodato/Weterings 2015; Hane-Weijman et al. 2018; Nyström 2018) relate the regional industry mix to the qualitative absorptive capacity. Since regional labour markets appear to be endowed with different capabilities to provide laid-off employees with new jobs, this absorptive capacity seems to differ across regions (Hane-Weijman et al., 2018). Dawley et al. (2014) investigate a service plant closure in an OIA in Northern England and detect higher re-employment rates for low-skilled workers than for highly qualified persons. The occupational structure, a long-run specialisation in jobs at low and intermediate skill-levels, limits the regional adaptability and thus options to diversify into qualitatively new growth paths. Hane-Weijman et al.

(2018) and Nyström (2018) study large-scale redundancies in Swedish regions. Hane-Weijman et al. (2018) find that the presence of unrelated industries positively affects re-employment in regions with low unemployment rates. In contrast, the likelihood of post-redundancy employment is greater in case of related industries in regions with high unemployment. The study of Nyström (2018) confirms that the surrounding regional economic environment determines the reallocation of redundant human capital. It is shown that related and unrelated variety are both relevant for re-employment rates of displaced workers in Swedish regions exhibiting moderate re-employment rates. Consequently, the quality of the absorptive capacity and the regional economic conditions are both crucial for the post-redundancy probabilities of individuals to get a new job.

All in all, these studies provide some indication on the important role of the composition of the regional industry mix for the quality of the matching process after plant closures. Consequently, the qualitative characteristics of the absorptive capacity affect the opportunities of regions to reallocate redundant labour. Moreover, these works provide some evidence that the opportunities for regions to diversify depends on the quality of the absorptive capacity. Nonetheless, further systematic research is required to be able to assess which regional structures – industry, occupation, qualification – sustain in the regional economic context favorable conditions for the reallocation of released human capital.

Human capital is a key determinant of regional development, and universities evidently play a crucial role for human capital accumulation in regions (Gennaioli et al., 2013). However, graduates of local universities will only contribute to the human capital endowment if they stay in the university region (e.g. Fratesi, 2014). Findings by Abel/Deitz (2012) indicate that migration is an important factor for the geographic distribution of human capital. Outward migration might especially be an issue for smaller and lagging regions which usually have problems attracting young, highly skilled workers. Instead, graduates tend to move to large urban agglomerations (Frenkel/Leck, 2017; Krabel/Flöther, 2014). According to Haussen/Übelmesser (2018) the options of economically weak regions to enlarge their human capital endowment via keeping their own graduates and attracting graduates from other university regions are rather limited. Therefore, understanding the migration decision of graduates is of particular importance for lagging regions with HEI (Haapanen/Tervo, 2012).

If many graduates leave a university region, this region will presumably benefit less from the returns on the educational investments made. This could be particularly the case in Germany, as the federal states finance part of higher education (Haussen/Uebelmesser, 2018). For this reason, it might be of interest for regional policy makers to receive more detailed information on the share of stayers. Besides, measures intending to increase the probability that graduates enter the local labour market require detailed knowledge on the factors that determine the graduates' propensity to migrate after studies.

The extensive literature on student and graduate migration mainly investigates the factors that determine the migration decision. These studies resort primarily to human capital theory (Becker, 1962) and signalling theory (Spence, 1973) to explain the relationship between individual and study-related factors and migration decisions of the young highly educated whereas regional science highlights the importance of the regional environment for the migration behaviour of young workers (Buenstorf et al., 2016).

- One group of analyses uses information on the aggregate level and aims to explain interregional migration flows. For example, Faggian/McCann (2008) investigate the interdependence between graduate migration and the innovation performance of regions using a simultaneous equation model. Some studies apply gravity models to investigate the determinants of migration flows of students and graduates (e.g. Delisle/Sheamur, 2010; Faggian/Franklin, 2014).

- A second group of studies, using individual-level information, focuses on the probability of graduates migrating after having finally left university. Probit and logit models are estimated to identify individual, study-related and contextual factors that influence the decision to leave the university region and to belong to different migration types (e.g. Faggian et al., 2007; Krabel/Flöther, 2014). Other studies examine the destination choice of graduates based on multinomial logit models (e.g. Gottlieb/Joseph, 2006; Haussen/Uebelmesser, 2015).

This extensive empirical literature shows that individual, study-related and regional factors affect the spatial mobility of the young and highly educated. Individual characteristics such as gender, nationality, age and life-cycle effects (having a partner, children and residential property etc.) evidently determine the length of graduates' propensity to stay in university regions. Human capital factors such as the length of study, the degree, the field of study and the final grade may influence the decision to migrate as well. Corresponding evidence on the effects of the final grade is ambiguous showing that better graduates are either more likely to move to other regions or more inclined to stay in the university region (e.g., Haussen/Uebelmesser, 2015). A few works, such as Krabel/Flöther (2014), provide evidence that graduates' contacts with local employers influence their migration behaviour. Apart from economic and labour market indicators such as wage level, economic growth and unemployment rate, the literature in regional science also highlights the importance of local amenities (e.g. cultural offerings, varieties of regional consumption goods, ethnic diversity) and disamenities (e.g. crime rates) in urban agglomerations which are the main destinations of graduate migration (e.g. Arntz, 2010; Buch et al., 2014).

Despite of this extant comprehensive evidence on graduate migration, there are still some unresolved issues and research questions which deserve further attention in graduate research. Graduate surveys often provide information on the residence of graduates at specific points in time after having obtained the degree, but the exact date of a move is unknown. By now, a very few studies have addressed this issue using history event methods (Busch/Weigert, 2010; Haapanen/Tervo, 2012) and detect that the majority of migration events takes place shortly after graduation and that the propensity to leave the region of studies declines as the length of the residence spell increases. Besides, the use of administrative micro data on the biographies of graduates may enable to minimise problems usually linked to graduate survey data (e.g. selection problems) and may allow to employ additional quantitative methods. Moreover, the role of social networks for the migration decision has received also sparse attention until now. Besides, further investigations could focus in more detail on differences in the migration behaviour between distinct graduate groups to obtain a better understanding about the migration patterns. For instance, it is still known very little about the migration patterns of international graduates entering the labour market in the destination country. The same applies to gender-specific patterns of outmigration after studies.

### 3. Main findings of the analyses

#### *Industrial agglomerations and trajectories of Old-Industrial Areas (OIAs)*

Dauth, W.; Fuchs, M.; Otto, A. (2018): Long-run processes of geographical concentration and dispersion. Evidence from Germany. *Papers in Regional Science*, 97(3), 569-593, [doi.org/10.1111/pirs.12271](https://doi.org/10.1111/pirs.12271).

The geographical agglomeration of economic activity and externalities accruing from the proximity to firms of the same or different industries are central issues in regional science and economic geography. A large literature documents the importance of these externalities and their varying impact across different industries (e.g., Beaudry/Schiffauerova, 2009) and illustrates for various regional and sectoral delineations at specific points in time (detailed) rankings of industries according to their degree of geographic concentration. The importance of agglomeration forces also varies over time (Neffke et al., 2011) for the main part due to technological progress, structural and geopolitical changes. These alterations of agglomeration patterns are only sparsely documented in the literature. The few long-term studies approaching a dynamic perspective predominantly document the dispersion of manufacturing activity across several European and North American countries (e.g., Cutrini, 2010; Behrens/Bouagna, 2015). However, evidence on the underlying mechanisms explaining these long-run changes is still largely missing.

This first paper of the compilation provides an investigation of long-run changes in geographical concentration of economic activities in West Germany, using the agglomeration index developed by Ellison/Glaeser (1997). This study assesses changes of agglomeration forces between 1980 and 2010 in all economic sectors, and in manufacturing, services, and in the knowledge-intensive sector separately and sheds light on the plant life cycle as an important mechanism for long-run changes in geographical concentration.

The study draws on a comprehensive Establishment History Panel (EHP) of the Institute for Employment Research (IAB) which consists of all firms with at least one employee liable to social insurance contributions. Since empirical analyses on geographical concentration react sensitive towards the level of data aggregation (Ellison/Glaeser 1997), the investigation takes into account different industrial levels (2-/3 digit-industries) and regional levels (counties/labour market regions). The values of the Ellison-Glaeser-Index index are compared between these different levels of sectoral and/or regional aggregation for all industries as a whole and for the manufacturing, service and knowledge-intensive sector over a time period of 30 years. The obtained results are robust to sensitivity checks of the EG index that explicitly incorporate spatial neighbourhood effects and the industry size structure. To identify the underlying mechanisms, the aggregate change of concentration is decomposed into the four factors that constitute the life cycle of a firm – creation, growth, decline and closure. The plant life cycle concept is similar to the industry life cycle concept.

Although, the results show that most industries in West Germany are stronger geographically concentrated than a purely random distribution of firms would imply, the main finding is a secular decline of forces leading to spatial concentration in the period between 1980 and 2010. It can be concluded that agglomeration forces have slightly lost importance as the driving motor for spatial dynamics in West Germany.

The study discloses some differences in the agglomeration patterns and dynamics between the three considered sectors:

- Agglomeration forces are stronger in manufacturing compared to the service and knowledge-intensive sectors. The greatest part of highly localized industries consists of mature manufacturing industries (e.g., jewellery, ceramics, cutlery, textile), industries requiring the access to natural sites (e.g., mining) or other site-specific features - irrespective of structural crises and decline of most of these industries. Transport activities (e.g., shipping) and related services are strongly concentrated, too. Although knowledge spillovers are expected to be pivotal for a high degree of localization of knowledge-intensive industries, only a small group of manufacturing and business services in this sector is highly localized.
- The long-run dynamics clearly differ: Whereas in manufacturing a trend of deconcentration can be ascertained from 1990 onwards, agglomeration forces in services and the knowledge-intensive sector decreased in the first half of the 1980s, only to remain roughly constant afterwards.
- Concerning the role of the different components of the plant life cycle for the changes in the degree of concentration it is found that in the manufacturing sector, the decline of concentration in the 1990s can largely be ascribed to existing plants in agglomerations that systematically declined more strongly than plants located outside these agglomerations. In the subsequent first decade of the 2000s, then, opposing effects by plant creations and closures prevailed. Obviously, agglomerative forces have lost in importance, giving over to a process of creative destruction within manufacturing. In the service sector, the slight decline of the EG index appears to result from the creation of new firms that were located outside of agglomerations. New service firms were established in regions where only few service firms of the same industry already existed.
- Although, the secular decline of geographic concentration took place slowly over time and some shifts towards more dispersed industries can be observed, the pattern of spatial concentration across single industries has remained considerably stable over time.

In the context of the overall compilation, the long-term analysis of this paper detects a secular decline of agglomerative forces in Germany over 30 years. The intensity of this deconcentration process is more pronounced in manufacturing than in services and can be ascribed to sector-specific processes of the plant life cycle. This shift towards more dispersed economic activities takes place very slowly, spatial concentration of industries is found to be quite persistent over time pointing to the path dependent trajectories of industrial agglomerations. Nonetheless, the degree of industrial agglomeration in mature manufacturing industries, foremost in OIAs, is still considerable despite spatial deconcentration over time.

**Bauer, F.; Otto, A. (2006): Schrumpfung im Ruhrgebiet, Wachstum im Saarland. Eine komparative Analyse der Beschäftigungsentwicklung in zwei ehemaligen Montanregionen. Zeitschrift für Wirtschaftsgeographie, 50(3/4), 147-161, doi.org/10.1515/zfw.2006.0016.**

The Saarland is a case in point for a former OIA in which the coal and steel industries are still highly concentrated geographically, despite of severe structural crises and shrinkage of these sectors in the past. Apart from Baden-Württemberg, the Saarland is the only Federal State in Germany with an upturn in employment in the 1990s (1993-2001). This positive employment growth is considered as success of economic recovery whereas employment in the old-industrialized Ruhrarea declined. The aim of this paper is to analyse the determinants of Saarland's employment growth in order to detect the strengths, but also the weaknesses of economic recovery. A comparison with the Ruhr area, an OIA with a similar trajectory, enables to identify the specific factors having favoured or complicated Saarland's recovery.

The theoretical relationship between the industry life cycle, the elasticity of sector-specific demand for goods and technical progress, as highlighted by Applebaum/Schettkat (1999), is put forth to explain sector-specific labour demand. If young (old) industries in early (later) life cycle stages are predominant in a region, sector-specific labour demand increases (stagnates/declines). The regional industrial portfolio is expected to be pivotal for regional employment growth (Amend/Otto, 2006).

The study uses a panel-shift-share-regression to explore the effects on employment growth in the Saarland and the Ruhr area in the period between 1993 and 2001 (Ludsteck, 2006). The regression analysis resorts to comprehensive data on regional employment in Germany. A conventional shift-share regression incorporates two components: regional industry mix and location effect. The employed econometric model, developed by Ludsteck (2006), regards additional structural regional determinants: the firm size structure, the qualification levels of the workforce and the wage level. In the model, the wage effect contains three components: the purely local-specific component of wages being corrected for impacts of industry, qualification structure etc., industry-specific elasticity of labour demand, and industry's local employment share.

The panel regression shows a negative effect of the industrial portfolio on Saarland's employment growth which could result from still predominant, but shrinking mature manufacturing industries such as mining, steel and metal. Although, the service sector has expanded in the past, dynamic service industries (e.g., business services) are still underrepresented in the Saar region. Medium-sized firms have evidently contributed to the expansion of employment in West Germany. As large firms still prevail in local mature industries, the proportion of small and medium-sized firms is below national average and results in a negative firm size effect on regional growth. Since Saarland's workforce lacks highly qualified workers, the impact of the qualification structure on regional growth is negative, too. This shortage of academic workforce might result from a relatively low demand for this type of labour, as knowledge-intensive sectors are underrepresented, and also from moderate local training capacities of higher education institutions and the fact that this region suffers from a long-term brain drain of young graduates (Otto/Schanne, 2005). The low relative wage level has positively affected regional employment growth. It is supposed in the paper that the workforce in the local mature industries might have supported economic recovery with wage restraint. Wage elasticities are an indicator of industrial wage sensitivity. As Saarland's economy is still strongly specialized in manufacturing, and this sector reacts quite strongly to a change in wages, the wage effect in this Federal State is presumably strengthened by the regional industry mix. The panel regression shows a positive location effect pointing to a supportive regional environment in the Saar region for local growth. The negative employment growth of the Ruhr area in the 1990s is, as the regression results show, due to negative structural effects and a positive wage effect, but also resulting from a negative location effect. In contrast to Saarland, employment growth in the Ruhr area is driven by a larger fraction of more dynamic service industries and by a larger fraction of highly qualified labour force as a rich infrastructure of higher education institutions was established. While agglomeration effects, additionally sustained by intense cross-border commuting, might have contributed to the positive growth impact of the local environment in Saarland, stronger intra-regional competition among urban centres in the Ruhr area might have dampened such effects to operate. Moreover, firms in mining, steel, metal and automotive sectors might have benefited from localization effects in the Saar region.

At a first glance, the upturn in Saarland's employment in the 1990s may be considered as result of a successful economic recovery after the severe crises of mining, steel and metal industries. However, the negative effects of the structural determinants – industrial mix, firm size and qualification structure - suggest a rather precarious employment growth. To improve the robustness of the regional labour market against a shock or crisis, these adverse effects should be taken into account. An important

driver for regional employment growth, as detected in the analysis of this paper, is the low relative wage level. However, an increase in regional wages might jeopardise this regional competitive advantage. Moreover, the local industry portfolio – above all the still strong specialization in mature mining, steel and metal industries – affects implicitly the other structural effects.

As contribution to this compilation, this study suggests that development trajectories of OIAs still specialized in mature manufacturing industries may still be affected by potential adverse impacts of the industrial portfolio. In addition, the findings in both case study regions indicate that the impact of other industry-related structural determinants like wage level, firm size and qualification structure on regional growth persisted also, in a pathdependent manner, despite deindustrialization and structural renewal.

**Trippel, M.; Otto, A. (2009): How to turn the fate of old industrial areas. Cluster-based renewal processes in Styria and the Saarland compared. *Environment and Planning, A, International Journal of Urban and Regional Research*, 41(5), 1217-1233, doi.org/10.1068/a4129.**

OIAs face the challenge to modernize the cluster of still predominant old mature industries and to diversify the industrial portfolio to master economic recovery and to improve the resilience of the regional economy. The objective of this paper is to study regional trajectories of OIAs with exploring the role of clusters and RIS for economic recovery. A comparative case study of the regions Styria and Saarland having both a similar economic history allows to identify specific factors having either sustained or hindered economic recovery in each region.

This paper proposes the idea that the cluster concept represents a useful approach in this regard, differentiating between an innovation-based adjustment of mature clusters (incremental change), the development of new clusters in established industries (diversification), and the emergence of clusters based on knowledge intensive sectors (radical change). The applied theoretical framework conceives clusters as integral part of RIS. It is proposed to regard different dimensions - such as knowledge application and exploitation (cluster), knowledge infrastructure, relational assets and institutional fabric of the region, political system – in order to study cluster-based diversification processes. The paper suggests that such processes are a demanding endeavor, resting on a complex interplay of firm strategies, changes in the knowledge infrastructure, institutional innovations and policy learning processes. Consequently, the capacity of a region to transform the whole regional innovation system turns out to be the decisive factor for renewal processes.

The results of the comparative empirical analysis of restructuring processes in the regions of Styria and Saarland provide support for this view and show different routes of RIS transformation.

The Saarland has been less successful in promoting an innovation-oriented adjustment of its old mining, steel & metal cluster, because only a few firms adopted innovation strategies, little has been done to improve the weak knowledge infrastructure for this mature cluster, and old policy routines were changed too late (incremental change). A regional innovation policy strategy was only implemented in the early 2000s. In the Saarland branch plants have been attracted by low wages, the region's weak endowment with knowledge providers and supporting institutions, and a late and less proactive policy response to the structural crisis provided rather unfavorable conditions for the dynamic evolution of the automotive cluster (diversification). In the Saarland the RIS exhibits an almost exclusive specialization on promoting only radical change. Hence, the Saarland has got a good performance regarding the rise of new high tech sectors, especially in information and communication services, brought about by new firm formation, the creation of new knowledge infrastructure

elements, the formation of innovation linkages and new policy approaches (radical change). In contrast, it is shown that Styria's reconstructed RIS contains a much larger variety of elements favoring the co-existence of different cluster-based development paths including incremental change in the metal cluster, diversification into the automotive sector and establishing a competitive high tech-cluster (radical change).

It is concluded that policy actors in OIAs face the challenge to facilitate an innovation-oriented restructuring of old clusters and to build up new ones whilst avoiding the pitfalls of specialized concentrations of economic activity. What seems to be vital in this context is a more or less regular search for and support of new clusters to broaden the economic base and to promote related diversification (Frenken et al., 2007) to avoid the risk of a too narrow economic specialization.

This comparative case study analysis of cluster-based renewal in Saarland and Styria adds to the compilation that an important prerequisite for firms to benefit from localisation effects and knowledge spillovers is not only the local proximity to other firms, suppliers, customers etc. within the cluster, but also the integration of the cluster into the RIS. While Styria's rich knowledge infrastructure enabled comprehensive cluster-based renewal of different sectors, Saarland's almost exclusive specialization promoted only radical change towards new high tech sectors, whereas missing innovation linkages between the RIS on one side and the mining, steel & metal cluster and the automotive cluster on the other are bottlenecks for the competitiveness of both clusters as positive externalities arising from such linkages are limited.

**Otto, A.; Nedelkoska, L.; Neffke, F. (2014): Skill-relatedness und Resilienz: Fallbeispiel Saarland. In: Raumforschung und Raumordnung, 72(2), 133-151, doi.org/10.1068/a4129.**

The starting point of this paper is the concept of relatedness and the process of related diversification from EEG. Industries are related to each other by cognitive and technological proximity, these linkages facilitate knowledge exchange. Knowledge spillovers between these related industries support innovation and growth. In this paper, the relatedness between industries refers to the skill-relatedness, which corresponds to similarities in human capital requirements between industries. The objective consists of introducing a tool box derived from the network structure (industry space) of skill-relatedness between industries at its core, to analyse a region's industrial structure, development prospects and resilience. The first part of the paper introduces the concept of skill-relatedness and compares this concept to related approaches in economic geography. In the second part, the operationalization of the skill-relatedness measure and the quality of the tool box is checked. The third part comprises a case study for the Saarland. It is carried out a SWOT-analysis based on indicators derived from this tool box and the industry space.

First, the concept of skill-relatedness is compared to related theoretical concepts in economic geography. Here, it is emphasised that the concept of relatedness is also an important component of clusters (Porter, 2003) and RIS. In a cluster there are many links between firms and local institutions (e.g., supplier-customer relationships). The delineation of a cluster often includes only certain sectors. However, there may be cross-links between sectors from different clusters, as both sectors require employees with similar qualifications and are therefore skill-related. The conceptual approach in this contribution is broader than in Paper 2, as the links are not limited to relationships between firms within the cluster on one side and to the RIS on the other, but include all links of skill-relatedness between industries. These links are expressed as networks that map the complex links in an economy.

Second, the calculation of the skill-relatedness measure is explained using data on inter-industry job switches from the Employment History of the Institute of Employment Research (IAB), and how the links of skill-relatedness are mapped in a network (industry space). The predictive quality of the embeddedness indicator derived from the tool box is validated by regressions showing that well-embedded industries in the regional industry space exhibit even growth in periods of overall economic decline (2008 to 2012) in Germany. A SWOT analysis combines the degrees of regional industry specialization and embeddedness to identify strengths, opportunities as well as weaknesses and risks for the trajectory of a regional economy. A case study for Germany's state Saarland illustrates in which ways this SWOT analysis can be employed to evaluate the resilience of a regional labour market. It is highlighted that the particular strength is the long-term specialisation in mature clusters in the steel, metal, automotive and mechanical engineering sectors. Due to the high density of strong skill-relatedness links between these sectors, they share a common knowledge base and are well embedded in the regional economy. In case of a crisis, workers in one of these industries have many opportunities to find a job in the other skill-related industries and minimise human capital losses. However, this strength can become a risk in the case of correlated exogenous shocks, when all of these large old industries in the region release workers simultaneously. However, the young knowledge- and technology-intensive industries, which are well connected to research and higher education are not well embedded in the regional economy and even not skill-related with the large older manufacturing clusters, so that growth potentials remain untapped.

Two options for potential supportive regional policy strategies can be derived from this case study:

- Similar human capital requirements among older manufacturing and younger service sectors resp. and between both industry groups can be specified in greater detail in practice, e.g. in the areas of personnel training and further training. The basic idea is that the range of sectors from which employees can choose when they change jobs will be extended in the region, and the transfer of knowledge between sectors is facilitated, too.
- A second approach could address missing links, e.g. between cognitively more distant sectors, which can be established through project-related cooperation and R&D projects. This could, for example, encourage links between older manufacturing industries and younger service sectors. The industry space offers an appropriate opportunity to identify such existing and missing links.

This paper contributes to the overall compilation by introducing a tool box which allows to identify potential barriers and opportunities for structural renewal of OIAs. As this methodological approach encompasses a region's entire industrial portfolio existing (missing) relatedness links within and/or between industrial clusters in a region can be detected to sustain knowledge spillovers and thus innovation activities and economic growth. The application of this toolbox enables to derive more place-sensitive policy strategies to build on existing activities, but untap additional resources.

### ***Regional inter-industry labour flows***

**Neffke, F.; Otto, A.; Weyh, A. (2017): Inter-industry labour flows. In: Journal of economic behavior & organization, 142(10), 275-292, doi.org/10.1016/j.jebo.2017.07.003.**

The overall objective of this paper is to provide with a broad set of analyses on the structures, flexibility, stability and predictive quality of inter-industry labour flows a better understanding on inter-industry labour flows in general and for the use of labour-flow based measures of skill-relatedness in

particular. The study is based on comprehensive micro data on job switches of workers compiled in the German Employee History (Beschäftigtenhistorik, EH). In the observation period from 1999 to 2008 on average 1.3 million job switches of workers are observed per year in Germany.

The analyses are organized around two sets of research questions which complement two debates in the recent literature, resp. As the findings of this study express strong regularities of inter-industry labour flows, the outcomes are summarized as stylized facts.

The first debate relates to human capital specificity and job switching. Labour economists have extensively studied job-switching rates (or, their complement, employment durations) and how they depend on business cycles, industry and worker characteristics. Recent work in this tradition finds that workers often change jobs across industries that belong to completely different sectors (Kambourov/Manovskii, 2008). This finding may lead to the conclusion that human capital has no strong industry-specific component. However, because this research fails to take into consideration which industries exchange workers, it implicitly assumes that all industries are equidistant from one another in terms of human capital requirements.

However, the following stylized facts as evidenced by the analyses in this paper on the network structure of inter-industry labour flows casts doubts on this conclusion:

- (1) Workers often switch jobs between industries that belong to different (highly aggregated) sections of the industry classification system.
- (2) This first stylized fact may be taken as an indication that workers can change industries relatively freely and a fortiori that human capital cannot be particularly industry specific, a closer inspection shows that industry switches are far from random. On the contrary, most labour flows take place within a narrow set of industry pairs.
- (3) It is found that the underlying pattern of inter-industry labour flows hardly changes over time. Hence, the structure of inter-industry skill-relatedness matrices remains quite stable over time.

A second related debate takes place in the literature on inter-industry relatedness. An increasing number of papers has turned to such flows as an expression of inter-industry relatedness. These papers assume that human capital is to some extent industry-specific. Consequently, labour flows are constrained and will predominantly take place between industries with similar human-capital requirements. This has resulted in labour-flow-based skill-relatedness measures (Neffke/Henning, 2013), which have been used in various papers (e.g., Diodato/Weterings, 2015). In accordance with this literature, further analyses were conducted to provide a better general evidence-based understanding of this measure.

The main findings of these analyses are condensed in the following stylized facts:

- (4) Job switches of workers in different labour-market segments exhibit similar skill-relatedness networks, i.e., the same industries are connected by labour flows, regardless of the labour-market segment.
- (5) Given the strong tendency of intra-regional job changes, skill-relatedness measures may just reflect industrial collocation patterns. It is found that short-distance and long-distance labour flows exhibit similar patterns of skill-relatedness. Hence, skill-relatedness estimates are not mainly driven by industry collocation patterns.
- (6) Following the literature on related diversification in economic geography (Hidalgo et al., 2018), it is tested whether this labour-flow-based skill-relatedness measure predicts local industries' entry

and growth rates better than other relatedness measures. The regression analyses show that the skill-relatedness index is a better predictor of industries' regional growth and entry than inter-industry relatedness measures based on co-location patterns (Porter, 2003; Hidalgo et al., 2007) or input-output relations.

- (7) The sparse network of skill-relatedness can be thought of as expressions of constraints to inter-industry labour mobility. Such constraints may hinder the efficient reallocation of workers from declining to expanding industries, which may affect a region's resilience to adverse shocks. The degree to which such mobility constraints cause reallocation frictions depends on whether or not related industries experience correlated shocks. A simulation and correlation analysis reveals that skill-related industries do not exhibit strongly correlated growth patterns. Hence, the skill-relatedness structure governing inter-industry labour flows doesn't present major obstacles in the reallocation of workers from shrinking to growing industries.

The general findings of this paper suggest that labour flows connect industries in a sparse skill-relatedness network (industry space), and it is stable over time, similar for different types of workers and independent of the geographic distance of job switches. In the regional context, findings on the predictive quality of the skill-relatedness indicator for industry growth and the uncorrelated growth patterns of skill-related industries may contribute to design more place-sensitive strategies for supporting the structural renewal and the resilience of lagging regions and OIAs still locked in decline.

**Eriksson, R.; Henning, M.; Otto, A. (2016): Industrial and geographical mobility of workers during industry decline: The Swedish and German shipbuilding industries 1970-2000, *Geoforum*, 75(10), 87-98, doi.org/10.1016/j.geoforum.2016.06.020.**

In the early 1970s, Sweden and West Germany were among the most important shipbuilding nations in the world. After 1970, a downturn of shipbuilding has begun, this crisis posed enormous challenges to many industrial cities such as Göteborg and Hamburg as redundant workers had to be shifted to jobs in other regional industries. In this paper, labour market outcomes are compared between displaced (former) shipbuilding workers of both countries during the period 1970-2000. The analyses resort to comparable data sets on employment biographies of former shipyard worker in both countries. This paper combines insights from extant literature on plant-closures and displacement with EEG and analyses the situation of the individual workers leaving shipbuilding, investigating the extent to which they were employed at all, tended to move to related sectors within or outside the region, and whether such moves were beneficial for the individuals.

The literature on plant close-downs and worker displacement has particularly focused on identifying the individual characteristics affecting the labour market outcomes of released workers (Fallick, 1996). The impact of the regional economic environment on the re-employment of displaced workers was investigated, too (Pinch/Mason, 1991; Bailey et al., 2012). Bluestone (1984) and Shuttleworth et al. (2005) highlight the 'absorptive capacity' of the regional labour market as crucial for creating job opportunities for redundant workers. In EEG one important qualitative aspect of regional absorptive capacity is discussed: As labour mobility between related industries allows workers to at least partially re-use previously acquired skills (Neffke/Henning, 2013), the presence of many related industries in a region may alleviate the re-allocation of displaced workers.

As a complement to the conventional redundancy and displacement literature traditional way of relying on occupations and formal skill levels between former shipyard jobs and new workplaces to assess the matching quality, information on human capital similarities between industries is used to

check whether the regional presence of skill-related industries matters for the propensity of an individual to move, and for his or her success when doing so.

First, this comparative study detects that despite considerable institutional differences between both countries in handling large-scale redundancies of shipyards, the final labour market outcomes in terms of re-employment rates and non-employment of ex shipyard workers were rather similar. Second, the regression analyses has shown that individual determinants on labour market outcomes do confirm previous evidence of plant-closure and displacement studies. Third, the regression analysis has also proven that the composition of the regional industrial portfolio affects labour market performance of former displaced shipbuilding workers. A strong regional specialization in shipbuilding made people stay in the industry as long as possible rather than going elsewhere, even during industrial decline in both countries. In the West German case, the regional specialization in industries being skill-related with shipbuilding was important in providing opportunities for exiting shipyard workers. The presence of skill-related industries in the region offers options to move to new sectors with high matching quality. Thereby, this kind of labour mobility presents opportunities for an incremental change of the regional industry structure (Diodato/Weterings, 2014). Hence, the productive re-allocation of redundant staff from declining to growing industries, thereby achieving a re-use and re-combination of existing region-specific human capital, could be one of the most important empirical drivers behind regional resilience. In Sweden, moving to related industries is not beneficial for released workers in the later study period (1990–2000), because related industries declined strongly in the major shipbuilding regions, too. Hence, opportunities to move to related industries in the same region became limited towards the end of the investigated period. In Germany, the story is different. Even though the number of employees in industries generically related to shipbuilding decreased in many of the major shipbuilding cities, employment in these industries on the national level stayed rather constant. In this respect, the overall structural change in the Swedish and German regions had quite different impacts on the labour market outcomes of ex-shipyard workers. The specific components of the regional industry structure – the same industries, related industries, and industrial diversification – are important aspects of the absorptive capacity (Bluestone, 1984) and the demand side of the regional labour market (Shuttleworth et al., 2005) in different phases of industry development.

This paper adds to this compilation by showing that the quality of the regional matching process of former shipyard workers when looking for a job depends on the regional industrial portfolio. A strong regional specialization in such a mature manufacturing industry is related with a higher likelihood of workers staying in this industry irrespective of its decline. In the West German case, the regional specialization in industries being skill-related with shipbuilding was important in providing job offers with a high matching quality for exiting shipyard workers. In contrast, the absorptive quality deteriorated in Sweden due to decline of both shipbuilding and related industries.

**Neffke, F.; Otto, A.; Hidalgo, C. (2018): The mobility of displaced workers: How the local industry mix affects job search. *Journal of urban economics*, 108(11), 124-140, 10.1016/j.jue.2018.09.006.**

Marshallian externalities are often related to the thickness of local labour markets which are associated with two separate, but related, mechanisms. First, firms benefit from locating close to other firms in their industry, because it helps them find workers with specialist skills. Second, specialist workers are attracted to such geographical clusters, because, if they were to lose their job, a local concentration of employers in their industry will make it easier to find new work that matches their skill profiles.

Hence, a large local concentration of an industry in a region reduces the risk of protracted unemployment for the specialized workers employed in that industry. This suggests that displacement will depend on how many local jobs exist that utilize a displaced worker's skills. Interestingly, although authors have studied the exit (Gathman et al., 2014) and entry (Greenstone et al., 2010) of large economic establishments to identify causal effects of Marshallian externalities by exploiting the employment shocks, these events create, this work has focused on the labour market pooling effects to firms, not workers. In line with this, a number of recent papers have studied how workers change industries and regions after having been displaced from their jobs, for instance, in the aftermath of shipyard closures (Paper 6; Holm et al., 2017). However, it has not yet been assessed empirically whether Marshallian externalities play a role in moderating the effects of establishment closures.

In the first part of this paper, it is therefore studied how local concentrations of the pre-displacement and related industries impact further careers of displaced workers. Do they affect the earnings drop associated with displacement? Do they affect the length of unemployment spells? Do they change the extent to which workers deal with displacement by switching industries or moving to other regions?

In this part of the paper the aim is to provide answers that address the causal mechanisms these questions imply by exploiting data on displaced workers. It is applied a combination of matching techniques and regression models to working histories of over 20 million employees recorded in the German Employee History (Beschäftigtenhistorik, EH) of the Institute of Employment Research. Using difference-in-differences estimation, first the causal effects of job displacement on post-displacement wages and careers are explored. Here, it is found that workers who are displaced in establishment closures not only experience significant earnings losses and are less likely to return to jobs covered by social security, but those who do return are also 66 percentage points (pp) more likely to change industries and 33 pp more likely to change regions than their statistical twins. Next, it is evidenced that there is substantial heterogeneity in these displacement effects that can be attributed to Marshallian externalities. First, the study reveals that a strong local presence of the pre-displacement industry reduces post-displacement industry and region switching rates by 31 percent, respectively 12 percent. In contrast, high shares of local employment in industries skill-related to the pre-displacement industry increase industry switching rates substantially, but do not prevent that workers leave the region. Turning to wages and re-employment rates, substantial moderating effects of the local industry mix are found. Whereas, on average, earnings drop by 39%, this drop is reduced to 32% in regions with large concentrations of the industry from which workers had been displaced. Moreover, with 24% and 7% lower long-run nonemployment rates, high concentrations of the pre-displacement and skill-related industries in the region offer some protection against long-term nonemployment.

Having shown that Marshallian effects play a role in whether and where unemployed workers find new jobs, the second part of the paper addresses the following question: If such Marshallian externalities in job search exist, do job searchers take advantage of them? To provide a framework for answering this question, it is employed the search model by Fallick (1992, 1993) in which unemployed workers divide their search efforts between two sectors: their own industry and a sector composed of suitable alternative (skill-related) industries. This model is adapted to the above question by assuming that greater search efforts translate, among other things, in a widening of the geographical search radius. As a consequence, the geographical mobility of workers will contain information about workers' (unobserved) allocation of search effort between the two sectors. The model predicts that favorable local conditions in a particular sector not only increase the likelihood of finding a job in this sector, but also induce workers to allocate most of their search efforts to this sector, at the expense of the other (related) sector. As a consequence, favorable conditions in one sector will reduce the spatial scope of search in the other sector. This prediction finds strong support in the data. That is, we not only show

that Marshallian externalities exist job-search, but also that they are reflected in workers' job-search strategies.

This study contributes to the compilation by showing that skill-related employment in an industrial agglomeration induces workers to change industries, while decreasing the likelihood of protracted nonemployment spells. In addition, the empirical findings suggest that clusters of related activities not only create agglomeration externalities for local firms, but also for workers.

**Teichert, C.; Niebuhr, A.; Otto, A.; Rossen, A. (2020): Work experience and graduate migration. An event history analysis of German data. *Regional studies*, 54(10), 1413-1424, doi.org/10.1016/j.jue.2018.09.006.**

Human capital is a key determinant of regional development, and universities evidently play a crucial role for regional human capital accumulation. Graduates of local universities will only increase the human capital endowment if they stay in the university region (e.g., Fratesi, 2014). Outward migration might especially be an issue for smaller and economically lagging regions. An extensive body of literature on student and graduate migration provides robust evidence on the importance of individual, study-related and regional factors for migration decisions after graduation (e.g., Buenstorf et al., 2016; Faggian et al., 2007). The impact of graduates' prior work experience on the decision of where to take up a job after graduation has received little attention so far. Employment before graduation might influence migration because it gives rise to location-specific knowledge and job-relevant networks. Graduates' contacts with local employers evidently affect the migration decision (Krabel/Flöther, 2014). Haapanen/Karhunen (2017) and Haussen/Uebelmesser (2018) examine the significance of work experience for migration, but they do not consider the role of the location of previous employment.

This study provides new evidence on the importance of different types of work experience for graduate migration. It is used a unique micro-data set that combines student records of German universities with administrative social security records. The moves linked to labour market entry of a sample of about 25,000 students who graduated between 1996 and 2012 are investigated. As the data encompass graduates' employment biographies on a daily basis, employment episodes, including information on the type of jobs and the location of the workplace, can be precisely identified.

The results indicate that the majority of migration events take place during the first two years after graduation. We detect significant relationships between prior work experience gained inside or outside the university region and the probability of outward migration, pointing to the importance of labour market contacts, local human capital and social networks for labour market entry and related mobility. However, the size of the effects depends on the type of work experience. We find stronger effects of regular jobs compared with marginal employment. The same applies to sector-specific and occupation-specific versus non-specific work experience. We detect the strongest effects for sector-specific experience obtained during studies through regular employment in the university region. The impact of corresponding experience gained outside the university region falls short of the former effect by factor of nine.

The results might be considered as potential contribution to the further development of already established policies that aim to increase the likelihood of labour entry of local graduates in the university region. Providing opportunities to gain knowledge about the local labour market and establishing labour market contacts via (regular) employment might be a possible strategy to deepen ties of graduates to the region of studies. Local authorities could therefore take into consideration to

intensify intra- regional collaborations (e.g., job fairs) between universities, firms and other relevant actors, such as employment agencies and chambers of commerce, in order to retain young, highly educated workers. In addition, work experience is usually perceived as an activity in addition to academic education. Instead, universities may embed more practical elements and learning opportunities as components into the curricula. Such work experience might contribute to students obtaining more targeted contacts for entry into the local labour market.

This paper adds to the compilation with stressing the importance of local labour market knowledge and social contacts gained through working experience before or while studying for regional labour market entry of highly skilled labour. This relationship is even more pronounced when the industry or occupation of previous work experience does coincide with the industry/occupation the first job after studies. Consequently, establishing such links sustains a higher likelihood of retaining higher education graduates in the university region.

#### **4. Summary**

The particular challenge for OIAs consists of mastering both to recover from the longlasting effects of severe crises of the former predominant industries and to adapt to ongoing multiple structural changes. The contributions in this compilation provide insights in which ways different factors affect the adaptability of OIAs and thus their divergent trajectories.

Despite a secular decline of agglomerative forces over decades, the degree of industrial agglomeration in mature economic activities is still remarkable in German regions. Remnants and fragments of these mature industries contributed to adverse effects of the industry mix on regional growth in OIAs like the Ruhr area and Saarland. In both regions, other structural determinants (e.g. firm size, qualification) hampered local growth, too. These factors are somehow ‚functions‘ of a region’s industrial portfolio and have persisted, in a path-dependent manner and aggravated renewal (Martin et al., 2016). The integration of industrial clusters in RIS enables firms to benefit from localisation effects and knowledge spillovers and sustains thus economic recovery, as evidenced for Styria. However, missing innovation linkages between the RIS and the mature manufacturing clusters can be bottlenecks for renewal, like in Saarland. Moreover, weakly embedded mature manufacturing clusters in an OIA’s industry space imply limited opportunities for knowledge spillovers and innovation due to missing skill-relatedness links across old and new clusters, this applies to the Saarland. Consequently, the adaptability of an OIA to structural change and the opportunities to develop a coherent industrial portfolio may be hampered by such missing links because workers’ knowledge and skills cannot be easily shifted from old to new related economic activities.

In addition, this compilation provide insights on the impact of the regional industrial mix on individuals’ post-redundancy re-employment opportunities, to which industries workers move after plant closures in industrial agglomerations and whether they remain in the region or not. The respective papers in this compilation show – in line with previous findings - that the likelihood of displaced workers to take up new employment does not rely merely on individual characteristics, but also on the ‘absorptive capacity’ (Bluestone, 1984) of the regional labour market, the regional industry structure, and the surrounding conditions. It is revealed that workers are far from random when switching jobs between industries, instead the majority of job switches take place between a small number of industry pairs. Most importantly, it is shown that the quality of the absorptive capacity, the presence of the same and skill-related industries, plays an important role for the re-employment of dismissed workers and in which industry and region they find a new job. Since the growth patterns of skill-related industries were found to be uncorrelated at the regional level, this implies that regions should be basically simply

able to shift easily redundant human capital to related activities. However, the findings of the contributions suggest that regional labour market conditions also matter whether related or unrelated industries are more beneficial. In times of severe decline, as shown for the Swedish shipyard industry, unrelated industries as regards the skill content, are of particular importance because many workers have to find new employment in various industries very shortly after displacement. The deterioration of the absorptive quality, the decline of both the pre-displacement industry and its related industries in this Swedish case, forced workers to move to unrelated industries. Therefore, to develop a coherent industrial portfolio and skill base appears to be decisive for the absorptive quality of the regional labour market and thus for its resilience and adaptability to structural change.

Nonetheless, the absorptive capacity is not only crucial for keeping the older qualified workforce, but also to retain young graduates after having left university. A high share of stayers is especially important for lagging regions to increase their human capital endowment to sustain innovation and growth. The findings of this compilation stress the importance of local labour market knowledge and social contacts gained through before or while studying for regional labour market entry of highly skilled labour. This relationship is even more pronounced when the industry or occupation of previous work experience does coincide with the industry/occupation of the first job taken up after studies. Hence, establishing such links sustains a higher likelihood of retaining higher education graduates in the university region.

## 5. Conclusions

The contributions in this compilation may complement already existing regional labour market, economic and innovation policies aiming at sustaining local knowledge transfer, innovation activities and growth. It can be derived a range of policy recommendations that seek to improve the coherence of the regional industrial portfolio and thereby its resilience and adaptability to structural change.

- The basic idea for one possible approach to create a more coherent regional industrial portfolio is to increase the range of sectors that employees can choose from when changing jobs in the region. The already existing skill-relatedness links between industries in the region can be strengthened to improve the cognitive proximity between them. In addition, knowledge transfer between industries in the region is also facilitated in this way. In particular, in OIAs, overlapping human capital needs between industries of mature clusters and younger clusters could be further specified in practice. For this purpose, local enterprises might cooperate with local labour market actors such as Chambers of Commerce and employment offices, institutions of the education system etc. Then, joint programmes and projects, for instance in apprenticeship and staff training as well as in further education of the workforce, could be established to alleviate job moves of workers between related industries and to improve the shared skill base of local industries. Promoting further linkages between existing clusters and other industries in a regional labour market is certainly a further option for strengthening the regional knowledge base.
- A second approach could focus on missing links, e.g. between cognitively more distant sectors. These could be established through project-related cooperations. These cooperations could, for instance, refer to joint research and development projects. Thereby, links between traditional industries and younger industries could be promoted in OIAs. An interface for establishing such links could be the local higher education system and the associated research infrastructure. The industry space offers a good opportunity to identify such existing and missing links. Moreover, such links could also be established between neighboring regions.

- Furthermore, it would be helpful for the placement of unemployed and employed job seekers if the regional employment offices and private placement services would employ software programmes and tools that sustain them in providing jobs in occupations and industries being skill-related to the former occupation and economic activity, resp. In the same vein, training measures to improve the employability of job seekers could be more oriented towards the relatedness concept. A more targeted job placement and training in the region also contributes to improve the regional skill base.

Empirical evidence on graduate migration, provided by this compilation, stresses the role of social networks gained through work experience before and during studies to retain the young highly educated in the university region. This finding might complement already existing measures and approaches to keep local graduates in the university region.

- Providing opportunities to gain knowledge about the local labour market and establishing labour market contacts via employment might be a possible strategy to deepen ties of graduates to the region of studies. Local authorities could therefore take into consideration to intensify intra-regional collaborations (e.g. job fairs) between universities, firms and other relevant actors, such as employment agencies and Chambers of Commerce, in order to retain young, highly educated workers, at least to some extent.
- In addition, universities may embed more practical elements and learning opportunities as components in the curricula. For instance, courses can combine the transfer of theoretical knowledge and practical work experience in local firms. This approach requires, of course, that companies offer adequate work opportunities for students enabling them to enhance their employability. Such work experience might contribute to obtain more targeted contacts for entry into the local labour market (see Evans/Richardson, 2017).
- To retain graduates in higher education regions is certainly easier in those regions where local labour demand adequately matches the academic education and salary expectations of graduates. Labour market entry outside the university region could go along with a more adequate job match and a wage premium (e.g. Di Cintio/Grassi, 2013). Hence, a potential conflict may arise between future prospects of university regions on the one hand and graduates' career out-comes on the other. This may be particularly true for lagging regions which likely offer less favourable labour market conditions for the career start of graduates.

These regional policy recommendations might contribute to reflect the structural opportunities, untapped potential, and constraints of each place (Iammarino et al., 2017) and may support OIAs and lagging regions in mastering the adaptation to structural changes.

## **6. Acknowledgements**

I would like to express my special appreciation and thanks to Prof. Dr. Ingo Liefner for the support that I have received through collaborative work and support. I am thankful that he offered me the opportunity for academic teaching in recent years and for enabling me to submit this compilation of papers as a habilitation dissertation. I am also very grateful for the joint work, discussions and support provided by Christan Teichert and Sebastian Losacker in Hanover.

Moreover, I would like to thank my colleagues Stefan Hell, Jochen Stabler and Gabriele Wydra-Somaggio and Antje Weyh for the daily support, input and discussions in our regional offices of the Institute of Employment Research (IAB) in Saarbruecken and Chemnitz. I would like to say a big thank to my head of department Stefan Fuchs at IAB who sustained my research activities and provided me with assistance for a long time.

I enjoyed particularly the research cooperations with my colleagues Frank Neffke, Martin Henning and Rikard Eriksson and the great opportunity for many research visits in Sweden, the Netherlands and the United States.

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## **Annex I**

### **References to contributions 1-8**

## **1: Reviewed Paper**

**Dauth, W.; Fuchs, M.; Otto, A. (2018): Long-run processes of geographical concentration and dispersion. Evidence from Germany. In: Papers in Regional Science, 97(3), 569-593, [doi.org/10.1111/pirs.12271](https://doi.org/10.1111/pirs.12271).**

## **2: Reviewed Paper**

**Bauer, F.; Otto, A. (2006): Schrumpfung im Ruhrgebiet, Wachstum im Saarland. Eine komparative Analyse der Beschäftigungsentwicklung in zwei ehemaligen Montanregionen. Zeitschrift für Wirtschaftsgeographie, 50(3/4), 147-161, [doi.org/10.1515/zfw.2006.0016](https://doi.org/10.1515/zfw.2006.0016).**

### **3: Reviewed Paper**

**Trippl, M.; Otto, A. (2009): How to turn the fate of old industrial areas. Cluster-based renewal processes in Styria and the Saarland compared. In: Environment and Planning. A, International Journal of Urban and Regional Research, 41(5), 1217-1233, doi.org/10.1068/a4129.**

#### **4: Reviewed Paper**

**Otto, A.; Nedelkoska, L.; Neffke, F. (2014): Skill-relatedness und Resilienz: Fallbeispiel Saarland. Raumforschung und Raumordnung, 72(2), 133-151, doi.org/10.1007/s13147-014-0285-8.**

## **5: Reviewed Paper**

**Neffke, F.; Otto, A.; Weyh, A. (2017): Inter-industry labour flows. Journal of economic behavior & organization, 142(10), 275-292, doi.org/10.1016/j.jebo.2017.07.003.**

## **6: Reviewed Paper**

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## **Paper 7: Reviewed Paper**

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## **8: Reviewed Paper**

**Teichert, C.; Niebuhr, A.; Otto, A.; Rossen, A. (2020): Work experience and graduate migration. An event history analysis of German data. *Regional studies*, 54(10), 1413-1424, [doi.org/10.1016/j.jue.2018.09.006](https://doi.org/10.1016/j.jue.2018.09.006).**