Annex 3: Additional information SWOT analysis of chapter 4

1.1.1 Further details on the methodology of the SWOT analysis used

Although a conclusive and applicable concept for an evaluation of the development potential of the individual branches in the region within the framework of an empirical SWOT analysis is available as described in section Chapter 4.1 of the interim report, its implementation requires a clear (and evidence-based) idea of the branches with which a focal branch is technologically or cognitively "related". Several approaches have been developed in the literature to identify this (cognitive) "branch proximity".[1] However, most of them are only able to identify proximity relationships within the manufacturing sector or within the service sector, which makes the unsuitable for the present project. For this reason, the present analysis relies on an approach by Neffke and Henning (2013) which attempts to derive proximity from flow data between branches of the entire spectrum of branches across economic sectors. Technological or cognitive "proximity" of branches is revealed from labour mobility between branches, which is central to knowledge spillovers, assuming that job changes occur primarily between jobs with similar skill requirements. This is because human capital of the workforce is highly job-specific, so that individuals (necessarily) lose part of their human capital when they move to a branch in which they cannot or can hardly make use of their previously accumulated (job- or branch-specific) knowledge (Neal, 1995; Parent, 2000). Such job changes between cognitively distant branches are rather unlikely. Rather, employees prefer to switch between branches that share a common knowledge base (i.e. are technologically or cognitively related to each other) and therefore need workers with similar skills, so that the employees can transfer a large part of their human capital when changing jobs between branches (and thus avoid losses of human capital and therefore income).[2]

Thus, the degree of cognitive or technological relatedness between two branches can be deduced from the probability of labour flows between these branches. Of course, this requires complete information on all job changes between branches at a very disaggregated sectoral level. Such data is provided by the results of a major research project conducted by the Institute for Employment Research (IAB) in Germany (Neffke et al., 2017A, 2017B), which examined labour flows between branches at a highly disaggregated level on the basis of the IAB dataset on employment history (BeH)[3] in order to define technologically or cognitively "close" branches

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[1] For a more detailed description of these approaches and their methodological advantages and disadvantages see Firgo and Mayerhofer (2018).

2 An empirical confirmation of this hypothesis is provided by Neffke et al. (2017A) for Germany. They show that job changes between branches are restricted to a limited spectrum of target branches that are cognitively "related" to the respective branch of origin.

3 In principle, the results were calculated at the 4-digit level of economic activities, but for our purposes they were aggregated to the level 3 branches. We are very grateful to Anne Otto of IAB Nuremberg for providing the data and additional processing for the purposes of our analysis. The BeH data set (for a more detailed description see Bender et al., 2000) represents a complete survey. The employee history contains comprehensive personal information on all employees and companies in Germany subject to social insurance contributions as of 30 June each year. Information on employees and companies can be

for Germany (referred to here as "skill-relatedness"). The application of the labour-flows between branches obtained for Germany to regions of other countries seems justified. It can be feasibly assumed that branches (groups) that prove to be technologically or cognitively "close" or "skill-related" in Germany on the basis of inter-sectoral labour market flows at the level of NACE 3-digit branches, will be so in other highly developed parts of Europe as well: In fact, it can be rather ruled out that the same NACE 3-digit branches in Germany and regions in Austria, Norway or (Northern) Italy - that are subject to the present analysis - as regions with very similar levels of economic and technological development, differ substantially from each other in terms of production technology, qualification structure, input-output interdependencies etc., such that they would require systematically different knowledge bases.

We therefore use the matrix of branch-relatedness obtained from intersectoral job changes in Germany and the resulting sectoral connections for the analysis of the stakeholder city regions of the project. IAB distinguishes a total of 265 branch groups at the NACE 3-digit level. This means that a symmetrical matrix can be used to map a total of more than 70,000 target-source relationships between branches. For each of these bilateral relations a "skill-relatedness" index (SRij) is formed, which depicts the relative magnitude of the respective flow of labour between two branches i and j as a measure of their "skill-relatedness". The basic idea here is that comparatively "large" labour flows between two branches are an indication that workers from branch i tend to move to branch j without any problems and can reuse their knowledge or skills from the old branch i quite easily. In this case the pair of branches under consideration can be qualified as cognitively/technologically "close" (or "skill-related").

What is meant by "comparatively large": In addition to their cognitive proximity, other factors are responsible for the extent of job changes between two branches, especially their size, but also their dynamics, wage levels or similar. An observable bilateral labour flow can thus be considered "relatively large" (and only then) if the number of job changes between the two branches is greater than would have been expected taking all the factors mentioned into account. Consequently, the "Skill-Relatedness" index compares the actual number of job changes measured with those that would have occurred if job changes between the two branches (given the characteristics of the branch) had been purely random. This (in the case of random changes) "expected" labour flows thus represents the benchmark for the classification of the observed labour flows. It can be easily calculated based on probability theory (cf. Otto et al., 2014).

Specifically, the "skill-relatedness" indicator as a measure of the cognitive "proximity" between two branches i and j is thus denoted as

Equation *(3)* $SR_{ij} = \frac{F_{ij}}{\hat{F}_{ij}}$,

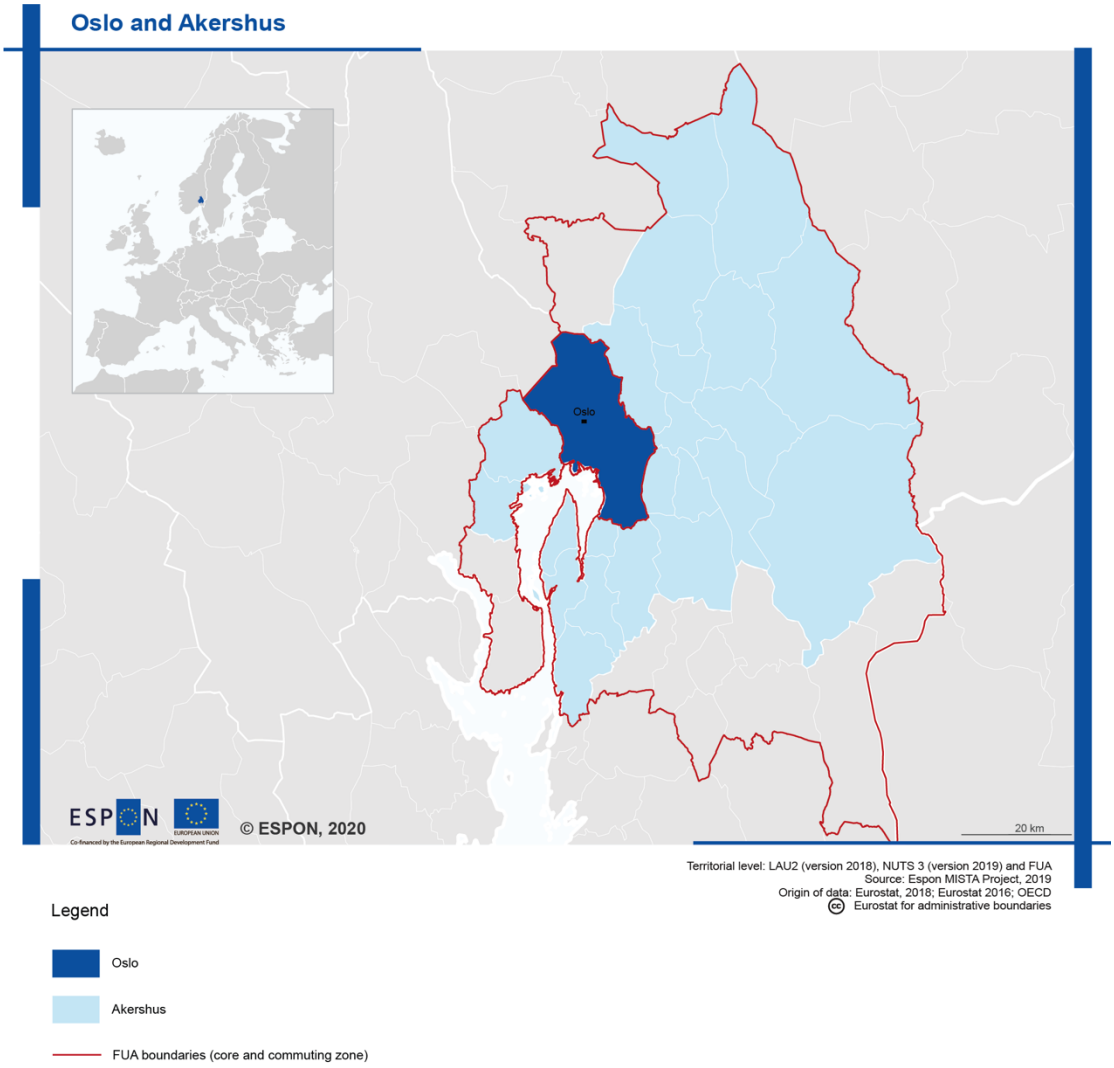
linked by means of anonymous personal and company numbers, so that on this basis (also) changes of job of employees can be identified.

where F_{ij} denotes the observed job changes between branches i and j, and $\hat{F}_{ij}$ denotes the expected job changes between i and j. If this "skill-relatedness" index is > 1, the actual flows between the two branches are greater than would be expected in the case of purely random job entries and exits, which means that the pair of branches can be regarded as technologically or cognitively "related" or "skill-related". With index values < 1, on the other hand, job changes between the two branches are less frequent than would be expected, and a technological or cognitive relatedness obviously is not high in this case.[4] On the basis of the matrix of these 70,225 indicator values for the 265 branch groups of the NACE classification (level 3) it is now possible to represent the entire network of cognitively or technologically "related" branches and to use it subsequently for the calculation of the embeddedness (see above) as part of the empirical SWOT analysis for the individual branches in each stakeholder region.

[4] In the further analysis, a normalized "skill-relatedness" index is used, which assumes values between -1 and +1. Positive values thus indicate cognitive proximity, whereas negative values do not indicate such proximity.

1.1.2 Further illustrations for Oslo

Map A.3.1: Definition of the metropolitan region of Oslo

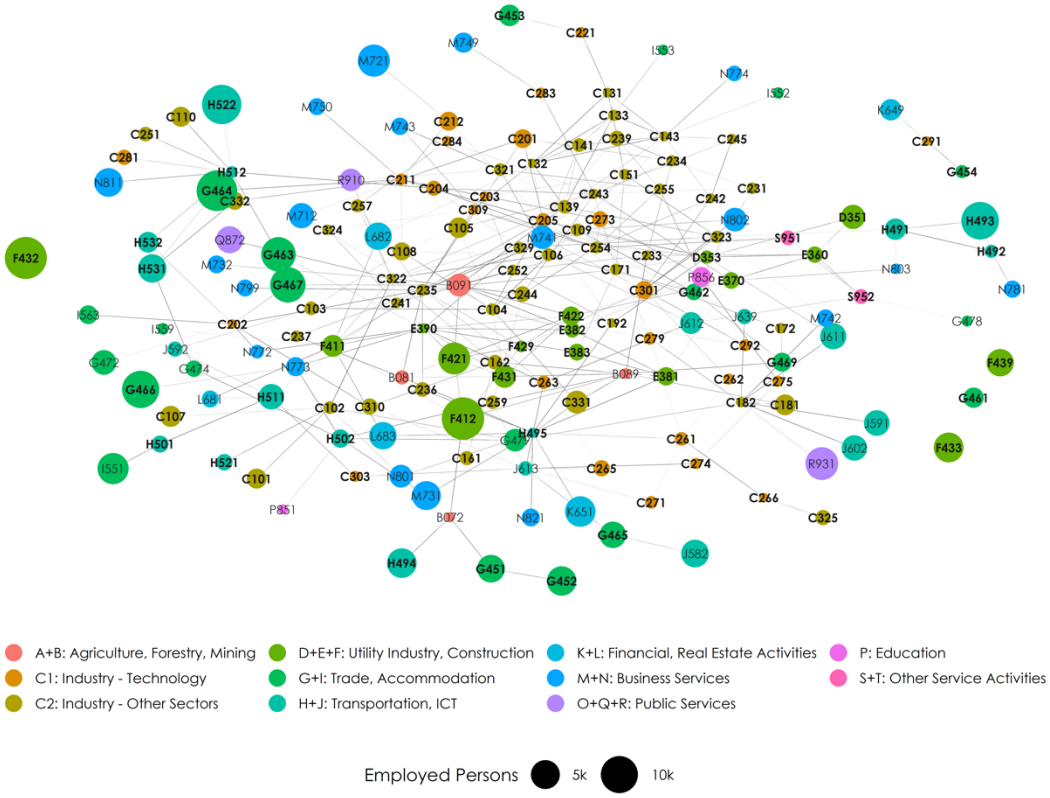


Note: As described in the ESPON SPIMA project, the metropolitan area of Oslo does not have an officially defined scale, and the delineation is still discussed. A commonly used definition is according to the formal borders of the City of Oslo and the County municipality of Akershus, with its 22 municipalities, which also is the area of the joint regional plan (1,3 mill people). The reason for the understanding of the metropolitan area being Oslo-Akershus is also strongly linked to the political reality, where the two regional bodies have binding joint agreements for transport investment, public transport, economic development and strategic planning.

Figure A.3.1: Overlay of FUA, MR and ALL

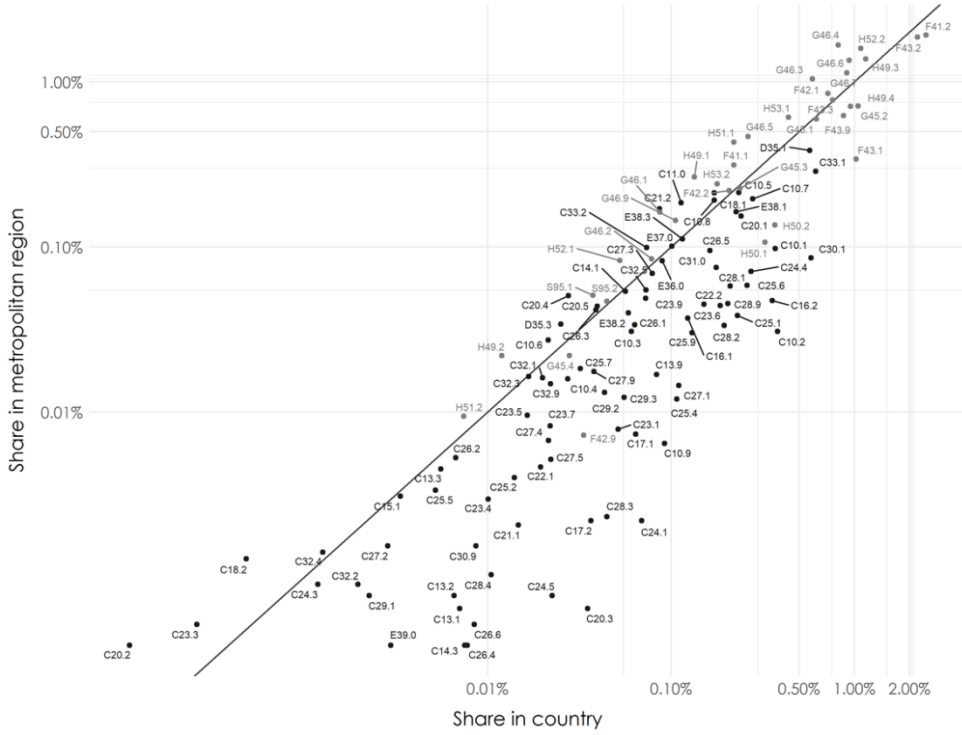
Source: MISTA team original illustration

Figure A.3.2: Network of branches for the functional urban area of Oslo



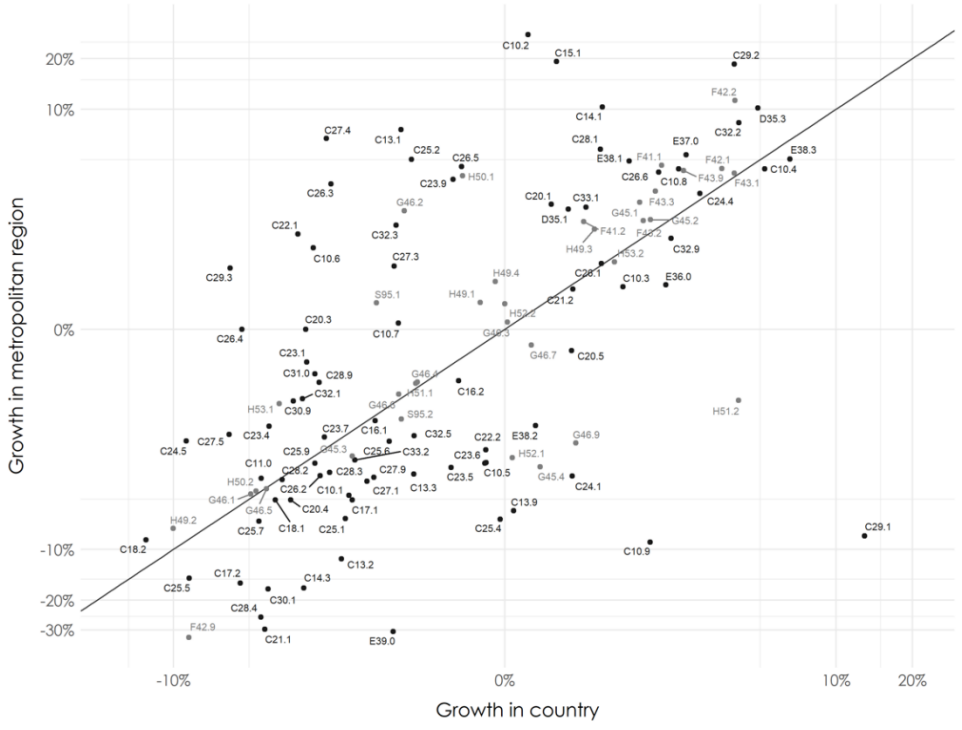
*Source: Statistics Norway, network structure based on Neffke et al. (2017B), MISTA team calculations; For illustrative purposes, only NACE 3-digit branch groups marking **productive activities (in bold)** and non-productive activities with strong links to productive activities are displayed.*

Figure A.3.3: Localisation of productive activities in Oslo and Norway
Sector shares in employment 2019



Source: Statistics Norway, MISTA team calculations; Industry (service) activities in black (grey); For NACE codes and branches see Table A.3.1.

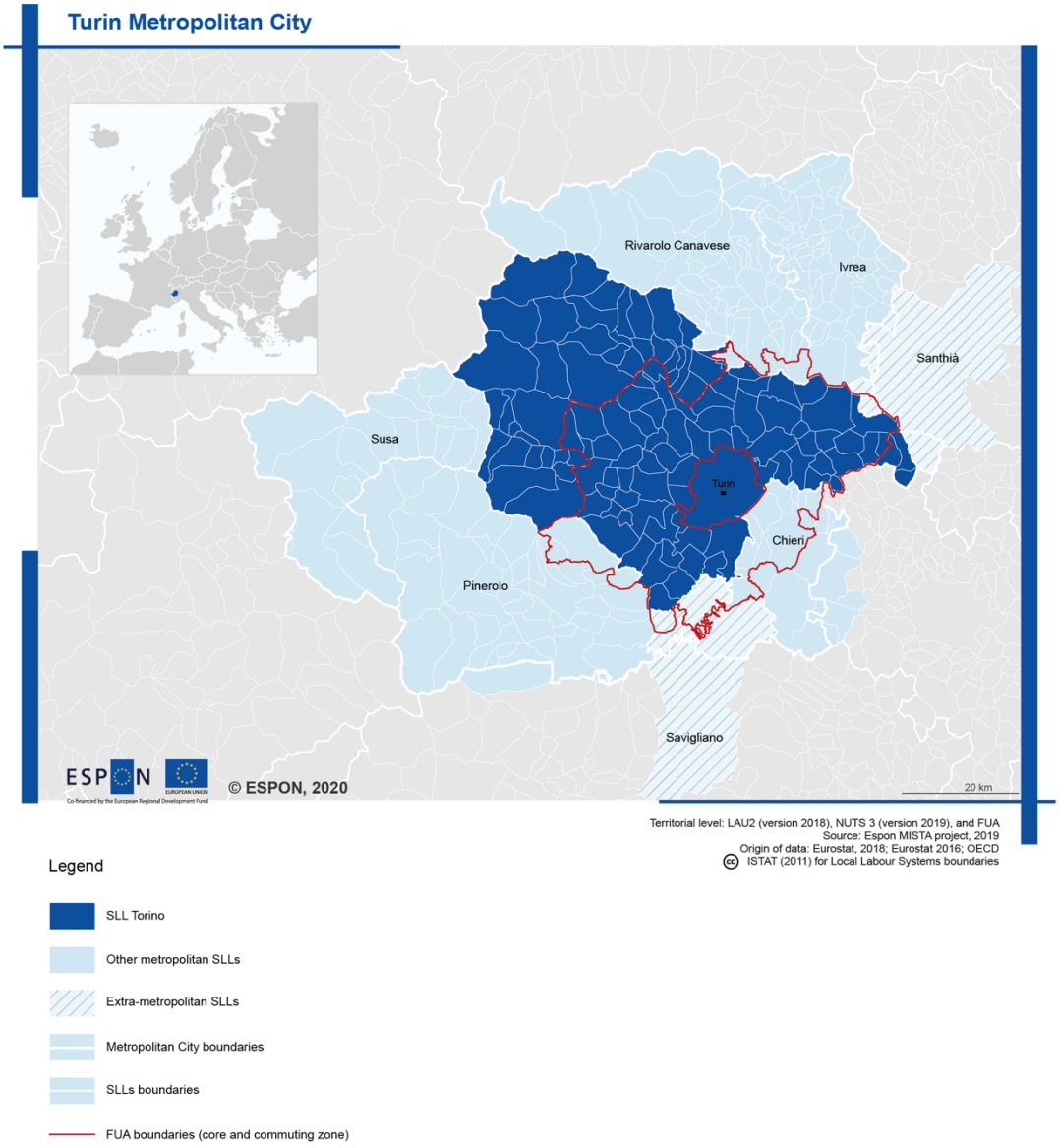
Figure A.3.4: Growth of productive activities in Oslo and Norway
Average annual employment growth 2012/2019



Source: Statistics Norway, MISTA team calculations; Industry (service) activities in black (grey); For NACE codes and branches see Table A.3.1.

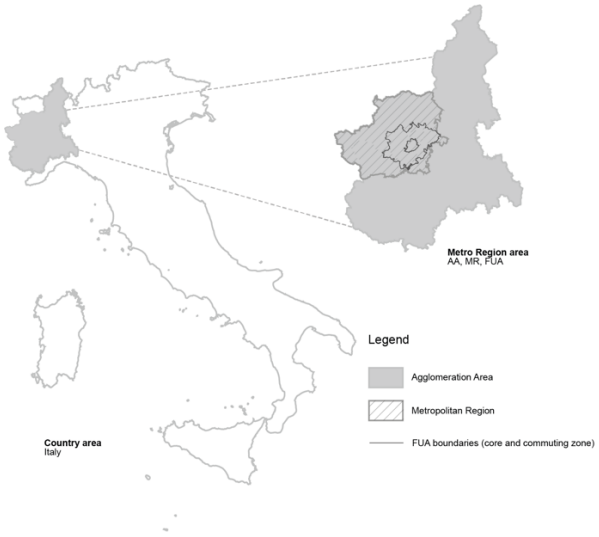
1.1.3 Further illustrations for Turin

Map A.3.2: Definition of the metropolitan region of Turin



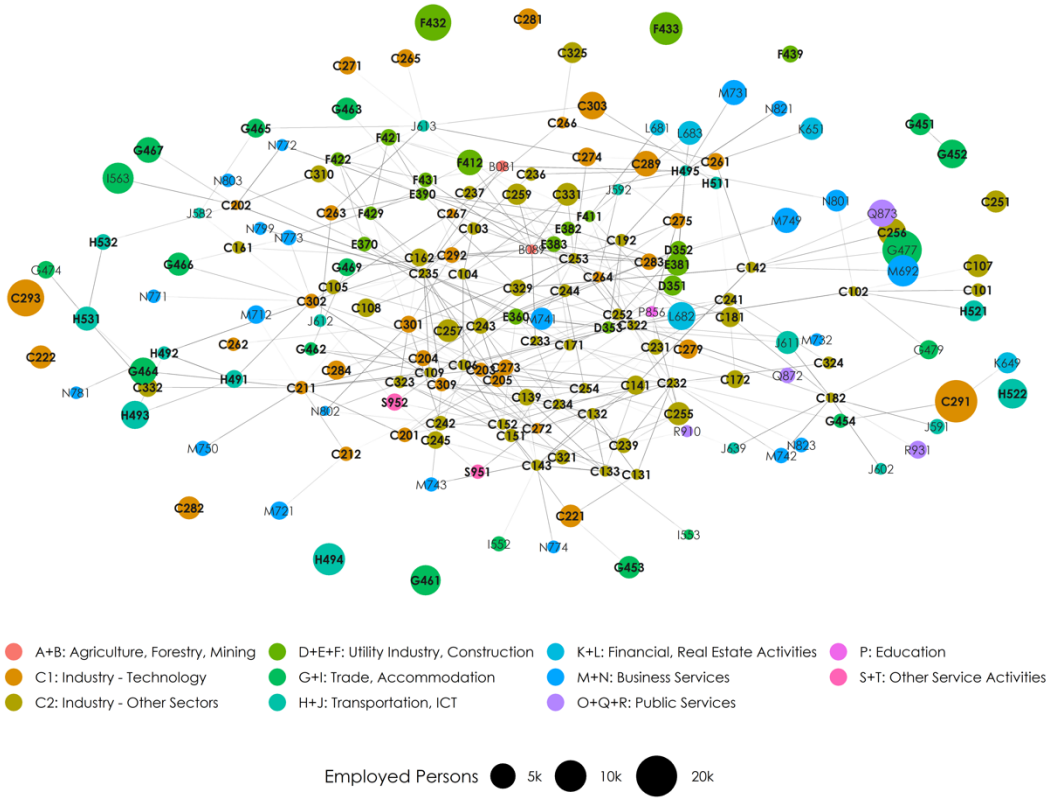
Note: the map shows the six Local Labour Systems (SLLs) of the Metropolitan City of Turin. Drawing on the home-work commutes, SLLs are defined by Istat (2011) – that is Italian National Institute of Statistics -, as territorial areas (consisting of two or more neighbouring municipalities) that record constant commuting flows and within which nearly all of socio-economic relations are entertained (see annex 4 for a delineation of each SLLs specialization). Next to this, the Turin Functional Urban Area (FUA) perimeter is displayed on the map. FUAs are defined by OECD (2019) as "economic units characterised by a city (or core) and a commuting zone that is functionally interconnected to the city". For illustrative purposes, only the Turin SLL is highlighted as the analysis has been conducted on this area.

Figure A.3.5: Overlay of FUA, MR and ALL



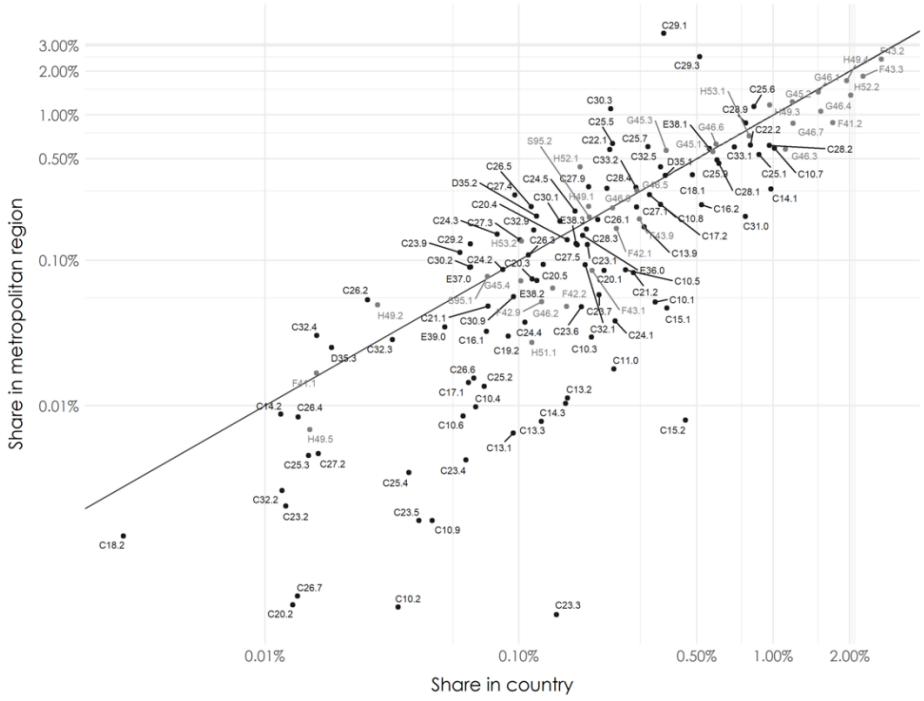
Source: MISTA team original illustration

Figure A.3.6: Network of branches for the functional urban area of Turin



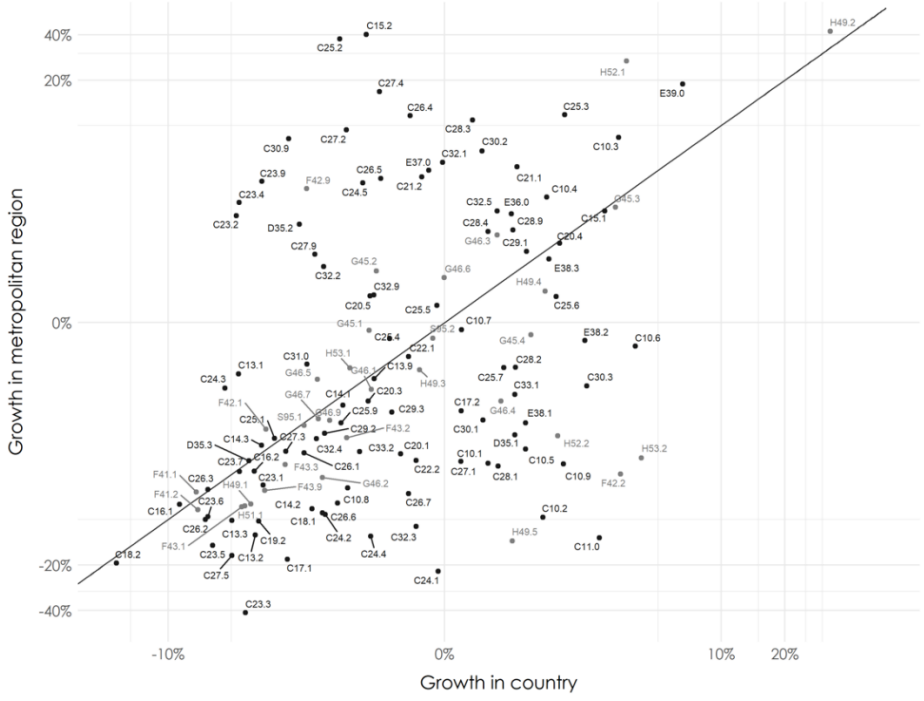
*Source: Istat, network structure based on Neffke et al. (2017B), MISTA team calculations; For illustrative purposes, only NACE 3-digit branch groups marking **productive activities (in bold)** and non-productive activities with strong links to productive activities are displayed.*

Figure A.3.7: Localisation of productive activities in Turin and Italy
Sector shares in employment 2017



Source: Istat, MISTA team calculations; Industry (service) activities in black (grey); For NACE codes and branches see Table A.3.1.

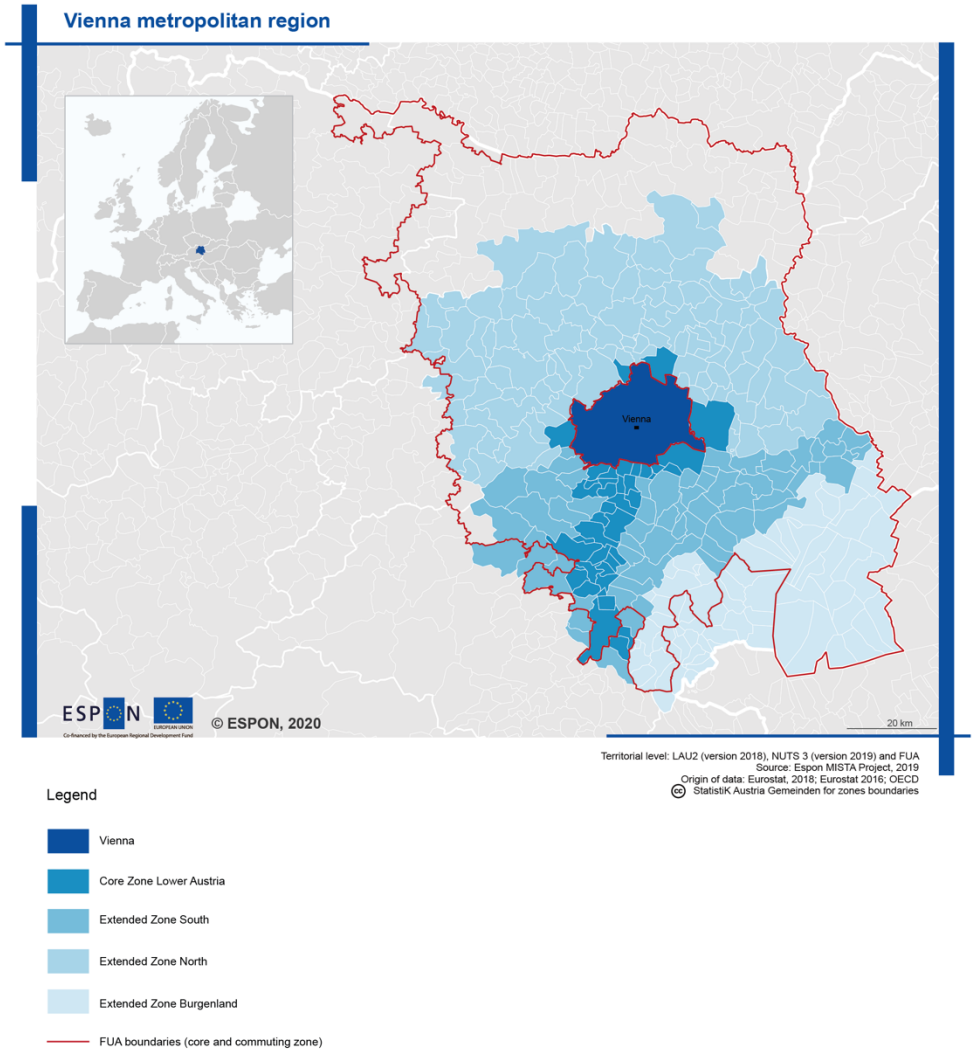
Figure A.3.8: Growth of productive activities in Turin and Italy
Average annual employment growth 2012/2017



Source: Istat, MISTA team calculations; Industry (service) activities in black (grey); For NACE codes and branches see Table A.3.1.

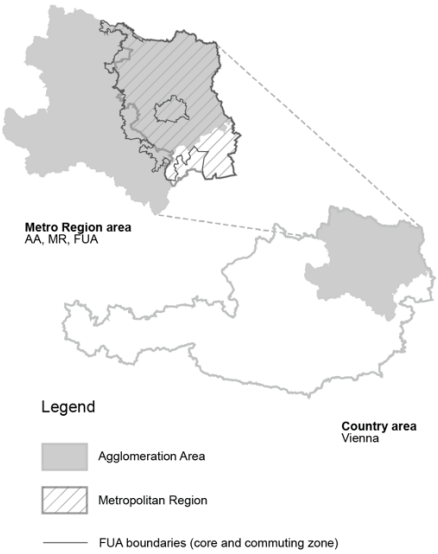
1.1.4 Further illustrations for Vienna

Map A.3.3: Definition of the metropolitan region of Vienna



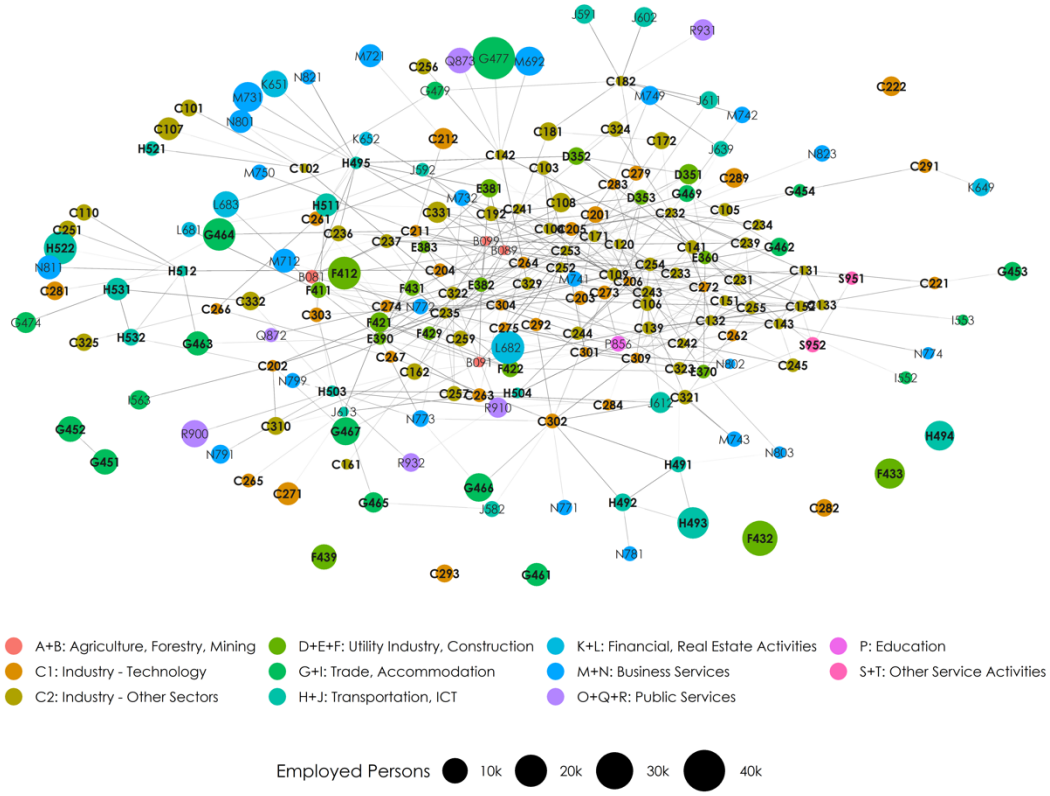
Note: As there is no official statistical definition of Vienna the map is based on a definition of the Vienna region by the Planungsgemeinschaft Ost (called Stadtregion+) that has been used in various studies on the Vienna region.See Planungsgemeinschaft Ost (Hrsg.), "Stadtregion+ Zwischenbericht. Planungskooperation zur räumlichen Entwicklung der Stadtregion Wien Niederösterreich Burgenland", PGO, Wien, 2011.; Statistik Austria; WIFO.

Figure A.3.9: Overlay of FUA, MR and ALL



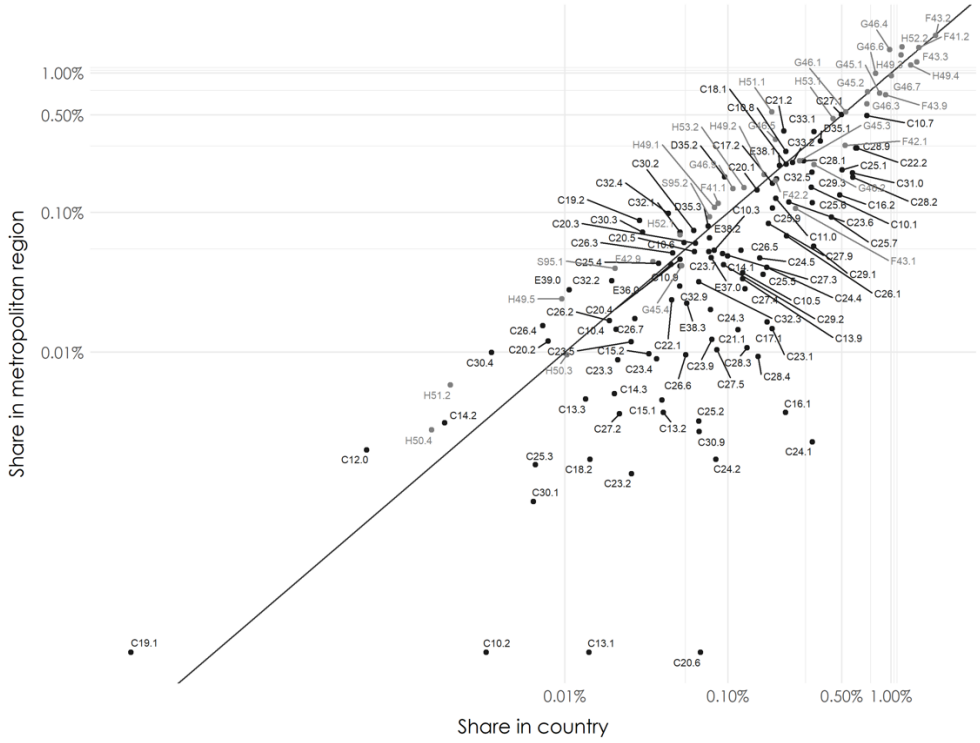
Source: MISTA team original illustration

Figure A.3.10: Network of branches for the functional urban area of Vienna



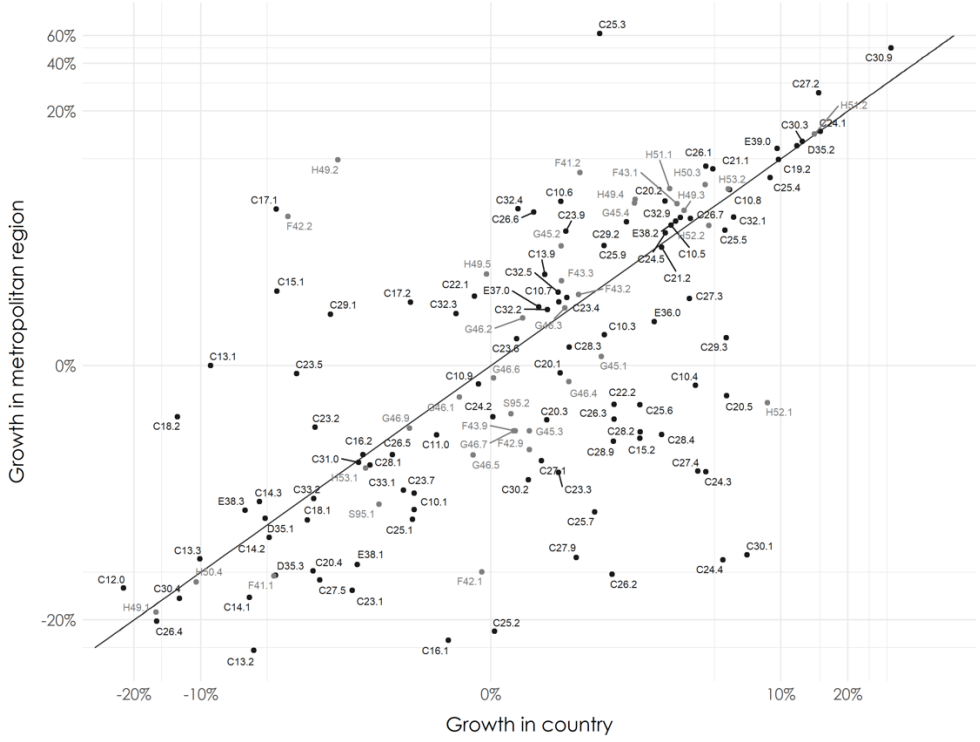
*Source: Statistics Austria, network structure based on Neffke et al. (2017B), MISTA team calculations; For illustrative purposes, only NACE 3-digit branch groups marking **productive activities (in bold)** and non-productive activities with strong links to productive activities are displayed.*

Figure A.3.11: Localisation of productive activities in Vienna and Austria
Sector shares in employment 2017



Source: Statistics Austria, MISTA team calculations; Industry (service) activities in black (grey); For NACE codes and branches see Table A.3.1.

Figure A.3.12: Growth of productive activities in Vienna and Austria
Average annual employment growth 2012/2017



Source: Statistics Austria, MISTA team calculations; Industry (service) activities in black (grey); For NACE codes and branches see Table A.3.1..

1.1.5 Summary Table of Branch Groups and their SWOT Profiles

Table A.3.1: NACE 3-dgit branch groups and SWOT profiles

NACE Rev. 2.0 Code and name		Oslo	Turin	Wien
C10.1	Processing and preserving of meat and production of meat products		W	
C10.2	Processing and preserving of fish, crustaceans and molluscs		W	
C10.3	Processing and preserving of fruit and vegetables		W	
C10.4	Manufacture of vegetable and animal oils and fats			
C10.5	Manufacture of dairy products		W	W
C10.6	Manufacture of grain mill products, starches and starch products		W	T
C10.7	Manufacture of bakery and farinaceous products		W	
C10.8	Manufacture of other food products		W	
C10.9	Manufacture of prepared animal feeds		W	W
C11.0	Manufacture of beverages		W	W
C12.0	Manufacture of tobacco products			
C13.1	Preparation and spinning of textile fibres		W	W
C13.2	Weaving of textiles		W	W
C13.3	Finishing of textiles		W	
C13.9	Manufacture of other textiles	W	W	W
C14.1	Manufacture of wearing apparel, except fur apparel	O	W	O
C14.2	Manufacture of articles of fur			
C14.3	Manufacture of knitted and crocheted apparel		W	W
C15.1	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery and harness; dressing and dyeing of fur		W	W
C15.2	Manufacture of footwear		W	
C16.1	Sawmilling and planing of wood	W	W	W
C16.2	Manufacture of products of wood, cork, straw and plaiting materials	W	W	W
C17.1	Manufacture of pulp, paper and paperboard		W	W
C17.2	Manufacture of articles of paper and paperboard		W	W
C18.1	Printing and service activities related to printing	S		
C18.2	Reproduction of recorded media	S	O	O
C19.1	Manufacture of coke oven products			
C19.2	Manufacture of refined petroleum products		O	
C20.1	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	W		
C20.2	Manufacture of pesticides and other agrochemical products	S		
C20.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics		W	
C20.4	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	S	W	
C20.5	Manufacture of other chemical products		W	
C20.6	Manufacture of man-made fibres			W
C21.1	Manufacture of basic pharmaceutical products	O	W	O
C21.2	Manufacture of pharmaceutical preparations	S	W	
C22.1	Manufacture of rubber products	W		W
C22.2	Manufacture of plastics products	W		W
C23.1	Manufacture of glass and glass products	W	W	W
C23.2	Manufacture of refractory products			W
C23.3	Manufacture of clay building materials	T	W	W
C23.4	Manufacture of other porcelain and ceramic products	W	W	W
C23.5	Manufacture of cement, lime and plaster	W	W	
C23.6	Manufacture of articles of concrete, cement and plaster	W	W	W
C23.7	Cutting, shaping and finishing of stone	W	W	W
C23.9	Manufacture of abrasive products and non-metallic mineral products n.e.c.	W		W
C24.1	Manufacture of basic iron and steel and of ferro-alloys	W		W
C24.2	Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	W		W

C24.3	Manufacture of other products of first processing of steel			W
C24.4	Manufacture of basic precious and other non-ferrous metals	W		W
C24.5	Casting of metals	W		W
C25.1	Manufacture of structural metal products	W		W
C25.2	Manufacture of tanks, reservoirs and containers of metal	W		W
C25.3	Manufacture of steam generators, except central heating hot water boilers			W
C25.4	Manufacture of weapons and ammunition	W	O	T
C25.5	Forging, pressing, stamping and roll-forming of metal; powder metallurgy	W	S	W
C25.6	Treatment and coating of metals; machining	W		W
C25.7	Manufacture of cutlery, tools and general hardware	W	S	W
C25.9	Manufacture of other fabricated metal products	W		W
C26.1	Manufacture of electronic components and boards	O		
C26.2	Manufacture of computers and peripheral equipment	O	S	
C26.3	Manufacture of communication equipment	O		S
C26.4	Manufacture of consumer electronics		O	
C26.5	Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	O	S	
C26.6	Manufacture of irradiation, electromedical and electrotherapeutic equipment	O	O	O
C26.7	Manufacture of optical instruments and photographic equipment			
C26.8	Manufacture of magnetic and optical media			
C27.1	Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus		O	
C27.2	Manufacture of batteries and accumulators			W
C27.3	Manufacture of wiring and wiring devices		S	W
C27.4	Manufacture of electric lighting equipment	O		
C27.5	Manufacture of domestic appliances	W		W
C27.9	Manufacture of other electrical equipment		S	W
C28.1	Manufacture of general-purpose machinery	W	O	W
C28.2	Manufacture of other general-purpose machinery	W		W
C28.3	Manufacture of agricultural and forestry machinery	W		W
C28.4	Manufacture of metal forming machinery and machine tools	W	S	W
C28.9	Manufacture of other special-purpose machinery	W	S	W
C29.1	Manufacture of motor vehicles	O	S	O
C29.2	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	W	S	W
C29.3	Manufacture of parts and accessories for motor vehicles	W	S	W
C30.1	Building of ships and boats			
C30.2	Manufacture of railway locomotives and rolling stock		S	
C30.3	Manufacture of air and spacecraft and related machinery	O	S	
C30.4	Manufacture of military fighting vehicles			
C30.9	Manufacture of transport equipment n.e.c.			W
C31.0	Manufacture of furniture	W	W	W
C32.1	Manufacture of jewellery, bijouterie and related articles	O		
C32.2	Manufacture of musical instruments		W	
C32.3	Manufacture of sports goods		W	W
C32.4	Manufacture of games and toys			T
C32.5	Manufacture of medical and dental instruments and supplies		T	
C32.9	Manufacturing n.e.c.		T	W
C33.1	Repair of fabricated metal products, machinery and equipment	W		T
C33.2	Installation of industrial machinery and equipment			
D35.1	Electric power generation, transmission and distribution	O		
D35.2	Manufacture of gas; distribution of gaseous fuels through mains			
D35.3	Steam and air conditioning supply			
E36.0	Water collection, treatment and supply		W	
E37.0	Sewerage		T	W
E38.1	Waste collection	W		

E38.2	Waste treatment and disposal		W	W
E38.3	Materials recovery		W	W
E39.0	Remediation activities and other waste management services		W	
F41.1	Development of building projects			
F41.2	Construction of residential and non-residential buildings	W	W	
F42.1	Construction of roads and railways	T	W	W
F42.2	Construction of utility projects	W	W	W
F42.9	Construction of other civil engineering projects	W	W	T
F43.1	Demolition and site preparation	W	W	
F43.2	Electrical, plumbing and other construction installation activities	W		
F43.3	Building completion and finishing		W	W
F43.9	Other specialised construction activities	W	W	W
G45.1	Sale of motor vehicles			
G45.2	Maintenance and repair of motor vehicles			
G45.3	Sale of motor vehicle parts and accessories		S	W
G45.4	Sale, maintenance and repair of motorcycles and related parts and accessories		O	
G46.1	Wholesale on a fee or contract basis	S		
G46.2	Wholesale of agricultural raw materials and live animals		W	
G46.3	Wholesale of food, beverages and tobacco		W	
G46.4	Wholesale of household goods	S	W	
G46.5	Wholesale of information and communication equipment	S		S
G46.6	Wholesale of other machinery, equipment and supplies			T
G46.7	Other specialised wholesale	T	W	
G46.9	Non-specialised wholesale trade	S		
H49.1	Passenger rail transport, interurban	S		S
H49.2	Freight rail transport			S
H49.3	Other passenger land transport			
H49.4	Freight transport by road and removal services	W	W	
H49.5	Transport via pipeline	O	O	S
H50.1	Sea and coastal passenger water transport	O		
H50.2	Sea and coastal freight water transport	O		
H50.3	Inland passenger water transport			
H50.4	Inland freight water transport			
H51.1	Passenger air transport	S		S
H51.2	Freight air transport and space transport			
H52.1	Warehousing and storage	S	S	
H52.2	Support activities for transportation	T	W	
H53.1	Postal activities under universal service obligation	S	W	
H53.2	Other postal and courier activities		T	
S95.1	Repair of computers and communication equipment	S		S
S95.2	Repair of personal and household goods	S		

Source: MISTA team calculations; S… Strength, W… Weakness, O… Opportunity, T… Threat; Empty cell indicates no specific SWOT profile in the region.