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Abstract

This paper presents an evolutionary perspective on regional development traps that centers around the structural inability of regions to develop new and complex occupations. Using European Labor Force Survey data, we follow occupational trajectories of 237 European regions and provide evidence on which regions are trapped, what kinds of traps they have fallen into, and which regions have managed to escape such traps. We find a clear-cut divide in Europe: almost all non-trapped regions are in Northern and Western Europe, while trapped regions are found primarily in South and Eastern Europe. However, this geographical divide does not apply to all types of regional traps. Our results also show that regional development traps are persistent: regions often remain in the same trap, but not always. Our study suggests a feasible pathway for low-complexity regions to overcome a development trap is by building capabilities in related occupations and then diversify into complex occupations. Once complexity levels are high, regions tend not to lose their complexity.

Key words: regional development traps, evolutionary traps, occupations, relatedness, complexity, low complexity trap, structural trap

JEL codes: J24, J82, R11, O15.

1. Introduction

A large body of literature in economic geography has studied long-term processes of economic stagnation and decline in regions (Hall and Preston 1988). Special attention has been placed on old industrial regions that were once the engines of economic prosperity but became trapped in rigid specializations and old technological pathways from which it was hard to escape (Scott 1988; Storper and Walker 1989; Grabher 1993; Hassink 2005). Recently, the relationship between stagnation and structural decline of regional economies and the rise of discontent and populism has gained increasing attention among both academics and policy makers (De Ruyter et al., 2021; Rodriguez-Pose et al., 2023). The persistente nature of this phenomenon has led scholars to conceptualize sustained patterns of low economic growth as development traps (Iammarino et al., 2020; Diemer et al., 2022; Rodriguez-Pose et al., 2024).

Regions might be in a development trap because they are locked in a structure that prevents them from diversifying into new activities (Pinheiro et al. 2022a). In Evolutionary Economic Geography (Boschma and Lambooy 1999a; Martin and Sunley 2006; Boschma and Frenken 2018), regional development has been long considered as a self-reinforcing, path-dependent process that make some regions thrive while other regions experience structural decline (Storper 1992; Rigby and Essletzbichler 1997; Boschma 2004; Martin 2010). Such an evolutionary framework opens the possibility to reformulate and reframe regional development traps in terms of a structural inability of regions to move into new growth paths.

Balland and Boschma (2024) proposed an evolutionary concept of regional development traps based on the relatedness and economic complexity literature (Hidalgo et al., 2007; Hidalgo and Hausmann, 2011; Balland et al., 2019; Hidalgo, 2021). Leaving behind a conceptualization of development traps that rely on economic output, they defined regional development traps as the structural inability of regions to develop new complex growth paths. They argue that regions accumulate specific sets of capabilities over time (see e.g. Lawson 1999; Maskell and Malmberg 1999; Antonelli 2000; Boschma 2004), which provide opportunities, or not, to develop new activities, and if so, whether these concern complex activities or not. Such an approach broadens the development trap concept, as it offers insights into the heterogeneities of development traps that regions may experience (Balland and Boschma 2024). However, there exist no comparative studies to date that have identified different development traps.

The objective of the paper is to explore this evolutionary concept of development traps and apply it to an empirical study of regions in Europe using occupational data from the European

Labor Force Survey. By relying on occupation data in manufacturing industries and services, we can identify opportunities and challenges faced by all regions in Europe. Studies show indeed that the occupational structure of a region has impact on diversification opportunities in regions (Muneepeerakul et al. 2013; Brachert 2016; Fitjar and Timmermans 2017; Farinha et al. 2019; Galetti et al. 2021, 2022; Chen et al. 2024; Deegan et al. 2024) but also on productivity, employment and wage growth in regions (Wixe and Andersson 2017; Hane-Weijman et al. 2022; Elekes et al. 2023). Using patent data would underestimate the opportunities of regions to develop new growth paths, especially in lagging regions that hardly patent (Pinheiro et al. 2022a). Using industry data would leave untouched the question whether opportunities in industries are in high or low complex activities inside each industry (Thompson and Thompson 1985; Markusen et al. 2001, 2008; Feser 2003). Using occupation data instead, we obtain a more comprehensive view of diversification opportunities of regions and whether regions are trapped or not, especially in lagging regions.

First, we determine which regions in Europe are trapped and which are not, and in what kinds of traps they are caught, following the regional trap taxonomy of Balland and Boschma (2024). We find that almost all regions that are not trapped are from Northern and Western Europe. This is very different from trapped regions which are found primarily in South and Eastern Europe (and in France). However, this does not apply to all types of traps we differentiate, which shows the relevance of our typology. Second, we investigate which regions have remained trapped, which regions managed to escape from a trap, and which regions have fallen into a trap over time. Results show that regional development traps are persistent: regions often remain in the same trap, but not always. Our findings suggest a feasible pathway for low-complexity regions to overcome a development trap is by developing capabilities in related occupations and then diversify into complex occupations. Once complexity levels of their occupations are relatively high, regions tend not to lose their complexity over time.

The paper is structured as follows. Section 2 reviews the recent literature on regional development traps. Section 3 presents the data and methods on how we empirically identify the development traps based on regional occupational structure. Section 4 presents the results. Section 5 concludes and discusses the implications for future research.

2. An evolutionary perspective on regional development traps

A well-established body of literature has extensively studied how countries and regions can become trapped. For instance, scholars have identified poverty traps in low-income countries that struggle to escape persistent underdevelopment (e.g., Redding 1996; Barrett and Swallow

2006). Similarly, the concept of the middle-income trap has been extensively discussed, describing how emerging economies may stagnate after a period of rapid economic growth (e.g., Gill and Kharas 2007, 2015; Kharas and Kohli 2011; Cai 2012). Unruh (2000) proposed the carbon lock-in concept to describe that countries might get trapped in fossil fuel-based energy systems due to range of inertial forces. Recently, the trap concept has found new applications. An OECD (2019) study refers to four types of development traps that limit countries to shift to higher levels of development, especially where it concerns inclusive and sustainable growth. The European Commission (2023) proposed the notion of 'talent development trap'. Fuest et al. (2024) talks about the 'middle tech trap' in a recent attempt to characterize the technological state-of-affairs in the EU versus the US and China.

Besides studies at the national scale, regional traps have also been investigated at the sub-national scale. Here, regional studies often draw their inspiration from the evolutionary literature on path dependence and lock-in (David 1985; Arthur 1994; David et al. 1998) and show how increasing returns might lock economies into rigid specializations or systems. In geography, lock-in has been associated almost exclusively with processes of structural economic decline in old industrial regions (e.g. Grabher 1993; Boschma and Lambooy 1999b; Martin and Sunley 2006; Pike et al. 2009; Hassink 2007, 2010; Martin 2010; Evenhuis 2017). Grabher (1993) made an useful distinction between different forms of lock-in, such as economic, cognitive and institutional lock-in. This literature adopted mainly case study approaches that generated key insights into how regions might get stuck in old mature technologies, rigid economic specializations, old ways of doing things, and entrenched institutional structures.

However, there are few studies to date at the sub-national level that have identified regional traps in a comparative way. Recently, Iammarino et al. (2020) defined regional development traps in terms of persistent patterns of low economic growth, based on a combined indicator of Gross Regional Product (GRP) per capita, productivity and employment to population ratio. Regions are considered trapped when their growth is structurally lower compared to other regions, as well as to their own past growth (Diemer et al. 2022). Their seminal study showed that trapped regions in Europe not only involve low to medium-income areas that experienced growth but then got stuck, but also old industrial regions that used to be wealthy but witnessed a prolonged decline in their principal activities. Rodríguez-Pose et al. (2023) showed this may have socio-political implications. Their study suggests a tight connection between being economically trapped and support for political parties that oppose European integration and green policies. And the more intense the economic stagnation is, and the longer it lasts, the stronger the support for such parties in elections becomes.

Iammarino et al. (2020) made key contributions to the regional trap concept but gave limited attention to the role of history and path dependencies in shaping the development prospects of regions. Balland and Boschma (2024) addressed this gap by introducing an evolutionary framework to understand regional traps, emphasizing how self-reinforcing dynamics shape regional trajectories and influence their ability to develop new growth paths. It is a well-known fact that regions follow distinct paths in terms of the capabilities (as embodied in people, organizations, habits and institutions) that emerge from social interaction and accumulate over time (Storper 1992; Rigby and Essletzbichler 1997; Lawson 1999; Maskell and Malmberg 1999; Antonelli 2000; Boschma 2004; Martin 2010; Isaksen and Trippl 2016). According to Balland and Boschma (2024), this impacts the intensity but, above all, the nature of the trap regions can get caught in. They argue there is a need to move beyond simply measuring the intensity of regional traps (the degree to which regions are trapped) and instead create a typology of regional traps that differentiates between traps. Balland and Boschma (2024) also moved away from a regional development trap indicator that is based primarily on economic output. They proposed a measure that allows to test whether being trapped or not, and the type of traps regions are caught in, has implications for the economic performance of regions.

This regional development trap concept accounts for different sets of diversification opportunities available to regions, building on the notions of relatedness and complexity (Balland et al. 2019). Relatedness refers to the costs of developing a new activity, as proposed by Hidalgo et al. (2007). These costs are considered to be lower, the more related local capabilities are to the capabilities that are required to develop a new activity (Kogler et al. 2013). New activities, like technologies, industries, products, occupations, trademarks, do not arise randomly but are often based on combinations of local resources (Neffke et al. 2011; Essletzbichler 2015). Relatedness refers to the ability to develop a new activity. The importance of relatedness for regional diversification has been confirmed in many studies (see for an overview, Boschma 2017 and Hidalgo et al. 2018). Complexity refers to the economic returns of developing a new activity. Complex activities are hard to copy because they combine many capabilities (Hidalgo and Hausmann 2009; Hausmann et al. 2013). The higher the complexity of local activities, the lower the amount of regions that can master and produce them, the higher the economic benefits for the regions concerned. The idea that complex activities have a positive effect on economic development has been demonstrated in many studies (e.g. Balland and Rigby 2017; Balland et al. 2020; Davies and Maré, 2021; Antonelli et al. 2022; Mewes and Broekel 2022; Pintar and Scherngell 2022; Rigby et al., 2022).

Balland and Boschma (2024) made a distinction between three types of regional development traps. The low complexity trap concerns regions that have opportunities to diversify into new activities but only in low-complex activities. They are stuck in a low complex economy, because they lack the capabilities to move into high-complex activities that would enable them to climb the ladder of complexity. This is in line with Pinheiro et al. (2022a) who observed that low-income regions have diversification potentials primarily in low-complex rather than high-complex activities (Petralia et al. 2017; Hartmann et al., 2020). The low relatedness trap concerns regions that have a relatively high level of complexity in their economic structure but the underlying capabilities do not provide opportunities to develop new activities. This implies their complex activities have evolved in isolation from other local activities (e.g., due to multinational corporations investments) and form cathedrals in the desert as a result. These complex activities do not provide opportunities to make new combinations and develop new activities, as their underlying capabilities are disconnected from other local activities that do not have the capacity to absorb their complex knowledge. The structural trap concerns regions with a low-complex economy that offers little opportunities to develop new activities.

To define regional development traps, Balland and Boschma (2024) referred to industrial and technological capabilities of regions, not to occupational capabilities in regions. However, data on occupations might capture better the opportunities of regions that do not engage in patent activity, that are active in low-tech and low-complexity activities (Azzoni and Tessarin 2024), and that have few specializations in industries (Markusen 2004; Moretti and Kline 2013; Farinha et al. 2019). Using patent and industry data may therefore underestimate the opportunities that regions might have in (complex) occupations. Rather than looking at industries, a focus on occupations and the functions they perform takes up better what people actually do and what type of skills they perform (Thompson and Thompson 1985; Feser 2003). Different functions are performed in the same industry, each of which may have their own geography (Markusen et al. 2001; Barbour and Markusen 2007; Renski et al. 2007). Therefore, regions with the same industrial specialization may have very different underlying capabilities (Markusen et al. 2008), as embodied in their skill and complexity levels (Buyukyazici et al. 2024). Using occupation data enables us to capture the complexity of jobs within industries in regions. This is crucial, as occupations with sophisticated skill combinations have the potential to generate high economic benefits for regions, because they involve workers with higher educational levels, higher salaries, and distinctive skills that are better able to overcome a crisis, in contrast to routine occupations that may be easily replaced (Acemoglu and Autor 2010). However, it might be very difficult for regions to diversify into complex occupations, especially when regions do not possess relevant capabilities (Balland et al. 2019; Deegan et al. 2024).

Thus, going beyond patent and industry data and using occupational data instead, we can obtain a more comprehensive view of the the structural inability of European regions to move into new, complex activities, especially in lagging regions. There is a large body of literature that have actually looked at occupation dynamics in regions. Scholars have been applying occupation data from linked employer-employee data or labour force surveys to study the diversification of regions in individual countries, like Muneepeerakul et al. (2013) on US metropolitan areas, Brachert (2016) on German regions, Shutters et al. (2016) on US regions, Fitjar and Timmermans (2017) and Deegan et al. (2024) on Norwegian regions, Farinha et al. (2019) on US cities, and Galetti et al. (2021, 2022) on Brazilian regions. These studies all confirm the importance of occupational relatedness for entry of new occupations in regions. But other regional economic effects have also been identified. Wixe and Andersson (2017) have shown that occupational and educational relatedness matter for regional productivity growth, more so than industry relatedness. Hane-Weijman et al. (2022) showed that an increase in occupational relatedness in a region was positively related to employment growth. Elekes et al. (2023) observed that an increase in related high-income jobs in a region was conducive to low-wage workers moving to higher-paid jobs.

3. Data and Methods

3.1 Data and Coverage

To study regional development traps using occupational data, we employ micro-data of the European Labour Force Survey (EU-LFS) from Eurostat. These microdata contains information of surveyed individuals on their education level in International Standard Classification of Education (ISECD), employment status, occupation in 3-digit minor group in the International Standard Classification of Occupations (ISCO-08), 1-digit industry in the Statistical Classification of Economic Activities in the European Community (NACE Rev.2), and place of work (at the NUTS-2 region). We focus on the period 2012-2019 for two reasons. First, the lastest occupation classification (ISCO-08) was implemented in EU-LFS since 2011. Second, we conclude our analysis in 2019 to avoid the disparate impact of the COVID-19 crisis on the employment and occupational structure of regions. The final dataset include 237 NUTS regions from 29 European countries (24 EU member countries, Norway, Switzerland, Iceland, Liechtenstein and the United Kingdom)[1].

[1] Bulgaria, Malta, and Slovenia are excluded in the analysis because EU-LFS microdata does not contain information on the occupation of surveyed individuals at 3-digit ISCO-08 level in these three countries. The EU-LFS also does not contain information on place of work for surveyed individuals in the Netherlands, and only information on place of work at the NUTS-1 level region for individuals in the United Kingdom.

3.2 Occupation relatedness and complexity

We follow the definition of the different development traps proposed by Balland and Boschma (2024) and calculate the average relatedness density and the average complexity of occupations in a region, using the EconGeo R package developed by Balland (2017). In this typology, regions in a low complexity trap are characterized by a high average occupation relatedness and a low occupation complexity: they have opportunities to diversify, but merely in low complexity occupations. Regions in a low relatedness trap have a low average occupation relatedness but a high average occupation complexity: they have little opportunities to diversify, despite their high complexity of occupations. Regions with a low average occupation relatedness and a low average occupation complexity are considered to be in a structural trap: they have a weak structural capacity to develop occupations, limiting their future development.

To measure the average occupation relatedness of a region, we first calculated the relatedness between each pair of 3-digit ISCO-08 occupations based on their co-occurrence in 1-digit NACE Rev.2 industries[2], normalizing it using the association method. A higher value of relatedness indicates that two occupations are more frequently needed in the same industry, and thus complementary to each other. To link occupational relatedness with the economic structure of NUTS-2 regions, we calculated the conventional measure of relatedness density of each 3-digit ISCO-08 occupation in each region following Hidalgo et al. (2007). Relatedness density is defined as the ratio of the sum of the relatedness values for a given occupation to the total number of possible related occupations, in the sense that it gives a measure of how well-connected an occupation is within the network, indicating the density of its relatedness with others. Finally, we took the average relatedness density of occupations in which a region is specialized as the average occupation relatedness of the region.

To measure occupation complexity and the average occupation complexity of regions, we follow Hidalgo and Hausmann (2009) and Mealy et al. (2019), using the eigenvector reformulation of the Method of Reflection. This method considers the diversity of occupations in a region and how many other regions can develop these occupations. This captures the idea that many regions can develop simple occupations, but only a few regions can engage in complex occupations that require capabilities from a wide range of occupations. We calculate an average complexity of occupations in a region, defined as the average complexity of all occupations in which a region has a revealed comparative advantage. We took the second largest eigenvector of the region-occupation matrix as the occupation complexity and the second largest eigenvector of the occupation-region matrix as the average occupation

[2] The relatedness between each pair of occupations is normalized in the co-occurrence matrix using the association strength method (Eck & Waltman, 2009).

complexity of region. The occupation complexity index provides a way of assessing the potential benefits of an occupation: the higher the complexity, the higher the potential benefits.

Table 1 shows the top and bottom occupations in terms of their complexity. We see that there is a high correlation between our measure of occupational complexity and the skill requirements of occupations. Complex occupational categories typically require bachelor degree or higher while those at the bottom of this table usually require secondary education. Note that by leveraging occupational data, we are able to include and identify the complexity of a very disparate set of activities that includes all manufacturing and services sectors. Creative occupations, management, administration professionals, and STEM occupations (science, technology, engineering and math) are among the most complex occupations. Legacy manufacturing and agricultural activities typically rank at the bottom of this hierarchy.

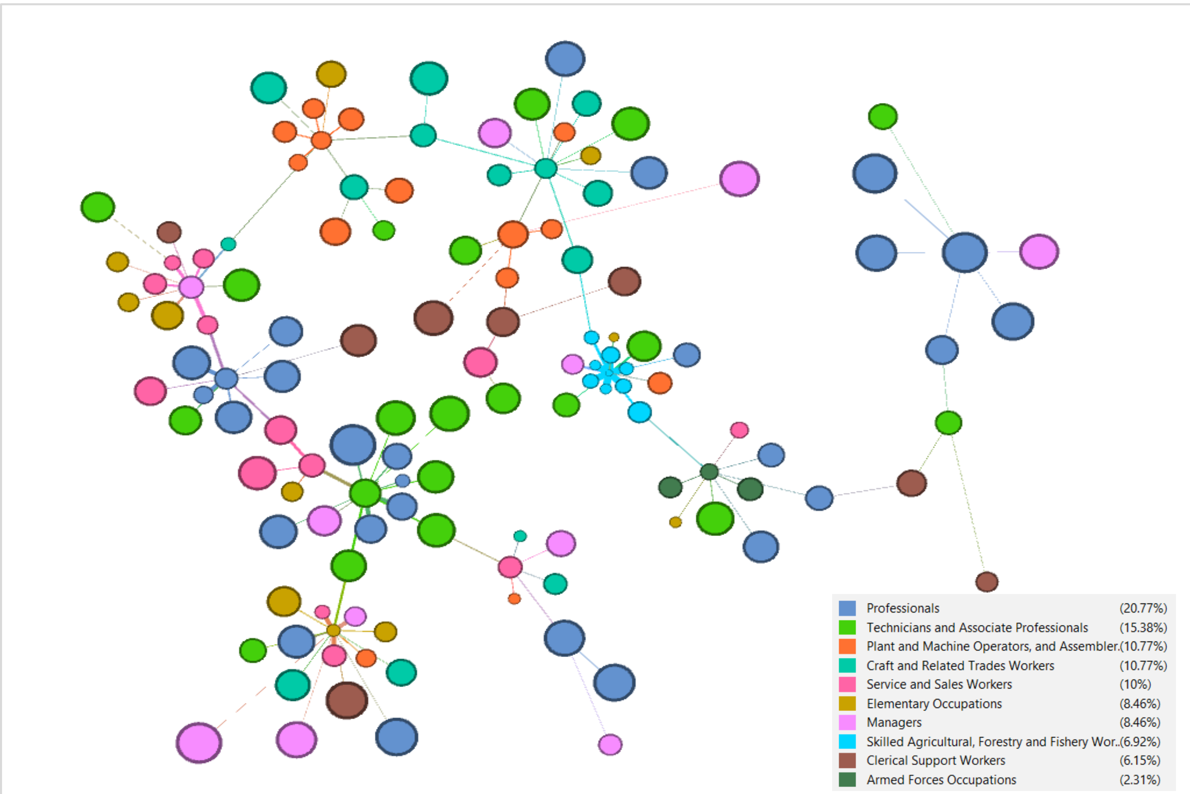
Table 1: Top and Bottom Complex Occupations in the EU (2019)

Rank	ISCO-08 code	Description	Average level of education (ISCED)	Complexity Index
Most complex occupations				
1	251	Software and Applications Developers and Analysts	Bachelor	100.00
2	223	Traditional and Complementary Medicine Professionals	Bachelor	95.55
3	212	Mathematicians, Actuaries and Statisticians	Master	93.00
4	264	Authors, Journalists and Linguists	Bachelor	92.61
5	341	Legal, Social and Religious Associate Professionals	Short-cycle tertiary education	88.63
6	243	Sales, Marketing and Public Relations Professionals	Bachelor	88.42
7	334	Administrative and Specialised Secretaries	Short-cycle tertiary education	87.84
8	242	Administration Professionals	Bachelor	87.82
9	265	Creative and Performing Artists	Bachelor	87.75
10	112	Managing Directors and Chief Executives	Bachelor	87.25
Least complex occupations				
121	631	Subsistence Crop Farmers	Upper secondary education	24.62
122	751	Food Processing and Related Trades Workers	Upper secondary education	22.52
123	611	Market Gardeners and Crop Growers	Post-secondary non-tertiary education	19.47
124	613	Mixed Crop and Animal Producers	Post-secondary non-tertiary education	18.61
125	961	Refuse Workers	Upper secondary education	18.41
126	815	Textile, Fur and Leather Products Machine Operators	Post-secondary non-tertiary education	14.66
127	753	Garment and Related Trades Workers	Post-secondary non-tertiary education	14.53
128	921	Agricultural, Forestry and Fishery Laborers	Post-secondary non-tertiary education	13.46
129	633	Subsistence Mixed Crop and Livestock Farmers	Upper secondary education	4.71
130	632	Subsistence Livestock Farmers	Has not been a student or apprentice	0.00

Source: Own elaboration based on LFS.

Figure 1 illustrates how these occupations relate to each other. We show the occupational space, following Hidalgo et al. (2007). In this figure, each node represents an occupation, while its size represents its complexity level. Nodes are related to one another when two occupations share the same skills and characteristics which make them likely to co-occur in the same industry, Nodes are colored according to the main occupational description. Occupations typically tend to cluster with (or be highly connected to) other occupations within the same broad sector, such as such as agriculture, manufacturing, transport, health care, and ICT services. There are, however, interesting relationships across broadly defined sectors. For instance, the light blue nodes in the center represent "Skilled Agricultural, Forestry and Fishery Workers", which are lower complexity occupations but closely connected to complex ones such as "Life Science Technicians", "Related Associate Professionals", "Veterinary Technicians and Assistants" (light green nodes), "Life Science Professionals" (blue node), and "Managers in Agricultural Sectors" (pink node). In addition, we see that certain high-complex occupations under the category of professionals (dark blue) or technicians (green) serve are spread all over the network, connecting different types of activities.

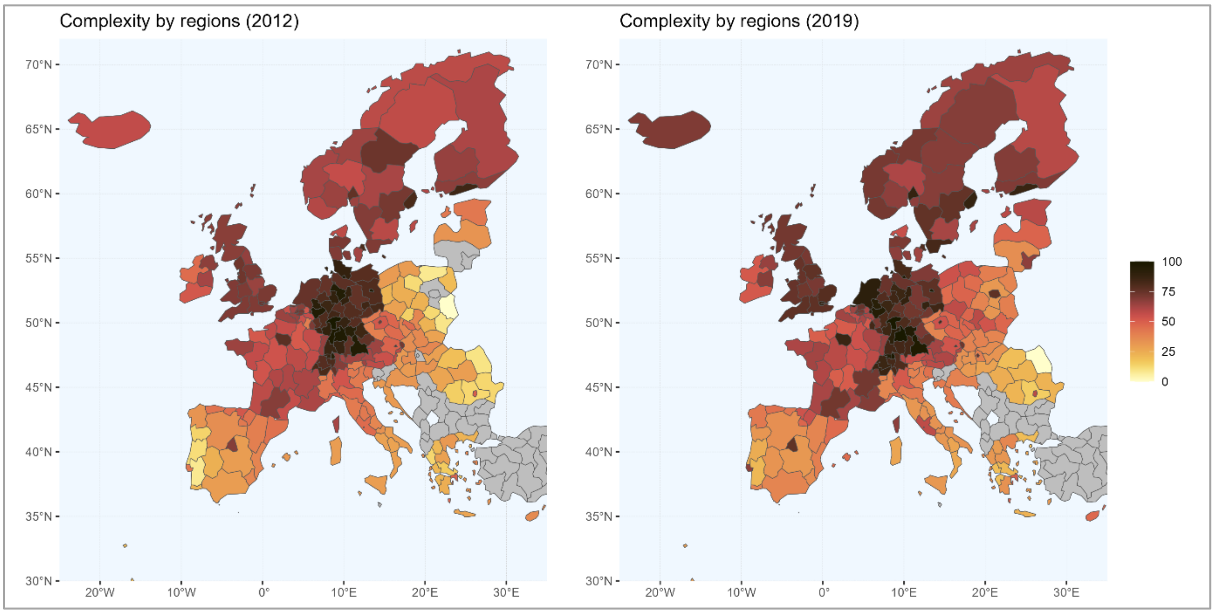
Figure 1: Occupation Space (2017-2019)



Source: Own elaboration based on EU-LFS microdata. Note: Colors represents the ISCO major groups; and the size of nodes represents the complexity of occupation. The percentages in brackets indicates the share of 3-digit ISCO occupations in the ISCO 1-digit occupation main group.

Figure 2 shows a map of the average occupation complexity of regions at the NUTS 2 level in 2012 and 2019. It is interesting to note that the most complex regions are concentrated in Nordic countries (Norway, Sweden, Finland, Iceland), the United Kingdom, and in many regions in Germany, Switzerland and France. However, a selected group of regions in Eastern Europe have managed increase the complexity of their occupational structure.

Figure 2: Average occupation complexity of regions



Source: Own elaboration based on LFS.

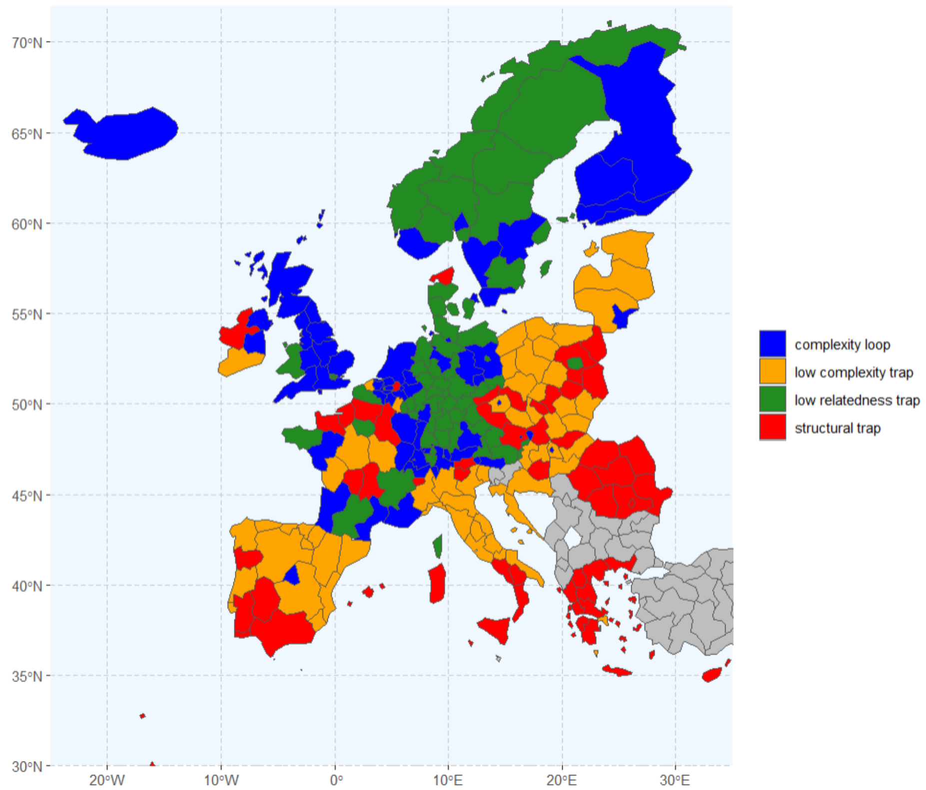
4. Results

4.1 Taxonomy of regional development traps

This section adopts the typology of regional development traps proposed by Balland and Boschma (2024) to determine whether certain European regions are trapped and, if so, the specific type of trap they have fallen into. Figure 3 shows the map considering the average scores of relatedness density and average complexity of their occupation for all European regions in terms of rankings over the period 2012-2019. Regions that are not in a trap (blue color) consist of many capital regions, such as the Capital Region of Denmark, Vienna, East Norway (including the capital Oslo), Madrid, Budapest, Dublin and Prague, but also regions in Germany, France, Belgium, South of Sweden, South Norway, as well as entire countries such as the Netherlands, the UK and Iceland, for which no regional occupational data are available.

Many regions in Southern and Eastern Europe find themselves in a structural trap (in red), most notably in Greece, the South of Portugal, the South of Spain, large parts of South of Italy, Romania, and West Poland. Some Western European regions are also in a structural trap, most notably in France (like the North of France) but also in the North of Ireland. These regions have mainly low-complexity occupations that do not require advanced skills or technologies to perform their tasks. On top of that, these occupations are not much embedded in the local economy, nor do they provide many relevant capabilities to develop new occupations. Such regions therefore have weak structural conditions to transform themselves. These regions differ from those in a low-complexity trap (indicated in orange), which are predominantly located in Southern Europe (North and Central Italy, and North and Central Spain) and Eastern Europe (Croatia, Slovakia, Czech Republic, Hungary, Northern and Western Poland, and the Baltic States). These regions have capabilities that are mainly aligned with occupations that require less sophisticated skills and technologies, such as those demanded in agriculture and tourism, and that face intense competition from other regions. Their ability to diversify into more complex occupations is limited, because complementary occupations are largely missing. Finally, there is a large group of regions in Northern Europe (many regions in Germany, Norway, Sweden, Denmark, some regions in France) that is in a low relatedness trap. Even some capital regions are involved, such as Ile de France, IGreater London and Warsaw Capital. Despite having complex occupations, the average occupational relatedness is low, which limits their ability to create synergies and support the development of new occupations.

Figure 3: Regional traps in Europe based on occupational structure (by rankings)



Source: Own elaboration based on LFS.

4.2 Regional development trajectories over the period 2012-2019

This section analyzes the occupational dynamics of European regions, focusing on the paths they have taken, which regions have remained trapped, which regions have managed to escape such traps, and which regions have fallen into a trap. The data allows us to follow the trajectories of regions from 2012 to 2019. Table 2 presents a transition matrix where rows represent the initial year of our sample (2012) and columns represent the final year (2019). Each cell indicates the percentage of regions that fall into a specific trap following the typology of Balland and Boschma (2024). Regions in a complexity loop are regions that are not trapped, meaning they have a high average relatedness and a high average complexity. As expected, there is high persistency: 65% of all regions remained in the same category. This figure is even higher for regions stuck in a structural trap (74%) and a low relatedness trap (73%), indicating that regions that have escape them is an oddity. Almost none of the regions that escaped a structural trap managed to increase their complexity levels: most of them got stuck in a low complexity trap. Only 18% of the regions in a low relatedness trap managed to escape their trap and ended up in a complexity loop. Only 14% of the regions in a low complexity trap did the same, while 18% of regions in a low complexity trap fall back into a structural trap. Remarkable is the high number of regions (24) in a complexity loop in 2012 that ended up in a low relatedness trap in 2019. This might not be unexpected, as regions with high complexity are more likely to diversify into unrelated occupations, which are complex in nature but not necessarily closely related to their existing specializations (Pinheiro et al. 2022b).

]**Table 2:** Traps transition matrix based on occupations (2012-2019)

		2019				
		Complexity loop	Low relatedness trap	Low complexity trap	Structural trap	
2012	Complexity loop	32 (55%)	24 (42%)	2 (3%)	0	100%
	Low relatedness trap	10 (18%)	41 (73%)	3 (5%)	2 (4%)	100%
	Low complexity trap	9 (14%)	5 (8%)	39 (60%)	12 (18%)	100%
	Structural trap	3 (5%)	1 (2%)	11 (19%)	43 (74%)	100%

Source: Own elaboration based on LFS.

Figure 5 provides a detailed view of the trajectory regions have taken, showcasing their transition between 2012 and 2019. Remarkably, there appears to be a prevailing path that regions follow when they transition out of these development traps: (1) regions in a structural trap primarily move to a low complexity trap (in light blue), struggling to significantly increase their complexity levels. In our sample, these regions include areas from Romania, Poland, Portugal, and Slovakia.; (2) a number of regions in a low complexity trap were able to advance their complexity levels, transitioning to a complexity loop (in dark orange). These regions are primarily located in Belgium, France, Poland, and Estonia. This suggests that relatedness may play a key role in facilitating regions' progress out of this trap, enabling them to advance to higher levels of complexity. Notably, relatedness appears to be a key channel through which regions can escape also the low relatedness trap and transition into a complexity loop (in yellow). This group primarily consists of regions in France and Germany.

Figure 5: Transition regions from 2012 to 2019

Source: Own elaboration based on LFS.

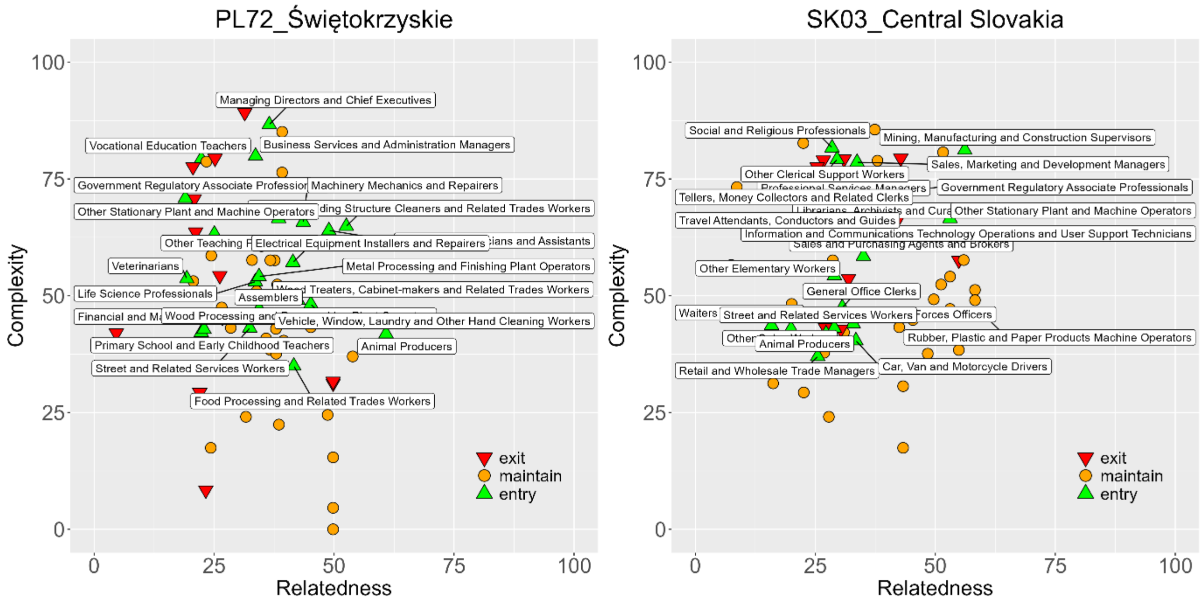
Furthermore, there are also seems to be a prevailing pattern in how regions make downward transitions, as shown in Figure 5: (1) when regions in a complexity loop become trapped, they usually fall in a low relatedness trap (in purple), not in a low complexity trap. That is, they tend to decrease their levels of relatedness but not their levels of complexity. These concern mainly regions in Germany, Switzerland, Norway and Sweden. One might wonder whether this transition represents a real downgrade, since regions with high complexity are more likely to diversify into unrelated occupations (Pinheiro et al. 2022b). It remains to be seen whether this is a condition that will perpetuate itself and allow the region to return to the complexity loop, or whether the reduction in its relatedness density will lead to a regression towards less complex occupations; (2) a considerable number of regions in a low complexity trap fall back in a structural trap, decreasing their levels of relatedness (in light green). Many concern Italian regions; (3) when regions are in a low relatedness trap, they tend not to fall in a structural trap; (4) once a region is in a complexity loop, it does not fall back in a low complexity trap. This all suggests that downward transitions are characterized by a decrease in relatedness, not in complexity: once complexity levels are relatively high, regions tend not to lose their complexity levels over time.

4.3 Occupation dynamics in regions that escaped or fell into a trap

In order to understand better how regions transition, we selected eight European regions according to the evolution of their occupational trajectories over the period 2012-2019. This is depicted in Figures 6-9. The green triangles indicate the occupations in which the region gained a comparative advantage in 2019. The orange circles refer to occupations in which the region remained a comparative advantage throughout the whole period. The red triangles indicate the occupations in which the focal region lost a comparative advantage between 2012 and 2019.

Figure 6 shows the occupational dynamics of 2 regions (Świętokrzyskie region in Poland and Central Slovakia region) that moved from a structural trap in 2012 to a low complexity trap in 2019. The average occupation relatedness of the two regions increased significantly over the period 2012-2019, because they managed to gain comparative advantage in a significant number of occupations that were closely related to their existing occupational structure. Many of these occupations are in the manufacturing sector.

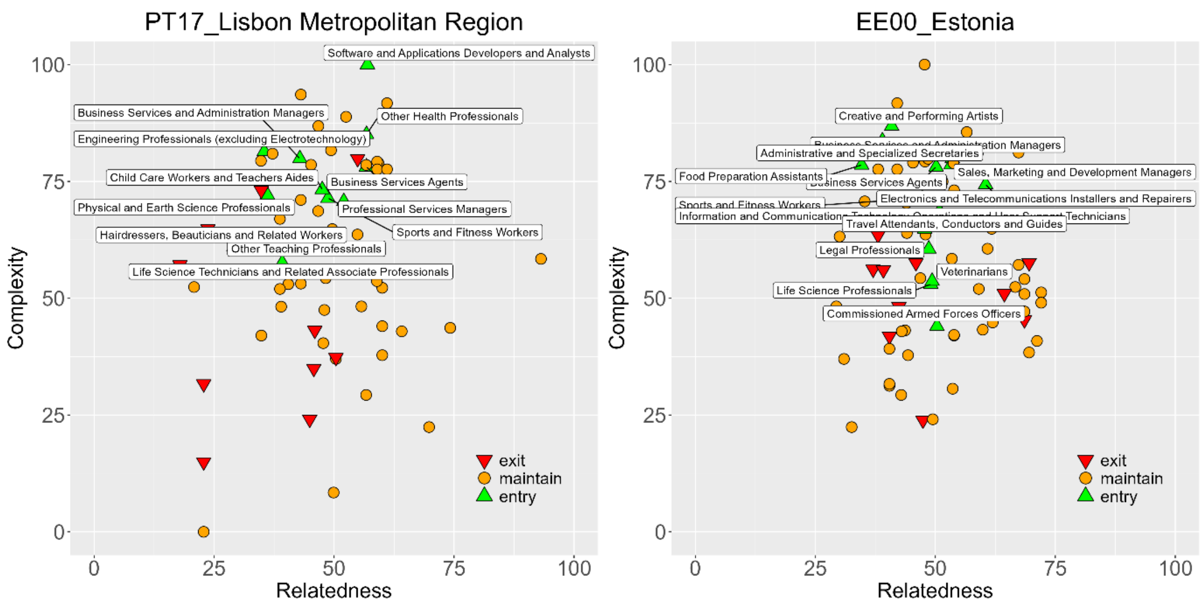
Figure 6: Regions moving from a structural trap to a low complexity trap



Source: EU-LFS, own elaboration.

On the other hand, Figure 7 shows the dynamics of occupations in the Lisbon metropolitan region and Estonia These two regions significantly climbed the ladder of occupation complexity and moved from a low complexity trap in 2012 to a complexity loop in 2019. They managed to do so by developing new comparative advantages in many complex occupations. For example, the Lisbon metropolitan region managed to gain a comparative advantage in complex occupations such as "Software and Applications Developers and Analysts", while Estonia succeeded to do so in "Creative and Performing Artists".

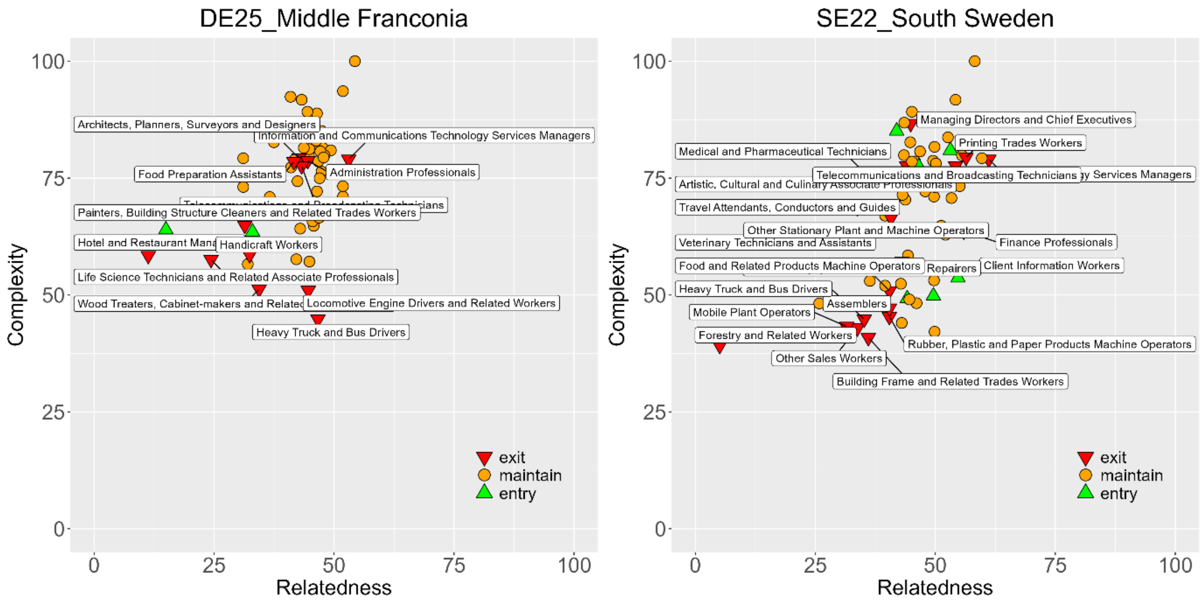
Figure 7: Regions moving from a low complexity trap to a complexity loop



Source: EU-LFS, own elaboration.

Figure 8 shows the dynamics of occupations in the German region of Middle Franconia and the South Sweden region. Both transitioned from a complexity loop into a low relatedness trap. They lost comparative advantage in many occupations with a high relatedness over the period 2012-2019. In Middle Franconia region, these concerned occupations like architects, planners, surveyors and designers, and ICT services managers. In South Sweden, these included managing directors and chief executives, and medical and pharmaceutical technicians. Many of these occupations were also complex occupations. Even though the two regions still have relative high occupation complexity, the declining occupation relatedness raises the question whether they will be able to keep a comparative advantage in those occupations.

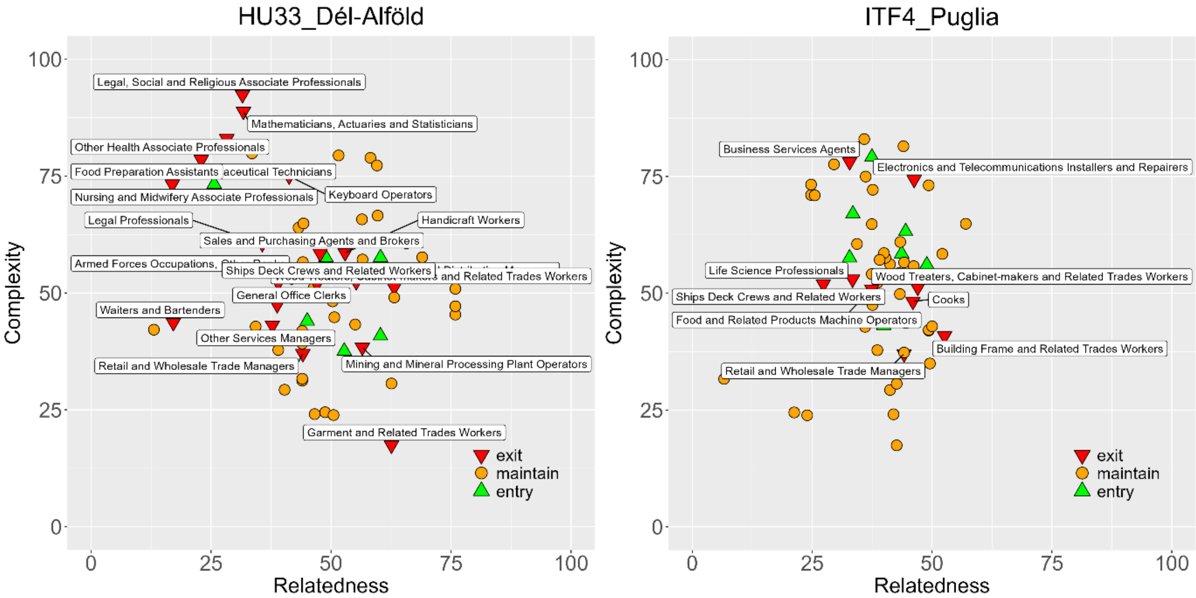
Figure 8: Regions moving from a complexity loop to a low relatedness trap



Source: EU-LFS, own elaboration.

Figure 9 shows the dynamics of occupations in the Southern Great Plain region in Hungary and the Puglia region in Italy which fell back into a structural trap in 2019. These two regions lost their comparative advantage in many occupations that are closely related to their existing occupational structure, such as Electronics and Telecommunication Installers and Repairers in Puglia. At the same time, the Southern Great Plain region also lost its comparative advantage in many high complex occupations, like legal, social and religious associate professionals, mathmaticians, actuaries and statisticians. This is mainly due to their relative low relatedness to the existing occupational structure of the region.

Figure 9: Regions moving from a low complexity trap back to a structural trap



Source: EU-LFS, own elaboration.

5. Concluding Remarks

This paper has made an effort to empirically operationalize the evolutionary perspective on regional development traps proposed by Balland and Boschma (2024), using occupation data. First, we determined which regions in Europe are trapped and which are not, and in what kinds of traps (i.e. a structural trap, a low-complexity trap or a low relatedness trap), based on their average occupation relatedness and average occupation complexity. Almost all regions that are not trapped are located in Northern and Western Europe, and many of them concern capital regions. This is very different from regions in a structural trap, of which many are situated in South and Eastern Europe (and in France) but almost none in Northern Europe. Regions in a structural trap have mainly low-complexity occupations that are not much integrated in the local economy either. They have weak structural conditions to transform themselves, as relevant capabilities to move into new occupations are often missing. Many regions from the same part of Europe (in South and Eastern Europe and France) find themselves in a low-complexity trap. Their state is different from the previous category, as they do have capabilities to diversify, but primarily in low-complexity occupations. Their ability to diversify into complex occupations is limited, and their low-complex occupational structure (in e.g. agriculture and tourism) makes them vulnerable to fierce competition. Lastly, we found a large group of regions in Western and Northern Europe that is in a low relatedness trap. Despite having complex occupations, the coherence of their occupational structure is rather weak, which limits their ability to create synergies and support the emergence of new occupations.

Second, we investigated which regions have remained trapped, which regions have been able to escape from a trap, and which regions have fallen into a trap over time. Results show that regional development traps are persistent: regions often remain in the same trap, but not always. Regional traps are very tough to break down, but some regions manage now and then. When they do, we observe some patterns: regions that overcome a structural trap primarily move to a low complexity trap, finding it hard to increase their complexity levels. These concern regions mainly from Eastern and Southern Europe. Some regions managed to escape from a low complexity trap, advancing their complexity levels and transitioning to a complexity loop. Another group of regions in France and Germany succeeded in overcoming a low relatedness trap and moved into a complexity loop. These findings suggest a feasible pathway for low-complexity regions to escape from a development trap is by building capabilities in related occupations and then diversify into complex occupations. Once complexity levels of their occupations are high, regions tend not to lose their complexity levels over time. When regions in a complexity loop become trapped, they usually fall in a low relatedness trap, not in a low complexity trap. These concern regions in Germany, Switzerland, Norway and Sweden.

Our analysis of regional development traps based on occupation data also call for future research. First, our study found that a considerable number of (Italian) low-complex regions fall back in a structural trap, because their occupational relatedness declined. One expects this will negatively affect their ability to develop new occupations in the future. However, this is less clear for high-complex regions that were once in a complexity loop but ended up in a low relatedness trap, as such regions are more likely to diversify into unrelated occupations (Pinheiro et al. 2022b). It remains to be seen in the long run whether the reduction in their occupational relatedness will lead to a regression towards less complex occupations. Second, being in a trap or not may have important economic implications for the regions concerned (Balland and Boschma 2024). Future research should take up this important question. Third, our study has remained rather descriptive, focusing on the nature and dynamics of regional traps in Europe, and how to identify those. However, the analysis did not shed light on the factors that might be responsible for a region being trapped or not, and in what kind of trap. We leave this crucial question for future research. An in-depth analysis of cases that managed to escape a trap can throw light on this issue. Fourth, there is widespread agreement that the digital transition is affecting the occupational structure of regions due to new technologies such as robots and AI (Acemoglu and Restrepo 2019). It is crucial to further understand how the occupational structure of a region can withstand the challenges and seize the opportunities in this new wave of technology development and deployment, and whether it will deepen or create new development traps in regions. Fifth, migration, especially of high-skilled migrants, is an important factor that induces structural change in regional labour market (Miguelez and

Morrison 2023). Hausmann and Neffke (2019) showed that many firms that pioneer unrelated industrial diversification in a region tend to hire workers in the same occupation from outside the region. It would be interesting to assess whether migrants help regions to overcome a regional trap. Sixth, future research should incorporate the role of institutions and institutional entrepreneurship (Sotarauta and Pulkkinen 2011). Institutional agents might be crucial to tackle traps, because they build legitimacy, mobilize resources, and promote collective action. This could be one of the factors that explains why some regions manage to escape a trap, while others not. Seventh, we did not look at inter-regional linkages`which could even be made part of the definition of regional traps. Bachtrögler-Unger et al. (2023) showed that inter-regional collaborations take place mainly inside national borders, while relevant complementary capabilities are mainly available outside countries and thus require international linkages to get access to. This would imply that regions can also be trapped in an inward-looking state.

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