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Alexander Cordes (NIW), Birgit Gehrke (NIW), Christian Rammer (ZEW), Roman Römisch (wiiw), Paula Schliessler (ZEW) and Pia Wassmann (NIW)

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The Vienna Institute for International Economic Studies
Wiener Institut für Internationale Wirtschaftsvergleiche

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ALEXANDER CORDES (NIW)
BIRGIT GEHRKE (NIW)
CHRISTIAN RAMMER (ZEW)
ROMAN RÖMISCH (WIIW)
PAULA SCHLIESSLER (ZEW)
PIA WASSMANN (NIW)

Birgit Gehrke is a Researcher at the Lower Saxony Institute for Economic Research (NIW). Alexander Cordes and Pia Wassermann were NIW Researchers at the time the report was written. Roman Römisch is Research Economist at the Vienna Institute for International Economic Studies (wiiw). Christian Rammer is Deputy head of the Department of Industrial Economics and International Management at the Centre for European Economic Research (ZEW). Paula Schliessler was ZEW Researcher at the time the report was written.

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Abstract

This study introduces a suitable method to break down national trade data to the regional level. This allows producing trade indicators at the regional level, revealed export advantages in particular. Identifying industries in which a region realises a strong trade specialisation plays a twofold role in industrial and regional policy-making. Firstly, identifying successful structures at the industry-region level helps to improve the understanding of micro- and meso-foundations for competitiveness as well as scope and cases for policy intervention. Secondly, knowledge of the spatial distribution of competitive industries and required location factors is necessary for differentiated perspectives on future economic development and the choice of policy instruments. The study applies descriptive, econometric and case study analysis to identify regional patterns of trade specialisation, as well as region- and industry-specific factors related to success in international markets. Based on the results obtained, the study develops conclusions for EU regional and smart specialisation policies.

Keywords: EU regions, regional foreign trade, EU regional policy, smart specialisation strategies, regional competitiveness, determinants of competitiveness

JEL classification: R12, R15, R58, F14

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Executive summary

Smart specialisation aims at understanding and exploiting the strengths of European regions in order to boost innovation, competitiveness and, ultimately, economic growth. For regional policy strategies to be effective, and for an efficient use of the available funds, it is crucial to analyse in detail the assets with which each region is endowed, the technologies available, and the business connections among different regions. This study introduces a suitable method to break down national trade data to the regional level. This allows producing trade indicators at the regional level, revealed export advantages (RXAs) in particular. Identifying industries in which a region realises a strong trade specialisation plays a twofold role in industrial and regional policy-making. Firstly, identifying successful structures at the industry-region level helps to improve the understanding of micro- and meso-foundations for competitiveness as well as scope and cases for policy intervention. Secondly, knowledge of the spatial distribution of competitive industries and required location factors is necessary for differentiated perspectives on future economic development and the choice of policy instruments.

Descriptive results of regional-industrial RXAs show that high- and low-income regions exhibit different trade specialisation patterns. While high-income regions on average tend to be specialised in high-technology-intensive goods, low-income regions are specialised in medium-low- and low-technology-intensive goods trade. The medium-income regions are somewhere in between, having slight disadvantages in the high-technology trade, and a more or less balanced specialisation in the medium-low- and low-technology goods trade. Accordingly, the geographic distribution of export advantages in the ‘high/medium-high-technology-intensive’ goods trade follows a more or less distinct core-periphery pattern in the EU. When looking at the dynamics, results suggest that large changes in the regions’ specialisation patterns over time are relatively rare events. Although the size of revealed export advantages may increase or decrease over time, a complete shift of the revealed specialisation structure, i.e. moving from being specialised in exporting low-technology-intensive goods to being specialised in exporting high- and medium-high-technology goods is quite unlikely. This implies that the development of specialisation patterns is path-dependent. This is important to know for the development of smart specialisation strategies, because it suggests that their reference point should be the existing strengths of the regions. It also confirms the important role scientific, technological and economic specialisation plays for the development of comparative advantage and regional economic growth as it is also one distinct area for conceptual and policy implications of smart specialisation (OECD, 2013).

Along with the descriptive analysis, the study also investigates in a multivariate approach as to which region- and industry-specific factors are related to success on international markets. As far as the cross-sectional analysis is interpreted, shifting from competitive low-technology to competitive high-technology exports would also require fundamental changes in other regional characteristics, the innovation system in particular. Although innovation (measured by patents as a throughput indicator) significantly increases competitiveness in nearly every industry, it becomes clear that the structures of regional innovation systems vary between industries. Competitiveness in low- and medium-low-technology industries is linked to innovative SMEs, although it is not necessarily linked to firm-specific R&D. Instead, non-technological innovations without significant R&D efforts or impulses from other actors, such as High

Education Institutions (HEIs), seem to be similarly important. This illustrates the high relevance of successful cooperation and knowledge transfer between local firms and higher education institutions particularly in those low- and medium-low-technology industries. High-technology industries, in contrast, are often located in larger and diverse regions and their innovation outcomes rely more heavily on the innovation performance of larger firms.

The regional endowment with HEIs is possibly one of the most directly susceptible regional characteristics when it comes to policy implications. However, in order to promote competitiveness in medium-high/high-technology industries, guaranteeing quality of government is likewise important; it probably requires fewer fiscal resources and enables the economy to evolve independently of industrial and related planning strategies. Also several other studies conclude that the regions with good governance are generally those which are less likely to require policy assistance (McCann and Ortega-Argilés, 2013; Ederveen et al., 2006). Cluster effects, i.e. the presence of several firms working in similar or related industries within a region, are still visible. This underlines the structural embeddedness of highly competitive industries. However, cluster policies need to provide perspectives on future technological developments, in related industries in particular, in order to meet the requirements of smart specialisation strategies (S3). In regions with lower political capacities (governmental quality, cluster management) it is suggested first to build up social capital and opportunities for entrepreneurial discovery as a necessary precondition before initiating bottom-up processes such as S3 (European Commission, 2013).

Three types of regions are analysed through in-depth case studies. In the more advanced and developed regions (Berkshire, Buckinghamshire, Oxfordshire; Middle Franconia; Overijssel; Sydsverige) universities are key actors, accompanied by sufficiently present business services and the larger market potential of regional firms resulting from the proximate metropolitan centres. They host not only high-tech industries, but also low-tech industries with high comparative advantages. The latter, however, are of decreasing importance or have successfully transformed themselves and now focus on innovation in niche products. (Regional) policy is further developing the research infrastructure and clearly addresses its agile SMEs. Leading companies are identified to some extent, but regions' economies and innovation systems do not substantially depend on them. In contrast, they increasingly benefit from the local innovation potential and knowledge-oriented structural change. Future perspectives are thus positive.

The less developed and transition regions regarded (e.g. Castile–La Mancha, Norte, Puglia) are somewhat trapped in their specialisation. Approaches aiming to diversify the industry structure suffer from low critical mass and a lack of attractiveness for FDI. Universities have not played a crucial role thus far. Existing comparative advantages rely on long industrial traditions and are found to be driven mainly by innovative SMEs in the region. Price competition on international markets, however, is a permanent challenge, and the regions under consideration would probably benefit from refining their industrial composition in favour of business services and functional specialisation on higher-value activities such as design, marketing and management. This goal is challenged by the problem of skilled labour supply; here, the less developed regions face additional challenges as they compete with more central locations over high potentials.

The transforming regions in Central and Eastern Europe (Chemnitz, Jihozápad, West Transdanubia), in contrast, attracted significant FDI and established large production clusters with several multinational leading companies. Chemnitz, in particular, succeeded in restructuring its outdated industries and production sites and created conditions for increasing integration into a rich regional innovation system. The two Eastern European regions still face the challenge of transforming their initial cost and fiscal advantages into knowledge-based foundations in order to raise income levels and sustain or expand their industrial competencies in and around the city centres. The cases of the two Eastern European regions provide evidence that not just the accumulation of capital, but also structural change, is a driver of economic growth.

The results of the analyses are in line with preceding studies. They show that trade specialisation patterns are highly path-dependent and do not significantly change over time. More specifically, the results show that the industrial history is a decisive factor and greatly determines the current trade specialisation patterns of European regions. Hence, it is recommended to strengthen the endogenous potential of regions by encouraging the transformation of economic activities based on the existing economic structure. In most cases this implies modernising existing industries or enabling lagging sectors to improve their competitiveness, for instance through the adoption of General Purpose Technologies (GPT) such as ICT and the specialisation in specific functions or activities along the supply chain. This is particularly relevant for innovative SMEs that play an important role for revealed export specialisation advantages in low- and medium-low-technology industries. Furthermore, HEIs are potentially crucial actors for providing access to GPT applications and organisational strategies, both via collaboration as well as developing the local highly skilled labour supply. If they succeed in creating not just geographical but also cognitive and technological proximity, HEIs are important vehicles for implementing place-based approaches in different transmission channels (European Commission, 2014).

To improve growth opportunities, innovation strategies should also place emphasis on the development of inter-regional cooperations and support firms engaged in inter-regional and international knowledge networks (Charles et al., 2012). Policies promoting labour mobility between related industries may also enhance structural changes due to a recombination of regional skills and potentials, which, in turn, may increase regional competitiveness and growth. It might also be crucial to stimulate the inflow of skilled labour from other regions and countries, because it brings new ideas and knowledge to the regions (Saxenian, 2006; Boschma and Gianelle, 2014). Existing clusters in particular can play an important role in promoting these dynamics (European Commission, 2013). However, following this approach also requires the formulation of exit strategies in order to avoid adverse (political) lock-in effects (European Commission, 2013).

1. Introduction

Smart specialisation aims at understanding and exploiting the strengths of European regions in order to boost innovation, competitiveness and, ultimately, economic growth. In this context, the European Commission's Cohesion Policy sets a framework to reduce differences between regions and to ensure growth across Europe through the help of Structural Funds. For regional policy strategies to be effective, and for an efficient use of the available funds, it is crucial to analyse in detail the assets each region is endowed with, the technologies available, and the business connections among different regions. Since Smart Specialisation is fundamentally a bottom-up approach to policy, starting from the initial industrial structure, European regions need to identify niche areas of competitive strength in order to accumulate demand-driven investments and innovation partnerships and to align resources and strategies between private and public actors of different governance levels.

One of the tools that can be used to support the design of appropriate regional policies is the analysis of international trade performance of European regions. Identifying industries in which a region realises a strong trade specialisation may enable policy-makers and regional stakeholders to understand the sectoral specialisation of each region and the related success on international markets. This information plays a twofold role in industrial and regional policy-making to increase competitiveness at the regional level as well as in the EU as a whole. First, identifying successful structures at the industry-region level helps to improve the understanding of micro- and meso-foundations for competitiveness and scope and cases for policy intervention. Second, information on the spatial distribution of competitive industries and required location factors is necessary for differentiated perspectives on future economic development and the choice of policy instruments.

In this study, the focus is on export specialisation, which illustrates the export advantage of a country or region in a certain industry. This is traditionally measured by the Revealed Export Advantage (RXA), which indicates whether a country or region puts more or less focus on exporting particular products than other countries or regions do. Thus, a positive RXA value indicates that the country (region) realises comparably higher export market shares in this specific product group/industry than it does in total manufacturing goods.

However, so far, analyses of trade specialisation and trade performance indicators at the regional level have been limited by the lack of available data. Since trade data are usually collected at the national level, it has not been possible to examine trade specialisation and performance at the regional-industry level. This report aims at introducing a suitable method to break down national trade data to the regional level. In addition to regional gross exports, this report will also analyse regional Trade in Value Added (TiVA). Such analysis has become increasingly popular, and this report for the first time presents such analysis at the level of EU regions. The method to estimate regional TiVA data is based on well-established methods to estimate national TiVA flows and uses a straightforward method to disaggregate these data to the regional level. The analysis of regional TiVA flows also allows analysing the role and importance of services, which is not possible in the case of using international (product) trade statistics. Hence, providing a reliable methodology to produce trade indicators at the regional level is the aim of this study. Besides the key task to provide the European Commission with an initial dataset and the computational information required for future updates, supplemental analyses are conducted in order to validate the data and give first indications for related policy issues by means of descriptive and multivariate analyses as well as case study evidence. In general, when confronting the generated data with additional quantitative and qualitative information, it becomes clear that the proposed regional trade indicators are adequate to identify regions and industries with exceptional trade performance.

The results of the analyses are in line with preceding studies. One major insight is that high income levels and regional growth are not necessarily related to fundamental changes in the sectoral strength of a region. Given a suitable industrial configuration, regional endowment with Higher Education Institutions (HEIs) as well as focused policies, international competitiveness is achieved in very different industries. Historical roots and path-dependencies are decisive factors. However, while in some highly competitive regions the regional industrial legacy may hinder future growth perspectives, in several lagging regions entrepreneurial discovery processes succeeded in refining the regional specialisation by developing new applications of already existing products. Despite this case-specific evidence, there is still a divide in the specialisation of high- and low-income regions: While high-income regions on average tend to be specialised in high-technology-intensive goods, but are less competitive in less technology-intensive goods, low-income regions are specialised in medium-low- and low-technology-intensive goods trade, but show some deficits in the high-technology trade.

Overall, this report is structured as follows: the next chapter (2) briefly outlines the relevance of regional trade indicators for determining the competitiveness of a region. In chapter 3, the methodology for the calculation of regional trade performance indicators is introduced, and the elementary results are described. Chapter 4 presents an econometric analysis relating key regional characteristics to international success of local industries. Based upon the regional distribution of comparative advantages, chapter 5 reports the results of ten regional case studies. Finally, chapter 6 summarises the results and provides policy implications.

2. Patterns of regional export specialisation

The extent to which a region is specialised in producing and exporting certain goods is largely determined by the region's industrial characteristics and location economies. Understanding why certain economic activities take place in one region and not in another, and formulating policies to influence the specialisation patterns of regions, would require an extensive knowledge of those characteristics, how they affect production and export structures, and how they interact. Yet, the list of such characteristics is potentially endless. Many of them are known, or at least suggested by theory (cf. chapter 5.1), while others are outside the focus of attention such as traditions, culture, history or even random incidents etc., but may be of similar importance in shaping the regions' economic structure. The understanding of regional specialisation patterns is further complicated by the fact that only a part of these characteristics is appropriately measurable. Likewise, the formulation of policies faces the difficulty that only part of those characteristics are changeable, while others, such as geographic location or climate, are not.

The same holds for the level of detail at which regional production or export specialisation is analysed. In many instances, goods produced in and exported from a region could be considered unique to this region, even though other regions might produce and export similar goods. For a full understanding of a region's specialisation pat-tern and of its competitiveness in global markets, it would therefore be necessary to analyse it at the finest possible level of detail, yet by necessity data in this respect are always aggregated in one way or the other. So, to some extent an analysis of regional specialisation always remains incomplete, or at least has the tendency to disguise more or less important differences between the regions. As a consequence, even though the results of the analysis may show important trends and patterns, it is important to keep in mind that, in the end, each region is special.

The following descriptive analysis of regional export specialisation patterns is performed at a relatively high level of aggregation. This is mainly done for the sake of clarity and to present the results in a concise way, without blurring the main messages to policy. That is, being aware of all the characteristics that may differentiate regions, only one indicator is used to group the EU NUTS 2 regions in three different categories. This indicator is regional GDP per capita at PPS (purchasing power standards). This is done for three reasons. Firstly, experience shows that regional GDP is highly correlated with a number of other characteristics important for specialisation (such as the supply of skilled labour, market size, R&D, accessibility etc.) and thus can be viewed as a summary indicator. Secondly, it is still the standard measure for economic well-being. And, after all, any measures to increase the regions' competitiveness and to improve their pattern of specialisation can only be justified if they increase the well-being of the people living in the regions. Finally, GDP p.c. is the main determinant for the distribution of EU Structural Funds, and thus is of direct policy relevance. The three different categories of regions used in the analysis are:

› regions with a GDP p.c. at PPS of less than 75% of the EU-28 average (measured in 2005) to mirror the 'less developed regions' (formerly 'Convergence' or 'Objective 1' regions);

› regions with a GDP p.c. between 75% and 110% of the EU-28 average; and

› regions with a GDP p.c. higher than 110%.

Equally, the level of industrial detail of regional export specialisation is highly aggregated, to keep the analysis and results manageable. Hence, even though the original data on regional foreign trade have been estimated on a highly disaggregated goods level (i.e. separately for each of the 22 product groups according to the NACE Rev. 1 classification), these data are aggregated again for the descriptive analysis. That is, the original 22 manufacturing export goods have been aggregated to three categories according to their average technology level (see Table 2.1):

› high/medium-high-technology-intensive goods,
› medium-low-technology-intensive goods, and
› low-technology-intensive goods.

This grouping is based on a Eurostat recommendation[1] and, on average, is perceived as a good representation of the differences in Research and Technological Development (RTD) needed in the production of the respective goods. Yet it does not mean that all goods included in the group 'Low-technology-intensive goods' are indeed low-technology goods or that all firms that belong to those particular industries are not or less performing RTD. In fact, some of them may require quite sophisticated technologies. The same is true for the other two groups. The exact methodology for deriving regional-level export and import data and for estimating regional trade specialisation indicators is explicitly described in Appendix 7.1.

Table 2.1 / Aggregation scheme of regional foreign trade data

Industrial group	NACE description	NACE Rev. 1.1 category
High/medium-high-technology-intensive goods	Chemicals and chemical products	24
	Machinery and equipment n.e.c.	29
	Office machinery and computers	30
	Electrical machinery and apparatus n.e.c.	31
	Radio, television and communication equipment	32
	Medical, precision and optical instruments	33
	Motor vehicles, trailers and semi-trailers	34
	Other transport equipment	35
Medium-low-technology-intensive goods	Coke, refined petroleum products and nuclear fuel	23
	Manufacture of rubber and plastic products	25
	Other non-metallic mineral products	26
	Basic metals	27
	Fabricated metal products, except machinery	28
Low-technology-intensive goods	Food products and beverages	15
	Tobacco products	16
	Textiles	17
	Wearing apparel; dressing and dyeing of fur	18
	Leather; manufacture of luggage, footwear etc.	19
	Wood and of products of wood and cork, except furniture	20
	Pulp, paper and paper products	21
	Publishing, printing and reproduction of recorded media	22
	Manufacture of furniture; manufacturing n.e.c.	36

[1] See: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:High-tech

2.1. INDICATORS FOR MEASURING TRADE SPECIALISATION AND TRADE PERFORMANCE

Trade indicators measure an economy's ability to produce and commercialise internationally competitive products. Thus, trade specialisation indicators reveal how a country's, region's or industry's technological, productive, institutional, etc. properties translate into global trade success. For the purpose of examining regional and industrial trade specialisation patterns and for linking them to their potential determinants, different indicators are defined and consequently used.

The idea to measure a nation's (or region's) international trade performance by trade specialisation indicators such as the Revealed Export Advantage (RXA) or Revealed Comparative Advantage (RCA) instead of absolute shares in global exports goes back to Balassa (1965). Since Balassa's seminal work, many studies (e.g. Vollrath, 1991; Greenaway and Milner, 1993; Iapadre, 2001; Fertö and Hubbard, 2001; Utkulu and Seymen, 2004) have discussed, refined (normalised), and employed his indicators. The theoretical background of using the trade specialisation approach is based on the presumption that the international competitiveness of industries or products relies on their performance in national (or regional) inter-industry factor competition.

In this study, the focus is on the export specialisation that illustrates the export advantage of a country or region in a certain industry, which is traditionally measured by the Revealed Export Advantage (RXA). The RXA indicates whether a country or region puts more or less focus on exporting particular products than other countries or regions do. It, thus, reveals in which industries a country or region realises an export advantage or export disadvantage. More precisely, the RXA compares the export share of a certain industry in all manufacturing exports in a given region with the global export shares of this industry in the global exports in manufacturing goods. The RXA, thus, indicates whether the significance of a certain industry in a country's (region's) total manufacturing exports is higher or lower compared to the significance the industry has in global manufacturing exports.

Formally, the RXA of a certain industry *i* in year *t* can be expressed as follows:

$$RXA_{ir} = \ln[(\frac{X_{irt}}{X_{rt}})/(\frac{X_{it}}{X_t})] * 100,$$

whereby X_{irt} denotes the export volume *X* in region *r* and industry *i* in year *t*, X_{rt} denotes the total export volume in region *r* in year *t*, X_{it} denotes the total global export volume of a certain industry *i* in year *t* and, finally, X_t denotes the total global export volume across all manufacturing industries in year *t*. By using the log calculation, a positive RXA value indicates that the country (region) realises comparably higher export market shares in this specific product group/industry than it does in total manufacturing goods.

The advantage of the RXA in comparison to absolute trade indicators such as export market shares is that relative indicators like the RXA allow comparisons between larger and smaller countries or regions and avoid distorting effects that result from cyclical or exchange rate fluctuations (Gehle-Dechant et al., 2010). Moreover, the RXA considers the global export performance in a certain industry and compares regional or national export shares with their global counterparts. Thus, the regional export specialisation allows drawing conclusions about the regional export advantages and (smart) specialisation strategies, making the RXA a very relevant indicator for this study.

Additionally to the Revealed Export Advantage (RXA), which constitutes the main trade indicator in this report, the Revealed Comparative Advantage (RCA) is analysed. In contrast to the RXA, the RCA considers both sides of the trade balance. Technically, the RCA indicator relates the ratio of exports (*X*) to imports (*M*) in a certain country (and region, respectively) *r* for a respective product group or industry *i* to the export to import ratio for total manufactured goods in year *t*. Formally, it can be expressed as follows

$$RCA_{ir} = \ln[(\frac{X_{irt}}{M_{irt}})/(\frac{X_{rt}}{M_{rt}})] * 100$$

A positive (negative) Revealed Comparative Advantage (RCA), thus, indicates a positive (negative) trade specialisation and, in turn, a comparative advantage (disadvantage) for the respective product group/industry. Hence, positive RCA values reveal a highly competitive performance of domestic firms in the industry/sector under consideration.

2.2. STATUS QUO OF REVEALED EXPORT ADVANTAGES

The analysis starts with the status quo of the regions' export specialisation, which for data reasons refers to the year 2011. In this respect, Table 2.2. captures the essence of the present situation, by summarising the regions' export specialisation by aggregated regional income groups and aggregated trade categories.

The results in Table 2.2 are quite likely to fit common expectations. High-income regions (i.e. regions with a GDP p.c. above 110% of the EU average) on average tend to be specialised in high-technology-intensive goods, but are less competitive regarding the trade in less technology-intensive goods. Vice versa low-income regions (GDP p.c. level below 75% of the EU average) are specialised in medium-low- and low-technology-intensive exports, but show some deficits in the high-technology trade. The medium-income regions are somewhere in between, having slight disadvantages in the high-technology trade, and a more or less balanced specialisation in the medium-low- and low-technology exports.

Table 2.2 / Average RXAs by regional income groups and trade categories, 2011 (population-weighted average)

Regional group	high/medium-high-technology exports	medium-low-technology exports	low-technology exports
GDP p.c. below 75%	-25.1	16.6	16.5
GDP p.c. between 75% and 110%	-8.3	-2.0	-0.4
GDP p.c. above 110%	4.7	-18.9	-16.0

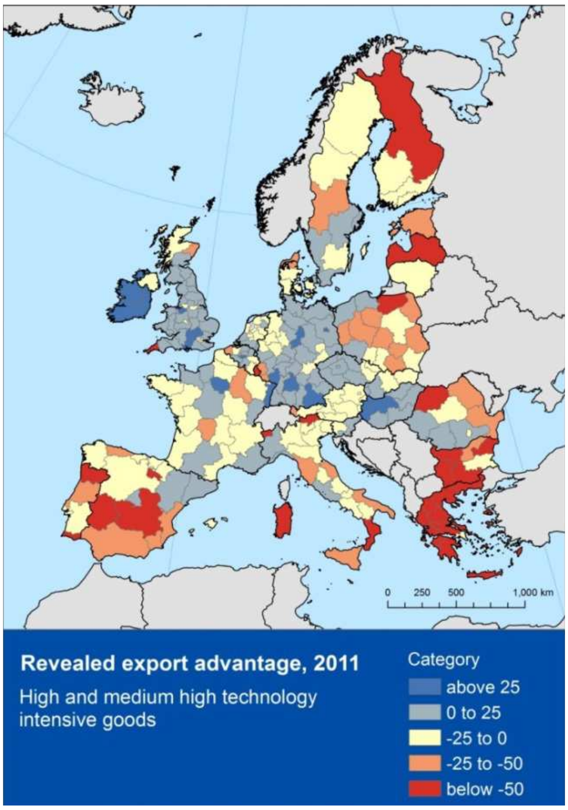
Source: GDP: Eurostat, regional trade: wiiw estimates.

These numbers disguise large regional variations in the export specialisation. To illustrate these variations, Figure 2.1 shows the revealed export advantages in the 'high/medium-high-technology-intensive' goods for the EU NUTS 2 regions in 2011.

The geographic distribution of export advantages in the 'high/medium-high-technology-intensive' exports follows a more or less distinct core-periphery pattern in the EU. Germany performs very well, as the vast majority of its regions have advantages in the trade of these types of goods. The same holds for Ireland

and the majority of the British regions. For other countries in the centre of Europe, the distribution of export advantages is less homogenous and is concentrated in a more limited number of regions in the respective countries, such as Paris and Alsace in France, Brussels and its surrounding regions (Belgium) and a couple of Swedish, Spanish and Italian regions. By contrast, many of the Southern EU regions, in Bulgaria, Greece and Spain in particular, have quite substantial disadvantages regarding the export of high-technology-intensive goods.

Figure 2.1 / Revealed export advantages, 2011, high- and medium-high-technology-intensive goods



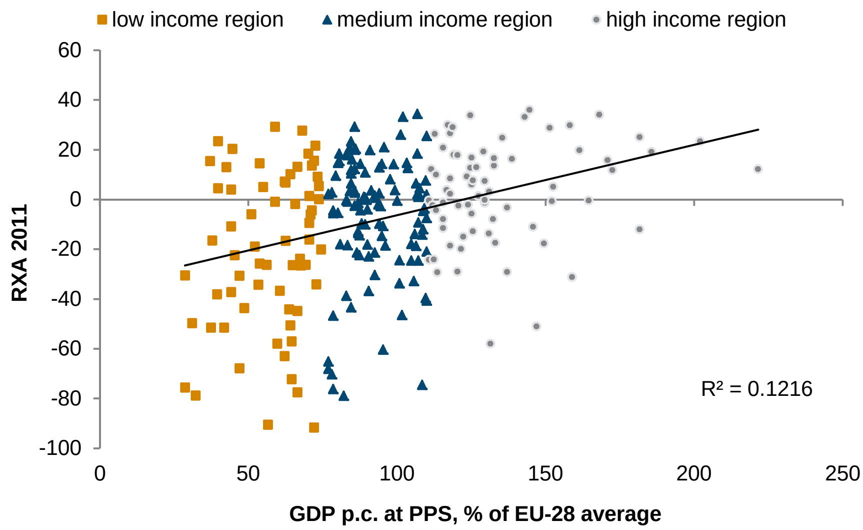
Source: wiiw estimates

Remarkably, a number of Eastern European regions show strong advantages in exports from high-technology industries. Foremost, this applies to Hungary, particularly to the three Western regions (including the region around Budapest) as well as the majority of Czech regions. But this also applies to one of the two Slovenian regions, as well as the three Western Polish regions, the Western parts of Slovakia and even three Romanian regions. All of them (with the exception of Bratislava and Budapest) are low-income regions. This suggests that the link between high income levels and specialisation in high-technology goods may be more a trend than a general rule. It also shows that it is possible to develop advantages in high-technology exports in low-income regions, presumably via foreign direct investment (FDI) and global value chains, thus potentially raising the long-run growth potential of these regions.[2]

[2] Further background information to one Czech region and one Hungarian region is provided in the case studies in chapter 6.

The link between regional GDP levels and revealed exports advantages in high-technology goods is more explicitly shown in Figure 2.2.

Figure 2.2 / Correlation of GDP p.c. at PPS (in % of the EU average) and revealed export advantages in high-technology-intensive goods, 2011



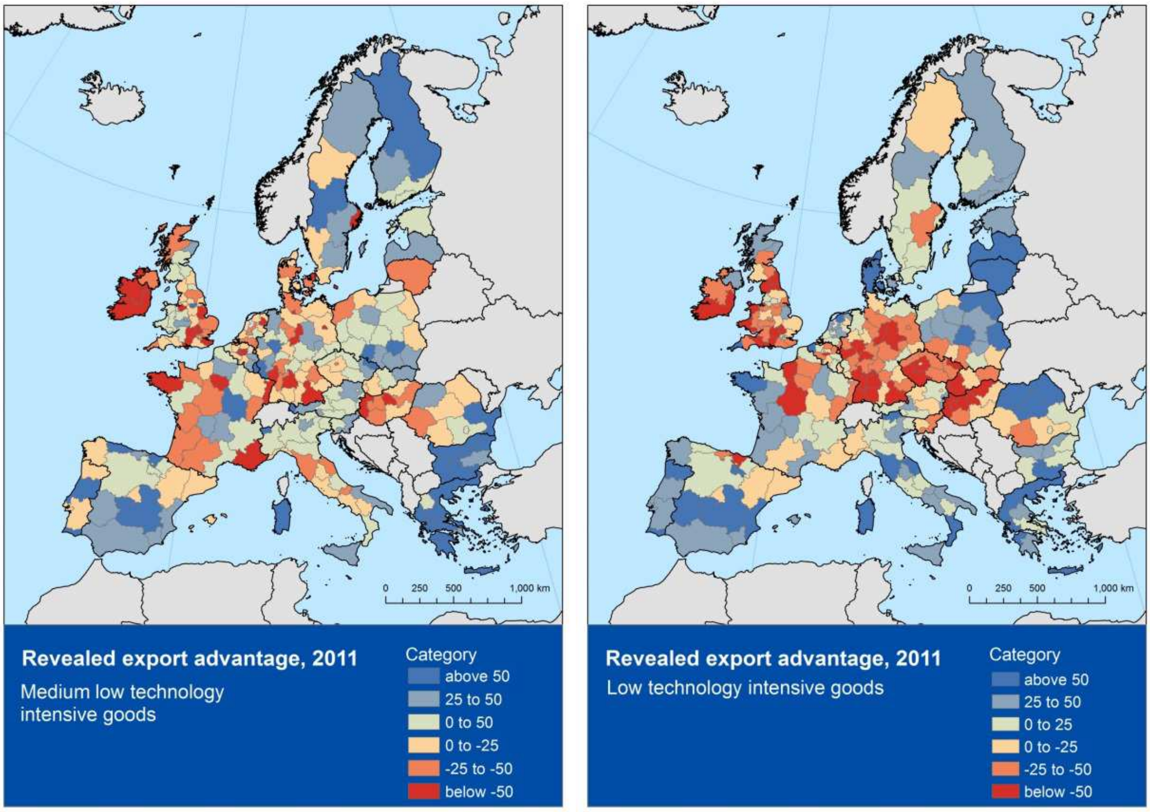
Note: excluding outliers
Source: GDP: Eurostat; RXAs: wiiw estimates.

As already indicated above, there is a positive correlation between the levels of regional GDP p.c. and the extent to which regions have an advantage in the exports of high-technology-intensive goods. But this correlation tends to be relatively weak. Especially for those regions around the EU-28 average (EU-28 average = 100), there is no systematic relationship between export advantages in high-technology exports and income levels. It might be argued though, that as far as the poorest EU regions are concerned (i.e. those around 50% of the EU-28 average), there is some correlation between disadvantages in exporting high-technology goods and income levels. That is, many of the poorest regions show particularly high negative values of the revealed export advantage index, which is not the case for higher-income regions, which may have export disadvantages in high-technology goods, but these are much less pronounced.

The opposite is observable when revealed export advantages in both medium-low- and low-technology goods are concerned (see Figure 2.3 and Figure 2.4). Firstly, the geographic distribution of the export advantages in both categories is more or less the reverse of the core-periphery pattern observed for the revealed export advantages in high-technology-intensive goods. That is, regions that have their advantages in exporting high-technology-intensive goods, by construction, tend to be less specialised in the export of medium-low- or low-technology goods. This is most obvious for the German, UK and the Irish regions, but also for all others that showed strong revealed export advantages in high-technology-intensive goods. Still, this argument needs some qualification, as it applies especially to the comparison of the revealed export advantages in high- and low-technology goods. That is, regions that are specialised in high-technology exports are generally not specialised in low-technology exports. As far as the medium-low-technology exports are concerned, the evidence is more ambiguous. There are some regions, e.g. in Germany or the UK, that have high revealed export advantages in the high-technology-intensive segments and, in addition, also advantages in medium-low-technology goods, even though these advantages might be small. On the other hand, there are regions that are exclusively specialised in high-technology exports, such as the Irish regions, Paris, Oberbayern (Munich) and Stuttgart in Germany.

As far as the Southern and Eastern periphery regions are concerned, they are highly specialised in medium-low- and low-technology-intensive exports. For example, the Bulgarian, Greek and Southern Spanish regions have high revealed export advantages in both types of goods, while other regions, e.g. in Portugal, Southern Italy, East Poland or North Romania, are specialised in exporting low-technology-intensive goods only.

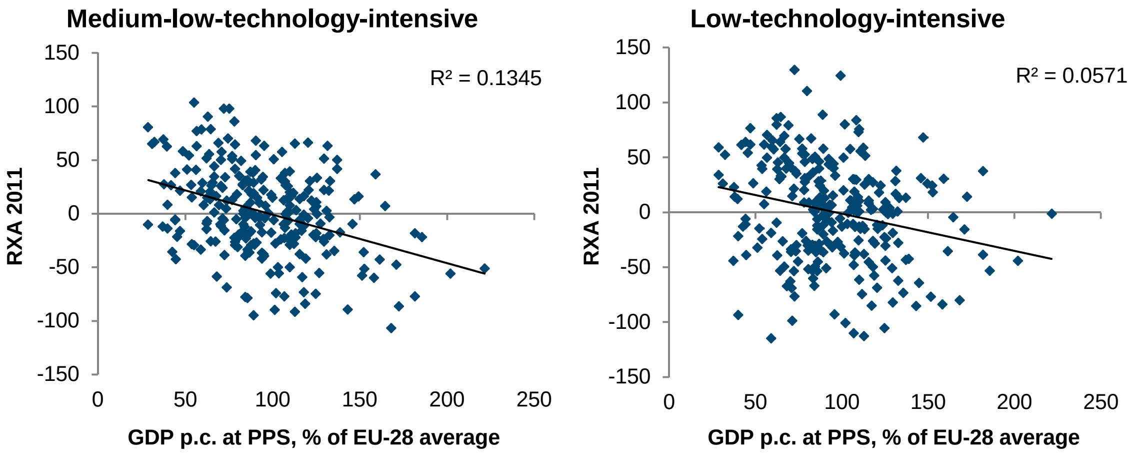
Figure 2.3 / Revealed export advantages, 2011, medium-low- and low-technology-intensive goods



Source: wiiw estimates.

Still, the conclusion that the pattern of the regions' revealed export advantages is clearly linked to their GDP level is somewhat misleading. Undoubtedly, there is a correlation between the level of GDP p.c. and export specialisation in medium-low- and low-technology-intensive goods (see Figure 2.4). But this correlation is weak, as was already the case with specialisation in high-technology exports. As a matter of fact, for the regions with GDP p.c. levels between 80% and 150% of the EU-28 average, there is no correlation between any type of export specialisation and GDP p.c. levels. There is some correlation regarding the regions with the highest income levels (i.e. above 150% of the EU-28 average), as they are, with only very few exceptions, exclusively specialised in the export of high-technology-intensive goods. More importantly, there is a strong correlation between specialisation in medium-low- and low-technology exports and GDP p.c. levels in the economically weakest EU regions. In comparison with other regions, they are much more specialised in medium-low- and low-technology-intensive exports and at the same time show larger disadvantages in the export of high-technology goods.

Figure 2.4 / Correlation of GDP p.c. at PPS (in % of the EU average) and revealed export advantages in medium-low- and low-technology-intensive goods, 2011



Note: excluding outliers
Source: GDP: Eurostat; RXAs: wiiw estimates.

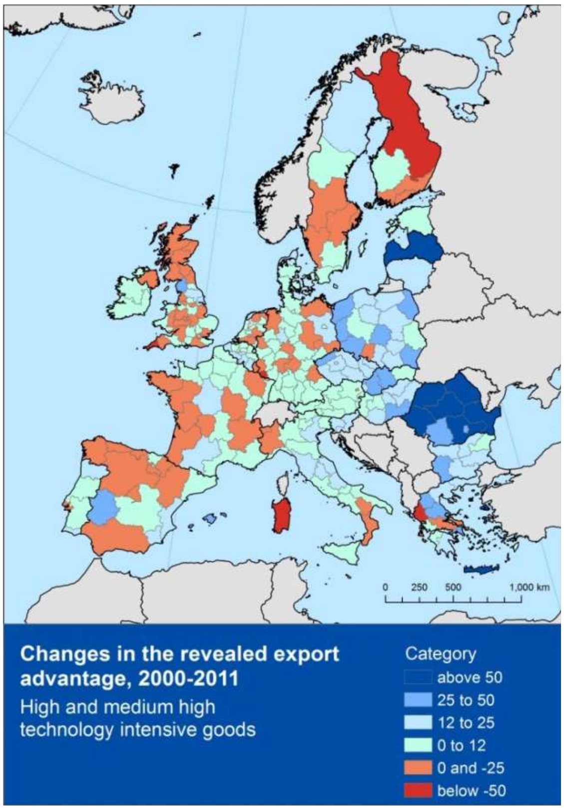
One important message emanates from this. For the majority of regions, strategies to foster economic growth and development do not necessarily need to be connected with a dramatic change in specialisation pattern (e.g. moving from low-technology specialisation to being specialised in high-technology exports). Decently high income levels can be achieved with different types of specialisation patterns. This finding is in favour of smart specialisation strategies that build on the existing strengths of especially, though not exclusively, the economically weakest regions. Bearing in mind that they are mostly specialised in medium- and low-technology exports, the above results suggest that is not so much a question of radically changing those regions' specialisation pattern. It seems much more relevant in terms of economic development to upgrade and further develop their existing (exporting) industries in order to increase productivity levels in those industries and consequently increase the value added and GDP produced in the least developed EU regions.

2.3. CHANGES IN REVEALED EXPORT ADVANTAGES

The above section argued that regional smart specialisation strategies do not necessarily have to focus on radical changes in the regions' specialisation structures to improve their economic growth performance. Still, the intention to do so may exist. But, how likely are such more radical strategies to succeed? To shed some light on this question it is instructive to analyse the changes in the regions' revealed export advantages over the past decade. Hence this section investigates the changes in the regions' export specialisation in the high-technology, medium-low- and low-technology goods from the year 2000 to the year 2011. For the sake of consistency, the starting values for the regions' revealed export advantage are defined as the average export advantage over the first three years of the period. Likewise, the end value is defined as the average of the last three years. Hence, the change in the regions' export specialisation (ΔRXA_i) is defined as: $\Delta RXA_i = RXA\_end_i - RXA\_start_i$, with i denoting the three groups of manufacturing goods.

The analysis starts with the development of the revealed export advantages in high- and medium-high-technology-intensive goods. These are illustrated in Figure 2.5. It reveals that, in the majority of EU NUTS 2 regions, specialisation in high-technology exports increased over the last decade. This trend was on average stronger in the Eastern European regions, especially in Romania, though the Romanian regions started from quite low levels of specialisation. The revealed export advantage also increased in the majority of regions in Austria, Belgium, Germany and Italy, while a particularly large number of French and UK regions encountered a decline in their export advantage in high- and medium-high-technology-intensive goods.

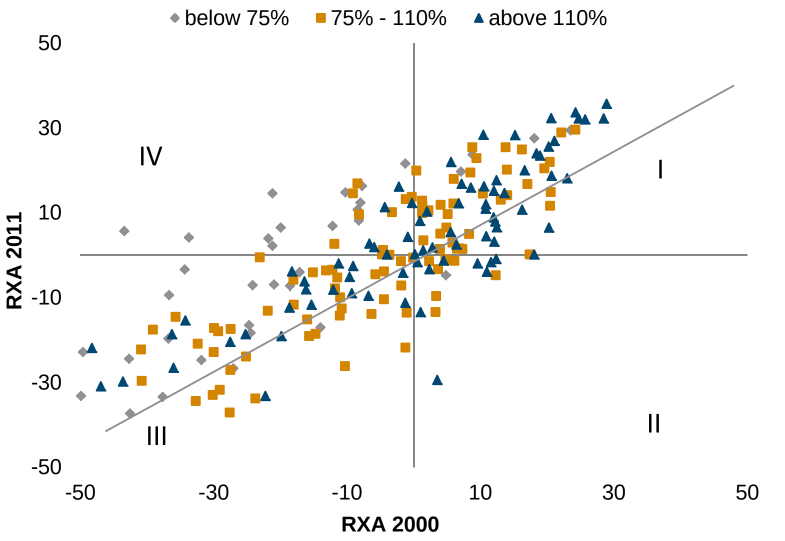
Figure 2.5 / Changes in the revealed export advantage, 2000-2011, high- and medium-high-technology-intensive goods



Source: wiiw estimates.

These changes are further illustrated in Figure 2.6, which plots the starting values of the revealed regional export advantages (x-axis) against the respective end values (y-axis). Thus, the position of the regions in this figure indicates to what extent the changes in revealed export advantages led to a change in their overall pattern of specialisation. Regions in the upper right quadrant (I) had a positive revealed advantage in high- and medium-high-technology exports at the beginning as well as at the end of the period. Hence, although the size of their export advantage may have changed over time, their general characteristic of being specialised in high-technology exports did not. The same applies for the lower left quadrant (III), only that those regions had a revealed disadvantage both at the beginning and at the end of the period. The most interesting cases are those in the off-diagonal quadrants. In the upper left quadrant (IV) there are those regions where the increase in the revealed export advantage was so high that they climbed up from the group of regions having disadvantages in high-technology exports to the group of regions with revealed export advantages. Oppositely, the regions in the lower right quadrant (II) moved from being specialised in high-technology exports at the start of the period to having revealed export disadvantages at the end of the period. That is, those regions changed in their characteristics and trade specialisation.

Figure 2.6 / Revealed export advantages, high- and medium-high-technology goods, 2000 and 2011

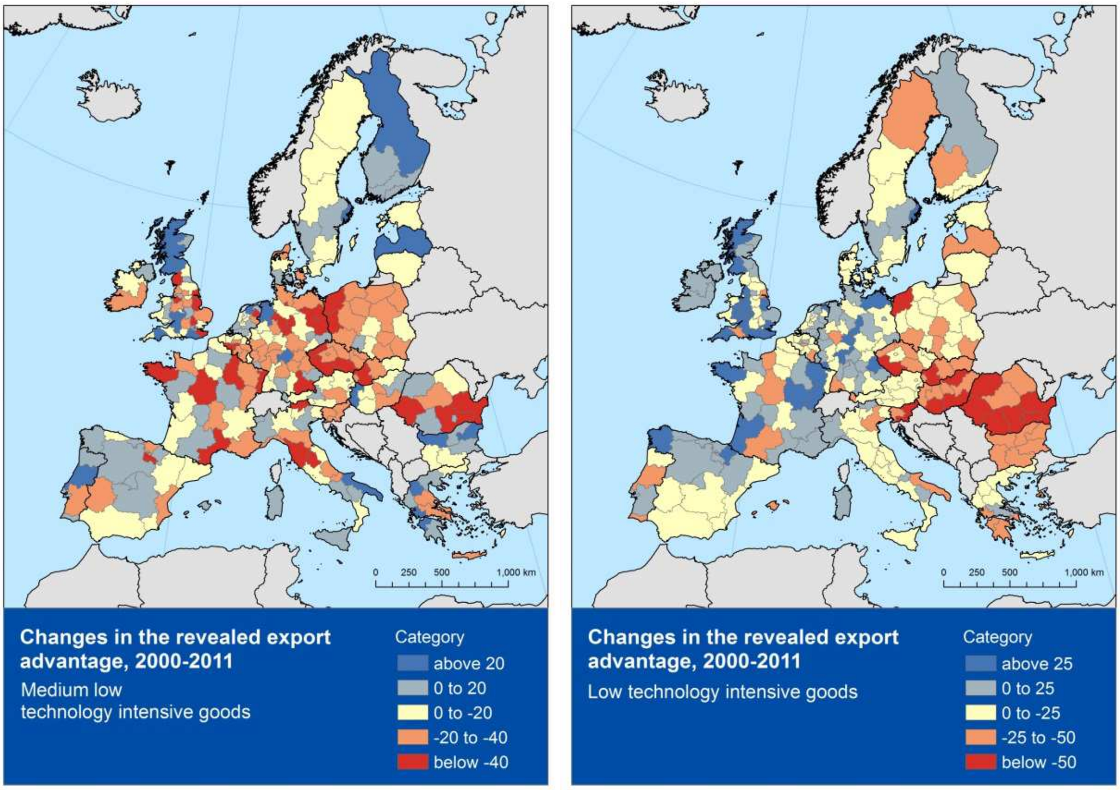


Source: wiiw estimates.

Figure 2.6 suggests that the general pattern of export specialisation for the majority of EU NUTS 2 regions did not change over the last decade (as most regions are either in the upper right or lower left quadrant), despite the fact that there was a general increase in the level of the revealed export specialisation (this is indicated by the large number of regions above the 45° line). Most regions that had a revealed (dis)advantage in high-technology exports in 2000 also had a (dis)advantage in 2011. On the other hand, the number of regions that changed their specialisation pattern with respect to high-technology exports was relatively small. Out of the 263 NUTS 2 regions in the sample, only 33 (i.e. 12.5%) became specialised in high-technology exports within this period of time. Among these 33 regions, 15 belong to the group of low-income regions and are all located in the Central and East European countries. Furthermore, among those 33 regions there were 11 medium-income regions (mainly from Belgium, Germany, France and the UK) and 7 high-income regions, with two of them again being located in the Central and East European countries (i.e. Bratislava and Prague). The number of regions that became de-specialised in high-technology exports was even smaller, as in only 18 regions (i.e. 7% of the total regions) the initial revealed export advantage turned into a revealed disadvantage. These 18 regions comprise only one (Italian) low-income region, and 8 medium-income regions as well as 9 high-income regions (with the bulk of regions being located in Germany and the UK).

Changes in the revealed advantages in medium-low- and low-technology exports are illustrated in Figure 2.7. For medium-low-technology-intensive exports there is a slight trend of a general decline (this is also shown in Figure 2.8), though not without some notable exceptions. Export advantages tended to decline in large parts of Austrian, French and German regions and also in the majority of the regions in Central and Eastern Europe. By contrast, advantages in medium-low-technology exports increased in many regions of Southern EU countries, such as Greece, Portugal, Spain and Southern Italy, but also in Northern areas such as Finland and Scotland.

Figure 2.7 / Changes in the revealed export advantage, 2000-2011, medium-low- and low-technology-intensive goods



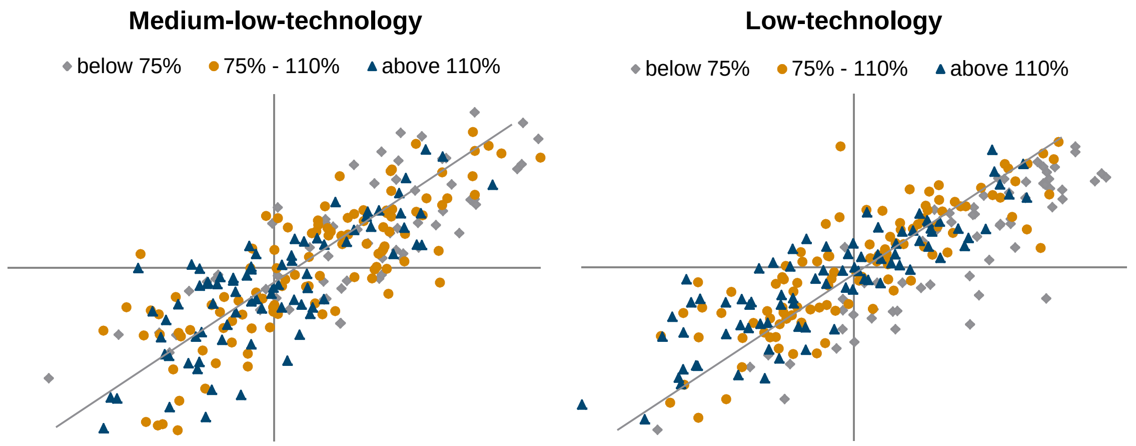
Source: wiiw estimates.

In the case of low-technology-intensive exports, in all regions of the Central and East European countries the revealed export advantages declined from 2000 to 2011, inversely to the simultaneous increase in high-tech export specialisation (shown in Figure 2.1). In the Western and Southern European countries, the developments were considerably more heterogeneous: In almost all countries there was quite an even distribution between regions where the revealed advantage in low-technology exports increased and others where it declined.

Still, as in the case of high- and medium-high-technology-intensive exports, the changes in the size of the revealed advantages in both medium-low- and low-technology exports did not alter the general pattern of specialisation for the majority of EU NUTS 2 regions. This is illustrated in Figure 2.8, which shows the scatter plot of revealed export advantages at the beginning and at the end of the period 2000 to 2011, for both medium-low- and low-technology-intensive exports. In either case it illustrates that as a rule the EU regions tended to have a stable pattern of specialisation during this decade. That is not to say that there are no exceptions to this rule. Interestingly, with respect to the revealed specialisation in medium-low-technology exports, the number of regions that initially had revealed disadvantages but moved to having revealed advantages in exporting these types of goods is low. In fact, only six regions developed in this way. By contrast, the number of regions losing their revealed advantage in medium-low-technology exports is considerably higher, i.e. 41 regions or 15.5% of all EU regions.

Concerning the changes in the export specialisation patterns of low-technology-intensive exports, the proportion of regions whose revealed export advantage turned positive or negative was more balanced, at least in terms of numbers but not from a geographic perspective. Thus, 17 EU NUTS 2 regions moved from a revealed disadvantage to a revealed advantage from 2000 to 2011. The majority of these regions are located in the UK (5), Germany (3), France, Spain and Sweden (2 each). By comparison, in 27 regions the initial revealed export advantage in low-technology goods turned into a disadvantage, of which 17 were NUTS 2 regions in Central and Eastern Europe.

Figure 2.8 / Revealed export advantages, medium-low- and low-technology goods, 2000 and 2011



Source: wiiw estimates.

The descriptive analysis above already suggests that, in general, there is no systematic relationship between the specialisation pattern of the regions and their GDP level. Yet the focus of smart specialisation strategies is not necessarily the level of GDP per capita in a region, but rather the changes therein, i.e. economic growth. From this point of view, it is of interest whether shifts in specialisation are associated with higher regional growth rates. To analyse this, the following simple convergence equation is estimated:

$$g(GDP_r) = \alpha + \beta \ln\left(GDP_{r,t}\right) + \gamma\ DRXA_r + \varepsilon_r + country\ dummies$$

In this equation $g(GDP_r)$ is the average annual regional GDP per capita growth rate of the years 2000 to 2011, $GDP_{r,t}$ is the initial GDP level of the region, $DRXA_r$ is the change in the revealed export advantage from 2000 to 2011 and ε_r is the residual term. This equation is estimated using least squares, including country dummies in order to account for country growth effects. The estimation is first run for the changes in the export advantage in each of the three aggregated trade sectors. Secondly, these estimations are repeated for each income group of regions as changes in specialisation might have different effects on the regions depending on their state of economic development. The results are presented in Table 2.3 and Table 2.4.

Table 2.3 / Regression results; dependent variable growth of GDP 2000-2011

	High- and medium-high-technology	Medium-low-technology	Low-technology
GDP per capita in 2000	0.067	0.066	0.069
	(-0.37)	(-0.36)	(-0.38)
Change in the revealed export advantage	0.001	0.001	0.001
	(0.38)	(-0.54)	(-0.32)
Observations	260	260	260
R-squared	0.78	0.78	0.78

Note: Absolute value of t-statistics in parentheses ; *significant at 5%; ** significant at 1%

All estimation results indicate that there is no systematic correlation between changes in specialisation and regional growth performance. This is not to say that for individual regions it may not pay off to become increasingly specialised in one or the other sector. It just means that there is no general trend across regions, that e.g. becoming more specialised in exporting high-technology-intensive goods is conducive to economic growth. Hence, if there exist specialisation advantages with respect to economic growth, they appear to be region-specific. Interestingly enough, the estimation also finds no evidence for economic convergence across the EU regions, with the exception of convergence within the medium-income regions[3].

Table 2.4 / Regression results; dependent variable growth of GDP 2000-2011; by income groups of regions

	Low-income regions			Medium-income regions			High-income regions		
Technology groups	High, medium-high	Medium-low	Low	High, medium-high	Medium-low	Low	High, medium-high	Medium-low	Low
GDP per capita in 2000	1.162	0.974	1.197	-1.966	-1.769	-1.857	-0.348	-0.46	-0.397
	(-1.33)	(-1.11)	(-1.37)	(4.46)**	(4.03)**	(4.21)**	(-0.93)	(-1.19)	(-1.03)
Change in the revealed export advantage	0.003	-0.007	-0.002	0.004	0.004	0.001	-0.004	0.003	-0.001
	(-0.6)	(-1.29)	(-0.3)	(-1.41)	(-1.71)	(-0.63)	(-0.74)	(-0.94)	(-0.38)
Observations	63	63	63	112	112	112	85	85	85
R-squared	0.82	0.83	0.82	0.79	0.79	0.79	0.69	0.69	0.69

Note: Absolute value of t-statistics in parentheses ; *significant at 5%; ** significant at 1%

Summarising, the results suggest that significant changes in the regions' specialisation patterns over time are relatively rare. Although the size of revealed export advantages may increase or decrease over time, a complete shift of the revealed specialisation pattern, i.e. moving from being specialised in low-technology-intensive exports to being specialised in high- and medium-high-technology exports is quite unlikely, though not completely impossible. This is important to know for the development of smart

3 A similar pattern was found in the Sixth Report on economic, social and territorial cohesion (EU Commission, 2014a, p. 3), which attributes the break in the convergence trend to the economic crisis in 2008 and 2009.

specialisation strategies, because it suggests that their starting reference point should be the existing strengths of the regions. It is worth considering them first and building specialisation strategies around them. There is a reason why certain regions have their advantages in low-technology-intensive exports while others have advantages in high-technology-intensive goods. Any attempts to change a region's specialisation pattern in a more radical fashion need to take this into account, and have to check whether the regional characteristics are supportive of such a change.

Still, there are examples of regions that managed to move from medium-low- or low-technology export specialisation to high-technology export specialisation. The majority of these examples are found in the Central and East European countries. Yet these examples were not the result of particular specialisation strategies of the respective regions. Rather, they were the results of high levels of quite targeted investments, mostly fuelled by foreign direct investments of foreign multinational companies (this is also suggested by the case studies below). Without such investments the shift in the pattern of specialisation of those regions would have been much more gradual. This leads to the conjecture that, in the end, structural change in a region's pattern of specialisation is a function of the level of investment in this region and time. The Central and East European NUTS 2 regions received a lot of investment over a relatively short time period, and this may explain their revealed advantages in high-technology exports (see e.g. the yearly wiiw FDI Reports, wiiw, 2002-2015). In other regions where investments and large-scale investments in particular were low, the change was much more gradual. This again speaks for smart specialisation strategies that focus on the existing advantages of the regions, as such large-scale investments are rare and are likely to become even rarer. A gradual approach is also much more in line with current EU regional policies. Structural Funds support for regional development is quite substantial, and accounts for around 2% to 4% of the GDP of the less developed countries in the EU (see Mrak et al., 2015). But these funds are split up to target various goals such as infrastructure, environment and education, and only a fraction of them are demand-oriented and go into enterprise support (e.g. for RTDI projects).

2.4. REVEALED ADVANTAGES IN VALUE ADDED EXPORTS

This section deals with revealed advantages in regional value added exports, which measure how much of the value added produced in a domestic region is directly or indirectly contained in the final consumption of a foreign country. Data on regional foreign trade in general and regional export data in particular only take account of the (gross) value of goods that flow from a domestic region to a foreign country, but they cannot measure how much of this value is actually produced in the respective region. In fact, if the exports of a region are to a large extent made of imported intermediate inputs, the actual value added produced in the region might be quite low. Still, despite that, this region may record high exports, on the basis of foreign trade statistics. Arguably, this induces a certain bias to the true extent of regional trade specialisation. Regional value added exports are supposed to correct for this bias.

The methodology to estimate regional value added exports is described in detail in the Appendix. In short, regional value added exports are not based on foreign trade statistics but on global input-output tables.

The analysis is split into two parts, the first dealing with manufacturing industries and the second dealing with services sectors. This is done because the results regarding manufacturing industries are to a large extent similar to the results of the previous section, though it was on goods instead of industries. In contrast, the second part deals explicitly with selected services sectors (business, financial and tourism services) as they are economically important but have not been covered so far.

2.4.1. Manufacturing industries

The analysis of revealed advantages in value added exports is based on the classification of industry by sectors (NACE Rev 1.1). Importantly, though the same classification as in the analysis of revealed export advantages is used, the analysis of value added exports is in terms of industry sectors. This is in contrast to the above analysis, which was based on a classification by products. 14 different industry sectors are available in the original dataset (from the WIOD database) but in order to keep the analysis and the presentation of results manageable, we aggregated them into three groups of industries:

a) high- and medium-high-technology-intensive industries,

b) medium-low-technology-intensive industries, and

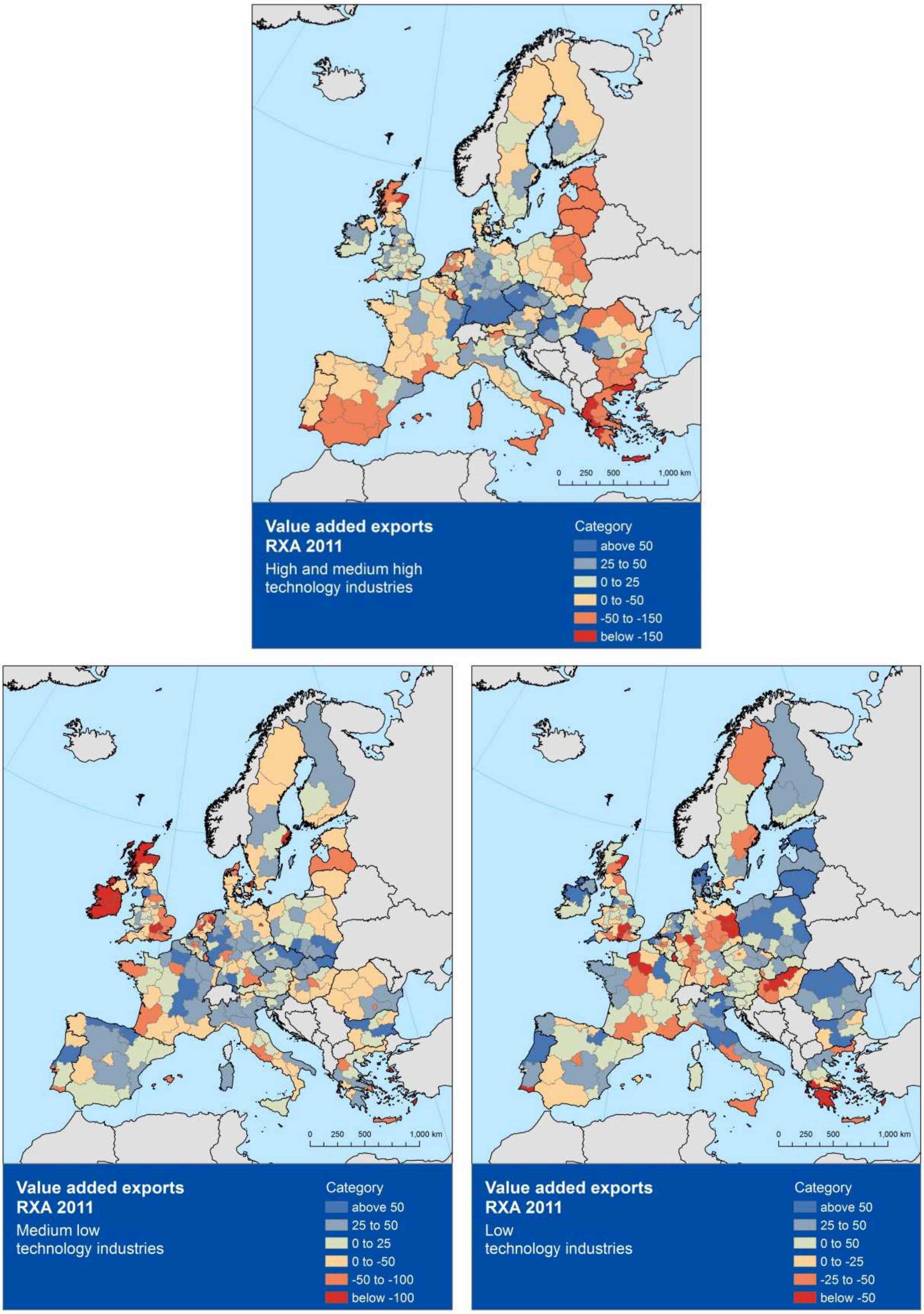
c) low-technology-intensive industries.

The grouping of industries follows the scheme in Table 2.1 above, only that instead of being applied to goods exports it is applied to manufacturing industry sectors.

The fact that value added exports are in terms of industry sectors also has implications for comparing the results with those derived above from the analysis of revealed export advantages as there is no exact one-to-one match between industry and product level data. Although being correlated, industry and product level data differ, as e.g. one product could be produced by different industry sectors. Even if this difference may be small in practice, it has to be kept in mind when comparing the results of the two analyses.

Figure 2.9 shows three maps (one for each aggregated industry group) on the regional distribution of revealed advantages in value added exports. As already mentioned, from a general perspective the geographic pattern of revealed advantages in value added exports of high- and medium-high-, medium-low- and low-technology-intensive industries corresponds strongly to the respective pattern of revealed gross export advantages described above. Thus, there is strong evidence of a core-periphery distribution in revealed advantages for high- and medium-high-tech and low-technology industry value added exports. For medium-low-technology industries, the geographic pattern is much more heterogeneous, with revealed advantages quite evenly distributed over the EU regions.

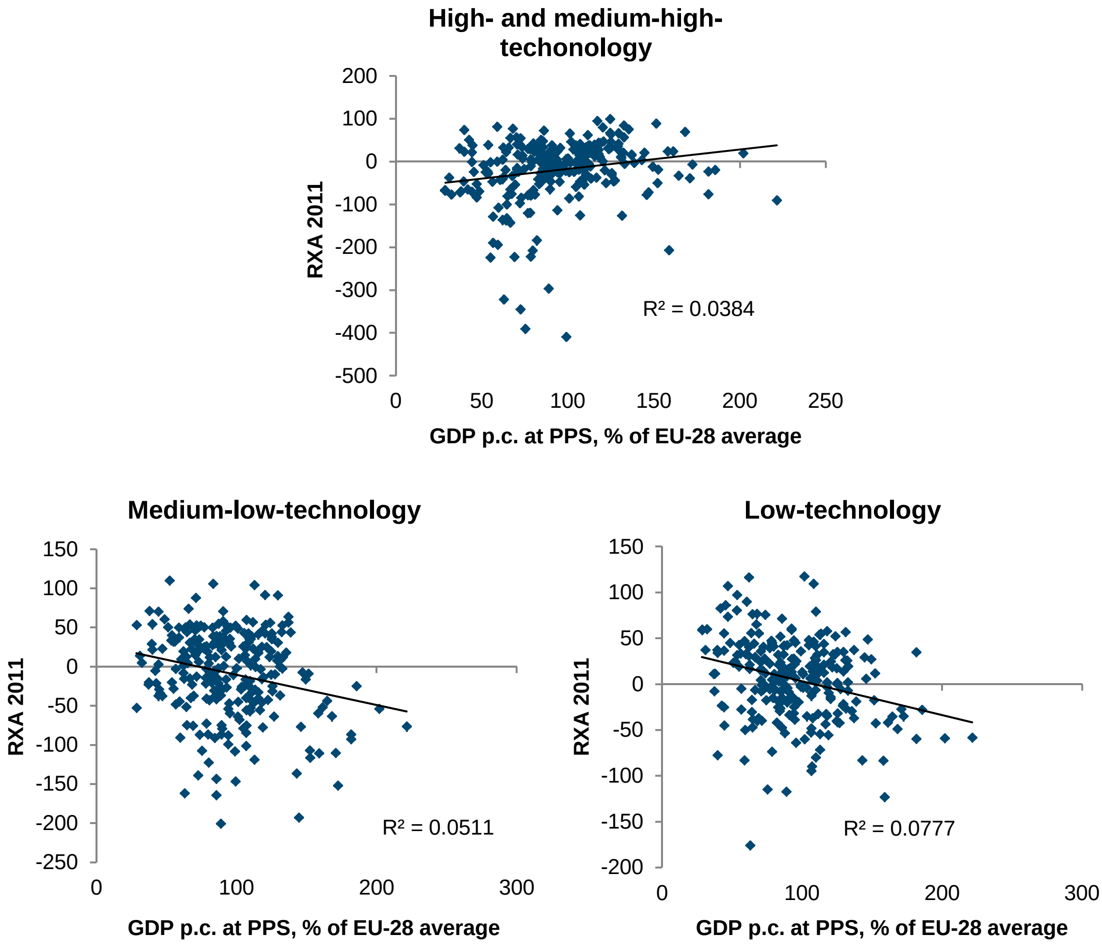
Figure 2.9 / Revealed advantages in value added exports in manufacturing industry sectors



Source: wiiw estimates.

Similarly, the correlation of GDP per capita levels and the size of revealed advantages in value added exports for each industry group in 2011 (Figure 2.10) strongly resembles the correlation of GDP per capita and revealed gross export advantages (Figure 2.2. and Figure 2.4). There is a positive but weak correlation between GDP per capita levels for high- and medium-high-technology industries value added exports, while for medium-low- and low-tech industries value added exports there is a weak negative correlation with GDP levels.

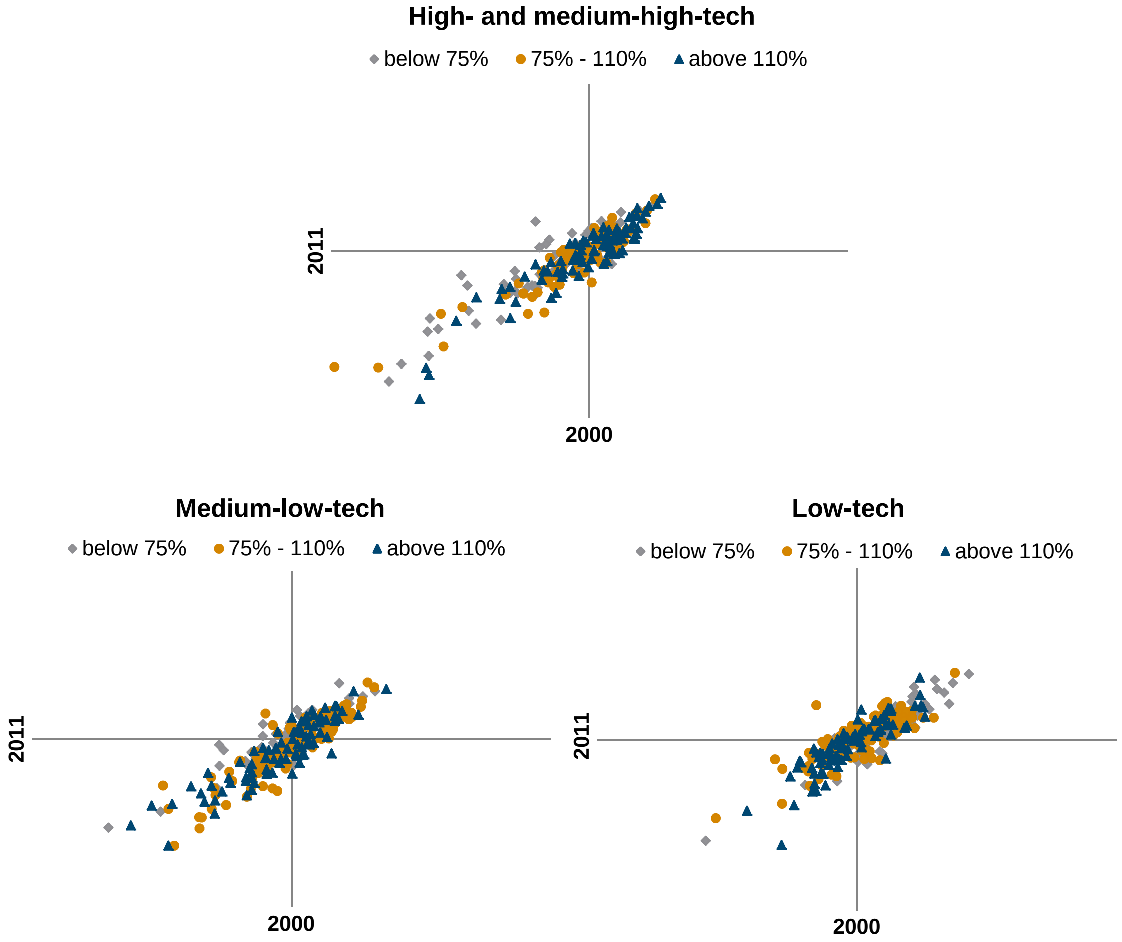
Figure 2.10 / Correlation of GDP p.c. at PPS (in % of the EU average) and revealed advantages in value added exports in manufacturing industry sectors, 2011



Source: wiiw estimates, Eurostat.

The similarity between revealed advantages in value added and gross exports holds also over time as Figure 2.11 demonstrates. Plotting the revealed advantages in value added exports for the three industry groups for the year 2000 against the respective value for 2011 indicates, just as in the analysis above, that the regional patterns of revealed advantages in value added exports tend to be very stable over time, with only few regions experiencing a shift in their patterns.

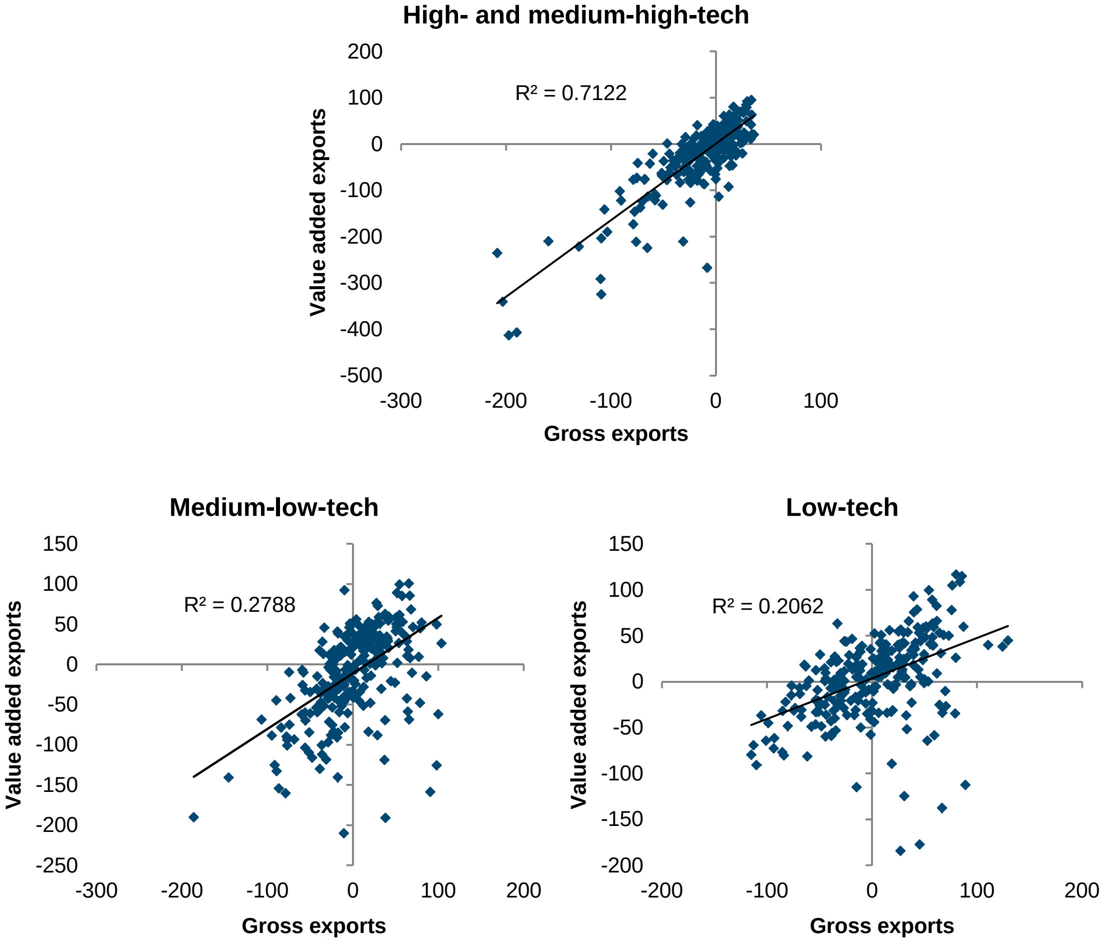
Figure 2.11 / Revealed advantages in valued added exports 2000 and 2011; manufacturing industry sectors



Source: wiiw estimates.

The correlation between revealed advantages in valued added and gross exports is shown in Figure 2.12. Interestingly enough, this correlation is strongest for the high- and medium-high-tech area and somewhat weaker for the medium-low- and low-tech areas. For the latter two, the values of revealed advantages measured for value added exports and for gross exports tend to differ, in some cases substantially, for the EU regions. Still, for the majority of EU regions the general assessment, whether they have a revealed advantage or disadvantage in the medium-low- or low-tech area is the same, regardless of whether these advantages are measured in terms of value added exports (of industries) or gross exports (of products). However, the size of these revealed advantages or disadvantages is different depending on the measure that is used.

Figure 2.12 / Correlation of revealed advantages in value added exports and revealed gross export advantages by aggregated industry groups, 2011

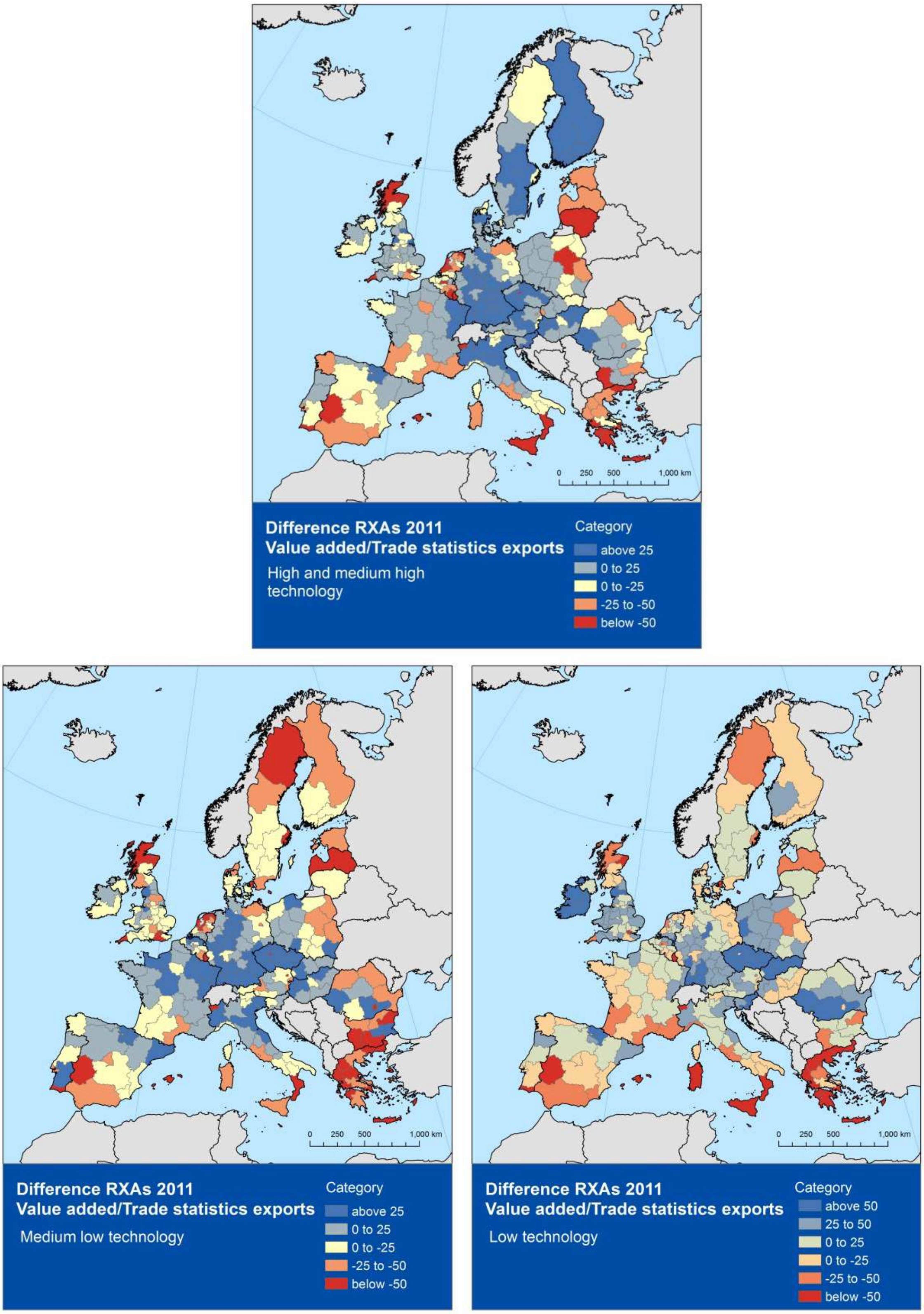


Source: wiiw estimates.

To analyse this further, the maps in Figure 2.13. show the differences in RXAs estimated on the basis of value added exports and gross exports for the EU regions and the three technology areas. Blue colours in the map indicate that the RXA based on value added exports is higher than the RXA measured by gross exports, while red colours indicate that value added export RXAs are lower than gross export RXAs.

All three maps, or technology areas respectively, show a striking core-periphery pattern in the sense that for the core regions, including the Eastern regions of France, Germany, Austria, the North of Italy, the Western regions of Poland, the Czech Republic, Slovakia, Hungary and Slovenia, the RXAs measured in terms of value added exports tend to be considerably higher than the RXAs measured in terms of gross exports. By contrast, in the peripheral regions, i.e. Southern Spanish and Italian regions, all Greek regions as well as the Baltic states, the situation is the opposite as value added export RXAs are lower than foreign trade RXAs.

Figure 2.13 / Differences in RXAs based on value added exports and foreign trade exports, 2011



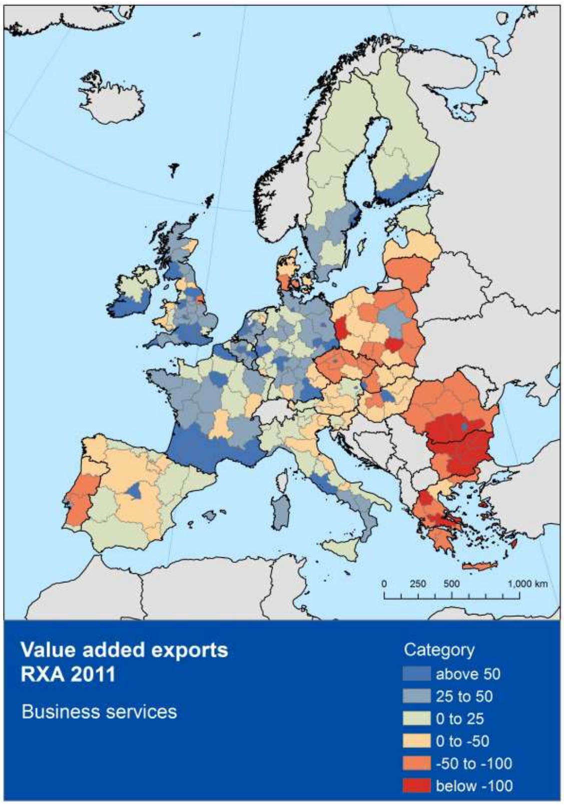
Source: wiiw estimates.

2.4.2. Revealed advantages in value added exports of the services sector

This section focuses on revealed advantages in value added exports of the services sector, covering only tradeable services, while non-tradeable services, e.g. public administration, education etc., are disregarded. More specifically, three types of services will be analysed:

- Business services, i.e. NACE Rev. 1.1. sectors 71 to 74, hence: ‘Renting of machinery and equipment’, ‘Computer and related activities’, ‘Research and development’ and ‘Other business activities’ such as legal and accounting activities, tax and business consultancy, market research.
- Financial services, i.e. NACE Rev. 1.1. sectors 65 to 70, hence: ‘Financial intermediation’, ‘Insurance and pension funding’, ‘Activities auxiliary to financial intermediation’ and ‘Real estate activities’.
- Tourism services, i.e. NACE Rev. 1.1. sector 55 ‘Hotels and restaurants’.

Figure 2.14 / RXAs – value added exports: business services, 2011



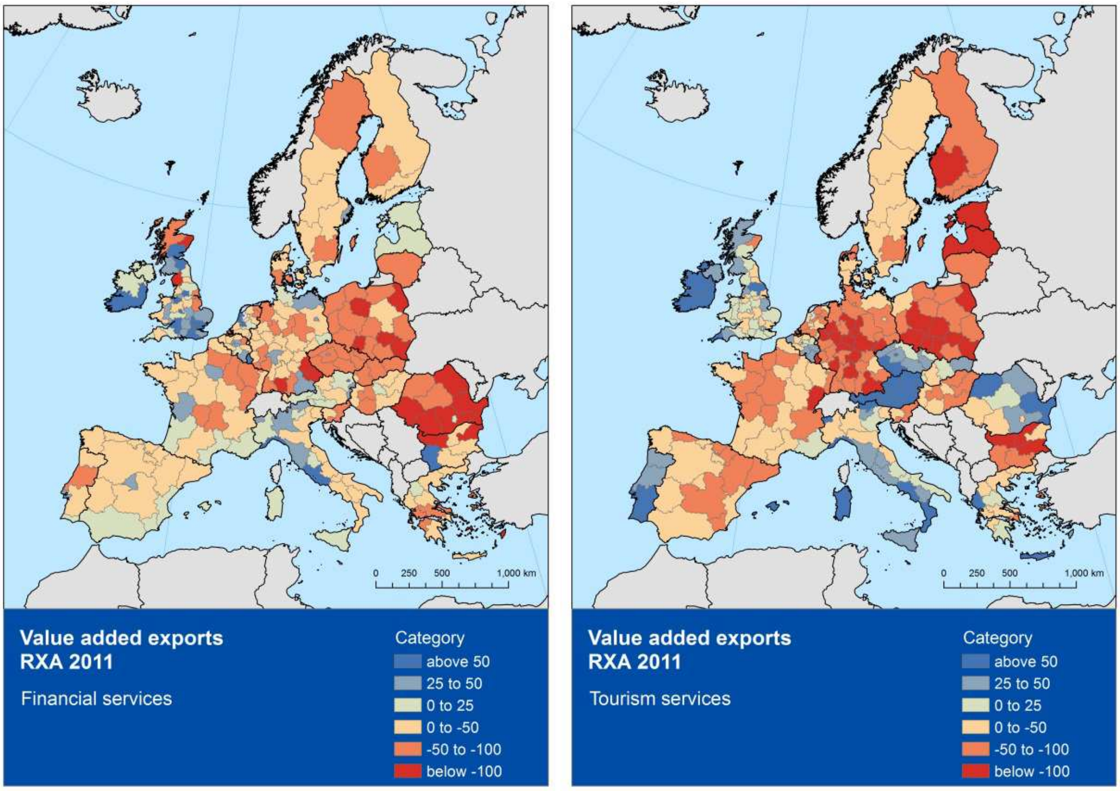
Source: wiiw estimates.

The analysis starts with the geographic distribution of revealed advantages in those three services sectors across the EU regions. In this respect Figure 2.14. shows the RXAs for Business services and Figure 2.15. shows the RXAs for Financial services and Tourism, each for the year 2011. As far as Business services are concerned, there is a clear geographical divide in the revealed advantages, as the high-income countries and regions tend to have revealed advantages in the value added exports of Business services, while the less developed countries and regions in the South (Greece, Portugal and

Spain) as well as in the East have revealed disadvantages. An exception to this is the capital city regions, in the CEE countries in particular.

As far as financial services are concerned, the geographic distribution is highly skewed towards the large urban agglomerations, especially, but not only, the capital city regions, as they are typically the centre of financial activities in each country. Similarly, also the distribution of revealed advantages in value added exports of the Tourism services is highly unequal. Thus large revealed advantages are found in the typical tourist areas such as Austria, Italy, Portugal, the Greek Islands, the Baleares, Ireland, but also in Scotland, the Czech Republic and some regions in Romania.

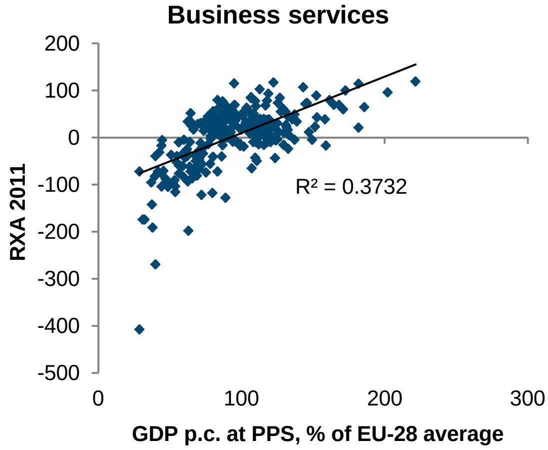
Figure 2.15 / RXAs – value added exports: financial and tourism services, 2011



Source: wiiw estimates.

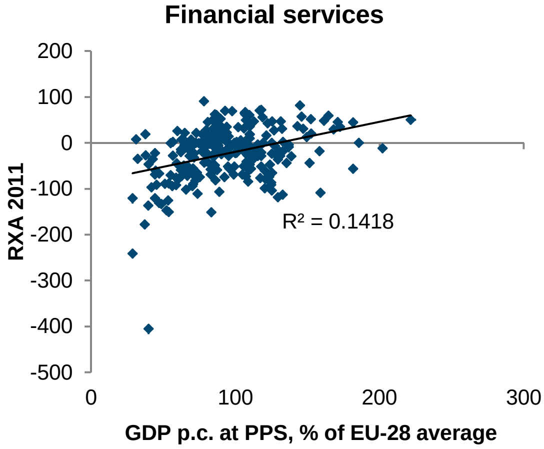
Especially the geographic distribution of Business services hints towards the fact that revealed advantages in value added exports of this sector are highly correlated with GDP per capita levels. This is confirmed by Figure 2.16. Amongst all economic sectors, manufacturing industries or services, Business services have the highest correlation with regional GDP per capita levels. There is also a positive correlation between financial services and GDP per capita level, which however rests mainly on the fact that large urban agglomerations are not only the centres of financial services activities but usually also the regions with the highest GDP per capita levels. As far as Tourism is concerned, there is no correlation between revealed advantages in value added exports and GDP per capita levels, as these advantages largely depend on the natural endowment of the regions, which are independent of the GDP level.

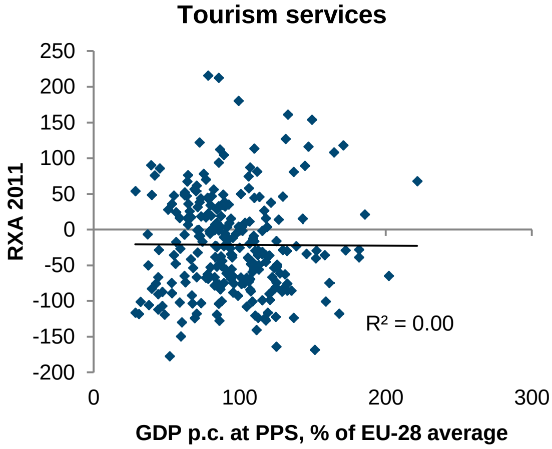
Figure 2.16 / Correlation of GDP p.c. at PPS (in % of the EU average) and revealed advantages in value added exports in Business services, 2011



Source: wiiw estimates.

Figure 2.17 / Correlation of GDP p.c. at PPS (in % of the EU average) and revealed advantages in value added exports in Financial and Tourism services, 2011



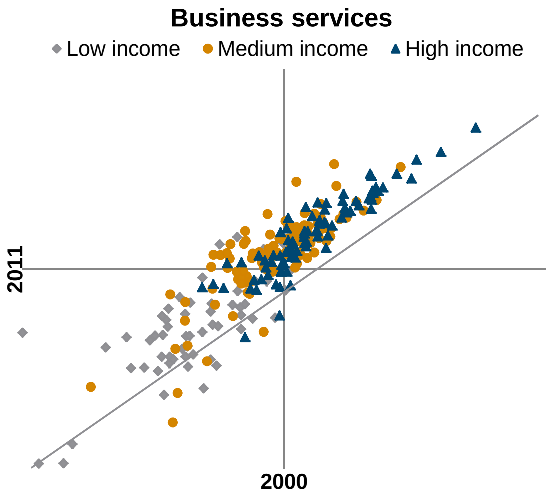


Source: wiiw estimates.

As a final step, the changes over time in revealed advantages in services value added exports are analysed. These are shown in Figure 2.18 for Business services and in Figure 2.19 for Financial services and Tourism. Each graph plots the regional RXAs of the year 2000 against the respective RXAs in the year 2011. Thus, regions in the upper right quadrant had revealed advantages in value added exports both in the year 2000 as well as in the year 2011. Oppositely, regions in the lower left quadrant had revealed disadvantages in both years. Regions in the upper left quadrant experienced a shift in their pattern of revealed advantage, as they moved from having a disadvantage in 2000 to having a revealed advantage in 2011. The opposite is the case for the regions in the lower right quadrant. Regions on the 45° degree line had identical RXAs in 2000 and 2011.

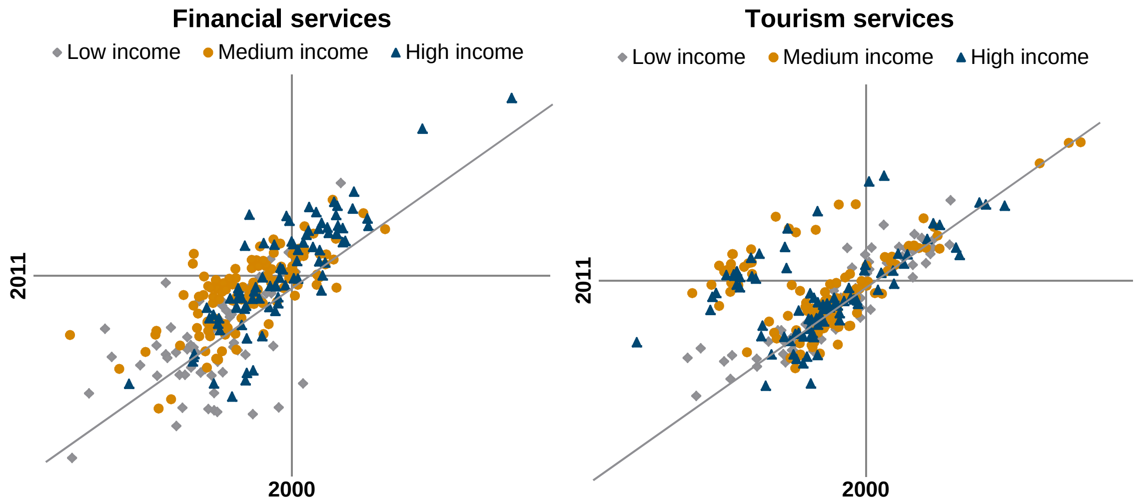
As far as Business services are concerned, there was quite an impressive improvement in revealed advantages for almost all EU regions (as the majority of regions lies above the 45° degree line). Thus, either regions reduced their disadvantage, improved their already existing advantage, or in many cases turned their revealed disadvantage into a revealed advantage. To a lesser extent, this was also the case in financial services value added exports. For Tourism, only a selected number of regions improved their revealed advantages in value added exports, while for the majority of regions these changes were small. Notably, amongst those regions that improved their RXA in tourism there are almost exclusively middle- and high-income regions and only very few.

Figure 2.18 / Revealed advantages in valued added exports 2000 and 2011; business services



Note: Low-income regions are those with GDP p.c. below 75% of the EU-28 average (measured in 2005); in medium-income regions GDP p.c. is between 75% and 110%; in high-income regions GDP is above 110% of the EU 28 average.
Source: wiiw estimates.

Figure 2.19 / Revealed advantages in valued added exports 2000 and 2011; financial and tourism services



Source: wiiw estimates.

3. Regional determinants of international trade performance

3.1. INTRODUCTION

The core work of this research project consisted in generating data on regional external trade flows (see Appendix for more details). The descriptive statistics in the previous sections have shown some intuitive and realistic patterns. As an additional quality check, we assess whether the variation in the data is also correlated with typical regional and industry-specific factors. The following results provide some empirical evidence with regard to the main factors underlying competitive advantages. This analysis is complemented by ten case studies, which support the quantitative results with qualitative information.

The remainder of this report concentrates exclusively on the export performance of manufacturing industries. This restriction to manufacturing industries is due to the fact that TiVA data for service industries rely on estimates derived from international I-O tables instead of original trade data as it is the case for manufacturing. Therefore, comparability between manufacturing and services is limited. Moreover, trade specialisation in the few aggregated sectors available (financial services, business services, tourism) is potentially determined by other factors than manufacturing. An analysis of the three sectors would thus require to develop empirical models which are more specific for these very different sectors. For instance, tourism-related services rely heavily upon geographical characteristics and other amenities while business services are expected to be related to the local industry structure and skilled labour markets. In contrast, the analysis of trade specialisation solely in manufacturing industries allows to derive policy conclusions on a common basis. It is suggested, however, that future analyses of the generated data lay focus on industry-specific studies for each of these service sectors in order to get a comprehensive picture of a region's trade profile.

3.2. DRIVERS OF REGIONAL TRADE SPECIALISATION

Studies that focus explicitly on the determinants of regional competitiveness in international trade are scarce. However, some insight might be drawn from works on regional economic growth. The recent study by Crespo-Cuaresma et al. (2014) gives a comprehensive overview of the factors that potentially explain variations in growth rates between European regions. Drawing from the various approaches to economic growth, the authors identify six broad sets of variables that potentially explain regional growth, including factor accumulation and convergence, human capital, technological innovation, sectoral structure and employment, infrastructure variables and socio-geographical characteristics. In a similar vein, Delgado et al. (2012) identify three interrelated drivers of national competitiveness (measured by national productivity levels), including political institutions, monetary and fiscal policies and the microeconomic environment. While monetary and fiscal policies should not play a major role in the EU regional context, at least when comparing regions within the same national economy, political institutions and the microeconomic environment might be relevant drivers of regional competitiveness. The general macroeconomic conditions and their correlates can be proxied by GDP per capita (at PPS) and regional labour costs in the manufacturing sector. Since we aim to identify factors explaining regional variation in the industry-specific trade performance, we use RXA as dependent variable. A complementary analysis of RCAs in contrast to RXAs is provided with respect to the robustness of the results.

Since the analysis focuses not only on differences between regions, but also on differences between industries within a region, on top of region-specific variables, information at the regional-industrial level is also relevant. Information on this level of disaggregation is, however, only available for a relatively small number of variables. In the following model specifications, two factors that potentially explain differences in RXAs between industries are taken into account: patent intensity, and the presence of a regional cluster in the industry (Table 3.1).

Patent intensity, which is calculated in relation to local population, can be used to measure the technological know-how and innovativeness of an industry. Information on patent activities at the regional-industrial level is obtained from the OECD RegPat database for all NUTS 2 regions in the EU-28 included in the empirical analysis. The patent indicator shows the technological relevance of the new knowledge produced in a region for a certain industry, as well as the commercialisation of new technologies. Since patents are a way to protect the commercialisation of new technology, firms often file patents close to the market launch of the related products. For this reason, patent activity and commercialisation activity, including success in export, are often interlinked.

Similarly, the presence of a regional cluster in an industry is also included as a further variable explaining the trade performance at the regional-industry level. It is assumed that the presence of an industrial cluster may stimulate the trade performance. Thus, clusters of related and supporting industries enable regional firms to realise higher productivity levels (Porter, 1990, 1998; Delago et al., 2012). This is because regional specialisation stimulates high levels of local or regional competition that is, in turn, crucial for high regional performance (Porter and Sakakibara, 2004; Carlin et al., 2004). Furthermore, the vitality of competition affects the entry of new firms, the exit of underperforming old firms and the performance of existing firms (Bloom and van Reenen, 2007; Bloom, 2012). Moreover, a regional cluster in a single or in multiple industries and the related concentration of economic activities in space may lead to lower costs and higher productivity of firms. It also provides beneficial conditions for knowledge spillover, labour supply and shared inputs (the so-called Marshall-Arrow-Romer (MAR) externalities) (Porter, 1998; Delgado et al., 2012).

Along with the industry-specific variables, a number of region-specific variables are included in the estimation model. These include structural and geographical characteristics, economic indicators, regional innovation capacity indicators and regional institutional characteristics.

Structural characteristics include the regional population density, geographic peculiarities such as a border or seaside location and, closely related, the regional accessibility. Following the urban systems approach (e.g. Henderson, 1974 and 1982) or the New Economic Geography (NEG) (e.g. Krugman, 1991; Krugman and Venables, 1990, 1993), it is plausible to assume that agglomerations should reveal a better trade performance, given the concentration of economic activities and human capital in these regions. Besides the size usually associated with densely populated areas, interaction possibilities and spillover effects are also reflected by population density. Additionally, the presence of business services clusters within a region is included in the model. Business services clusters may facilitate access to new markets as well as enabling technological, organisational and other changes which help the firms to adapt to highly competitive international markets. It is thus an indicator for the functional specialisation of a region focusing upon knowledge-intensive and strategically important tasks such as R&D, design, marketing or distribution (Duranton and Puga, 2005). As is also the case for manufacturing industry clusters, information on business services clusters is gained from the EU Cluster Observatory.

Table 3.1 / Explanatory variables

Variable	Measures	Data Source
Regional knowledge base/innovation capacity		
Industry-specific patent intensity	Number of Patents filed in a certain industry in a given year per 1,000 inhabitants (log.). See Schmoch et al. (2003) for the industry-specific assignment of patents.	OECD RegPat
Technological and non-technological innovations reported by SMEs	Normalised indicator for innovating SMEs as a share on all SMEs. Two types of innovation are distinguished: Technological innovations Non-technological innovations	EU Regional Innovation Scoreboard
Business expenditure on R&D (BERD)	BERD related to GDP (log.). Annual data partially estimated through linear interpolation.	Eurostat Regional Database
Higher education expenditure on R&D (HERD)	HERD related to GDP (log.) Annual data partially estimated through linear interpolation.	Eurostat Regional Database
Share of 30 to 34-year olds with tertiary education	Share of 30 to 34-year olds with tertiary education (ISCED97 5 and 6).	Eurostat Regional Database
Regional economic characteristics		
GDP per capita	Gross domestic product (GDP) at current market prices divided by total population (in 1,000s)	Eurostat Regional Data Base
Population Density	Total Population (as on January, 1st) divided by the size of the region.	Eurostat, Regional Database
Industry-specific clusters	Variable indicating the size of an industrial cluster within a certain region, yearly values from 0 to 3. The average over the whole time span was calculated in order to overcome missing information in single years.	European Cluster Observatory
Business Services Clusters	Binary Variables indicating the presence of relevant services clusters in a given region. The service sectors include: business services, distribution, education and knowledge creation, financial services and transportation and logistics. Constant averages (see ‘Clusters’).	European Cluster Observatory
Regional institutional characteristics		
ERDF innovation	Regional ERDF Funding (2007-2012) devoted to research and innovation, share of priority 1 on total funding	DG Regio (raw data downloaded on 12/11/2014 from http://ec.europa.eu/regional_policy/index.cfm/de/policy/evaluations/data-for-research/), own estimations (e.g. assignement of funding information only available at NUTS 1 level.)
Institutional Quality	Quality of Government Index 2010 (log.)	Charron et al. (2014)
Accessibility and borders		
Accessibility	Composite index including regional endowment with road, railroad and airports.	ESPON
Border Region	Dummy variable indicating whether a region is located at the national border.	Own reseach
Sea Border	Dummy variable indicating whether a region is located at the sea.	Own reseach

Source: Own compilation by NIW.

Along with these structural factors, the regional knowledge base as well as knowledge spillovers between regional actors is relevant for a region's economic performance (Romer, 1986; Lucas, 1988). According to the New Economic Growth model, these factors stimulate innovation and, in turn, economic growth by generating MAR-externalities. According to Duranton and Puga (2014) these externalities arise by learning through regional knowledge spillovers, and by matching employment qualifications with industrial needs. The variables that are used as general proxies for these characteristics are regional R&D expenditures by businesses (BERD) and higher education institutions (HERD), as well as the share of the total population with tertiary education among the 30 to 34-year-old, reflecting the renewal of high-skilled labour supply within a region. In contrast to the classic economic growth model, these variables are conceived as endogenous factors of the particular region. The regional research infrastructure (as measured by HERD) is also crucial for the economic prosperity of a region. According to the Regional Innovation System (RIS) approach, the regional research infrastructure is the building block of the regional knowledge generation subsystem which stimulates regional innovativeness (Cooke, 2001; Asheim and Gertler, 2005). The R&D expenditures attributed to universities and research institutions are a good indicator for the regional endowment with research infrastructure.

In recent years, the political and institutional setting defining the context in which economic activities take place, has also been recognised as a potential driver of regional economic performance (Rodriguez-Pose, 2013). Institutional quality is a multi-dimensional concept, comprising aspects such as the rule of law, protection of property rights, the quality of government and the level of corruption, which are seen as precondition of economic prosperity. Even though these aspects are subject to national or supranational law, defining national or EU standards, variation among EU regions exists as indicated by the Quality of Government Index (Charron et al., 2014). Given its multi-dimensional nature, institutional quality is frequently measured by an index comprising different quality dimensions (Charron et al., 2014).

Along with these contextual factors, public support programmes can also play a relevant role for the region's international competitiveness. Particular policies supporting research and development are seen as preconditions for regional growth (Fagerberg, 1988; Czarnitzki and Lopes-Bento, 2013). Here, the allocation of ERDF funding along thematic priorities provides a rough approximation of the focus of public support for economic growth policies in the respective region. Complementary to the innovation system approach, the share of funding devoted to research and innovation is calculated and included in the empirical model.

The region's endowment with physical infrastructure may also play an important role for explaining variations in international trade performances. Thus, in several of the more recent regional economic development theories, physical infrastructure, including roads, railroads, waterways and airports, is an important asset, as it determines the cost of trade between different regions (Thissen, 2005; Bröcker et al., 2010). In this study, the regional endowment with physical infrastructure, is measured by the aggregated accessibility indicator, comprising the endowment with roads, railroads and airports. A further aspect related to transportation costs is the sheer geographic location of a region. As Brühlhart et al. (2004) point out, bordering regions located at the EU's external border might engage more strongly in international trade. Therefore, marginality and accessibility are also included as control variables in the empirical model.

3.3. DESCRIPTIVE STATISTICS

Before trade specialisation is analysed as a dependent variable of different regional and industry-specific characteristics, some descriptive evidence is provided on the distribution of these characteristics over the European regions which constitute the sample. The main distinction is between regions of different income and development levels, i.e. the structural funds categories (1) 'less developed regions', (2) 'transition regions', and (3) 'more developed regions'. Firstly, results for RXA and RCA (gross exports)[4] are presented. Secondly, the two variables which are available at the industry-region level, i.e. patent intensity and cluster rating, are described for each of the 22 industries and comparing the three structural funds categories. Thirdly, the distribution of the (solely) region-specific variables is presented. In order to provide information for the commonly most recent point of time, the descriptive data analysis refers to 2011.

For a comprehensive picture, the distribution of the single data points is shown as box plots which depict the middle half of the sample (the values between the 25%- and the 75%-quartile) within a box. The full range is covered by vertical lines, and, in extreme cases of outliers, single dots. The intermediate horizontal line presents the median, i.e. the observation value which half of the sample exceeds while the other half is below. From this information, one can get a first idea of whether the distribution is broad (large box) or concentrated (small box) or whether the distribution is skewed to the left (median is nearer to the first quartile) or to the right (nearer to the third quartile). In order to facilitate the description of the results, the interpretation aims at summarising at the level of the three major industry sectors (low-technology, medium-low, high/medium-high, see chapter 2).

3.3.1. RXA and RCA

RXA values are defined as the relative deviation of the regional export share of an industry from the share that this industry holds within world manufacturing exports. Higher regional shares exceed the zero threshold, lower shares are negative. Since the denominator not only contains EU exports it is possible that in some industries which are typically the comparative advantage of non-EU countries, RXA values are mostly smaller than zero in the majority of EU regions. This is especially the case in many low-technology industries such as textiles, wearing apparel, leather, wood, refined petroleum products, and furniture. Only in few industries (tobacco, wearing apparel, wood), at least the majority of less developed EU regions exhibits positive export specialisation. Among the low-technology sectors only food manufacturing is a particular export strength for a substantial number of regions although the RXA values are distributed quite broadly. In contrast, specialisation in the medium-low-technology sector does not vary markedly between EU regions, yet it is mostly positive. The region types (by structural funds categories) are not distinctive either (see Figure A 1 in the appendix).

In the high-technology sector, EU regions are specialised below average in the manufacture of office machinery and computers, television and communication equipment, as well as medical, precision and optical instruments, i.e. in these industries, the main body of the box plots is below zero (Figure A 1). Regarding the manufacture of chemicals, machinery and transport equipment other than motor vehicles, often half of the transition regions and the more developed regions are globally important exporting

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[4] The results for trade-in-value-added RXA are available upon request. They are not presented here due to the differing industry classification of 14 industries. The additional presentation of trade specialisation, patent intensity and cluster ratings at this level in a comprehensible manner would go beyond the scope of this report.

regions. Finally, in each structural funds category nearly half the regions are specialised in exports of the manufacture of motor vehicles.

The Revealed Comparative Advantage (RCA) indicator, which considers both the export share and import share of a region in an industry, shows an even more distinctive pattern. Less developed regions often yield high RCA values with respect to tobacco, wood and furniture, while for most industries the regional RCA in the two other structural funds types is far below zero. The only exception is publishing etc. where regional RCA values are quite evenly distributed around zero. In the medium-low- as well as the high/medium-high-technology sector the median region often shows an RCA value near zero. As stated before, most regions also exhibit a comparative trade disadvantage in office machinery and computers, television and communication equipment, and medical, precision and optical instruments (Figure A 2).

3.3.2. Industry-specific characteristics: patent intensity and cluster rating

Patent intensity is measured as patents in the corresponding industry related to total regional population (10,000s). In less developed regions, in nearly every industry the number of patents per 10,000 inhabitants is almost zero. In more developed regions, it is only the manufacture of tobacco products in which patent intensity is also very low. The highest median values are found in the manufacture of machinery and equipment (5.2), followed by chemicals and chemical products (including pharmaceuticals) as well as medical, precision and optical instruments (2.8 each), and by television and communication equipment (1.7). All other industries show median values of less than 1. However, the differences between more developed and other region types are marked (Figure A 3).

Cluster ratings range from 0 to 3 and are averaged over the whole time span for each region. The picture of their distribution is particularly polarised in the sense that, except as concerns the manufacture of food products, transition regions are not notably represented in the regional distribution. Interestingly, while clusters in the low-technology sector are almost exclusively found in less developed regions (except for the manufacture of furniture etc.), there are several industries in the medium-low as well as in the high/medium-high sectors which have similarly distributed and on average high cluster ratings in less developed regions and more developed regions alike. The respective industries are the manufacture of metals, fabricated metal products, machinery and equipment, and electrical machinery and apparatus. By way of contrast, the manufacture of motor vehicles shows a higher number of clusters in less developed regions than in more developed regions. Finally, some industries from different sectors only have a small number of clusters, such as tobacco, publishing, rubber and plastic products, and transport equipment other than motor vehicles (Figure A 4).

These elaborations show that both indicators have an unambiguous regional distribution and no general conclusion can be drawn. However, while patent intensity is clearly biased towards more developed regions, cluster structures also play a role for less developed regions. Transition regions do not show any particularities with respect to both industry-specific characteristics.

3.3.3. Region-specific characteristics

The region-specific characteristics are considered to be industry-unspecific in the sense that they are potentially beneficial to any industry in a region. Two aspects, however, cannot be disentangled from the data. Firstly, the data contain no information on the extent to which the regional characteristics are oriented towards the exporting industries, e.g. whether regional business (BERD) or higher education expenditures on R&D (HERD) are focused on the industries in question, whether the education expansion develops in favour of their required occupations or whether accessibility is not only beneficial to individual traffic but also for the modes necessary to deliver the specific goods produced. Secondly, causal interpretations of the estimated effects are hindered by self-selection, i.e. it is not clear whether the creation of high R&D activities, skilled labour supply etc. favoured the development from non-specialised locations to specialised locations or whether existing leading firms decided to (re-) locate sites and activities to these regions.

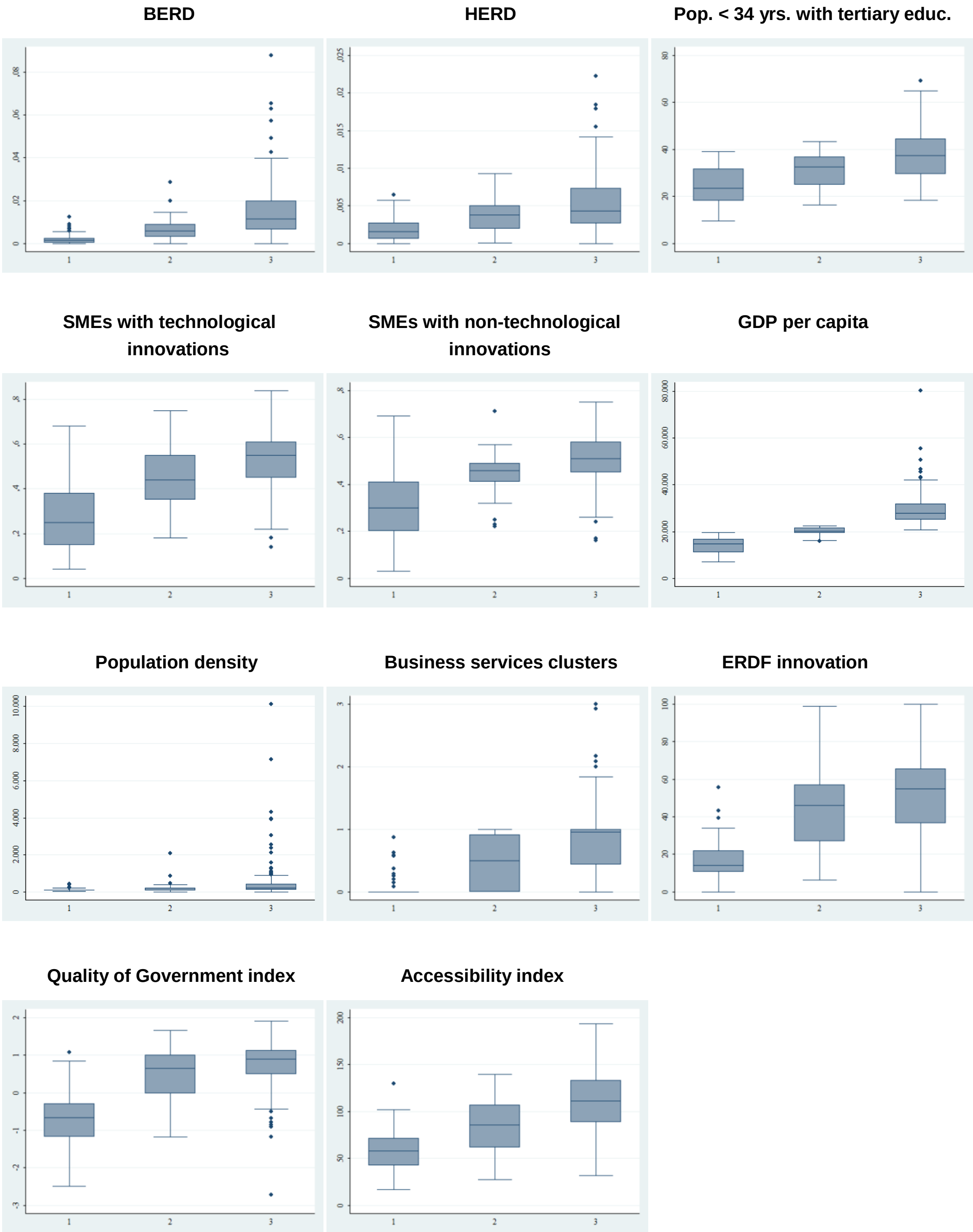
Comparing business and higher education expenditures on R&D, the two show a similar distribution between and within region types: R&D efforts increase along with the level of development (Figure 3.1). The major differences between the two types of actors are, first, that BERD is generally higher, second, the regional variation, which is much lower, and third, the increase from transition to more developed regions is more pronounced than compared to BERD. The share of innovating SMEs is distributed more broadly within the region types. In contrast to the distribution of R&D intensities, both, the shares of SMEs with both technological and non-technological innovations are of similar size – between 20% and 60% from the first quartile in the less developed regions to the third quartile in the more developed regions – and the slope with respect to the state of development is steeper than it is the case for BERD and HERD. The similarity between R&D intensities and the shares of innovating SMEs is that the distribution of less developed regions is well below that of transition and more developed regions which are partially overlapping – at least regarding the lower half of more developed regions. Concerning the supply of young talents, which is expressed by the share of the 30- to 34-year-olds holding a tertiary degree, the median values ranges from 24% in the less developed regions to 38% in the more developed ones. The educational expansion is thus more pronounced in regions with higher income levels.

Regarding the set of economic characteristics[5], GDP per capita is distributed over the region types as could be expected from its constituting role for the definition. As can be seen from the box plots, there are more outliers in the upper part of the distribution than in the lower part. This pattern is even more pronounced regarding population density, which often follows an exponential distribution that shapes the whole picture: thus the vast majority of regions are hard to distinguish when the total range of population density with its meaningful outliers is displayed. Therefore it has to be reported that while the median values of less developed and transition regions are of similar size (93 vs. 99 persons per km²), the difference between the upper quartiles is quite larger (123 vs. 205). The figures for more developed regions, however, are more than twice that size (median: 211, 75%-quantile: 425). Business services are a particular feature of agglomerations that can make a difference in terms of a region's functional specialisation (Duranton and Puga, 2005). Like the industry clusters, business services clusters are measured on a scale from 0 to 3 which has been developed by the European Cluster Observatory. Their distribution, however, concentrates on the range from 0 to 1. The differences between the region

5 Due to their industry-specific dimension, the distribution of clusters – which are also regarded as an economic characteristic –is described in the previous section.

categories are very pronounced: Firstly, there are only few less developed regions with non-zero values (even the third quartile amounts to zero). Secondly, the range of transition regions covers the span between 0 and 1 evenly. Thirdly, half of the more developed regions have business services cluster ratings near 1 or larger, only the lowest quarter has ratings from 0 to 0.5.

Figure 3.1 / Distribution of regional variables by structural funds category (box plots), 2011



Source: NIW/wiiw calculations.

The policy variables deal with the innovation focus of regional policy (measured by the respective share of investments within the ERDF) and, more generally, the quality of government index by Charron et al. (2014). With respect to innovation policy, most less developed regions devote not more than 20% of their ERDF funding to innovation policy instruments, while the median values of transition and more developed regions are more than twice that size (46% and 55%, respectively). Interestingly, there is a similar distribution of the quality of government index: more than three quarter of the less developed regions yields negative values but most of the transition and more developed regions are between 0 and 1, each with a further quarter of their regions between 1 and 2.

Finally, the accessibility index from the ESPON project shows that, although the range of accessibility index values increases along with the regional income level and state of development, also the main bodies of the distribution achieve higher values than in the case of the regions with lower income levels.

The above box plots altogether show that there is a strong relationship between regional income levels and other regional characteristics which potentially determine trade specialisation and competitiveness. Moreover, it is intuitive that there are also correlations between different variables. For example, the last results for the accessibility index are probably related to population density since both are characteristics of urbanised regions. Another possibility is that large universities both promote HERD and shares of tertiary education among the younger population. However, as is also visible, there are different patterns of distribution between regions, even of the same income level. Therefore, all variables will also be included in the empirical model.

3.4. ESTIMATION RESULTS

This section, first, reports the industry-specific results of regressing the RXA of each industry on the characteristics presented above. Gross exports are preferred to the TiVA data that have the limitation of a smaller number of industries to be distinguished (14 instead of 22) (see section 2.4.1). An advantage of taking RXA as opposed to RCA is the more intuitive interpretation in terms of export specialisation rather than also considering imports to be affected by the explanatory variables. In a second step, however, additionally to RXA based on gross exports, also RXA based on TiVA data and RCA are considered as alternative dependent variables for the purpose of robustness checks.

The analysis is based on a panel of partially aggregated manufacturing industries (NACE Rev. 1.1, 2-digit codes 15 to 36) at the NUTS 2 level in 21 EU Member States[6] for the years 2000 to 2011. Overall, 22 (gross exports) respective 14 (TiVA) single industries are distinguished (see sections 2.2 and 2.4.1). The observation period is sufficiently large for assessing trends and developments in regional trade competitiveness. The analysis also considers subgroups of regions with similar income levels in order to assess possible determinants of differences in trade specialisation between regions of a similar state of development. Here, regions are clustered along their structural funds categories which provide a suitable and also policy-oriented distinction.

6 As regional export and import data are not available for Croatia, the two Croatian NUTS 2 regions are not included in the dataset. Furthermore, small countries constituting their own NUTS 2 region (LT, LV, EE, LU, MT, CY) were excluded for two reasons. First, their inclusion would imply comparing sub-national entities in some countries with national entities in others, although the policy-making process at the sub-national level follows a different logic (and especially political competencies) than it does at the national level. Second, some explanatory variables (particularly those on clusters) are constructed differently.

One important empirical feature to be kept in mind is that regional variables cannot exhibit effects of a certain direction in all of the industries. By definition, the construction of the dependent variable (export specialisation) implies an inverse relationship between RXA values of different industries in the same region. Since export specialisation in one industry is related to relatively lower specialisation in other industries, a positive correlation between a regional explanatory variable and a high RXA value in one industry translates into a negative correlation of this regional variable with RXA values in other industries. The larger the positive effect of one regional characteristic in one or few industries, the more it is likely that in other industries negative effects occur. The two variables patent intensity and industrial cluster are not affected because of their exclusively industry-specific dimension.

Given the time series structure of our data, econometric panel analyses are conducted to control for unobserved heterogeneity of the regional characteristics. Since some of the regional characteristics do not vary over time, the random effects model (RE) is chosen. The econometric baseline model is an RE regression model with RXA values at the regional-industry level for the years 2000 to 2011 as the dependent variable. Results for subgroups, i.e. structural fund categories, are reported in the case study context in chapter 4 in order to confront the qualitative findings with typical requirements found for similar regions. Referring to Wooldridge (2002: 251ff.), the regression formula in the case of estimating the determinants of industry- and region-specific RXAs can be written as:

$$RXA_{i,r,t} = \beta_1 PAT_{i,r,t} + \beta_2 CLU_{i,r} + \boldsymbol{\beta X}_{r,t} + \boldsymbol{\beta Z}_r + v_{i,r,t}.$$

The varying combination of indices shows that the right-hand side variables are of different dimensions. While only patent intensity $PAT_{i,r,t}$ is available for each point of time and regional industry, cluster rating is constant over time $CLU_{i,r}$. Most of the variables described above are only available at the regional level and more or less time-variant ($\boldsymbol{X}_{r,t}$). Regional indicators which do not change over time (such as for marginality) are written as $\boldsymbol{Z}_r$. Finally, the composite error $v_{i,r,t}$ comprises the unobserved effect of the industry-region and an idiosyncratic error.

3.4.1. Industry-specific results

In the following analysis, firstly, industries are pooled in three major sectors (i. e. high-, medium-low-, high/medium-high-technology-intensive industries). In order to go into more detail, the regressions are run for each industry separately. The results are summarised to the extent possible. An in-depth discussion of individual industries is provided together with the case studies in the light of the qualitative results. When discussing the results, three sets of indicators are distinguished according to the above-mentioned classification:

- characteristics representing the regional-industrial technological knowledge base (industrial patent intensity, BERD, HERD, young talents, innovation behaviour of SMEs);
- structural regional characteristics (e. g. GDP per capita, population density, cluster availability);
- institutional characteristics (share of ERDF funding in research and innovation, quality of government, accessibility).

Low-technology sector

In the low-technology sector effects concerning the regional-industrial technological knowledge base mainly emanate from patent intensity and technologically innovating SMEs (Table 3.2). Regarding the individual industries, however, significant effects of both variables are found only in some cases. At least the sign of the coefficient estimates shows more or less in the same direction. The main exception is an even significantly negative coefficient for patents in the tobacco industry (Table 3.2: 16).[7]

In the low-technology sector in general, but also in some individual industries a significantly negative effect of BERD is found. This results stems from the fact that BERD inversely exhibits strong positive effects in other sectors (see the following section). If regions which have high BERD values are specialised in medium-high/high-technology industries, their specialisation in other sectors is inevitably lower, which in turn induces a negative correlation between BERD and low-technology sectors. Similarly, this result occurs if regions which are specialised in low-technology sectors have rather low BERD. Therefore, one has to be careful in interpreting these – at a first sight implausible – effects since they are potentially caused by otherwise directed effects in sectors of a different technology level.

Other noteworthy effects that are found only in few industries are positive effects of a young high-skilled labour force in the manufacture of pulp and paper products (21) as well as in the publishing, printing and reproduction of recorded media (22). In contrast, regions that are specialised in textile (17) or furniture exports (36) are characterised by lower shares of tertiary educated among the 30- to 34-year-olds. These two industries, together with the leather industry also show significantly negative correlations with GDP per capita. Presumably, the cost advantage of producing in low-income regions is of special relevance in these industries.

As another important regional economic characteristic, population density is found to be a beneficial factor for textiles (17) and wearing apparel (18) while specialisation in products made of wood etc. (20) is rather a case for sparsely populated areas. Clusters of same-industry agglomeration, instead, are of great importance to almost any of the low-technology industries except for food (15) and tobacco (16) products. Business services clusters, in contrast, are a less important feature of regions which are specialised in low-technology sectors. Again, in these two aforementioned industries but also in the manufacture of wood (20), this structural focus on headquarter functions, consulting etc. is below average in the corresponding regions. Similarly, exactly these three industries prove to be less focused on innovation measures in their regional policy design although there is no general effect regarding the sector as a whole (Table 3.2).

The variable on governmental quality also exhibits significant effects for certain industries. Moreover, there is a noticeable heterogeneity expressed by positive effects in the food (15), tobacco (16) and pulp and paper industries (21) on the one hand and strongly negative effects in the manufacture of textiles (17), wearing apparel (18) and leather (19) on the other hand.

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[7] Since there are no technology fields linked to NACE industry 22 'publishing etc.', the patent intensity has to be neglected in this case.

Table 3.2 / Regression of RXA in the low-technology sector

RXA (gross exports)	L	15	16	17	18	19	20	21	22	36
(log) patent intensity	3.376 *	2.646	-70.633 *	6.402	9.556	27.153	20.384 *	1.033	-	-1.293
(log) techn. innov., SMEs	14.736 **	25.315 *	33.579	27.861 **	6.287	-25.277	6.271	2.972	59.111 ***	9.994
(log) non-techn. innov, SMEs	5.666	-8.331	-42.240	7.527	13.836	19.697	23.315	11.886	-8.051	0.921
tertiary educ. < 35 yrs.	0.056	0.039	0.787	-1.103 ***	0.049	0.308	-0.590	0.561 ***	0.471 *	-0.585 *
(log) HERD	1.314	3.133	31.255 ***	1.525	-9.127 *	-7.710	5.343 *	-2.625	3.063	-3.924 *
(log) BERD	-3.780 **	-3.766 **	8.689	-9.059 ***	-9.683 *	5.711	-4.404	0.415	-3.069	-10.238 ***
GDP per capita	-0.001 ***	0.000	0.004 ***	-0.001 **	-0.001	-0.006 ***	0.000	0.000	-0.001	-0.001 *
(log) population density	4.998	-2.618	8.681	12.071 **	33.280 ***	-0.596	-33.800 ***	7.156	-1.450	-0.107
cluster	66.902 ***	6.954	32.056	41.453 ***	77.373 ***	138.388 ***	46.975 ***	56.477 ***	27.212 *	46.526 ***
business services	-14.361 ***	-25.296 ***	-87.228 ***	-5.542	-11.197	0.804	-33.984 **	9.485	4.525	6.995
ERDF innovation	-0.049	-0.579 ***	-1.059 **	0.281	0.209	0.683	-0.530 *	-0.345	0.190	0.280
(log) quality of governm.	-1.780	12.846 *	38.397 *	-28.937 ***	-19.340 **	-34.600 **	-2.776	13.064 *	1.009	-9.742
accessibility index	-0.033	-0.174	-0.972 *	-0.077	-0.614 **	0.893 *	-0.163	0.195	0.424 **	0.179
R^2 within	0.003	0.003	0.147	0.065	0.029	0.026	0.004	0.012	0.007	0.049
R^2 between	0.136	0.289	0.059	0.407	0.417	0.299	0.532	0.254	0.500	0.182
R^2 overall	0.120	0.235	0.067	0.352	0.353	0.240	0.454	0.221	0.419	0.194
No. of observations	25,015	2,800	2,654	2,800	2,800	2,763	2,800	2,799	2,799	2,800
No. of clusters	2,242	250	242	250	250	250	250	250	250	250

Note: * p<0.1, ** p<0.05, *** p<0.01. Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

Finally, accessibility is no major characteristic of regions that are specialised in low-technology industries. This generally results from two significantly positive effects in the leather (19) and publishing (22) industries which contrast the negative effects found in the tobacco (16) and wearing apparel (18) industries.

Medium-low-technology sector

Locations with specialisation advantages in medium-low-technology exports show very different characteristics (Table 3.3). This not only leads to the lowest goodness-of-fit (indicated by the comparatively low R^2 values) compared to the other two sectors but also to ambiguous interpretations. The only significant effects for the sector as a whole are found for the two industry-specific variables, patent intensity and cluster, and the policy-related variables concerning the innovation focus of regional policy and governmental quality (Table 3.3).

Table 3.3 / Regression of RXA in the medium-low-technology sector

RXA (gross exports)	ML	23	25	26	27	28
(log) patent intensity	7.077 ***	-16.922	0.047	3.649	1.609	-0.969
(log) techn. innov., SMEs	13.286	-33.158	19.981 *	50.277 ***	22.440 **	26.216 ***
(log) non-techn. innov, SMEs	-2.141	13.595	-4.045	-11.094	-22.611 *	4.218
tertiary educ. < 35 yrs.	-0.320	1.458	-0.635 **	-1.119 ***	-0.515 ***	-0.757 ***
(log) HERD	0.667	0.539	5.522	-1.282	-4.535 **	4.851 ***
(log) BERD	4.293	28.289 **	5.983 *	-4.464	-0.345	-2.619 *
GDP per capita	-0.001	-0.001	0.000	-0.002 **	-0.001 ***	0.000
(log) population density	8.037	57.189 ***	-11.109 **	-13.268 **	-0.487	-2.243
cluster	38.339 ***	100.951 ***	21.391 ***	1.631	12.731 **	21.990 ***
business services	-8.453	5.909	-19.719 **	-11.192	1.885	-18.363 ***
ERDF innovation	-0.580 ***	-2.071 ***	-0.052	-0.152	-0.092	-0.073
(log) quality of governm.	-11.213 *	-8.333	-15.389 ***	-28.378 ***	-2.641	-7.611 *
accessibility index	-0.019	0.151	0.184	0.093	-0.201	-0.275 **
R^2 within	0.001	0.008	0.015	0.046	0.073	0.033
R^2 between	0.074	0.283	0.138	0.315	0.171	0.424
R^2 overall	0.068	0.186	0.115	0.243	0.139	0.386
No. of observations	13,950	2,750	2,800	2,800	2,800	2,800
No. of clusters	1,248	248	250	250	250	250

Note: * p<0.1, ** p<0.05, *** p<0.01. Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

Regarding the regional-industrial knowledge base the generally positive effect of patent intensity cannot be ascribed to certain industries due to missing effects at that level.[8] The opposite structure of effects is found for the share of technologically innovative SMEs, which is highly relevant to four of the five industries (except for the manufacture of coke, refined petroleum products and nuclear fuel (23)). In the same way educational expansion, which also shows no effect for the sector, is found to be largely below average again in these four industries. The effects of R&D intensities, in turn, are unevenly distributed across industries. For both kinds of actors, business and HEIs, there are in each case few positive and negative effects of varying significance.

[8] This is due to fact that the three industries with positive signs of patent intensity slightly exceed the significance levels while the two industries with negative signs have too high standard errors of the corresponding coefficient estimate to compensate for the positive tendency of the three others.

From a regional economic point of view, GDP per capita has a tendency to be negatively correlated with trade specialisation in medium-low-technology sectors. Significant effects in this direction are found for the manufacture of other non-metallic mineral products (26) and basic metals (25), indicating that locations of these two industries benefit from cost advantages. In terms of agglomeration, the picture is mixed again. While the initially reported positive clustering effect is only missing in the manufacture of other non-metallic mineral products (26), population density is mostly found to be positively correlated, though of different significance. The exception where trade specialisation is more frequently observed in densely populated areas is the manufacture of coke, refined petroleum products and nuclear fuel (23).

The policy-related variables are the most unambiguous determinants of trade specialisation in the medium-low-technology sectors, though not in a positive sense: specialised locations are more frequently found in regions with a less ambitious innovation focus and lower governmental quality (Table 3.3).

Finally, the sign for the control variable for accessibility is not significant as it is also the case for most corresponding industries with different directions. At least trade specialisation in the manufacture of fabricated metal products, except machinery and equipment (28) is significantly related to accessibility, with the negative sign indicating that locations which are specialised in this industry are less accessible than the average region.

High/medium-high technology sector

The results for the high/medium-high-technology sector show a clear pattern of innovation-oriented locational requirements while the economic characteristics are less of a special feature of the regions being specialised in these industries.

First of all, patent intensity is significantly positive correlated with RXA in most of the industries. This is especially the case for the manufacture of office machinery and computers (30), manufacture of electrical machinery and apparatus n.e.c. (31) and manufacture of other transport equipment (35). But also chemicals and chemical products (24) and radio, television and communication equipment and apparatus (32) at least have a positive, yet not significant, sign (Table 3.4). Similarly, R&D efforts, and this concerns both kinds of actors, HEIs and businesses, are higher in regions with a specialisation in high/medium-high-technology industries. Regarding HERD, any of the industries is on average more specialised in regions with higher R&D expenditures from HEIs. Only three out of eight industries lack significant coefficient estimates. Business expenditures on R&D also tend to be higher in specialised regions, though significantly only in three industries. In contrast to these figures, innovative capacity provided by SMEs is on average lower. The only exception are locations specialised in exporting other transport equipment (35), which have on average a higher share of SMEs with non-technological innovations. The overall much lower weight of innovative SMEs is presumably due to the fact that smaller firms play less of a role in these industries. The same holds for the importance of patent intensity and BERD since these activities are predominantly conducted by larger firms.

Table 3.4 / Regression of RXA in the high/medium-high-technology sector

RXA (gross exports)	MHH	24	29	30	31	32	33	34	35
(log) patent intensity	0.557 **	0.306	-0.066	1.376 ***	2.809 ***	0.142	-0.070	-0.699	11.141 ***
(log) techn. innov., SMEs	-26.133 ***	-18.206	8.621	-23.853	-32.045 ***	-32.954 **	-32.252 ***	-15.365	-71.962 ***
(log) non-techn. innov, SMEs	-12.052 *	-14.674	-17.662 *	-20.984	-5.744	-37.413 *	-10.329	-8.432	39.389 ***
tertiary educ. < 35 yrs.	-0.134	0.816 ***	-0.287	-0.282	-0.660 ***	-1.595 ***	0.253	0.289	0.445 *
(log) HERD	9.605 ***	0.767	8.140 *	17.693 ***	3.406	15.152 ***	7.268 **	15.255 ***	2.456
(log) BERD	3.689 **	-0.666	0.039	2.867	8.203 *	16.467 ***	5.694 *	-1.687	0.148
GDP per capita	0.000	-0.002 ***	0.000	0.000	0.000	0.001	0.000	0.000	-0.002 ***
(log) population density	-2.760	4.353	-9.884 **	1.827	4.824	-2.163	-11.833 *	-7.907	15.876 **
cluster	47.484 ***	50.225 ***	32.625 ***	9.338	46.407 ***	26.107 **	22.107 **	48.705 ***	42.158 ***
business services	1.720	16.498 **	3.823	2.460	0.409	8.008	18.416 ***	-15.138	4.770
ERDF innovation	0.147	0.202	0.655 ***	-0.210	0.126	-0.352	0.535 ***	-0.151	0.544 **
(log) quality of governm.	20.903 ***	15.208 **	-2.210	44.922 ***	5.584	28.330 ***	27.184 ***	26.288 **	26.588 **
accessibility index	0.487 ***	1.026 ***	0.375 *	0.646 *	-0.063	-0.171	0.834 ***	0.858 **	-0.018
R^2 within	0.013	0.013	0.018	0.039	0.013	0.054	0.036	0.043	0.017
R^2 between	0.217	0.461	0.336	0.302	0.306	0.160	0.589	0.228	0.218
R^2 overall	0.167	0.368	0.263	0.234	0.233	0.107	0.546	0.190	0.187
No. of observations	22,398	2,798	2,800	2,800	2,800	2,800	2,800	2,800	2,800
No. of clusters	2,000	250	250	250	250	250	250	250	250

Note: * $p<0.1$, ** $p<0.05$, *** $p<0.01$.Control variables bordering and seaside location.
Source: NIW/wiiw calculations.

Except for the indicator of prevalent clusters, which is throughout all industries (other than office machinery and computers (30)) unambiguously positively related to export specialisation, the other economic characteristics show no clear distributional pattern. In two cases, manufacture of chemicals and chemical products (24) and manufacture of other transport equipment (35), GDP per capita is on average lower in specialised industries indicating that also in these high-tech industries cost advantages can play a decisive role. Furthermore, only locations which are specialised in exports of other transport equipment (35) are more densely populated, especially as compared to regions specialised in machinery and equipment n.e.c. (29) and medical, precision and optical instruments, watches and clocks (33). Business services clusters tend to be higher rated in most specialised locations of the high/medium-high-technology sector. Although there is no significance of this characteristic found at the sector level, at least chemicals and chemical products (24) and again medical, precision and optical instruments, watches and clocks (33) exhibit significant coefficient estimates.

The policy-oriented indicators consistently have positive coefficient estimates on regional export specialisation except for the manufacture of motor vehicles, trailers and semi-trailers (34) for both variables and for the manufacture of office machinery and computers (30) as well as manufacture of radio, television and communication equipment and apparatus (32) regarding the innovation focus of ERDF implementation in specialised regions.

In contrast to the two sectors with lower technology intensity, accessibility is found to be a highly significant feature of most high/medium-high-technology industries. The few cases with negative, yet not significant, effects are the manufacture of electrical machinery and apparatus n.e.c. (31), manufacture of radio, television and communication equipment and apparatus (32) and manufacture of other transport equipment (35).

3.4.2. Robustness checks

In order to check the robustness of the preceding results, in a first step the regression analyses for three aggregate sectors are conducted for two other independent variables, i.e. the RCA based on gross exports and the RXA (TiVA) considering trade in value added (robustness check I). The second investigation of robustness is the exclusion of two potentially problematic variables. The first is GDP per capita, which is expected to be inherently and largely correlated with other regressors. The second crucial variable – which is possibly too similarly constructed as compared to the dependent variable – is the cluster rating. Finally, regressions are run by sub-samples, i.e. structural fund categories (robustness check III).

In contrast to the industry-specific results, here only the perspective of major sectors (pooled disaggregated industries) is taken (Table 3.5). Generally, the coefficient estimates do not differ markedly, especially when comparing the results by major sector, significance and size are quite similar. Some coefficients turn significant when using RCA (gross exports/imports) in contrast to RXA (gross exports). The overall goodness-of-fit, however, is slightly lower, especially the explanatory power regarding the variation between regions. Concerning the TiVA-RXA, there are also only some changes of the significance but not in the sign of already significant coefficients.

Table 3.5 / OLS regression of different dependent variables and datasets

RXA (gross exports)	Total	L	ML	MHH
(log) patent intensity	1.364 ***	3.376 *	7.077 ***	0.557 **
(log) techn. innov., SMEs	0.088	14.736 **	13.286	-26.133 ***
(log) non-techn. innov, SMEs	-3.133	5.666	-2.141	-12.052 *
tertiary educ. < 35 yrs.	-0.096	0.056	-0.320	-0.134
(log) HERD	3.971 ***	1.314	0.667	9.605 ***
(log) BERD	0.913	-3.780 **	4.293	3.689 **
GDP per capita	-0.001 ***	-0.001 ***	-0.001	0.000
(log) population density	3.486	4.998	8.037	-2.760
cluster	57.182 ***	66.902 ***	38.339 ***	47.484 ***
business services	-7.860 **	-14.361 ***	-8.453	1.720
ERDF innovation	-0.098	-0.049	-0.580 ***	0.147
(log) quality of governm.	4.430 *	-1.780	-11.213 *	20.903 ***
accessibility index	0.135	-0.033	-0.019	0.487 ***
R^2 within	0.001	0.003	0.001	0.013
R^2 between	0.096	0.136	0.074	0.217
R^2 overall	0.083	0.120	0.068	0.167
No. of observations	61,363	25,015	13,950	22,398
No. of clusters	5,490	2,242	1,248	2,000

RCA (gross exports)	Total	L	ML	MHH
(log) patent intensity	1.504 ***	2.791	6.046 ***	0.514 **
(log) techn. innov., SMEs	4.377	16.879 ***	27.450 **	-25.772 ***
(log) non-techn. innov, SMEs	-10.836 **	-8.852	-4.679	-14.857 **
tertiary educ. < 35 yrs.	-0.330 ***	-0.508 ***	-0.380	-0.108
(log) HERD	4.650 ***	3.112	3.404	7.395 ***
(log) BERD	0.883	-4.662 ***	5.792 *	3.774 ***
GDP per capita	-0.001 ***	-0.001 ***	-0.001	0.000
(log) population density	2.711	0.875	10.857 **	-1.041
cluster	40.204 ***	50.536 ***	27.404 ***	29.145 ***
business services	-5.465 *	-14.437 ***	-0.661	3.578
ERDF innovation	-0.171 **	-0.270 **	-0.538 ***	0.173 **
(log) quality of governm.	3.513	2.728	-14.211 **	16.040 ***
accessibility index	0.190 **	0.197	-0.128	0.432 ***
R^2 within	0.003	0.009	0.002	0.011
R^2 between	0.062	0.096	0.060	0.191
R^2 overall	0.053	0.087	0.050	0.134
No. of observations	61,363	25,015	13,950	22,398
No. of clusters	5,490	2,242	1,248	2,000

RXA (TiVA)	Total	L	ML	MHH
(log) patent intensity	0.662 ***	3.988 **	2.388 **	0.219
(log) techn. innov., SMEs	4.927	5.103	19.448 **	-12.772 **
(log) non-techn. innov, SMEs	-2.201	5.776	-5.674	-6.090
tertiary educ. < 35 yrs.	0.071	-0.034	0.104	0.209 *
(log) HERD	-0.175	-1.638	-1.915	3.943 ***
(log) BERD	-1.979 **	-6.233 ***	-0.083	2.174 *
GDP per capita	0.000	0.000	0.000	0.000
(log) population density	1.816	6.020 *	-3.961	0.951
cluster	56.818 ***	80.618 ***	24.782 ***	58.971 ***
business services	-5.670 **	-6.194	-12.687 **	1.431
ERDF innovation	-0.050	-0.042	-0.338 **	0.179 *
(log) quality of governm.	1.992	5.220	-10.863 **	13.083 ***
accessibility index	-0.107	-0.322 ***	-0.002	0.193 *
R^2 within	0.000	0.005	0.000	0.008
R^2 between	0.155	0.280	0.102	0.278
R^2 overall	0.142	0.256	0.089	0.231
No. of observations	37,057	15,821	10,142	11,094
No. of clusters	3,460	1,490	975	995

Note: * $p<0.1$, ** $p<0.05$, *** $p<0.01$. Control variables for accessibility, bordering and seaside location, Technology level: L=low, ML=medium-low, MHH= medium-high/high.
Source: NIW/wiiw calculations.

The second robustness check concerns the inclusion of GDP per capita and cluster rating (Table 3.6). The idea behind this variation of the model specification is that, firstly, GDP per capita indicates a region’s general state of development and thus leads to biased estimates for other variables which are directly or indirectly related to this. Secondly, since specialisation in terms of employment is one of the categories on which the cluster rating is based, this variable might be highly correlated with trade specialisation just by construction and without any economic meaning.

In the course of the exclusion of GDP per capita, the variable for tertiary education of young people gains significance, similarly when considering all industries but also for the medium-low and the high/medium-high-technology sectors. This is possibly due to the fact that the educational expansion in poorer, less developed regions (and of course countries) in the EU is still in progress. Put otherwise, the cost advantage, i. e. the negative coefficient estimate of GDP per capita on RXA, is related to low skill levels – not only among the young but also the remaining working-age population. Besides the skill supply variable there is a loss of significance of the coefficient for patent intensity, but from an already low (10%) level. The coefficient estimates of the remaining variables, however, are largely unaffected by the exclusion of GDP per capita.

Concerning the relevance of the cluster rating for the model, its omission leads to several smaller variations in the coefficient estimates of some variables. Firstly, in the high/medium-high-technology sector, the business services variable now shows a very significant positive sign. The consequence is that also for the whole sample of industries the coefficient is no longer significantly negative. Secondly, and again in the high/medium-high-technology sector, the coefficient on the share of innovation-related ERDF funding turns slightly significant. Thirdly, increasing significance is found for the negative coefficients on governmental quality in the medium-low- as well as in the low-technology sectors. Thus, the estimate for the whole sample of industries is now insignificant. Finally, accessibility now achieves a slightly significant estimate. To sum up the implications of omitting the cluster variable, especially estimates for the policy-related variables as well as some structural indicators such as the presence of business services clusters and accessibility are affected. This would not be the case if the cluster variable was just similarly constructed as the dependent variable. In contrast, the implications for the estimated effects of other variables indicate that real economic relations are considered when including the cluster variable.

The third robustness check is not for methodological purposes only but is also of interest as to content. Again, the reference results are those for RXA (gross exports) (Table 3.5). The first sub-sample is the category of less developed regions. Here the most marked difference compared to the full sample is the lack of significance for patent intensity. As the descriptive evidence suggests, this is probably due to lower variation. Significance also disappears concerning business services, quality of government (except the MHH sector) and GDP per capita. The latter variable even turns out to be significantly positive with respect to RXA values in the MHH sector. In contrast to that, within this group of regions those with higher shares of high-skilled among the young working-age population now exhibit significantly higher trade specialisation. These changes indicate that, within this group of regions with similar cost advantages, those with slightly better structural characteristics are favoured, especially in industries of higher technology intensity.

Table 3.6 / Robustness check II: omission of variables

Omitted variable: GDP per capita

RXA (gross exports)	Total	L	ML	MHH
(log) patent intensity	1.245 ***	2.598	6.485 ***	0.516 **
(log) techn. innov., SMEs	-1.274	12.711 **	11.834	-26.560 ***
(log) non-techn. innov, SMEs	-5.267	2.397	-4.334	-12.851 *
tertiary educ. < 35 yrs.	-0.277 ***	-0.216	-0.511 **	-0.195 *
(log) HERD	3.574 ***	0.721	0.261	9.500 ***
(log) BERD	0.790	-3.965 **	4.200	3.627 **
(log) population density	2.895	4.160	7.428	-3.131
cluster	56.928 ***	66.401 ***	38.243 ***	47.379 ***
business services	-9.368 ***	-16.656 ***	-10.154	1.258
ERDF innovation	-0.101	-0.054	-0.582 ***	0.146
(log) quality of governm.	4.656 *	-1.473	-10.949 *	20.947 ***
accessibility index	0.116	-0.065	-0.038	0.486 ***
R^2 within	0.001	0.001	0.001	0.013
R^2 between	0.094	0.138	0.071	0.215
R^2 overall	0.081	0.120	0.065	0.165
No. of observations	61,363	25,015	13,950	22,398
No. of clusters	5,490	2,242	1,248	2,000

Omitted variable: Cluster

RXA (gross exports)	Total	L	ML	MHH
(log) patent intensity	1.886 ***	4.993 **	7.749 ***	0.891 ***
(log) techn. innov., SMEs	-1.444	16.933 **	11.140	-29.719 ***
(log) non-techn. innov, SMEs	-1.684	1.731	3.079	-9.569
tertiary educ. < 35 yrs.	-0.131	0.014	-0.361	-0.150
(log) HERD	3.893 ***	1.057	0.528	9.682 ***
(log) BERD	1.368	-3.234 *	4.747	3.975 ***
GDP per capita	-0.001 ***	-0.001 ***	-0.001	0.000
(log) population density	2.536	4.661	8.027	-4.612
business services	-4.155	-13.107 **	-8.497	9.288 **
ERDF innovation	-0.079	-0.041	-0.559 **	0.166 *
(log) quality of governm.	-0.689	-10.518 **	-14.344 **	18.640 ***
accessibility index	0.149 *	-0.098	-0.008	0.561 ***
R^2 within	0.001	0.002	0.001	0.013
R^2 between	0.016	0.029	0.043	0.157
R^2 overall	0.012	0.027	0.038	0.110
No. of observations	61,363	25,015	13,950	22,398
No. of clusters	5,490	2,242	1,248	2,000

Note: * p<0.1, ** p<0.05, *** p<0.01. Control variables for bordering and seaside location, Technology level: L=low, ML=medium-low, MHH= medium-high / high.
Source: NIW/wiiw calculations.

In the group of transition regions, some deviations from the full sample are also in need of explanation. First of all, in some sectors significance of patent intensity and the share of SMEs with technological innovations diminishes as is the case for HERD regarding the whole set of sectors. BERD, however, is now significanctly positive related to trade specialisation, although still on a low (10%) level. Similary to the set of variables on the knowledge base and innovation focus of a region, also the variables on the economic structure are less distinct than in the full sample of regions, i. e. significance is especially reduced for GDP per capita, business services, and the share of innovation measures within ERDF funding.[9] The interpretation of these deviations again refers to the lower variation within this group as the distribution of characteristics in the descriptive analysis shows.

[9] However, this does not imply that the model is less suitable. At least the R^2 is slightly higher than for the full sample.

Table 3.7 / Robustness check III: sub-samples of regions (structural fund categories)

Less developed regions

RXA (gross exports)	sf1 total	sf1 / L	sf1 / ML	sf1 / MHH
(log) patent intensity	3.299	-18.708	-14.920	-4.835
(log) techn. innov., SMEs	1.484	28.744 ***	28.876	-47.238 ***
(log) non-techn. innov, SMEs	-2.784	-14.239	11.087	6.330
tertiary educ. < 35 yrs.	0.538 **	0.327	0.944 *	0.552
(log) HERD	4.404 **	4.786	-1.295	7.070 ***
(log) BERD	-1.245	-5.391 **	5.977	-0.741
GDP per capita	0.000	-0.003 ***	-0.001	0.005 ***
(log) population density	-1.916	4.881	-17.433	9.263
cluster	66.188 ***	65.295 ***	29.759 ***	69.569 ***
business services	-16.053	-38.318	0.754	-3.011
ERDF innovation	0.459	0.543	-0.645	1.017 *
(log) quality of governm.	-1.464	-12.541	-20.957	24.082 ***
accessibility index	0.354	-0.203	0.431	0.868 ***
R^2 within	0.009	0.007	0.007	0.082
R^2 between	0.153	0.249	0.054	0.226
R^2 overall	0.134	0.201	0.052	0.196
No. of observations	14,768	6,036	3,342	5,390
No. of clusters	1,320	540	300	480

Transition regions

RXA (gross exports)	sf2 total	sf2 / L	sf2 / ML	sf2 / MHH
(log) patent intensity	3.447 ***	7.818	8.728 ***	1.442
(log) techn. innov., SMEs	-0.834	-1.749	13.954	-9.840
(log) non-techn. innov, SMEs	-62.977 ***	-15.163	-124.586 **	-80.345 ***
tertiary educ. < 35 yrs.	-0.774 ***	-0.133	-1.531 *	-1.028 ***
(log) HERD	3.458	0.667	0.120	8.889 **
(log) BERD	4.440 *	1.172	5.992	7.265 **
GDP per capita	-0.001	-0.003 *	-0.001	0.001
(log) population density	-5.250	-1.502	-1.675	-11.749 **
cluster	64.887 ***	59.728 **	55.633 **	56.769 ***
business services	9.049	-4.598	-24.393	44.756 ***
ERDF innovation	-0.129	0.040	-0.741	0.076
(log) quality of governm.	21.719 ***	2.251	-1.523	58.046 ***
accessibility index	0.437	-0.158	0.993	0.766 **
R^2 within	0.006	0.005	0.008	0.019
R^2 between	0.077	0.053	0.071	0.406
R^2 overall	0.055	0.061	0.068	0.253
No. of observations	10,842	4,429	2,461	3,952
No. of clusters	1,033	423	234	376

More developed regions

RXA (gross exports)	sf3 total	sf3 / L	sf3 / ML	sf3 / MHH
(log) patent intensity	1.518 ***	2.862	9.212 ***	0.833 ***
(log) techn. innov., SMEs	-3.525	8.357	-4.204	-19.311 **
(log) non-techn. innov, SMEs	13.489	49.574 ***	-15.734	-9.931
tertiary educ. < 35 yrs.	-0.126	0.185	-0.307	-0.359 ***
(log) HERD	-0.629	-1.179	-0.390	0.443
(log) BERD	-2.568	-6.447 **	-3.619	1.128
GDP per capita	-0.001 ***	-0.001 **	-0.001	0.000 *
(log) population density	5.912 *	8.385 *	12.052 *	-3.823
cluster	51.972 ***	71.961 ***	41.802 ***	38.793 ***
business services	-5.348	-18.215 ***	-1.834	10.219 **
ERDF innovation	-0.046	-0.145	-0.370	0.262 **
(log) quality of governm.	4.691	-2.484	-3.360	20.140 ***
accessibility index	0.050	-0.251	-0.035	0.561 ***
R^2 within	0.002	0.002	0.001	0.010
R^2 between	0.097	0.133	0.110	0.186
R^2 overall	0.083	0.107	0.088	0.148
No. of observations	35,753	14,550	8,147	13,056
No. of clusters	3,137	1,279	714	1,144

Note: * p<0.1, ** p<0.05, *** p<0.01. Control variables for bordering and seaside location, Technology level: L=low, ML=medium-low, MHH= medium-high / high.
Source: NIW/wiiw calculations.

Within the group of the more developed regions, fewer changes are found than for the two other structural fund categories. Regarding the total of industries, only HERD and quality of government lose significance while population density is now significantly positively related to trade specialisation. The latter two cases of deviation from the full sample concern changes of a merely 10% significance threshold and thus are of lower importance. Interestingly, it is found that in the low-technology sector of more developed regions the share of SMEs with non-technological innovations as well as as population density turn out to be significantly positive. In contrast, the beneficial effects in the high/medium-high-technology sector emanating from regional HERD and BERD diminish while business services (positive) and the share of tertiary educated 30- to 34 year olds (negative) now show significant coefficient estimates.

To sum up the region type specific analysis, it is found that many effects disappear when regarding variation within groups of a similar stage of development. Generally, most of the effects are related to this difference, i. e. the characteristics are positively correlated with region income levels. Moreover, inter-sectoral differences are also prevalent. It is thus of special interest to what extent these inter-regional and inter-sectoral differences are explained on a more detailed level of analysis as it is the goal of the case studies.

3.5. SUMMARY

In summary, measurements at the single industry level, represented by patent intensity and cluster structures, are mostly positively correlated with high RXA values. This result is in line with the empirical literature and is an important evaluation of the data created since innovation and (other) productivity enhancing factors such as patents and clusters should be strongly related to competitiveness. Concerning the explanation of different specialisation patterns, especially clusters prove to play a decisive role if similar regions (in terms of income levels) are compared. The distribution of patents, however, is too much concentrated on more developed regions – regardless of the specific industry – to be of relevance for explaining variation within the same region (structural funds) category.

Secondly, effects of regional characteristics which are not industry-specific but attributable to the whole regional economy are not homogeneous across manufacturing industries. Innovation behaviour of SMEs only affects low- and medium-low-technology industries. Presumably, this effect stems from the higher weight of SMEs in these industries (making the indicator more industry-specific). High-technology industries, in contrast, are supposed to be rather located in diverse regions and more heavily rely on larger firms than low-technology industries.

Thirdly, and in a similar vein, export specialisation in medium-high-/high-technology industries is associated with above-average business R&D efforts which are supposed to be shaped by large firms. Since these industries are defined by high R&D expenditures, among other things, it is not surprising that a higher BERD intensity on the regional level is correlated with above-average export shares of these industries. As a further actor in the innovation system, local institutions of higher education (HEI) are considered which also contribute more to high- and medium-high-technology industries than to other industries.

Finally, with regard to variables showing a comprehensive pattern, governmental quality exhibits positive effects mainly in medium-high/high-technology industries and, in two cases, also in low-technology industry. This feature is expected to favour the advanced developed regions in particular. A similar pattern is found for accessibility, which hardly plays a role for low- and medium-low-technology industries.

The results suggest that competitive high-technology industries rely on other regional features than most low- and medium-low-technology industries. Without having analysed the effects of regional characteristics on *changes* in the specialisation pattern, a cautious conclusion could be that a structural shift from competitive low-technology to competitive high-technology exports is less likely – since it would require to alternate its whole structure – than starting from non-competitive low-technology locations. This structural difference is expressed by the varying emphasis of the innovation system. Although own R&D efforts as measured by patents as a throughput indicator are effective in nearly every industry, it becomes clear that, on the one hand, competitiveness in low- and medium-low-technology industries is linked to innovative SMEs, with innovations not necessarily being linked to industry-specific R&D. On the other hand, medium-high/high-technology industries rely on high business R&D investments, which are more common for large companies. The only characteristic which has an unambiguously robust and positive effect on specialisation of medium-high/high-technology industries is quality of government, which proves to be an unconditional prerequisite.

Instead of aiming at changes in a region’s industrial structure, it is therefore recommended to strengthen the endogenous potential. The role played by SMEs has been shown for low- and medium-low-technology sectors. Innovation policy measures should not only focus on technological projects and capabilities but also on business strategies of a non-technological nature (e.g. design, marketing, distribution). At first glance, exploiting cost advantages, also via the attraction of foreign direct investment, seems to be a reasonable strategy for low-income regions, but it has to be considered as well that within the less developed regions tertiary education and HEIs play a non-negligible role.

4. Case studies

4.1. CASE SELECTION

So far, our analysis has focused on a large-N design that allows identifying the *extent* to which certain variables are correlated with the competitiveness of regions. However, this design and technique does not explain *how* these effects occur. In order to investigate the emergence and interplay of determinants for international competitiveness at the regional level, ten case studies of selected European regions are conducted. Their aim is to identify regional characteristics that explain the exceptional industrial performance of the industries, expressed by their high RXA or RCA values. Given their idiosyncratic nature, these factors vary across regions. Therefore, it is not feasible to include them in the quantitative regression models. These regional factors encompass, for instance, the quality and focus of regional universities, clusters, historical events causing path dependencies, and other factors related to the idiosyncratic regional setting. To obtain background information on these factors, additional documents and information sources are analysed. Additional data sources that are explored in the course of the case studies include, for instance, the Regional Innovation Monitor Plus (RIM Plus), which describes the innovation systems in selected European regions.[10] The case studies further emphasise the performance implications of local, regional and – if applicable – national policy instruments aiming at fostering R&I investments and cluster creation. The goal is to descriptively trace the implications of specific policies and assess the extent to which policy interventions contribute to the regional trade specialisation and trade performance.

The case studies focus on best practice examples, i.e. regions that fulfil a number of selection criteria reflecting their exceptional performance in international trade. The selection follows a two-step data-driven explorative approach: In the first stage, three selection criteria are applied that target the performance of regions in international trade. These include the *durability*, the *variety*, and the *relevance* of trade specialisation. In the second stage, regions that meet these selection criteria are grouped along their *settlement structure* and their *structural funds* category in order to obtain variation in main economic and geographical characteristics. The rationale of these selection criteria is described in detail below. The selection is limited to regions in EU Member States with at least two NUTS 2 regions. This ensures that the case studies cover only countries in which intra-national variation and thus impacts of regional policies such as smart specialisation or similar strategies can be observed. Therefore, regions in Cyprus, Estonia, Latvia, Lithuania, Luxemburg, and Malta are a priori excluded from the sample.

Durability is defined as the property of regions that reveal above-average RCAs in a given industry throughout a substantial period of time (i.e. from 2000 to 2011). RCAs for the respective regions and industries are calculated based on national import and export data derived from the UN Comtrade Database. The durability selection criterion ensures that only regions whose trade specialisation (RCA) is permanently above-average (i.e. above the 75%-quantile in a given industry in each year from 2000 to 2011) are taken into account. Regions whose trade performance is volatile and only above-average in

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[10] See European Commission (2015a – k).

some years are not taken into consideration, as these individual peaks may not be explained by any structural characteristics, but reflect short-termed increases that are mainly driven by individual firms.

Variety is defined as the property of regions in which at least three industries exhibit high RCAs throughout the period 2000 to 2011. This aims at capturing regions with a wider industry mix, which is a proxy for better resilience against industry-specific shocks.[11] Furthermore, the criterion increases the likelihood of selecting regions which are dominated by SMEs and, hence, do not depend on one large company which shapes a monostructural regional trade specialisation. The industries considered here are restricted to 22 manufacturing sectors (i.e. product groups 15-36, according to the statistical classification of products by activity (CPA) 2002). Service industries are not considered.

Finally, *relevance* requires that the total export volume of the regional industries fulfilling the durability and variety criteria belongs to the upper half of EU regions in each year from 2000 to 2011. This ensures that the selected regions reveal substantial export volumes in the industries under consideration when taking the EU average as a reference point. Furthermore, this criterion potentially excludes cases where high RCA values only result from variation in small absolute numbers. Table 4.1 describes how the three selection criteria are operationalised.

Table 4.1 / Selection criteria for case study regions

Selection criteria	Operationalisation
Durability	RCAs for the respective regions and industries have continuously been above the 75%-quantile in each year from 2000 to 2011.
Variety	Region shows RCAs that have continuously been above the 75%-quantile between 2000 and 2011 in at least 3 industries.
Relevance	In each of the three (or more) industries with permanent above-average RCAs, the absolute export volume has continuously been above the EU average exports between 2000 and 2011.

Source: NIW compilation.

Applying these selection criteria, we get 34 regions. In Table 4.2, these regions (non-italic) are grouped according to their structural funds eligibility category for the funding period 2014-2020 as indicated by the EC (2014/99/EU). These eligibility categories reflect the economic performance. Regions are defined either as less developed regions (GDP below 75% of EU average), transition regions (GDP between 75% and 90% of EU average) or more developed regions (GDP above 90% of EU average). Furthermore, a distinction is made between rural regions, urban regions and agglomeration centres, following the classification of NUTS 2 regions outlined by the German Institute for Research on Building, Urban Affairs and Spatial Development (BBSR). This classification contains three settlement types, namely agglomeration regions, urban regions and rural regions, which are defined by the size of the largest regional centre and the population density. Agglomeration regions are characterised by a regional centre with at least 300,000 inhabitants and a population density above 150 inhabitants per km². Urban regions either reveal a population density above 150 inhabitants per km², but no regional centre above 300,000 inhabitants, or a population density between 100 and 150 inhabitants per km² and a regional centre with more than 300,000 inhabitants. In contrast, rural regions are characterised by a

11 If sectors belong to the same value chain, shocks can propagate through all of them. This possibility cannot be taken into account by the Variety property. The lack of regional IO tables makes it very hard to use more precise indicators.

population density below 100 inhabitants per km² (BBSR, 2014). The idea behind the additional differentiation of regions by their population density results from the necessity to differentiate regional policy approaches as well as the scope and opportunities to influence economic competitiveness. Dense areas, for instance, typically exhibit a more diverse industry structure as well as a broader base for knowledge spillover and innovation (Rosenthal and Strange, 2004; Head and Mayer, 2004). In contrast, rural areas often rely on a limited number of industries and are more often subject to path dependencies, while in agglomeration regions, the industrial development is more dynamic and evolutionary.

Table 4.2 / List of potential case study regions

Advanced developed regions (regional GDP > 90% of EU average; structural fund 3)			
	Agglomeration regions	Urban regions	Rural regions
	DE12 Karlsruhe **DE25 Mittelfranken** DE30 Berlin DK01 Hovedstaden FR10 Ile de France ITC1 Piemonte ITC4 Lombardia ITH5 Emilia-Romagna ITI4 Lazio NL32 Noord-Holland NL33 Zuid-Holland SE11 Stockholm	BE24 Prov. Vlaams-Brabant DE14 Tübingen DE24 Oberfranken DEF0 Schleswig-Holstein ITH3 Veneto ITH4 Friuli-Venezia Giulia IT13 Marche **NL21 Overijssel** **UKJ1 Berkshire. Buckinghamshire** **Oxfordshire** UKJ3Hamphire. Isle of Wight	DK04 Midtjylland FI18 Etelä-Suomi SE21 Småland med öarna **SE22 Sydsverige** SE31Norra Mellansverige
Transition regions (regional GDP > 75% and < 90% of EU average)			
	Agglomeration regions	Urban regions	Rural regions
	DED2 Dresden	**DED4 Chemnitz** *ITF1 Abruzzo*	***ES42 Castilla-La Mancha***
Less developed regions (regional GDP < 75% of EU average)			
	Agglomeration Regions	Urban Regions	Rural Regions
SF1	ITF3 Campania **ITF4 Puglia** ITG1 Sicilia	**PT11 Norte** *CZ04 Severozápad* *CZ07 Stredni Morava* *PL61 Kujawsko-Pomorskie*	PT16 Centro RO 12 Centru ***CZ03 Jihozápad*** *HU21 Közép-Dunántúl* ***HU22 Nyugat- Dunántúl*** *HU23 Dél--Dunántúl* *HU31 Észak-Alföld*

Source: NIW compilation.

Table 4.2 illustrates the grouping of regions which fulfil the trade criteria outlined above along their structural fund classification (i.e. economic performance) and settlement structure. Not surprisingly, the vast majority of regions that meet the selection criteria are classified as advanced developed regions following the EC structural fund eligibility category. In contrast, only seven regions classified as less developed or in transition meet the three performance criteria outlined above. The distribution along the settlement structure is quite balanced. Hence, one can find region types that exhibit a strong international trade specialisation among all three settlement types, i.e. agglomeration regions, urban regions and rural regions. This applies to both advanced regions and less developed regions. The sole transition region is Chemnitz, which is an urban region. Less developed regions that show an above-average trade competitiveness despite their below-average economic performance include, for instance, Puglia, Sicilia or Campania in Italy, Note and Centro in Portugal, or Centru in Romania. These regions are certainly interesting examples of specialised regions that are worth assessing in an in-depth case study.

However, there is only a small number of less developed regions, particularly from Eastern Europe, which limits the choice for our case studies. To enlarge the sample and facilitate case selection, the criteria outlined above are relaxed to identify regions with a solid international trade specialisation that are yet not above the EU average. We select regions in which the total export volume in a given industry exceeds the average within the respective group of less developed or transition regions. Furthermore, the regional RCA in a given industry only has to be in the 75%-quantile of all regions within the same structural fund category in every year of the period analysed (2000-2011). Similarly, the variety criterion (i.e. number of regional industries with an above-average export volume and regional-industrial RCA in the 75%-quantile) only refers to the distribution in the respective structural fund category. The additional transition and less developed regions that fulfil the relaxed selection criteria are indicated in italic letters in Table 4.2. In the transition regions, along with the German region of Chemnitz (DED4), three other regions fulfil these relaxed selection criteria. Among the less developed regions, along with the six regions identified before, eight further regions are identified.

Out of this list of potential case study regions, ten regions are selected for an in-depth analysis (indicated in bold letters). The selection considers both advanced regions and less developed as well as transition regions. Furthermore, the selection seeks to yield an even representation of agglomeration centres, urban regions and rural regions. Finally, we consider the national variation within the final list of case studies and choose regions from a variety of different countries, including the new Member States, as well as large and small Northern and Southern European countries.

Overall, it is important to note that the choice of regions is not perfectly determined by the selection criteria, and alternative considerations would be possible. Yet the case selection process described above provides a reasonable selection strategy.

4.2. MAIN RESULTS OF THE CASE STUDIES

In this chapter, ten European regions have been selected for an in-depth analysis of regional factors potentially enhancing the regional trade specialisation in certain industries. All ten case studies focus on regions that reveal above-average export volumes and above-average revealed comparative advantages in at least three industries over the years 2000 to 2011. Yet those industries vary considerably across regions, and trade advantages in some industries do not unconditionally translate into economic growth and prosperity. This is especially the case for regions that realise trade advantages in low-tech industries such as textiles, clothes, furniture or wood. As these industries, mainly competing on price, are currently shrinking in the EU, a trade advantage does not lead to a better economic performance. In contrast, it is mostly linked with above-average (high) employment reduction.

Regarding the specific trade specialisation patterns, the results of the case studies confirm the findings of the descriptive analysis. Hence, they show that the economically advanced European regions (i.e. regions with an above-average GDP) are frequently specialised in high-tech industries, whereas the less developed EU regions are frequently specialised in labour-intensive, low-tech industries. Furthermore, results suggest that trade specialisation patterns are highly path-dependent and do not significantly change over time. More specifically, the results of the case studies show that the industrial history is a decisive factor and greatly determines the current trade specialisation patterns of European regions.

With respect to the region and industry-specific factors that potentially enhance regional trade, the results of the case studies show that it is not possible to identify single factors explaining the above-average trade specialisation across all regions and all industries. Instead, the extent to which a regional characteristic constitutes a relevant factor for explaining differences in RXAs across regions and industries largely depends on the regional economic performance, and on the industries in which a region realises an export advantage. Thus, the findings of the case studies are in line with the results of the descriptive and multivariate analysis outlined in Chapters 3 and 4, while being also more focused on the individual region type. They clearly show that the trade performance is region- and industry-specific. Whether a regional factor such as the regional R&D expenditures or the share of innovating SMEs affects the international competitiveness depends on the industry a particular region is specialised in, as well as on the level of regional economic development. More precisely, the in-depth analysis of selected regions has shown that in more advanced EU regions focusing on high-tech industries, the regional endowment with private R&D expenditures, high-skilled human capital and advanced universities and research institutes plays a more important role than in regions specialised in low-tech industries, where low labour costs and natural resources are relevant factors, fostering trade specialisation.

Drawing on these findings, the case studies identify three groups of regions that share similar characteristics with respect to both the industries in which they reveal an above-average trade specialisation, and the regional characteristics potentially affecting the trade specialisation patterns:

1. Advanced developed regions (such as Berkshire, Buckinghamshire, Oxfordshire; Middle Franconia; Overijssel; Sydsverige) that are predominantly specialised in high-tech industries. In these regions, universities are key actors, and dense business services clusters are present and seem to be decisive factors for regional growth. Furthermore, the regions are characterised by geographical proximity to metropolitan centres, further enhancing the regional economic performance. Some of these regions which are primarily specialised in high-tech industries (e.g. Middle Franconia or Sydsverige) also reveal trade specialisation in low-tech industries. The latter, however, are of decreasing importance or have undergone a transformation specialising on the most innovative edges on these low-tech industries. The textile industry in Overijssel, for instance, increasingly specialises on technological textiles. (Regional) policies in these regions should – and do – primarily focus on further developing the regional research infrastructure and on strengthening its agile SMEs. Leading companies are identified to some extent but regional economies and innovations systems do not substantially depend on them. In contrast, they increasingly benefit from the local innovation potential and knowledge-oriented structural change. Future perspectives in these regions are thus positive.
2. Less developed and transition regions (such as Castile–La Mancha, Norte, Puglia) that are locked in their specialisation on labour-intensive, low-tech industries such as the textile and clothing industry, leather industry or furniture industry. Existing comparative advantages in these regions rely on long industrial traditions. However, the growing price competition on international markets arising from newly developing countries is a permanent challenge. Thus, the regions under

consideration would probably benefit from refining their industrial composition in favour of business services and functional specialisation on higher-value activities such as design, marketing and management. Approaches aiming at diversifying the industry structures suffer from low critical masses of regional R&D activities – in businesses as well as in public institutions – and a lack of attractiveness for FDI. Furthermore, the regions seem to suffer from a brain-drain of the young and high-skilled.

3. Old-industrial regions from the former Eastern bloc, including East Germany (Chemnitz, Jihozápad, West Transdanubia) that are specialised in high-tech industries as well as in medium- and low-tech industries. In contrast to the less developed regions of the EU-15, these regions succeeded in attracting significant FDI and establishing large production clusters with several multinational leading companies. Especially Chemnitz succeeded in restructuring its outdated industries and production sites and created conditions for increasing integration into a rich regional innovation system. Skilled labour supply, however, is a crucial factor which might impede further development unless successfully tackled. The two Eastern European regions in the Czech Republic and Hungary, respectively, face the challenge of transforming their initial cost and fiscal advantages into knowledge-based foundations for the regional economy.

Translated into the political context, the results reveal that it is not possible to proclaim a *one-size-fits-all* regional growth strategy. Instead, policy recommendations should (and do) vary considerably across regions. While the economically advanced regions should focus on further developing the regional research infrastructure and on strengthening agile SMEs, the less developed regions in both the old EU-15 and in Eastern Europe should concentrate primarily on the expansion of the skill level of the regional labour force and the endogenous potential for the foundation of new innovative firms. Furthermore, they should focus on the establishment of business services in order to increase the ties of the regional companies and foster cooperation among regional actors.

5. Conclusions and policy implications

This study has introduced a suitable method to break down national trade data to the regional level. This allows to produce trade indicators at the regional level, in particular revealed export advantages (RXAs) and revealed comparative advantages (RCAs). Identifying the industries in which a region realises a strong trade specialisation plays a twofold role in industrial and regional policy-making. Firstly, identifying successful structures at the industry-region level helps to improve the understanding of micro- and meso-foundations of competitiveness and the scope and cases for policy intervention. Secondly, information on the spatial distribution of competitive industries and required location factors is necessary for gaining differentiated perspectives on future economic development and the choice of policy instruments.

Patterns of regional export specialisation

Descriptive results have shown that high and low-income regions exhibit different trade specialisation patterns. While high-income regions on average tend to be specialised in high-technology-intensive goods, but are less competitive in less technology-intensive goods, low-income regions are specialised in medium-low- and low-technology-intensive goods trade, but show some deficits in the high-technology trade. The medium-income regions are somewhere in between, having slight disadvantages in the high-technology trade, and a more or less balanced specialisation in the medium-low- and low-technology goods trade. Accordingly, the geographic distribution of export advantages in the 'high/medium-high-technology-intensive' goods trade follows a more or less distinct core-periphery pattern in the EU.

When looking at the dynamics, results suggest that large changes in the regions' specialisation patterns over time are relatively rare events. Although the size of revealed export advantages may increase or decrease over time, a complete shift of the revealed specialisation structure, i.e. moving from being specialised in exporting low-technology-intensive goods to being specialised in exporting high- and medium-high-technology goods, is quite unlikely. This implies that the development of specialisation patterns is path-dependent. This is important to know for the development of smart specialisation strategies, because it suggests that their reference point should be the existing strengths of the regions. It also confirms the important role scientific, technological and economic specialisation plays for the development of comparative advantage and regional economic growth as it is also one distinct area for conceptual and policy implications of smart specialisation (OECD, 2013).

Regional determinants

Along with the descriptive analysis, the study also investigated in a multivariate approach which region and industry-specific factors are related to success on international markets. As far as the cross-sectional analysis is interpreted, shifting from competitive low-technology to competitive high-technology exports would also require fundamental changes in other regional characteristics, in particular those concerning the innovation system. Although innovation (measured by patents as a throughput indicator) significantly increases competitiveness in nearly every industry, it becomes clear that the structures of regional innovation systems vary between industries. Competitiveness in low- and medium-low-technology industries is linked to innovative SMEs, although it is not necessarily linked to firm-specific R&D. Instead, non-technological innovations without significant R&D efforts or impulses from other actors, such as HEIs, seem to be similarly important. This illustrates the high relevance of successful cooperation and knowledge transfer between local firms and higher education institutions particularly in those low- and medium-low-technology industries. High-technology industries, in contrast, are often located in larger and diverse regions and their innovation outcomes rely more heavily on the innovation performance of larger firms.

Regional industrial legacies are especially strong in some high-technology industries. The same is true for competitive low-technology industries which are also heavily bound to existing regional characteristics. Conversely, the fewest regional dependencies are found for the manufacture of motor vehicles and other transport equipment as well as for some medium-low-technology industries. However, although competitiveness in these industries is only to a small extent explained by regional characteristics, it is well known that large multinational companies, whose site location is mainly determined by the advantages of the international division of labour, market access conditions and favourable financial conditions (for FDI), are also responsible for regional competitiveness in several cases.

The regional endowment with HEIs is possibly one of the most directly susceptible regional characteristics when it comes to policy implications. However, in order to promote competitiveness in medium-high/high-technology industries, guaranteeing quality of government is likewise important; it probably requires fewer fiscal resources and enables the economy to evolve unaffected by industrial and related planning strategies. Also several other studies conclude that the regions with good governance are generally those which are less likely to require policy assistance (McCann and Ortega-Argilés, 2013; Ederveen et al., 2006). Clustering effects are still visible, which underlines the structural embeddedness of highly competitive industries. However, cluster policies need to provide perspectives on future technological developments, especially in bordering industries, in order to meet the requirements of smart specialisation strategies (S3). In regions with lower political capacities (governmental quality, cluster management) it is suggested first to build up social capital and opportunities for entrepreneurial discovery as a necessary precondition before initiating bottom-up processes such as S3 (European Commission, 2013).

In summary, the results of the multivariate regression analysis show that the impact of both region- and industry-specific factors is not homogeneous across industries and regions. It varies considerably between less developed and advanced regions, as well as between low- and high-tech industries. Any policy implication is therefore a case for place-based approaches.

Case studies

The findings of the case studies are in line with the results of the descriptive and multivariate analysis. The in-depth analysis of selected regions has shown that less developed regions are predominantly specialised in low-tech industries, while the more advanced European regions exhibit above-average export shares in high-tech industries such as the chemical and pharmaceutical or medical industries.

Conclusions are derived for the three types of regions which are represented in the case studies. The advanced developed regions (Berkshire, Buckinghamshire, Oxfordshire; Middle Franconia; Overijssel; Sydsverige) altogether show several distinctive features. Universities are key actors, accompanied by sufficiently present business services and ‘borrowed size’ from proximate metropolitan centres. They host not only high-tech industries but also low-tech industries with high comparative advantages. The latter, however, are of decreasing importance or have successfully transformed themselves and now focus on innovation in niche products. (Regional) policy is further developing the research infrastructure and clearly addresses its agile SMEs. Leading companies are identified to some extent, but regions’ economies and innovation systems do not substantially depend on them. In contrast, they increasingly benefit from the local innovation potential and knowledge-oriented structural change. Future perspectives are thus positive.

Concerning the less developed and transition regions, those considered from the EU-15 (Castile–La Mancha, Norte, Puglia) are somewhat caught in their specialisation. Approaches aiming at diversifying the industry structures suffer from low critical masses and a lack of attractiveness for FDI. Universities have not played a crucial role thus far. Existing comparative advantages rely on long industrial traditions and are found to be driven mainly by innovative SMEs in the region. Price competition on international markets, however, is a permanent challenge, and the regions under consideration would probably benefit from refining their industrial composition in favour of business services and functional specialisation on higher-value activities such as design, marketing and management. This goal is challenged by the problem of competing for skilled labour supply with more central locations.

The transition and less developed regions of Central and Eastern Europe (Chemnitz, Jihozápad, West Transdanubia), in contrast, attracted significant FDI and established large production clusters with several multinational leading companies. Chemnitz in particular succeeded in restructuring its outdated industries and production sites and created conditions for increasing integration into a rich regional innovation system. Skilled labour supply, however, is a crucial factor which might impede further development unless successfully tackled. The two Eastern European regions face the challenge of transforming their initial cost and fiscal advantages into knowledge-based foundations for the regional economy. Besides the development of a strong human capital base, new firm formation and building up coherent regional innovation systems are important pillars for transforming their production orientation into a functional specialisation on highly skilled tasks carried out at the other end of the (global) value chain. Focusing on these goals in order to raise income levels and sustain or expand their industrial competencies in and around the city centres, in the intermediate term, (medium-) skilled workers are the backbone of most manufacturing industries. Therefore, it is necessary to monitor the education system as to whether it provides further opportunities to develop this human capital base on the way to an even more knowledge-intensive production technology. The cases of the two Eastern European regions provide evidence that not just the accumulation of capital, but also structural change, is a driver of economic growth.

Considering this and the above-mentioned result that a radical change in regional specialisation patterns is very rare, it is recommended to strengthen the endogenous potential of regions by encouraging the transformation of economic activities from a structural perspective instead of aiming at radical changes in the industrial structure. In most cases this implies modernising existing industries or enabling lagging sectors to improve their competitiveness, for example through the adoption of General Purpose Technologies (GPT) such as ICT and the specialisation in specific functions or activities along the supply chain (e.g. design, R&D, procurement, operations, marketing, and customer services) (OECD, 2013). Innovation policy measures should thus not only focus on technological projects and capabilities but also on business strategies of a non-technological character. This is particularly relevant for innovative SMEs that play an important role for revealed export specialisation advantages in low- and medium-low-technology industries. Furthermore, HEIs are potentially crucial actors for providing access to GPT applications and organisational strategies, both via collaboration as well as developing the local highly skilled labour supply. If they succeed in creating not just geographical but also cognitive and technological proximity, HEIs are important vehicles for implementing place-based approaches in different transmission channels (European Commission, 2014).

General policy conclusions

Regional strategies should focus on industries or clusters which have growth and innovation potential. The selection of priorities should be made on the basis of already existing strengths or expertise within the region that provide suitable reference points for diversifying regional activities into areas of related expertise. Hence, strategies that help to cross boundaries of related industries, technology fields and activities may help regional economies to diversify into complementary fields. Here, experienced entrepreneurship is a key mechanism through which regional economies can diversify successfully into new industries (spinoffs) (Boschma and Gianelle, 2014). To improve growth opportunities, innovation strategies should also place emphasis on the development of inter-regional cooperation and support firms engaged in inter-regional and international knowledge networks (Charles et al., 2012). Policies promoting labour mobility between related industries may also enhance the recombination potential of regions and increase regional competitiveness and growth. It might also be crucial to stimulate the inflow of skilled labour from other regions and countries, because that brings new ideas and knowledge to the regions (Saxenian, 2006; Boschma and Gianelle, 2014). Existing clusters in particular are challenged to promote these dynamics instead of being evaluated only by static success indicators (European Commission, 2013).

An important point to keep in mind when developing such policies is the geographical or administrative level at which these policies should be conducted. Is it going to be at the European, national or regional level? EU structural and regional policy is peculiar in this respect: it is designed at the European level, yet is flexible enough to be tailored to the regions' needs. S3, being part of EU regional policy, is much more specific as it explicitly targets regional R&D and innovation. It is thus less flexible than general EU regional policy, raising the question of whether it, too, can be tailored to the needs of the 'less developed' regions in particular. The analysis has shown that these regions are mostly specialised in the export of low- and medium-low-technology-intensive products. At the same time, it was found that one source of being successful and competitive in these types of exports is represented by innovative SMEs. These facts provide a direct link to S3. However, one question in this respect is whether S3, by supporting R&D and innovation of SMEs, will pick only the regions' champions, i.e. those firms being able to absorb the funds dedicated to S3, or whether it will also promote the emergence of new firms. The number of eligible firms might be too small, especially in 'less developed' regions, to exhibit significant regional economic effects, despite perhaps spillover and trickle-down effects to other firms in the regions. If the number of such capable leading firms is limited, S3 may also be connected with a clustering strategy. In this respect, and as S3 focuses on R&D, such clustering may not necessarily be defined in terms of geographical proximity, but rather by technological proximity in the sense of creating regional R&D value added chains.

S3 specifically and regional policies in general are also suited to linking up local firms with existing HEIs by encouraging and fostering the exchange of knowledge or joint research efforts. However, these policies might be less suited to promoting non-technical innovations, especially those referring to issues of promotion and marketing, the adoption of new forms of work organisation or even the adoption of existing technologies, which could be a major issue for many firms in ‘less developed regions’. This would be the role of business services. Yet the case study analysis as well as the regression analysis for this type of regions has shown that, firstly, these services are generally less developed in the EU’s peripheral regions and, secondly, only contribute to trade specialisation in high-technology industries. Here, national strategies to develop these services may, for a number of countries, be more appropriate than explicit regional strategies, firstly because it is a country-wide issue, but also because it may require changes in the educational and institutional system which are unlikely to be carried out at the regional level. However, setting up business services firms in economically less developed regions is not the first step in developing a region’s economic structure, but rather an accompanying one if demanding manufacturing firms have successfully been attracted. National strategies are also to be preferred when it comes to raising the educational level of the workforce or the general improvement of HEIs. This is because educational matters are most likely to be subject to national and not regional policy matters.

Trade specialisation patterns are highly path-dependent and do not significantly change over time. More specifically, the results of the case studies show that the industrial history is a decisive factor and greatly determines the current trade specialisation patterns of European regions. Despite these path-dependencies it is found that technological progress spurred the reinvention of traditional industries rooted in the regions. The industries have evolved and adopted new technologies, although these processes were not necessarily induced by policy measures. Although policy can provide the ground for entrepreneurial discovery, as suggested by smart specialisation strategies, there is no broad evidence that similar policies were once responsible for the success stories that are reported in the case studies. The basis of these developments, at least in the CEE regions, was rather high levels of physical investment, mostly conducted by foreign multi-national enterprises. S3 or other regional policies are, because of a lack of funds, unlikely to deliver this. Investing in new areas of production and thus breaking the current pattern of specialisation requires great financial and organisational effort. EU-wide policies (such as the Juncker Plan) or national policies via state involvement in firms, support schemes and institutional arrangements to encourage and increase the level of investment could be much more promising in this respect than S3. However, S3 at least induces politicians to focus their economic and especially innovation-related measures on economic activities that can cut across traditional boundaries. It is their task to provide an environment for firms and HEIs to seek technological and business opportunities. This also requires permanent evaluation of the measures initiated and the formulation of exit strategies in order to avoid adverse (political) lock-in effects (European Commission, 2013).

Some final remarks concern the analytic potential of the data generated. This study provides descriptive evidence for major sectors, multivariate analysis of disaggregated industries and case studies for selected regional configurations. However, these analyses are only a first step in exploring the ways in which the data allow to investigate regional structures and dynamics, thus enabling the drawing of conclusions with respect to policy implications. Depending on industries and regions of interest as well as the availability of more suitable (industry-specific) supplementary information, many more insights can be drawn from the dataset which is expected to be developed and assessed further by the European Commission. Together with the recently published ‘S3 Inter-regional Trade and Competition Tool’ (http://s3platform.jrc.ec.europa.eu/s3-trade-tool), which aims to identify competitors at the regional level, the EC then provides a profound empirical basis to critically reflect the diverse smart specialisation strategies submitted by European regions in the course of the EU Cohesion policy funding period 2014-2020.

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7. Appendix

7.1. METHODOLOGICAL APPENDIX

Regional foreign trade is estimated in two steps: a) the estimation of regional exports and b) the estimation of regional imports. Despite some common features, the methods to estimate exports and imports yield some differences regarding certain details in the methodology, their complexity, their features as well as their extensions. Because of this the description of the methodology is split in two parts, with section 7.1.1 dealing with the estimation of regional exports and section 7.1.2 covering regional imports. The basic idea behind the estimation method, however, as well as the data set used, is the same.

The idea rests on the following line of reasoning: Given that regional foreign trade data are not a priori available, it should be possible to derive reasonable estimates by: a) using foreign trade data at the national level; b) using national supply and use tables to identify the domestic producers and recipients of the traded goods and services; and c) combining this information with suitable data at the regional level to allocate national foreign trade to the individual regions.

It is clear that such estimation relies on a number of more or less restrictive assumptions: although the results of the analysis are expected to be plausible and reasonable, they yet remain an approximation to reality. In turn, though, the proposed methodology potentially might be an improvement to the rare data on regional trade by statistical offices or other institutions which often suffer from certain problems such as capital city and harbour effects.

7.1.1. Regional exports

This section describes the methodology how national export data are broken down to the level of regions. The fundamental idea behind the methodology is that the regions' employment share in total country employment in a certain sector corresponds to the regions' output share in the same sector. As a consequence, this allows allocating the national output in each sector to the individual regions and, since exports are part of the output, they can also be allocated to the regions.

Still there are a couple of restrictions behind this idea that diminish its accuracy. Firstly, it assumes that output per worker, i.e. productivity in each sector, is equal across regions. Secondly, sectors are assumed to produce the same product mix in each region, with the individual products being either identical or close substitutes.

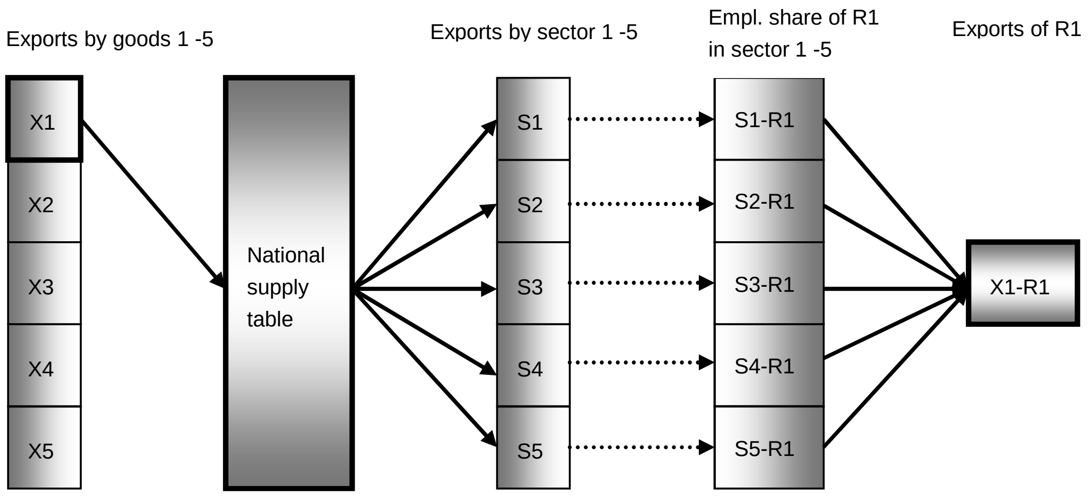
The first restriction can be relaxed to some extent by taking into account differences in regional productivity levels. Below a methodology is proposed how this can be implemented.

The second restriction may be relieved by increasing the level of detail as far as the sectoral breakdown for national output and regional employment is concerned. This approach is, however, restricted by the unavailability of actual output data by sectors and regions. That is, the more disaggregated the output and employment data that are available for analysis, the higher will be the accuracy of the estimates.

Figure 7.1 presents the complete method for estimating regional exports in a non-technical way. It starts on the left, showing actual exports as recorded in the trade statistics. Notably, at this stage exports are recorded by products, yet in order to derive regional exports it is essential to allocate the exported products to the sectors where they are produced first. Hence for each product the national supply matrix is used to calculate the share of each sector in the production of the respective good. (For simplicity reasons, in Figure 7.1 this is shown for good 1 only.) The implicit assumption is that the structure of total production, i.e. production for domestic use and exports, is identical to the production of exports. As a result of this procedure, exports by sectors can be estimated.

In a second step, to regionalise exports, regional employment data by sector are used and, given the assumption that employment is indicative of production, the shares of each region in the respective sectors are derived. Finally this allows estimating the export of each sector by regions.

Figure 7.1 / Regionalisation of national exports scheme



In practice, regional exports are estimated using the national supply table, which schematically is structured as in Table 7.1: The main elements of the supply table that are used for the estimation are the (product by industry) supply matrix S, as well as the domestic output vector (q-m), in the following denoted as qm. The supply table further consists of a vector of imports m, the output vector g and the total supply vector q, which is the sum of (q-m) and m.

Table 7.1 / Supply table

	Industries	**Output**	**Imports**	**Supply**
Products	S	q-m	m	Q
Output	g			

Given this, the transformation matrix (for the estimation of exports) T_x can be derived via:

$$T_x = inv\big(diag(qm)\big) * S \qquad 1)$$

As the individual elements in T_x show each sector's share in the total production of each good, T_x allows allocating actual exports by product to the sectors where they are produced. Total country exports by goods are given in vector form, with the rows corresponding to the individual goods. This vector is denoted *xt*. From this the matrix X is derived:

$$X = diag(xt) * T_x \qquad 2)$$

X is the matrix of exports of products by industries. To regionalise the exports, data on employment by sectors and regions are used. They are structured as illustrated in Table 7.2.

Table 7.2 / Employment

	Regions	**Total**
Industries	E	te

Matrix E simply represents employment by industries and regions, while the vector te represents total (country) employment in each industry.

To allocate country trade flows to the regions the first step is to derive the regions' employment share in each sector: the resulting matrix of regional employment shares is denoted by L:

$$L = inv\big(diag(te)\big) * E \qquad 3)$$

This allows deriving the export matrix by regions and products XR via multiplying the matrix of sector contributions to exports X with L:

$$XR = X * L \qquad 4)$$

To incorporate region-specific productivity levels, a matrix PR of regional productivities is defined, with each element in PR representing the productivity of a specific region in a specific sector. From this the vector mp is derived, where each row in mp corresponds to the lowest productivity level across the regions in the corresponding industry. Hence mp is defined as:

$$mp = \begin{bmatrix} min(pr_{1.n}) \\ min(pr_{2.n}) \\ \vdots \\ min(pr_{n.n}) \end{bmatrix} \qquad 5)$$

Vector mp is used to scale the regions' productivity in terms of the minimum productivity for each sector, so the region with the lowest productivity level has a value of 1:

$$\mathrm{PS} = \mathrm{diag(mp)}^{-1}\mathrm{PR} \qquad 6)$$

The matrix PS is used to adjust the regions' employment for differences in regional productivity defining a modified employment matrix E*:

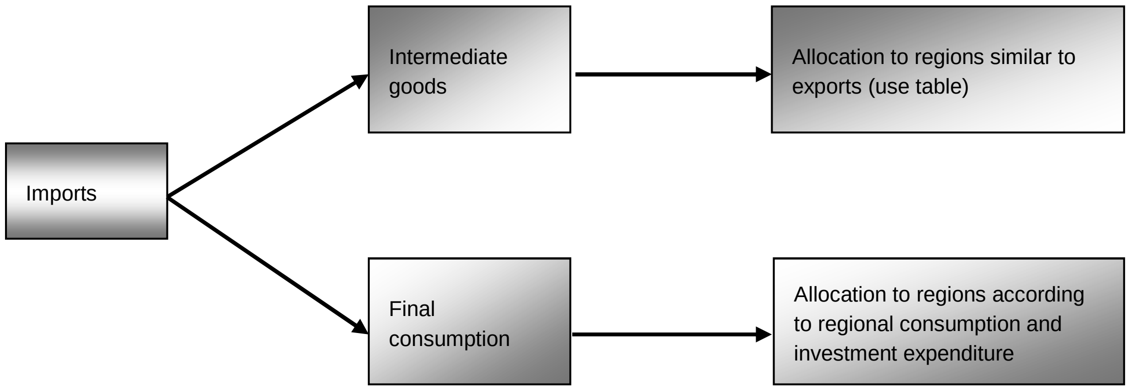
$$E^* = \begin{bmatrix} e_{1.1}ps_{1.1} & \cdots & e_{1.m}ps_{1.m} \\ \vdots & \ddots & \vdots \\ e_{n.1}ps_{n.1} & \cdots & e_{n.m}ps_{n.m} \end{bmatrix} \qquad 7)$$

E* might then be used instead of the original matrix E to calculate the regions' contributions to the national exports.

Regional imports

In contrast to the estimation of regional exports, the estimation of regional imports is split into two parts (see Figure 7.2): i) imports of intermediate goods for production and ii) imports of final goods for consumption and investment purposes[12]. The estimation of intermediate goods imports follows more or less the rationale of the estimation of regional exports, except that the national use table is used instead of the supply table. However, the estimation of final consumption differs to some extent.

Figure 7.2 / Estimation of regional imports scheme



The rationale behind this approach is that first total imports are split into intermediate and final consumption imports using the information of the use table. Moreover, final demand is split into final consumption and investment demand, which is then, roughly speaking, allocated to the regions according to their consumption and investment expenditures, with the background assumption that spending patterns across regions are identical.

The estimation of regional imports rests on a number of restrictive assumptions. Firstly, for all regions identical consumer preferences are assumed concerning final consumption imports. Secondly, investment behaviour is also assumed to be the same across regions. Furthermore, firms are assumed to apply the same production technology regarding the split of the intermediate imports, while trade

12 Other purposes are export or the accumulation of valuables and inventories.

costs or distance are disregarded. Without more detailed data, there is little to be done to relax these assumptions, thus the estimates are only considered to be highly indicative of real trade flows.

To start with imports of intermediate goods, the use table is schematically built as shown in Table 7.3:

Table 7.3 / Use table scheme

	Industries	Intermediate demand	Consumption. Investment	Final demand	Use
Domestic products	U_d	id_d	Y_d	f_d	q-m
Imported products	U_m	id_m	Y_m	f_m	m
Value added	W	w			w
Output	g	i_t	y	f_t	

The use table consists of two use matrices for domestic and imported products (U_d and U_m) and two vectors for total intermediate demand (id_d and id_m), i.e. the sum of the columns of U_d and U_m respectively. Furthermore, there are two matrices for final demand, Y_d and Y_m, with the columns in both matrices corresponding to final consumption and investment, respectively. Total final demand of either domestic or imported products is represented by the vectors f_d and f_m, and total use, i.e. the sum of intermediate and final demand, is given by the vectors (q-m) and m. Furthermore, matrices and vectors for value added and output are used, but they are less relevant for the estimation of regional imports.

For the estimation of regional imports, mainly the matrices U_m and Y_m are employed as well as the vectors id_m, f_m and m.

In practice, the first step in the estimation of regional imports is to split total imports into imports for intermediate and for final consumptions. For this the shares of both final and intermediate use in total imports are derived by using the vectors id_s and f_s as $id_s = inv\big(diag(m)\big) * id_m$ and $f_s = inv\big(diag(m)\big) * f_m$. These vectors represent the share of intermediate and final consumption in total consumption by product. The estimation of imports for intermediate as well as of imports for final demand (mi and mf) can be expressed as follows:

$$mi = diag(id_s) * mtot \qquad 8)$$

$$mf = diag(f_s) * mtot \qquad 9)$$

These vectors are the basis to allocate both final consumption and intermediate imports to the individual regions in a country.

Final demand imports

The estimation of final demand imports by regions splits final demand into its two relevant components, final consumption and investment. Consumption imports are allocated to regions according to the disposable income of households in the individual regions. Investment imports are distributed across regions according to the regions' level of investment. In a first step therefore the imports for final consumption and investment are estimated:

$$M_c = diag(cs) * mf \qquad 10)$$

$$M_{gcf} = diag(gcfs) * mf \qquad 11)$$

With cs defined as: $cs = inv\big(diag(f_m)\big) * c$ and gcfs as $gcfs = inv\big(diag(f_m)\big) * gcf$

Total consumption imports are split according to the assumption that the amount of final consumption is a function of the households' disposable income in the regions. That is, final consumption imports are allocated according to the regions' share in total national disposable income of households. Investment imports are split depending on the level of investment in the respective regions. For this the vectors shown in Table 7.4: are used. Vector di is disposable income by region, while *dit* is a scalar with total country disposable income. Similar for investment, *inv* is a vector of investment expenditures by region and *invt* a scalar of total country investment.

Table 7.4 / Disposable income and investment expenditure vectors

	Regions	Total
Disposable income	di	dit
Gross fixed capital formation	gin	gint

On that basis each region's shares in the country's total of disposable income and investment are defined through two vectors: $sdi = di * inv(dit)$ and $sgin = gin * inv(gint)$. These vectors are transposed and multiplied with an r×1 vector[13] of ones in order to split consumption and investment imports. This results in two matrices, which are denoted DIS and GINS. These can be employed to finally estimate regional imports for consumption and investment:

$$MRGCF = diag\big(I_{gcf}\big) * GINS \qquad 12)$$

$$MRC = diag(I_c) * DIS \qquad 13)$$

Regional final demand imports are then simply calculated as

$$MRFD = MRGCF + MRC \qquad 14)$$

7.1.2. Intermediate consumption

As in the case of exports, imports have to be allocated to the sectors of production that use them as inputs. For this the matrix U_m is used to get the transformation matrix T_m (for imports) as:

$$T_m = inv\big(diag(i_m)\big) * U_m \qquad 15)$$

13 r corresponds to the number of imported products

T_m has an interpretation similar to the transformation matrix T_x in the case of exports.

As a next step the imports of goods are allocated to the sectors of production:

$$Im = diag(mi) * T_m \qquad 16)$$

To disaggregate imports to the level of regions, again data on regional employment by sectors and regions are used. As above, these data are represented in matrix E. From this the regions' employment share in each industry (matrix L) is estimated as:

$$L = inv\big(diag(tE)\big) * E \qquad 17)$$

From this the regional imports for intermediate use are estimated, given by the (product by regions) matrix MRINT:

$$MRINT = Im * L \qquad 18)$$

Total imports *MR*, i.e. final consumption imports plus intermediate imports, follow directly as:

$$MR = MRFD + MRINT \qquad 19)$$

Data

The method is based on input-output tables available from the WIOD project. One advantage of the WIOD I/O table is that they differentiate between domestic use and the use of imported products, which not only facilitates the calculations but assumingly increases the accuracy of the results. A further, even more important advantage is the WIOD I/O tables' availability over time, i.e. they are available from 1995 to 2011. However, for the analysis only data from 2000 to 2011 have been used. This is due to limited availability of regional data.

Still, with small adjustments, the method described above could be easily replicated with I/O tables from other sources, e.g. OECD or Eurostat.

The method is fairly invariant with respect to the source of the trade data used. For the analysis the UN Comtrade Database has been used, but Eurostat's COMEXT is equally appropriate, though it limits the analysis to Europe.

Detailed employment data at the NUTS-2 level of regions were taken from the EU Labour Force Survey for the years up to 2008. These data are disaggregated to the 2-digit NACE Rev. 1.1 industry level. For the years beyond 2008, data have been updated in an estimation procedure using Eurostat LFS data.

Data on regional productivity, disposable income, investment and GDP were taken from Eurostat.

Regarding the regional data, the NUTS 2010 classification has been used. For the analysis the four French DOMs – Départements d'outre-mer: French Guiana, Guadeloupe, Martinique and Réunion in the Indian Ocean (Africa) – as well as the two Spanish enclaves in North Africa (Ceuta and Melilla) have been excluded. Furthermore, because of breaks in the regional division the two Finnish regions Helsinki-Uusimaa and Etelä-Suomi have been aggregated to one region.

Regional trade data were estimated from 2000 to 2011. The whole estimation procedure is programmed in STATA, and the basic data as well as the do files will be made available.

7.2. ESTIMATING REGIONAL TRADE IN VALUE ADDED

This section describes the method of estimating regional value added exports that is used in this report. Importantly, regional value added exports, in contrast to regional foreign trade flows, do not refer to the trade in goods (and services) as recorded in the foreign trade statistics. Rather, regional value added exports measure how much of the value added produced in a domestic region is directly or indirectly contained in the final consumption of a foreign country. Thus, data on regional foreign trade only take into account the value of goods that flow from a domestic region to a foreign country, but they cannot measure how much of this value is actually produced in the respective region. If a region's exports are to a large extent made of imported intermediate imports, the actual value added produced in the region might be quite low. Still, this region may record high exports, on the basis of foreign trade statistics. Arguably, this induces a certain bias concerning the true extent of regional trade specialisation. Regional value added exports are supposed to correct for this bias.

In contrast to regional foreign trade data, regional value added exports are not based on foreign trade statistics. Rather, because it is about value added, their fundament is global input-output tables (such as the WIOD I/O tables). That is also why, in contrast to regional foreign trade data, regional value added exports are not in terms of goods or products but rather in terms of industries. This reduces the comparability of the two datasets.

The procedure to estimate regional value added exports involves two steps. Firstly, value added exports are estimated at the country level. This step is methodologically well developed, so that the estimation of country value added exports follows with only small modifications the method of Stehrer (Stehrer, 2012). In a second step, country value added exports are broken down to the regional level using detailed regional employment data. The method to regionalise the data is rather straightforward and similar to the regionalisation method applied in the estimation of regional foreign trade data.

Regarding the first step, as the estimation of value added trade is based solely on input-output data, the fundamental relationship to start with is

$$y = Ay + f = Lf$$

Here, y is a gross output vector of the dimension $ni \times 1$, with n being the number of countries, i.e. in the case of the WIOD I/O tables 41 countries including the Rest of the World, and i being the number of industries, i.e. in the case of WIOD 35 industries. Hence in the estimation y is a 1435×1 vector. A is a $ni \times ni$, hence a 1435×1435 matrix of technical input-output coefficients, with each element denoting the input used in a particular industry in a country per unit of gross output. Furthermore, f is an $ni \times 1$, i.e. a 1435×1 final demand vector. The right-hand term of the equation is the traditional rearrangement of the output relationship using the Leontief inverse $L = (I - A)^{-1}$ and the final demand vector.

Following Stehrer, in a three-country example the equation can be written as (using partitioned matrices):

$$\begin{bmatrix} y^r \\ y^s \\ y^t \end{bmatrix} = \begin{bmatrix} A^{rr} & A^{rs} & A^{rt} \\ A^{sr} & A^{ss} & A^{st} \\ A^{tr} & A^{ts} & A^{tt} \end{bmatrix} \begin{bmatrix} y^r \\ y^s \\ y^t \end{bmatrix} + \begin{bmatrix} f^r \\ f^s \\ f^t \end{bmatrix} = \begin{bmatrix} L^{rr} & L^{rs} & L^{rt} \\ L^{sr} & L^{ss} & L^{st} \\ L^{tr} & L^{ts} & L^{tt} \end{bmatrix} \begin{pmatrix} f^{rr} + f^{rs} + f^{rt} \\ f^{sr} + f^{ss} + f^{st} \\ f^{tr} + f^{ts} + f^{tt} \end{pmatrix}$$

Here y^c (c = r,s,t) is the $i \times 1$ gross output vector of country c, L^{cd} is an $i \times i$ submatrix of the Leontief inverse and f^{cd} is an $i \times 1$ vector of final demand of country d in country c. Here, it is important to distinguish between final demand products produced in e.g. country r which include exports and the actual final demand of county r (which is produced in country r or imported from other countries). In the first case, the total final demand products produced in country r are given by the $i \times 1$ vector $f^{r*} = f^{rr} + f^{rs} + f^{rt}$. In the second case, the final demand of country r is given by the $ni \times 1$ vector $f^{*r} = ((f^{rr})', (f^{sr})', (f^{tr})')'$.

Pre-multiplying this equation with an $ni \times ni$ diagonal matrix V of value added coefficients, i.e. value added per unit of gross output by industries, results in value added. This will be used to estimate trade in value added terms.

In this example, value added exports of country r to all other countries are the sum of the value added created in r to satisfy the final demand in the countries s and t. Accordingly, the equation looks as follows:

$$vax^r = \begin{bmatrix} v^r & 0 & 0 \\ 0 & v^s & 0 \\ 0 & 0 & v^t \end{bmatrix} \begin{bmatrix} L^{rr} & L^{rs} & L^{rt} \\ L^{sr} & L^{ss} & L^{st} \\ L^{tr} & L^{ts} & L^{tt} \end{bmatrix} \begin{pmatrix} 0 + f^{rs} + f^{rt} \\ 0 + f^{ss} + f^{st} \\ 0 + f^{ts} + f^{tt} \end{pmatrix}$$

Here vax^r is an $ni \times 1$ of value added exports of country r by industries and countries s and t. To produce value added exports of country r, the elements v^s and v^t are set to zero, just as the final demand of country r, i.e. $f^{*r} = 0$. By this, re-imports of country r value added are excluded, which do not count as value added exports. Moreover, this equation also captures the valued added exports of country r to satisfy country s domestic demand and the demand via imports from country t. As these imports also use intermediate inputs from country r, they embody value added created in country r and thus count as country r’s value added exports.

Notably, so far value added exports are at the country level. To regionalise them in a second step it is important to remember that the vax^r vector for country r contains valued added exports by 35 industries and 40 trading partners. Since the focus is on global value added exports, i.e. valued added exports aggregated over the trade partners (but keeping the industry detail), the vax^r vector is manipulated accordingly, i.e. its elements are aggregated by industries over countries. Hence the $ni \times 1$ vax^r vector is aggregated to the $i \times 1$ $avax^r$ vector.

To regionalise this vector the same procedure as in the case of regional foreign trade (described above) is used. That means country value added exports are allocated to the regions by the regions’ employment shares in the respective regions. For this matrix E^r, representing employment by industries and regions, as well as the vector te, i.e. total country employment by industries, are used to estimate the matrix of regional employment ES^r as

$$ES^r = inv\big(diag(te)\big) * E^r$$

From this, regional value added exports are simply estimated as:

$$RVAX^r = diag(avax^r) * ES^r$$

Alternatively to matrix E also the productivity adjusted variant E^{r*} may be used (and actually is used for the analysis).

7.3. SELECTED REGIONS

7.3.1. Apulia

Regional background information

The region Apulia is located in the south-east of Italy. It is surrounded by the Ionian Sea in the south-east and by the Adriatic Sea in the east. The Salento peninsula, in the south of Apulia, forms the 'high heel' of the 'Italian boot'. Apulia covers an area of 19,358 km^2, i.e. 6.2% of the Italian territory. With over 4 million inhabitants (6.8% of Italy's population), its population density is about 210 inhabitants per km^2. Apulia's largest city and capital is Bari, followed by Taranto and Foggia. The seventh largest region in Italy, it consists of six provinces: Foggia, Bari, Brindisi, Tarento, Lecce and Barletta-Andria-Trani.

The regional GDP per capita measured in PPS shows a lower level and weaker growth rate than the rest of Italy. It is also below the EU-28 average. GDP per capita of Apulia amounted to 14,900 PPS in 2000, and 16,700 PPS in 2011. This implies an annual growth rate of 1%. During the same period, Italy's and EU-28 GDP per capita grew by 16.6% and 32.6% respectively. Because of its relatively low GDP (<75% of the EU average), Apulia is classified in Structural Funds category 1 as a less developed region in the funding period 2007–2014 (EC/2014/99/EU).

In Apulia, agriculture is still the primary resource and the agricultural industry is of higher importance for the economic structure than in the rest of the country. Traditionally, the region has strong exports of wheat, olive oil and tomatoes. One in ten works in agriculture and the industrialisation rate (26%) is below the national average of 31%. Nevertheless, the highest degree of specialisation in manufacturing, besides food products, is found in traditional 'made in Italy' sectors such as furniture, textiles, apparel and shoes. Other industries include papermaking (Foggia), engineering (Taranto, Brindisi, Bari), and construction materials. Furthermore, in Apulia tourism is an increasingly important economic factor as 8% of the regional GDP was generated by tourism in 2011, growing from just 3% in 2006 (Agrimi and Zonno, 2012, p. 6).

Apulia is strongly affected by the negative consequences of the financial and economic crisis, as well as by increasing globalisation and growing competition from new developing countries affecting its traditional manufacturing strengths in the low-tech sectors. The unemployment rate rose from 11.2% in 2007 to 19.8% in 2013 and is above the Italian average (12.2%).

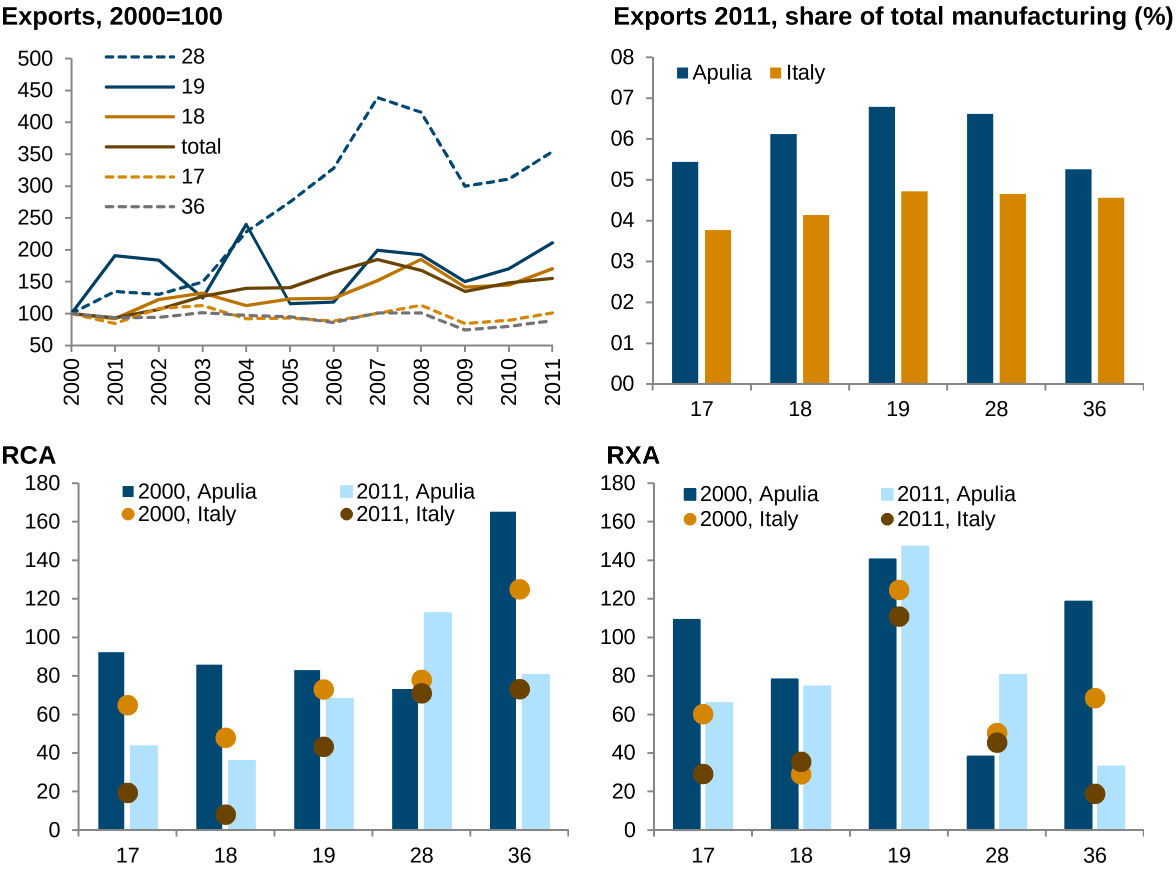
Selected industries

International trade

Trade indicators based on foreign trade, such as imports and exports, suggest the existence of internationally competitive manufacturing branches. The region was selected for its comparative advantages, indicated by positive RCAs above the 75%-quantile of less developed EU regions, in the following five, mainly low-tech industries:

- textiles, tanning and dressing of leather (NACE Rev. 1.1: 17),
- wearing apparel; dressing and dyeing of fur (NACE Rev. 1.1: 18),
- tanning and dressing of leather; manufacture of luggage, handbags, saddler, harness and footwear (NACE Rev. 1.1: 19),
- fabricated metal products, except machinery and equipment (NACE Rev. 1.1: 28),
- furniture; manufacturing n.e.c. (NACE Rev. 1.1: 36).

Figure 7.3 / Trade indicators of Apulia



Source: UN Comtrade, Eurostat; wiiw estimates and NIW calculations.

Each of these industries contributes a share between 5 and 7% to the regional exports, which is more than the corresponding national figure (Figure 7.3).

The RCA values for the textile industry and the related clothing industry continuously decreased since 2000. In 2011, both exhibited a value of about 40, which is higher than the (positive) Italian and the (negative) EU average. The similar development of these two branches can be explained by interdependencies and common value chains of businesses in Apulia. A sharply decreasing trade specialisation in textiles and clothing can also be observed at the national level. The same applies to the leather and footwear industry. However, in this case the deterioration of the RCA values is less distinct than in textiles and clothing.

The RCA value of the manufacture of fabricated metal products increased over time and is the only industry that shows a positive trend of the selected manufactures. Italy and Apulia initially had the same RCA, but due to the increase at the regional level and the stagnation at the national level, Apulia managed to gain an advantage over Italy as a whole. This is also indicated by RXA values.

Finally, the RCA value for the manufacture of furniture shows a decreasing trade specialisation in Apulia as well as in Italy as a whole. The negative trend, however, is stronger in Apulia than in Italy. Also RXA values suggest a similar trend.

The overall RCA and RXA trends are largely similar. Only one significant difference can be identified: The RXA value for the manufacture of wearing apparel, dressing and dyeing of fur showed a different performance than the RCA value. While the RXA value remained relatively stable, the RCA value decreased by about 50%, indicating that foreign suppliers succeeded in gaining disproportionately high market shares in Italy. The only positive trend is visible for the production of fabricated metal products. All other selected industries are confronted with decreasing RCAs and RXAs.

Manufacturing accounted for a share of 14.1% of Apulia's employment in 2013. A good third of it is allotted to the five industries listed above. In line with trade specialisation, most of manufacturing is concentrated in the low-tech sector. In 2013, 77% of the manufacturing employees were occupied in low-tech production and 23% in medium- and high-tech production (Table 7.5), while employment in high- and medium-high-technology manufacturing industries was significantly lower (3.3% in 2013) than the national average (6%) and the EU-28 average (5.6%). The same is true for the employment share in knowledge-intensive services, which (in the broad OECD/Eurostat definition)[14] amounts to 34.3% in 2013 and is significantly lower than the national (33.9%) and EU-28 average (39.2%). In the narrower NIW/ISI definition used in Table 4.3 which only regards 64 (telecommunications), 72 (computer and related services), 73 (research and development), 74 (other business services), 85 (health and social work) and 92 (recreational, cultural and sporting activities) as knowledge-intensive services (Legler and Frietsch, 2007, pp. 19f.), 20.9% of Apulia's workforce was employed in this sector.

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[14] Including 61 (Water transport), 62 (Air transport), 64 (Telecommunications), 70 (Real estate activities), 71 (Renting of machinery, equipment and personal), 72 (Computer and related services), 73 (Research and Development), 74 (Other business services), 80 (Education), 85 (Health and Social Work) and 92 (Recreational, cultural and sporting activities. See the respective KIS definition in European Commission (2009, pp. 17f.).

Table 7.5 / Regional key figures for Apulia

	Employment				Patent intensity	
Sector	**Number of employees**	**Regional employment structure (%)**		**Annual average growth rate of regional employment between 2000 and 2013 (%)**	**Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)**	
	2013		**2000**	**2000-13**	**2000-02**	**2009-11**
Region total	1,156,900	100.0	100.0	-0.3		
Manufacturing	163,000	14.1	16.3	-1.5	2.6	6.8
High- and medium-tech	38,600	3.3	4.0	-1.7	9.1	21.5
Low-tech	124,400	10.8	12.4	-1.4	0.8	2.2
Knowledge-intensive services	241,900	20.9	15.2	2.1		
Other	752,000	65.0	68.4	-0.7		
Selected manufacturing industries:						
17	4,100	0.4	1.2	-9.3	0.4	0.5
18	18,300	1.6	2.4	-3.4	0.1	0.2
19	6,300	0.5	0.8	-3.3	0.5	0.0
28	17,900	1.5	1.1	2.1	1.3	3.4
36	11,600	1.0	1.8	-4.7	1.0	3.3

Source: Eurostat; OECD RegPat; NIW and ZEW calculations.

Note that only the manufacture of fabricated metal products (28) shows growing RCA and RXA values and an employment increase of 2.1% against the trend in total manufacturing (-1.5% p.a., Table 4.3). Employment in the other four industries considered declined at above-average rates of over 3% in the apparel (18) and leather and footwear industry (19), nearly 5% in the furniture industry (36) and up to more than 9% in the textiles industry (17). Moreover, only the manufacture of fabricated metal products (with 3.4 patents per 10,000 employees) and the manufacture of furniture (3.3 patents) display an above low-tech industry average (2.2 patents) and significantly growing patent intensity over time. However, those trends take place on a very low level. Overall, the low patent activity in total manufacturing mirrors the low-tech orientation of the industry in Apulia. It is a negative indicator for the future development potential of the regional economy.

Drivers of regional trade specialisation and regional growth

Economic structure

The economic structure can give first insights on the main drivers of comparative advantages. Especially agglomerations of similar businesses have the potential to increase productivity and innovativeness. Thus, clusters are of particular importance. In recent years, the mechanical engineering and manufacturing industry have played an important role in Apulia. Despite the initial orientation towards agriculture, the main focus has changed to precision mechanics for the manufacturing industry. Today, 14 steel processing companies are located in Apulia (Bellais, 2014, p. 108). All these firms may explain the regional competitiveness in the manufacture of fabricated metal products (28). Financial incentives attracted large supplier companies from the automotive industry and the machinery and equipment manufacturing for the oil and gas industry. Smaller firms followed and, according to Florio et al. (2014), in 2009, 184 firms operating in precision mechanics for the manufacturing industry were located in the region. With its 16,000 employees, this cluster was responsible for about 25% of the regional exports (Florio et al., 2014).

Furthermore, the regional fashion cluster (particularly for footwear and apparel) and the wood and furniture cluster, classified as European star clusters according to the European Cluster Observatory, are potential drivers of the comparatively good trade performance of the region in these industries. Around the capital Bari, a 'sofa cluster' has been established, dominated by a few large enterprises and a variety of smaller firms, often suppliers, which are specialised in one single good. The cluster serves the markets in the EU and the USA (Veneto Region, n.d., p. 5).

Moreover, six smaller regional clusters can be identified in Apulia. The DHITECH cluster in nanotechnology, the DARe cluster in the sector of technologies for agriculture and food production, the MEDIS cluster in the mechanical engineering and manufacturing technology, the DiNTE cluster in the renewable energy industry, the DAP cluster in aerospace and finally the H-Bio Puglia District 'Health and Biotechnology' (BIAT, 2015; Florio et al., 2014).

Yet, it seems that the existence of most of the regional clusters does not translate into a leading and innovative role of the region. Apulia's trade advantages are not in high-tech- or knowledge-intensive industries. Manufacturing activities play a more relevant role than innovation and research, also in the larger foreign companies in the region. For instance, the German multinationals Bosch, Getrag (a world leader in the production of transmission systems for the automotive sector) and Osram (leading in producing lamps and lightning systems) have facilities in Apulia. Another international company producing in Taranto is Vestas, a Danish company specialised in wind turbines. Other important employers in the region are Marcegaglia, an Italian steel company, the oil and gas company Eni (IT), GE Oil & Gas (USA), ExxonMobil (USA), plus Enel (IT), a manufacturer and distributor of electricity and gas, pharmacy firms (Sanofi Aventis (FR), Merck Serono (GER)), the auto and truck parts manufacturer Fiat (IT), Bridgestone (JP), high-technology and aerospace firms (Avio (IT), Finmeccanica (IT)), food companies (Barilla (IT), Granarolo (IT), Amadori (IT)), Italian information and communication technology (ICT) firms (Transcom, Fastweb Telecom, Buzzi Unicem e Cementir, Teleperformance), and one of the world leading (glass) manufacturers of packaging products (Owens Illinois (USA)).

Regional innovation system

The overall R&D spending on GDP in the Apulia region is 0.7%, distinctly lower than the in rest of Italy where 1.3% of the GDP was invested in R&D in 2011. In absolute terms, EUR 500 million were spent in R&D in the same year, to which universities contributed with a share of 54%. Businesses invested 26% of the total sum and the public sector 14% (Eurostat Regional Database, 2015). The absolute R&D expenditures are thus comparatively low and particularly R&D spending of knowledge-intensive businesses is lacking. This is also reflected by the low patent intensity in regional manufacturing (Table 7.5).

More than twenty public R&D institutions belonging to the National Council of Research (CNR) are located in Apulia. In addition, the region of Apulia hosts three important universities. The universities of Bari and Salento and the Polytechnic University of Bari, doing research in the fields of engineering (innovation engineering, electronics, civil engineering and mechanical engineering), chemistry, informatics and physics (Florio et al., 2014).

In the private sector, Fiat was the first large company to open in 1976, a research and development institute in Apulia. Fiat hired local engineers and opened two additional research and development institutes in Apulia. Later, in 1994, the German company Bosch opened its own institute for research and development. Today, 160 engineers from local universities are working for Bosch in Apulia. Six years later, in 2000, Getrag opened a branch office in Apulia, employing 30 technicians and engineers (Florio et al., 2014).

The regional innovation system consisting of universities, enterprises and public funding seems only partially successful, as is reflected in the relatively low patent intensity and low regional R&D expenditures. Three weaknesses can be identified. First, the communication and the links between universities and companies are very weak. Second, the region has to deal with expenditure cuts for research and development programmes. Finally, a low demand for services was recorded. All that can cause a lack of investments in research and development in the mid run (Agrimi and Zonno, 2012, p. 7).

Political context and regional growth policies

As a less developed EU region (GDP <75% of the EU average), Apulia profits greatly from the EU structural funds (Technopolis group et al., 2011). For the current funding period, the region has set up a regional development strategy, the so-called SmartPuglia 2020. In the course of the project, the region plans to invest EUR 2.7 billion between 2014 and 2020. More than EUR 1 billion comes from the EU structural funds and around 6,000 companies will benefit from the programme. By involving all regional stakeholders in a dialogue, the programme tries to combine different policy fields, including internationalisation, employment and training, digital agenda, research and innovation, social innovation and competitiveness. The programme aims for three main innovation areas. The first area applies to sustainable manufacturing. Sustainable manufacturing includes, for the region of Apulia, aerospace, mechatronics, intelligent factories and advanced materials and nanotechnologies. Most of the fields match the above-described regional clusters in Apulia. Aerospace technology matches the DAP cluster, mechatronics is covered by the MEDIS cluster, and nanotechnologies benefits from the DHITECH cluster. The second innovation area focuses on health and environment. Besides ambient assisted living and the green and blue economy, agrofood with its cluster DARe (technologies for agrofood) plays an important role in the region of Apulia. The third innovation area covers digital communities and creativity. Particularly design, non-research and development innovations, services, social innovations and the cultural and creative industry are important for Apulia. Relating to this, H-Bio, a human health and biotechnology cluster, has been formed (Casalino and Agrimi, 2013, p. 7). Overall, in the course of the SmartPuglia 2020 programme, Apulia tries to change its image by new research and innovation policies such as introducing new Living and Open Labs, fostering new technological clusters and innovative partnerships and creating a network of public research institutions (Casalino and Agrimi, 2013, p. 5).

Conclusion

The case study of Apulia has shown that the region exhibits an above-average trade specialisation in five low-tech industries when taking the group of less developed regions (i.e. GDP < 75% of the EU average) as a reference group. Hence, the regional trade specialisation indicators are comparably high in the textiles and clothing industry, the leather industry, the metal industry, and the furniture industry. As all these industries are low-tech industries, the innovation output in these industries is quite low. Furthermore, with the exception of the metal industry, employment in the other four labour-intensive industries is sharply decreasing, given the increasing competition with low-wage countries in Asia, especially in the textile and clothing industry. Although a stronger focus on innovation-based industrial development should be expected, the regional R&D expenditures are still significantly below average. Private R&D expenditures in particular are very low as compared to the Italian average. Overall, the regional innovation system in Apulia is not as strongly developed as in other Italian regions. However, in recent years, innovation strategies and cluster initiatives focusing on high-tech industries have tried to strengthen these industries within the region. The current regional growth strategy for the EU funding period 2014-2020 follows this attempt.

Table 7.6 / Stylised industry-specific regression results for Apulia

Full sample

RXA (gross exports)	15	17	19	36	28
(log) patent intensity	2.646	6.402	27.153	-1.293	-0.969
(log) techn. innov., SMEs	25.315 *	27.861 **	-25.277	9.994	26.216 ***
(log) non-techn. innov, SMEs	-8.331	7.527	19.697	0.921	4.218
tertiary educ. < 35 yrs.	0.039	-1.103 ***	0.308	-0.585 *	-0.757 ***
(log) HERD	3.133	1.525	-7.710	-3.924 *	4.851 ***
(log) BERD	-3.766 **	-9.059 ***	5.711	-10.238 ***	-2.619 *
GDP per capita	0.000	-0.001 **	-0.006 ***	-0.001 *	0.000
(log) population density	-2.618	12.071 **	-0.596	-0.107	-2.243
cluster	6.954	41.453 ***	138.388 ***	46.526 ***	21.990 ***
business services	-25.296 ***	-5.542	0.804	6.995	-18.363 ***
ERDF innovation	-0.579 ***	0.281	0.683	0.280	-0.073
(log) quality of governm.	12.846 *	-28.937 ***	-34.600 **	-9.742	-7.611 *
accessibility index	-0.174	-0.077	0.893 *	0.179	-0.275 **
R^2 within	0.003	0.065	0.026	0.049	0.033
R^2 between	0.289	0.407	0.299	0.182	0.424
R^2 overall	0.235	0.352	0.240	0.194	0.386
No. of observations	2,800	2,800	2,763	2,800	2,800
No. of clusters	250	250	250	250	250

Less developed regions

	sf1 / p15	sf1 / p17	sf1 / p19	sf1 / p36	sf1 / p28
(log) patent intensity	-25.253 *	1.399	252.980	-31.010 ***	-7.496
(log) techn. innov., SMEs	50.099 ***	41.239 ***	-19.350	-1.353	31.182
(log) non-techn. innov, SMEs	-44.281 ***	-15.798	-11.298	4.307	-1.842
tertiary educ. < 35 yrs.	0.495	-0.931	-1.739	-0.851	-1.019
(log) HERD	5.812 **	5.926	-7.463	-2.687	5.369
(log) BERD	-4.480 *	-12.390 ***	-9.180	-9.218 ***	-2.858
GDP per capita	-0.001	-0.005 ***	-0.008 ***	-0.005 ***	0.000
(log) population density	-38.369 *	8.845	86.210 ***	56.048 ***	-4.532
cluster	6.716	29.797 ***	122.296 ***	100.568 ***	25.840
business services	-3.478	-31.208	95.635	91.302 **	-27.704
ERDF innovation	1.474	1.643 **	1.566	-1.074	-0.764
(log) quality of governm.	-5.615	-43.495 ***	-24.352	29.491 ***	0.124
accessibility index	-0.605	-0.320	-0.634	-0.437	0.335
R^2 within	0.037	0.298	0.126	0.310	0.085
R^2 between	0.533	0.537	0.698	0.519	0.534
R^2 overall	0.488	0.483	0.570	0.468	0.468
No. of observations	674	674	673	674	674
No. of clusters	60	60	60	60	60

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of food products and beverages (15), Manufacture of textiles (17), Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), Manufacture of fabricated metal products, except machinery and equipment (28), Manufacture of furniture; manufacturing n.e.c. (36). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

Regarding the locational requirements for the industries currently featuring high trade specialisation in Apulia, the low R&D efforts are typical not only for being a less developed region but also compared to regions with higher income levels and similar specialisation. As the econometric results show, HERD and BERD are rather below average in these locations (Table 7.6). In contrast to that, innovation participation by SMEs is a more important factor, especially in the low-technology industries. However, compared to other less developed regions, Apulia is rather disadvantaged with respect to population density and clustering structures. The only beneficial but not sustainable characteristic that is correlated with higher trade specialisation in these industries is the low-income level, i.e. the cost advantage. The strategy of an SME-based diversification as suggested by smart specialisation is probably the most promising approach.

7.3.2. Berkshire, Buckinghamshire, Oxfordshire

Regional background information

The region Berkshire, Buckinghamshire and Oxfordshire is located in the south-east of the United Kingdom, covering an area of 5,741 km2 (2.3% of the UK). The regional population amounts to 2.26 million inhabitants, representing 3.6% of the British population. With a population density of 395 inhabitants per km^2, the region is one of the most densely populated areas of the UK and characterised by many London commuter towns of intermediate size. The centres of the region are the university cities Oxford in Oxfordshire and Milton Keynes in Buckinghamshire. The proximity to the capital London is of high economic importance for the region.

In 2011 the region generated a GDP of 35,900 PPS[15] per capita, which is 36% higher than the national average and 43% higher than the EU-28 average. The region is therefore classified as an advanced region in funding period 2014–2020 (EC/49/2014). The formerly manufacturing-based economy has been transformed into an economy that relies to a large extent on knowledge-intensive services and high-tech manufacturing. The innovation induced by the major higher education institutions can be regarded as a key feature of the regional competitiveness.

The comparatively good economic performance of the region is also reflected by the regional employment figures. The unemployment rate in South-East UK is consistently lower than the national average. However, following the onset of the financial crisis, unemployment increased from 4.1% in 2008 to 5.2% in 2011 in Oxfordshire, Buckinghamshire and Berkshire and from 5.6% to 8.0% during the same period in the UK. Thus the region has a lower unemployment rate than the country average, but follows a similar trend of rising unemployment since 2008. Compared to its neighbouring regions, there is, however, significant variance in economic indicators within the larger (NUTS 1) region of South-East England (UKJ). The above-average employment and GDP figures can partly be attributed to the positive effect of London in the vicinity. Many people are not employed in Oxfordshire, Berkshire or Buckinghamshire but in London and commute to the capital for work. Proximity to business partners in London is also an important location factor for firms.

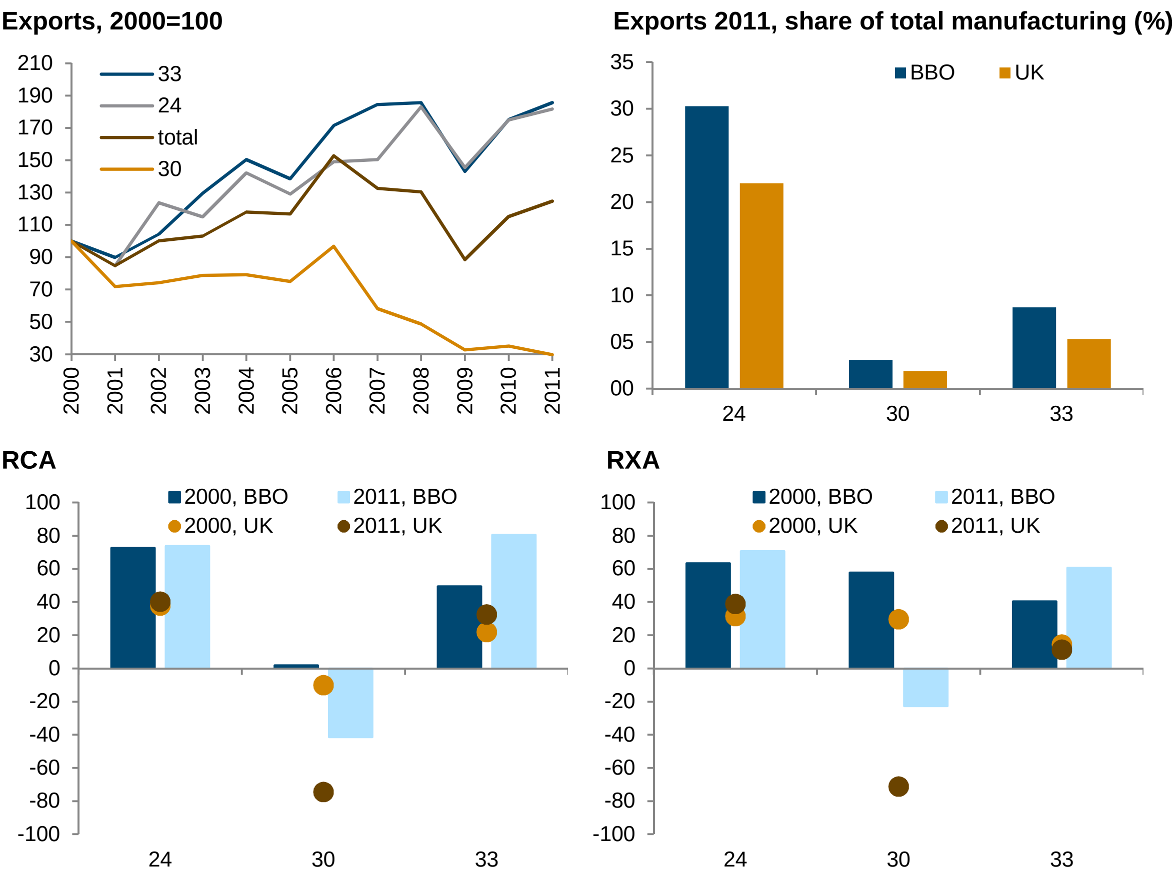
[15] Purchasing power standards (PPS) are purchasing power parities (PPP) defined by Eurostat. PPS is a fictive currency that reflects the weighted average of the purchasing power of the national currencies of the EU Member States. The real exchange rate of the PPS therefore is approximately 1.

Selected industries

International Trade

To identify above-average competitive industries, export levels and Revealed Comparative Advantages (RCAs) are taken into consideration. According to these selection criteria, the region of Oxfordshire, Berkshire and Buckinghamshire is specialised in three high-tech industries, namely manufacture of chemicals and chemical products (NACE Rev. 1.1: 24), manufacture of office machinery and computers (30) and the manufacture of medical, precision and optical instruments (33). As Figure 7.4 depicts, in terms of export shares, the chemical industry is of particularly high importance for the region, since the export share of chemical exports amounts to 30.3% of the total manufacturing exports of the region exceeding the national average by 8 percentage points.

Figure 7.4 / Trade indicators of Berkshire, Buckinghamshire, Oxfordshire (BBO)



Source: UN Comtrade. Eurostat. - wiiw estimates and NIW calculations.

The RCA indicates whether a region holds a comparative advantage (positive RCA) or disadvantage (negative RCA) in a certain industry. Its values are positive in both the chemical industry and the manufacture of medical, precision and optical instruments. In the chemical industry, the RCA has increased from 49 in 2000 to 81 in 2011, indicating further progress of the region's comparative advantage in this industry. The regional RCA exceeds the values of the UK and the EU in the chemical industry. In contrast to the RCA, the RXA (Revealed Export Advantage) indicates whether the significance of an industry in a certain region's total manufacturing exports is higher or lower compared to global manufacturing exports. The RXA indicator exhibits values for the chemical industry in Berkshire, Buckinghamshire and Oxfordshire similar to those of the RCA. As will be outlined below, the main drivers of the strong trade performance of the regional chemical industry are pharmaceutical companies.

The production of medical, precision and optical instruments accounts for 8.7% of total manufacturing exports of the region and is, thus, above the national average. The industry yields high positive RCAs in the region and lower positive RCAs at the country level. This indicates that Berkshire, Buckinghamshire and Oxfordshire hold a higher comparative advantage in this industry than the UK does on average. As it is the case in the chemical industry, the RXA and RCA show similar values in this region. This correlation suggests that the chemical industry has a high share of pharmaceutical companies in the region that cooperate with companies in the business for medical instruments. Accordingly, the performance of the two sectors in trade seems to be interrelated, at least to some extent.

The third industry with above-average trade specialisation is the manufacture of office machinery and computers. As Figure 7.4 depicts, the export share of this industry is significantly lower than in the other two industries. The low share of employees working in the industry underlines the comparatively lower importance of the industry for the region. When looking at the trade specialisation indicators (Figure 7.4), it becomes evident that the industry yielded negative RCA and RXA values in the region for 2011. A similar negative trend is observed at the country as well as the EU level. This negative tendency in the trade specialisation indicators is clearly driven by the decrease in regional exports that have sharply declined from 2006 onward.

Employment and patent intensity

As the employment figures in Table 7.7 illustrate, services are of high importance in the region, accounting for more than 90% of the regional employees (2011). Particularly knowledge-intensive services (KIS)[16] experienced a strong increase in employment: The share of employees in knowledge-intensive services rose from 33% in 2000 to nearly 40% in 2011. At the same time, the manufacturing sector lost in importance: The share of employment dropped from 16.5% in 2000 to 8.4% in 2013. Thus, the manufacturing sector is exceptionally small in the UK and the focus of the economy is on knowledge-intensive services. There are not many production facilities but rather service and administration offices of companies.

The still present regional manufacturing sector has undergone a restructuring from a manufacturing economy with a focus on low-tech industries such as agricultural production and brewing to an economy that is focused on high-tech industries (Lawton-Smith, 2009, p. 74). This change is also mirrored by the employment figures (Table 7.7). Between 2000 and 2011, the share of employees working in the low-tech manufacturing sector has decreased from close to 8% in 2000 to slightly over 3% in 2013, reflecting an average annual growth rate of 6.4%. Employment in the high- and medium-tech industry also decreased, but almost half that pace (-3.5%). Thus, 62% of the manufacturing workforce was employed in medium- and high-tech industries in 2013 and only 38% in low-tech industries.

16 Following the NIW/ISI definition, KIS are defined as NACE 64 (telecommunications), 72 (computer and related services), 73 (research and development), 74 (other business services), 85 (health and social work) and 92 (recreational, cultural and sporting activities) (Legler and Frietsch, 2007, pp. 19f.).

Accordingly, the share of employees in the selected manufacturing industries is low in relation to total employment. In 2000, initially 1.9% were employed in the chemical industry. That share decreased to 1% with a negative annual growth rate of -4.4%. The manufacture of medical and precision instruments and the production of office machinery and computers each employed 0.7% in 2013, having experienced a falling tendency from 2000 onwards.

A high number of patents per 10,000 employees (patent intensity) can be attributed to good innovation capabilities. All industries with an above-average trade performance depict an outstanding patent intensity (see Table 7.7). The chemical industry registered 198 patents per 10,000 employees on average annually from 2000–02 and 347 from 2009–11. The increase can be ascribed mostly to the research-intensive pharmaceutical and medical industry of the region. A similar positive trend took place in the production of medical and precision instruments where 201 patents per 10,000 employees were registered during 2000–02 compared to 263 in the years 2009-2011. While in the aforementioned industries a positive trend is indicated, the patent numbers in the manufacture for office machinery stagnated slightly above 100 patents per 10,000 employees.

Table 7.7 / Regional key figures for Berkshire, Buckinghamshire, Oxfordshire

	Employment				Patent intensity	
Sector	**Number of employees**	**Regional employment structure (%)**		**Annual average growth rate of regional employment between 2000 and 2013 (%)**	**Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)**	
	2013		**2000**	**2000-13**	**2000-02**	**2009-11**
Region total	1,189,200	100.0	100.0	0.4		
Manufacturing	99,600	8.4	16.5	-4.7	73.3	121.1
High- and medium-tech	62,100	5.2	8.7	-3.5	119.3	165.3
Low-tech	37,500	3.2	7.8	-6.4	19.3	47.9
Knowledge-intensive services	468,700	39.4	33.3	1.7		
Other	620,900	52.2	50.1	0.7		
Selected manufacturing industries:						
24	11,700	1.0	1.9	-4.4	198.0	347.6
30	8,200	0.7	1.1	-3.4	106.7	101.7
33	8,500	0.7	0.8	-0.5	200.8	263.2

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations.

Drivers of regional trade specialisation and regional growth

Economic structure

The ICT sector is the most important sector in the region, hosting many international companies in the university city of Reading. Among the largest enterprises are Microsoft and Oracle Corporation, located close to the university facilities. Other multinationals that have branch offices in the industrial park are Fujitsu, Hewlett-Packard and Intel, all involved in soft- and hardware manufacturing and contributing to the comparatively good trade performance of the manufacture of office machinery and computers (NACE Rev. 1.1: 33) outlined above. However, the regional ICT sector is mainly dominated by services and not by manufacturing activities: While employment in ICT manufacturing is rather low, the regional employment in knowledge-intensive services is at a high level – 33.3% in 2000, increasing to 39.4% in 2013, as reported in Table 7.7.

The Slough industrial area also hosts some major IT companies such as the headquarters of the telecommunications and internet services provider O_2 and offices of Blackberry, Amazon, HTC and others. The Slough industrial park is an important business centre of South-East UK but is lacking the innovation and research intensity which could be expected from the potential deriving from the endowment with higher education institutions. Furthermore, Bracknell is host to a number of electro-technical and IT firms such as Panasonic, Fujitsu, Dell, HP and Siemens.

Due to the outstanding reputation of Oxford University for life sciences, many biotechnology companies are located in the BBO region. Although the biotech industry is smaller than the regional ICT sector, it is still significant for innovation and foreign trade. As outlined above, the regional chemical industry is a major driver of the region's favourable trade performance. Large chemical and pharmaceutical companies such as Honeywell are located in the region. Also Bayer, one of the large multinational pharmaceutical companies, maintains headquarters in Newbury. Furthermore, a number of smaller, highly innovative biotechnological firms such as Oxford Glycosciences, active in drug discovery, and PowderJect, which conducts research in vaccines and immunotherapeutics, are located in the region.

In terms of infrastructure, two international airports in the direct proximity and national highways are important location factors for international businesses. Thus, several agglomerations of companies are situated in Berkshire, Buckinghamshire and Oxfordshire along the highways that are crossing the area. The M4 corridor comprises the cities along the highway stretching from London to South Wales which are both host to numerous high-tech companies. The strong spatial concentration promotes the firms' international competitiveness due to knowledge spillover effects and cooperation within the clusters. Many business clusters are closely connected to the local universities. Major industrial parks are found in Reading, Slough, Bracknell and Newbury.

Regional Innovation System

The regional knowledge base is largely characterised by major educational institutions such as the University of Oxford, Oxford Brooks University, the University of Reading and the University of Surrey. The public research activity is high due to a number of specialised research institutes that provide leading basic research. Furthermore, a growing number of spin-off companies utilise the knowledge created in and by the universities (Lawton-Smith, 2009, pp. 81f.).

Given the large number of universities and innovating firms located in the region, the regional innovation system of Berkshire, Buckinghamshire and Oxfordshire is quite strong. The volume of regional R&D expenditures is higher than in most other British regions. The regional R&D spending in 2011 summed up to EUR 3.09 billion, to which businesses contributed 57%, universities 28%, private organisations 0.18% and governmental institutions 13%. Non-profit organisations thus contribute more substantially to the funding of innovation in the region than in other English and European regions, although it is not much in relation to total spending. Even on this high level of R&D activities, a rising tendency is indicated. Only London (UJI1) excelled BBO in R&D expenditures with a total of EUR 3.34 billion in 2011. The high R&D spending is also reflected in the regional patent activity, as indicated in Table 7.7.

The two most prestigious universities located in the region are the University of Oxford and Oxford Brooks University which together educated over 44,000 students in 2011/12. Around a fourth of all students were enrolled in STEM (Science, Technology, Engineering, and Mathematics) or other medical-related fields of study thus also meeting local labour demand. ISIS Innovation is a subsidiary of the University of Oxford whose objective is to manage technology transfer in order to make new knowledge of the university available for business applications. Science Vale Enterprise Zone UK in Southern Oxfordshire contains a concentration of leading science and innovation enterprises focusing on advanced manufacturing and engineering, energy, ICT and pharmaceuticals. 13% of R&D employment in the South-East UK and 4% of the R&D employment in England is located in the Science Vale area.

The University of Reading also hosts institutions and businesses directly on its campus, such as the Science Technology Centre, which fosters and accommodates start-up companies, or the Reading Enterprise Hub, which is a business incubator for high-tech firms with a focus on environmental technology, IT and life sciences.

One of the most important public research facilities is the Rutherford Appleton Laboratory, a facility for physics, space and astronomy research that is operated by the Science Technology Facilities Council. It employs over 10,000 scientists and engineers and 1,200 staff members. The UK Atomic Energy Authority is an organisation that researches and develops nuclear fusion power as an alternative to the traditional fission power. It operates the Culham Centre for Fusion Energy at the Culham Science Centre in Oxfordshire. In 2009, the European Space Agency (ESA) opened The European Centre for Space Applications and Telecommunication at the Harwell campus. It researches topics related to telecommunication, integrated applications and space technology. The opening of the facility mirrors the growing importance of the space industry in the UK. According to the ESA, approximately 70% of the products are exported and thus they also have a bearing on the ICT sector.

The knowledge base in Berkshire, Buckinghamshire but especially in Oxfordshire is thus not only outstanding in the UK but also comprises a number of institutions that are innovation leaders worldwide. SME spin-offs are crucial to apply the basic research mostly in the field of life sciences and IT and commercialise new knowledge.

Political context and regional growth strategies

The history of economic policy-making in the UK has been unsteady during the last decades. Both regional and local approaches were subject to frequent reforms (Pike et al., 2015, p. 6). Regional Development Agencies (RDAs) were established in 1998 with a growing focus on innovation policies over time. They intended to support the knowledge transfer between businesses and collaboration between research and companies. Also, they aimed to foster clusters and science parks as well as investment in R&D infrastructure. The South East England Development Agency aimed to increase the accessibility of new knowledge created in the educational institutions for the local businesses (Lawton-Smith, 2009, pp. 87ff.).

Based on increasing criticism of regional centralism, bureaucracy, mismatch with functional economic areas and overly broad aims, the RDAs, which had previously been responsible for the development policies at NUTS 1 level, were abandoned in 2012 (Pike et al., 2015, p. 6). This resulted in a shift in the approach of policy-making towards more local and varied strategies for growth and innovation. In most

English regions including the south-east there is not one single agency anymore. Innovation strategies and measures are delegated to local authorities, e.g. city councils and other institutions at NUTS 3 level, or to Local Enterprise Partnerships (LEPs). LEPs are business-led private-public partnerships that seek to facilitate growth and job creation. The board of an LEP is typically constituted of local business actors, public sector leaders and members of the local university (European Commission, 2015b). There are three LEPs relevant for the region of Berkshire, Buckinghamshire and Oxfordshire, namely the LEP ‘Oxfordshire’, the LEP ‘Buckinghamshire Thames Valley’ and the LEP ‘Thames Valley Berkshire’.

Because of the restructuring from RDAs to LEPs, the LEP policies faced some initial technical problems. The LEPs intend to provide a network for the exchange of information about their respective economic policies and related issues. They thus link public administration and businesses. The LEPs will also be responsible for the implementation of most of the programmes of the EU structural funds in the period 2014–2020, so consequently the LEP policies will comprise innovation strategies in the future. The bulk of the funding of the LEPs comes from the ERDF and the ESF. The priorities of the operational programme in 2007–2013 were to promote the competitiveness of the region by knowledge transfer and a sustainable development in terms of reducing the ecological footprint. The total means comprised EUR 47.4 million of EU investments and national contributions.

The policies of the LEPs are to improve infrastructure, e.g. the availability of broadband access in rural areas, and to promote investment in the local companies. The LEP area ‘Thames Valley Berkshire’ has the highest per-capita GVA of all LEP areas in the UK (Pike et al., 2015, p. 8). Currently there is a trend for LEPs to take over tasks and funding of public institutions, thus problems with eligibility and legitimacy of private actors in the LEP administering public funds may arise.

The Oxford Trust has the objective of supporting start-up companies and scaling up new enterprises. It also intends to facilitate the communication between technology firms and the local and regional government as well as providing public relations to the local businesses (such as Oxford Science). The Oxfordshire County Council pursues an Economic Development Strategy that comprises the promotion of knowledge-intensive industries, research activities and lifelong learning. Among other agencies relevant for the region is, for instance, the Oxfordshire Economic Partnership, which seeks to form a network of informal institutions as does, e.g., the Oxford Trust.

After the RDAs had been abolished, innovation support measures were assigned to national institutions, e.g. the Technology Strategy Boards. One policy of the agency is the Small Business Research Initiative, which has the objective of improving the cooperation of innovative SMEs with the public sector. Thus a shift of innovation policies from the regional to the national level took place while growth strategies were transferred to the local level, namely LEPs. The reform towards the LEPs was motivated by the idea of administering policies in functional economic areas rather than arbitrarily allocated RDA areas. However, the effectiveness of the LEPs is still to be proven and the success will crucially depend on the transformation to legally accountable organisations.

Conclusion

The case study has shown that the region of Berkshire, Buckinghamshire and Oxfordshire is one of the most innovative EU regions. This is underlined by its high innovation efforts (R&D and patent intensity). The region greatly profits from several prestigious universities (such as Oxford University) acting as a pull factor in attracting innovative firms and research institutes located in the region. Given the large number of jobs in knowledge-intensive sectors (services as well as manufacturing industries), skill intensity of the regional workforce is necessarily high. Consequently, all three industries of special interest (i.e. chemical industry, office machinery and computer industry, and medical industry) belong to the high-tech sector. Here, regional firms also greatly profit from the existence of several regional clusters. Furthermore, the proximity to London provides another advantage related to access to a large labour market and business connections within short distance (‘borrowed size’).

Table 7.8 / Stylised industry-specific regression results for Berkshire, Buckinghamshire, Oxfordshire

Full sample

RXA (gross exports)	24	30	33
(log) patent intensity	0.306	1.376 ***	-0.070
(log) techn. innov., SMEs	-18.206	-23.853	-32.252 ***
(log) non-techn. innov, SMEs	-14.674	-20.984	-10.329
tertiary educ. < 35 yrs.	0.816 ***	-0.282	0.253
(log) HERD	0.767	17.693 ***	7.268 **
(log) BERD	-0.666	2.867	5.694 *
GDP per capita	-0.002 ***	0.000	0.000
(log) population density	4.353	1.827	-11.833 *
cluster	50.225 ***	9.338	22.107 **
business services	16.498 **	2.460	18.416 ***
ERDF innovation	0.202	-0.210	0.535 ***
(log) quality of governm.	15.208 **	44.922 ***	27.184 ***
accessibility index	1.026 ***	0.646 *	0.834 ***
R^2 within	0.013	0.039	0.036
R^2 between	0.461	0.302	0.589
R^2 overall	0.368	0.234	0.546
No. of observations	2,798	2,800	2,800
No. of clusters	250	250	250

More developed regions

	sf3 / p24	sf3 / p30	sf3 / p33
(log) patent intensity	0.402	1.506 **	0.154
(log) techn. innov., SMEs	-37.916 **	-48.016 **	-37.467 ***
(log) non-techn. innov, SMEs	-17.738	3.197	53.050
tertiary educ. < 35 yrs.	0.186	-1.778 ***	0.210
(log) HERD	-7.139 *	-1.762	1.636
(log) BERD	1.651	-6.611	1.055
GDP per capita	-0.001 *	0.000	0.000
(log) population density	13.393	2.232	-6.447
cluster	52.111 ***	17.665	21.213 **
business services	9.618	16.172	20.318 **
ERDF innovation	0.042	0.024	0.596 ***
(log) quality of governm.	22.679 **	74.440 ***	36.170 ***
accessibility index	0.776 *	1.217 ***	0.835
R^2 within	0.016	0.088	0.003
R^2 between	0.403	0.341	0.483
R^2 overall	0.316	0.297	0.472
No. of observations	1,632	1,632	1,632
No. of clusters	143	143	143

Note: * $p<0.1$, ** $p<0.05$, *** $p<0.01$. Manufacture of chemicals and chemical products (24), Manufacture of office machinery and computers (30), Manufacture of medical, precision and optical instruments, watches and clocks (33). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

As the regression results suggest, clustering structures, business services, quality of government as well as accessibility are beneficial factors which are also found in the case study. Especially governance structures favouring regional innovation policy proved to be relevant although this variable (ERDF innovation) has been found to exhibit a significant effect only for the manufacture of medical, precision and optical instruments, watches and clocks (33). Furthermore, innovative activities of SMEs are of minor importance. In accordance with the case study, but with the exception of the manufacture of chemicals and chemical products (24), R&D efforts in universities are also of a certain relevance. However, the manufacture of chemicals and chemical products (24) relies at least on the universities' functions as indicated by the significance of tertiary educated.

Thus, the case study emphasises the distinguishing role of strong universities compared to other economic and innovation-oriented characteristics. However, these regional characteristics might be substituted by the availability of short distance to London ('borrowed size').

7.3.3. Castile–La Mancha

Regional Background Information

Castile–La Mancha is the third largest Spanish region (after Castile y León and Andalusia). It is located in the centre of Spain, partly surrounding the capital of Madrid. Its size adds up to an area of nearly 80,000 km², representing almost 16% of the Spanish total territory. Despite its size, Castile–La Mancha is only the ninth most populous region, accounting for only 4.4% of Spain's population. Hence, it is one of the sparsely populated Spanish regions with an average population density of 25.7 inhabitants per km² (compared to the Spanish average of 93.4 inhabitants per km², as of 2014). The region's largest and most populous city is Albacete with 172,500 inhabitants, while Toledo (83,300 inhabitants), located approximately 65 km south of Madrid, is the regional capital. Given its low population density and the lack of any major city with more than 300,000 inhabitants, the region is classified as a rural region according to the regional classification of the German Institute for Urban and Regional Development (BBRS). In the years 2008-2012 the region's population increased by 3.9%, which is above the 2.4% national average. The registered foreign population is 236,049 people, or 11.1% of the total population (Eures, 2014). In 2012, the regional GDP amounted to EUR 17,698 per capita, which equals 77% of both the national and the EU average. Correspondingly, Castile–La Mancha belongs to the transition regions in the funding period 2014-2020 (EC/2014/99/EU). In 2012, the highest contribution to the regional GDP was made by the public sector, accounting for 20% of GDP, despite the estimated 8.0% decline compared to 2011. The other most important sectors are trade, transportation, restaurants and hotels with 18% and the manufacturing industry with 14% (European Commission, 2015c).

The economy of Castile–La Mancha is dominated by agriculture, especially the raising of livestock, while the manufacturing industry is traditionally underdeveloped (Vegas et al., 2003). However, since the accession of Spain to the EU in 1986, the region has shown progress and its industrial sector has been growing at a faster pace than the national average (European Commission, 2015). In recent years, tourism has become increasingly important for the region, in the form of agro-tourism in particular. Despite the fact that some important companies have lately established in the region, Castile–La Mancha still faces some disadvantages, mainly due to its low population density, a shortage of qualified workers, and a lack of any industrial networks resulting from the fact that firms are scattered across a large geographic area (European Commission, 2015b). Furthermore, the regional unemployment rate is still very high. In 2012, the regional unemployment rate was 29.5%, and thus even higher than the national average (26%) (Eures, 2014).

The regional business structure is dominated by SMEs and family businesses. 96% of regional firms operating in the industrial sector have less than 10 employees. The region's business network consists mainly of SMEs and traditional enterprises with a less established R&D tradition (European Commission, 2015). Hence, private R&D investments are very low in the region. In terms of higher education, the University of Castile–La Mancha (UCLM) is the region's largest public university. It is divided into four centres spread across the whole region.

Selected industries

International trade

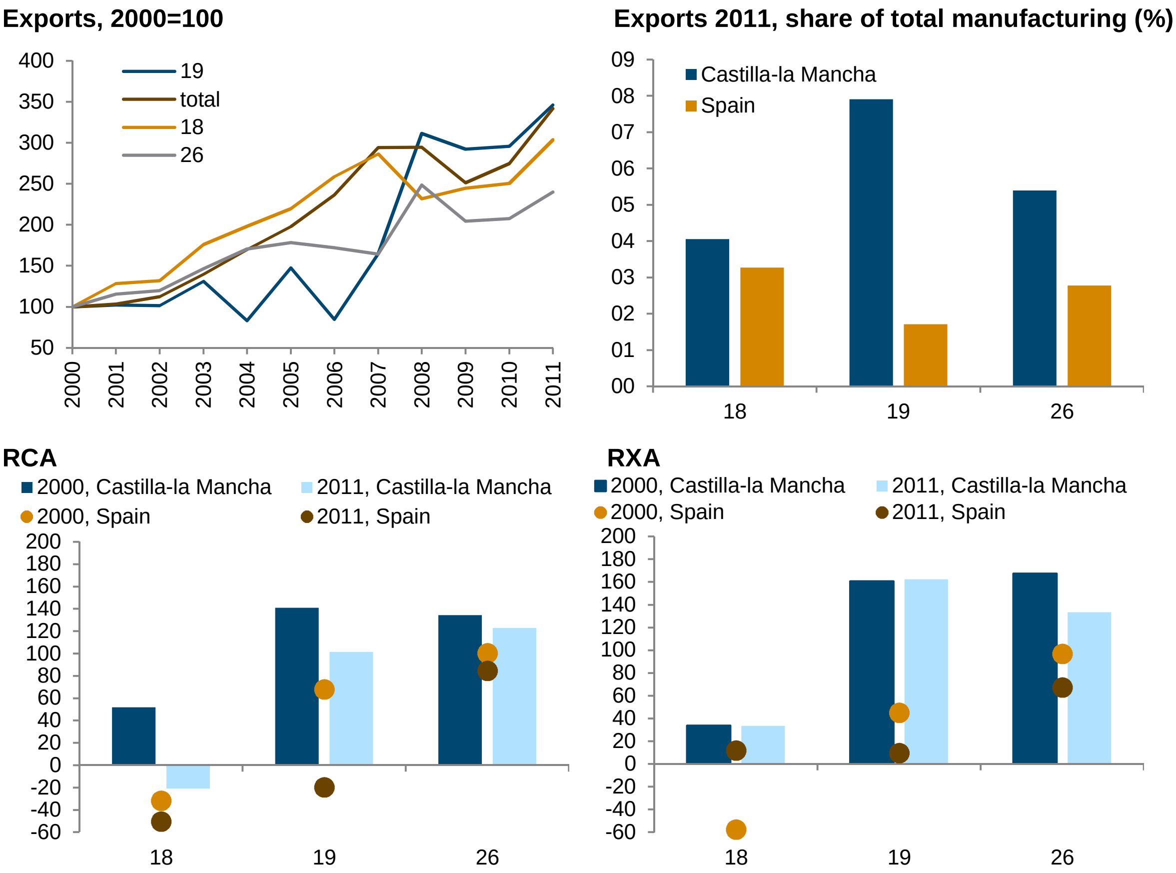
Even though the region has traditionally hosted only few industrial production sites, it nevertheless reveals an above-average trade performance in three predominantly low-technology manufacturing industries when taking the group of transition regions (GDP 75% and 90% of the EU average) as a reference group. The industries in which Castile–La Mancha shows an exceptional trade performance among the group of transition regions include manufacturing of wearing apparel, dressing and dyeing (NACE Rev. 1.1: 18), manufacturing and dressing of leather (19), and manufacturing of other non-metallic mineral products (26) (Figure 7.5).

Looking at the trade dynamics in the three industries, it becomes evident that in all three industries, the regional exports have increased from 2000 to 2011. While exports doubled between 2000 and 2008, the growth rates were less profound after the recent crisis. However, the regional textile industry has experienced a sharp increase in exports from 2007 onwards. Altogether, the three industries in which the region shows an above-average trade performance make up nearly one fifth of regional exports in the manufacturing industry. In contrast, their share in total Spanish exports sums up to a mere 7%. As Figure 7.5 depicts, in all three industries the export shares of Castile–La Mancha considerably exceed the Spanish average.

With an export share of nearly 8% in all manufacturing goods in 2011, the regional leather industry realises export shares that significantly exceed the Spanish average of merely 1.7%. In the same year, the share of textile exports in all regional exports summed up to 4.1% in Castile–La Mancha, compared to 3.3% in Spain. In non-metallic mineral products, the third industry under consideration, the regional export share of Castile–La Mancha amounted to 5.4%, nearly twice the Spanish average of 2.8%.

Along with the exports, the regional trade specialisation indicators in all three industries are also considerably higher than the national (i.e. Spanish) average. Hence, the Revealed Comparative Advantage (RCA), indicating whether a region holds a comparative advantage or disadvantage in a particular industry, is above the national average in the textile and leather industry and the manufacture of non-metallic minerals. However, as Figure 7.5 depicts, in all three industries, the RCA value declined between 2000 and 2011. In the textile industry, the regional RCA even turned negative by 2011, indicating that the region no longer holds a comparative advantage in this industry. In contrast to the RCA, the RXA (Revealed Export Advantage) indicates whether the significance of an industry in a certain region's total manufacturing exports is higher or lower compared to global manufacturing exports. As Figure 7.5 reveals, in all three industries under consideration, Castile–La Mancha realises positive RXA values that are way above the national average in the respective industries. In general, the increase in total exports did not entail an increase in RXA values. Hence, the regional RXA values remained rather constant in both the textile and leather industries. In the manufacturing of other non-metallic mineral products, the RXA slightly declined between 2000 and 2011.

Figure 7.5 / Trade indicators of Castile–La Mancha



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

Employment and patent intensity

Table 7.9 shows that the share of employment declined in both the textile and the leather industries. Especially the former experienced a sharp decline. Hence, the employment share decreased from 2.8% in 2000 to merely 0.5% in 2011. In the leather industry, the decline was less pronounced and added up to a decrease by an average of 1.5% per year. Only in the manufacturing of other non-metallic mineral products did the regional employment share remain constant at 1.6% in 2000 and 1.7% in 2011. Summarising, the figures show a weak employment performance of the regional industry, even in the industries in which Castile–La Mancha holds a trade specialisation.

In terms of regional innovativeness, it becomes evident that Castile–La Mancha is seriously lagging behind. The number of patents in the regional manufacturing sector only sums up to an annual average of 0.04 patents per 10,000 employees (2009 to 2011). Looking only at high- and medium-tech industries, it was only slightly higher (1.1 patents per 10,000 employees). With respect to the three industries with above-average trade specialisation indicators, the figures in Table 7.9 show that the patent intensity increased in all three industries between the years 2000 to 2011. However, with an annual average of 0.8 patents per 10,000 employees in the textile industry and the leather industry, and 1.9 patents per 10,000 employees in the manufacturing of other non-metallic mineral products, the innovativeness of the three industries is clearly underdeveloped.

Table 7.9 / Regional key figures for Castile–La Mancha

	Employment				Patent intensity	
Sector	Number of employees	Regional employment structure (%)		Annual average growth rate of regional employment between 2000 and 2013 (%)	Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)	
	2013		2000	2000-13	2000-02	2009-11
Region total	715,800	100.0	100.0	1.2		
Manufacturing	102,100	14.3	18.6	-0.9	1.2	4.4
High- and medium-tech	16,006	2.3	2.2	1.4	5.2	19.5
Low-tech	85,500	11.9	16.4	-1.2	0.6	0.5
Knowledge-intensive services	146,300	20.4	13.2	4.6		
Other	467,400	65.3	68.2	0.9		
Selected manufacturing industries:						
18	3,700	0.5	2.8	-11.0	0.0	0.8
19	6,100	0.9	1.2	-1.5	0.0	0.8
26	11,200	1.6	1.7	0.5	0.7	1.9

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations.

Drivers of trade specialisation and regional growth

Economic structure

All three industries in which Castile–La Mancha reveals an above-average trade specialisation belong to the low-tech industrial sector. Moreover, they all constitute traditionally strong regional industries. Embroidery, carpentry and work with leather belong to the common trades in the area. Most of them are very deeply rooted in the towns of Castile–La Mancha. Fibres and leathers are involved in the most typical craftwork in Guadalajara and the surroundings. Especially the towns of Azuqueca de Henares, Jadraque, Sigüenza and Brihuega host many small workshops that are specialised in the design and production of clothes and leather works (TURÉSPANIA, 2015). Besides these small workshops, a number of larger firms operating in the clothing, shoes and leather industry are located in the region (e.g. Almansa Cuero Piel, Curtidos Requena, Pielcu SL). These larger firms are more export-oriented than the smaller workshops that mainly produce for the local market (Curritidores Espanoles, 2015).

In the case of the manufacture of non-metallic mineral products, the region assumingly benefits from the regional mineral deposits. Thus, the petro mine in Puertollano near Ciudad Real entailed the establishment of a large petroleum refinery, which constitutes a major petrochemical centre in Spain

(Rodriguez, 2014). Also the mine in Almadén, producing mercury, led to a number of firms working in the manufacturing of other non-metallic mineral products locating in Castile–La Mancha. Furthermore, there are important deposits of iron in Guadalajara, and kaolin in Cuenca, which further involved the location of firms operating in the manufacturing of other non-metallic mineral products in the region (Rodriguez, 2014). Outside the province of Ciudad Real, the regional industrial sector is, however, underdeveloped.

Besides the three industries outlined above, Castile–La Mancha also plays a major role in the Spanish agrifood industry. Especially sectors such as wine, olive oil, vegetables, fresh and processed meat as well as cheese and dairy products are important in the region (Vargas et al., 2011). In recent years, the bio-economy has played an increasingly important role in the regional primary sector and renewable biological resources are now a core for a new economy scheme (IPEX, 2015).

Given its central location within Spain and its proximity to the capital of Madrid, it is not surprising that transport and logistics are important service industries within the region. Its central location and the fact that Castile–La Mancha has the most kilometres of *autopistas* (a type of limited-access highway) and *autovias* (dual carriageways) of all Spanish regions makes it a preferred location for the logistics industry (IPEX, 2015). Altogether, the regional infrastructure sums up to 2,790 road kilometres. The region greatly benefits from Spain's spider web structure transport network that positions Castile–La Mancha as a natural extension to metropolitan Madrid. Four of the six motorways radiating from Madrid to the main sea ports pass through Castile–La Mancha. Furthermore, the fact that Castile–La Mancha encloses much of the Madrid Region, the major consumer centre in Spain, makes it a very interesting destination for distribution operators, logistics companies as well as e-commerce logistic platforms at a more competitive price (IPEX, 2015).

Regional innovation system

According to the Regional Innovation Scoreboard (RIS) 2014, Castile–La Mancha ranks as a moderate innovator with an innovation performance below EU average. The comparatively weak innovation base is also visible when looking at the regional R&D expenditures. In 2012, the share of R&D expenditures in Castile La Mancha only represented 0.6% of the regional GDP, which is less than half of the Spanish average (1.3%). When looking at the sources of R&D expenditures, 62.9% of the regional R&D expenditure came from the private sector; this is much higher than the national average, which amounted to 46.3%. On the other hand, public R&D expenditures are of lower importance. The public R&D expenditures have severely suffered from budget cuts implemented during the recent economic crisis (European Commission, 2015c): The annual budget of Castile–La Mancha devoted to R&D decreased by 10% in 2013. However, in 2014, there was again an increase of 11% in the R&D budget. Nevertheless, it is too early to judge the long-term impact of these changes on the R&D policies.

The main regional university is the University of Castile–La Mancha (UCLM), which is relatively young. It was established in 1982, and consists of four centres spread across the whole region. Currently the UCLM has 30,043 students, among which 1,988 are enrolled in a postgraduates or PhD programme. 2,386 professors working in 115 research groups are employed at the UCLM. Those groups are very diverse and do not necessarily respond to the needs of the local or regional economy. Yet, the UCLM also maintains a network of centres and institutes in disciplines that are of special interest to the region, including clothing, wood, footwear, livestock, bio fuel or hazardous waste. The centres are publicly funded and undertake research activities in the respective industries and, thereby, contribute to the regional development by transferring technology to companies and opening up the possibilities for future graduates to enter the job market (Eures, 2014). Further regional institutions and organisations that foster knowledge exchange between science and businesses include the two regional Science and Technology Parks in Albacete and Guadalajara, where universities, research institutions and businesses interact and promote the creation and development of new businesses (European Commission, 2015c). CYTEMA (an Energy and Environment Science and Technology Campus), which forms part of the University of Castile–La Mancha, is another regional institution that promotes research and knowledge transfer, especially in the fields of energy and environmental industries (European Commission, 2015c). Furthermore, two independent research institutes are located in the region: the National Centre for Hydrogen and Fuel Cell Technology Experimentation, and the Yebes Astronomical Observatory. They both are large facilities, dedicated to leading edge research and technological development, as well as to promoting the exchange, transmission and preservation of knowledge and technology (European Commission, 2015c).

Despite the two flagship research institutions located in the region, half of the regional employees working in the field of R&D are employed at UCLM. 28.6% work in the private sector, and 21.1% in public administration. The total number of workers engaged in R&D during 2012 in Castile–La Mancha amounted to 7,607 persons, representing 2.2% of Spanish R&D workers. Still, the share of people working in the knowledge-intensive sector (KIS[17]) significantly increased between 2000 and 2013. While in 2000, the share of employees in KIS was only 13.2%, by 2013, it achieved 20.4% (Table 7.9). In the same period, the share of human resources allocated to low-tech industries decreased from 16.4% to 11.9%. These results point towards an increase in the qualification level of the regional human capital in Castile–La Mancha.

Yet Castile–La Mancha's regional innovation system is still characterised by low R&D investment and low innovation outputs, which has led the region to choose a strategy based on the creation of R&D Hot Spots, according to geographical or industrial needs and capacities. However, as outlined above, the recent financial and economic crisis has slowed down the implementation of some R&D strategies planned for these years.

Political context and regional growth Policies

Given the comparatively underdeveloped regional innovation system, Castile–La Mancha has undertaken activities aimed at reinforcing the science, technology and industry system by defining a regional science and technology policy. The priority of the regional government is to ensure that innovative business and research projects benefit from public resources so that they can be performed in Castile–La Mancha and contribute towards its economic and social progress. The EU structural funds are an important source for the region, given the national austerity programmes implemented in Spain as a response to the recent crisis.

The regional programme for the EU funding period 2014-2010 identifies several priorities to achieve smart, sustainable and inclusive growth and economic, social and territorial cohesion. The most important priorities are the strengthening of research, technological development and innovation

[17] Following the NIW/ISI definition, KIS are defined as NACE 64 (telecommunications), 72 (computer and related services), 73 (research and development), 74 (other business services), 85 (health and social work) and 92 (recreational, cultural and sporting activities) (Legler and Frietsch, 2007, pp. 19f.).

activities to create an environment conducive to innovation and capable of attracting new investment and activity in the field of R&D. Given the exceptionally high unemployment rate in the region, the ultimate goal is the creation of jobs. A further aspect that is outlined in the programme is the enhancement of the access to, and the use and quality of, information and communication technologies by companies and public administrations in Castile–La Mancha in order to increase the competitiveness of the economy, the participation of society and the efficiency of public administration. As a third priority, the regional programme lists the increase in the competitiveness of small and medium-sized enterprises (SMEs), supporting their capacity to grow in regional, national and international markets, and to engage in innovation processes.

Along with the regional operational programme for the EU funding period 2014 to 2020, Castile–La Mancha has also formulated specific regional policy goals under the PRINCET 2011-2015 strategy. PRINCET (Regional Plan for Scientific Research, Technological Development and Innovation) is a regional plan designed for promoting the regional system of science and technology (European Commission, 2015c). The specific objectives of the PRINCET plan are to increase and optimise existing resources, promote innovative and competitive business networks, foster the internationalisation of public and private actors in the regional science and technology system, promote public-private collaborations, boost research excellence of the public research organisations and promote a culture favouring science and technology (European Commission, 2015c). Overall, the plan has been structured along the thematic areas covered by FP7 and through six main action lines, namely internationalisation, training, collaboration between public and private sectors, fostering business activity, and dissemination of science and technology. In addition, three new instruments of coordination will be created: RETCAM (Technology Network of Castile–La Mancha), designed to foster business competitiveness; a Science Public Dissemination Unit that aims at spreading scientific culture; and the Institute of Agroforestry Research in Castile–La Mancha, which will be devoted to the agrarian and rural development (European Commission, 2015c). Besides the PRINCET, which focuses primarily on science and technology, the regional Endowment Plan aims to strengthen the industrial substance of the region. This plan is designed to support SMEs in gaining competences to increase their competitiveness (European Commission, 2015c).

Conclusion

Summarising, the case study of Castile–La Mancha has shown that this rural and sparsely populated Spanish region lags behind the leading European regions in a number of key characteristics such as the regional GDP per capita or the regional employment rate. Furthermore, the regional R&D expenditures and patent activities are quite low, pointing towards an underdeveloped regional innovation system. The main obstacles of the regional economy are the low population density, a shortage of qualified workers, and a lack of any industrial networks resulting from the fact that firms are scattered across a large geographic area. Despite these unfavourable conditions, the region shows a lasting trade specialisation in three industries of the low- and medium-low-technology manufacturing sectors. The comparatively good trade performance of Castile–La Mancha is mainly attributed to the regional industrial legacy, with textile and leather crafts playing a traditionally strong role in the region. In contrast, the strong performance of the manufacture of non-metallic mineral products is driven by the regional endowment with natural resources. Given these trade specialisation patterns, it becomes obvious that the region faces major challenges in the near future. Thus, in the wearing apparel and the leather industries, the region faces an increasingly strong competition from Asian countries where labour costs are lower.

Furthermore, the stock of natural resources is not abundant and thus further challenges regional economic policy. Here, the latest attempts to attract more firms operating in the bio-economy and to establish renewable energies, including bio fuels, as the basis of a new economy scheme certainly move in the right direction.

Table 7.10 / Stylised industry-specific regression results for Castile–La Mancha

Full sample

RXA (gross exports)	18	19	26
(log) patent intensity	9.556	27.153	3.649
(log) techn. innov., SMEs	6.287	-25.277	50.277 ***
(log) non-techn. innov, SMEs	13.836	19.697	-11.094
tertiary educ. < 35 yrs.	0.049	0.308	-1.119 ***
(log) HERD	-9.127 *	-7.710	-1.282
(log) BERD	-9.683 *	5.711	-4.464
GDP per capita	-0.001	-0.006 ***	-0.002 **
(log) population density	33.280 ***	-0.596	-13.268 **
cluster	77.373 ***	138.388 ***	1.631
business services	-11.197	0.804	-11.192
ERDF innovation	0.209	0.683	-0.152
(log) quality of governm.	-19.340 **	-34.600 **	-28.378 ***
accessibility index	-0.614 **	0.893 *	0.093
R^2 within	0.029	0.026	0.046
R^2 between	0.417	0.299	0.315
R^2 overall	0.353	0.240	0.243
No. of observations	2,800	2,763	2,800
No. of clusters	250	250	250

Transition regions

	sf2 / p18	sf2 / p19	sf2 / p26
(log) patent intensity	-80.354	39.229	11.250
(log) techn. innov., SMEs	-82.179 **	-104.829	-7.301
(log) non-techn. innov, SMEs	-120.341	-160.139	-119.465 *
tertiary educ. < 35 yrs.	-0.513	1.909	-2.860 *
(log) HERD	-22.758	4.040	2.876
(log) BERD	-16.479	49.834 **	-1.373
GDP per capita	-0.005	-0.013 *	-0.004
(log) population density	42.796 *	-14.729	1.396
cluster	146.220 ***	3.800	13.440
business services	-25.998	-7.264	-30.075
ERDF innovation	1.106	1.507	-0.635
(log) quality of governm.	20.054	-40.629	-21.132
accessibility index	-0.418	-0.384	0.350
R^2 within	0.041	0.037	0.072
R^2 between	0.331	0.317	0.433
R^2 overall	0.194	0.199	0.342
No. of observations	494	477	494
No. of clusters	47	47	47

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of wearing apparel; dressing and dyeing of fur (18), Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), Manufacture of other non-metallic mineral products (26). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

According to the empirical model, location requirements of the selected industries are not easily broken down to a common basis. However, the weak innovation activities in regions with similarly high specialisation in these three industries as it is expressed by the model in terms of lacking significant effects, mirrors the situation in Castile–La Mancha. The only features found are that, while comparative advantages in wearing apparel and leather manufacturing rely on industry-specific clustering, favourable innovation-related conditions for the third industry, manufacture of other non-metallic mineral products, are expressed by innovative SMEs.

At least, low requirements concerning the political environment are common to all three industries. This is however, no ideal precondition for developing the industrial structure even though starting points for development strategies are hard to identify by means of the results at hand. Industrial and innovation policy thus needs to be implemented with caution and requires considering both the exploration of new technologies and industries, such as renewable energies as described above, as well as supporting the prevalent industries in order to seek opportunities for diversification. In this process, policies supporting SME development can play a favourable role since SMEs are sufficiently agile to adapt to emerging trends suitable for the region’s economic preconditions.

7.3.4. Chemnitz

Regional background information

The region of Chemnitz is located in Eastern Germany, bordering on the Czech Republic and on the northern foothills of the Ore Mountains. It belongs to the German federal state of Saxony, which is the most successful state of the ‘new *Länder’* in terms of GDP per capita (Statistisches Bundesamt, 2015). In 2014, the regional population amounted to 1.5 million inhabitants (2% of German total population), with Chemnitz (242,000 inhabitants) and Zwickau (91,560 inhabitants) being the two largest cities. The regional population density amounts to 232 inhabitants per square kilometre. Against this background, it is classified as an urban region according to the regional classification of the German Institute for Urban and Regional Development (BBRS).

The region is one of the most important economic areas of Eastern Germany and part of the Central German Metropolitan Region (*Metropolregion Mitteldeutschland*) (Behr and Geissler, 2005). Despite its vast population losses in the recent past, it experienced strong economic growth. Particularly since 2000, the region’s economy has recorded high annual GDP growth rates, with the regional economy being based on the services sector and the manufacturing industry (Behr and Geissler, 2005).

Despite its above-average growth rates, the regional GDP still only amounts to 89% of the EU average in 2011. Given its GDP slightly below the 90%-threshold, the region falls under the transition regions in the EU structural fund period 2014-2020 (2014/99/EC). While unemployment was a major problem of the region in the 1990s, with rates frequently exceeding 20%, in the last ten years, the unemployment rate has been constantly declining, from 18% in 2005 (German average 10.7%) to 8.8% in 2011. Thus it is only slightly above the German average of 6.4%, but below the EU average of 9.5% in that year.

The regional business structure is predominantly characterised by small and medium-sized enterprises (SMEs), with mechanical engineering, metal processing and vehicle manufacturing the most important manufacturing sectors. The industrial tradition in Chemnitz reaches back to the 19th century. Industrialisation took hold quite early in the Zwickau-Chemnitz economic zone and the area used to be referred to as the Manchester of Germany (Behr and Geissler, 2005). The once major manufacturing industries of textile manufacturing, metal working, mechanical and automotive engineering grew naturally out of the trades and crafts historically practised in Chemnitz, and today still constitute its comparative advantage as shown below.

In 1990, Volkswagen exploited the regional knowledge and capital resources of the automotive industry by establishing a new production plant in Zwickau. Later on, the region succeeded in attracting firms specialising in new technologies, electronics and electrical engineering. Besides the skill demand emanating from these knowledge-intensive industries, there is also a large variety of higher education institutions such as the technical universities of Chemnitz and Freiberg as well as several applied universities contributing to the high skill intensity of the regional employment: correspondingly, the share of employees holding a tertiary degree amounts to more than twice the national average (28.7% vs. 13%) (Statistisches Bundesamt, 2015).

Selected industries

International trade

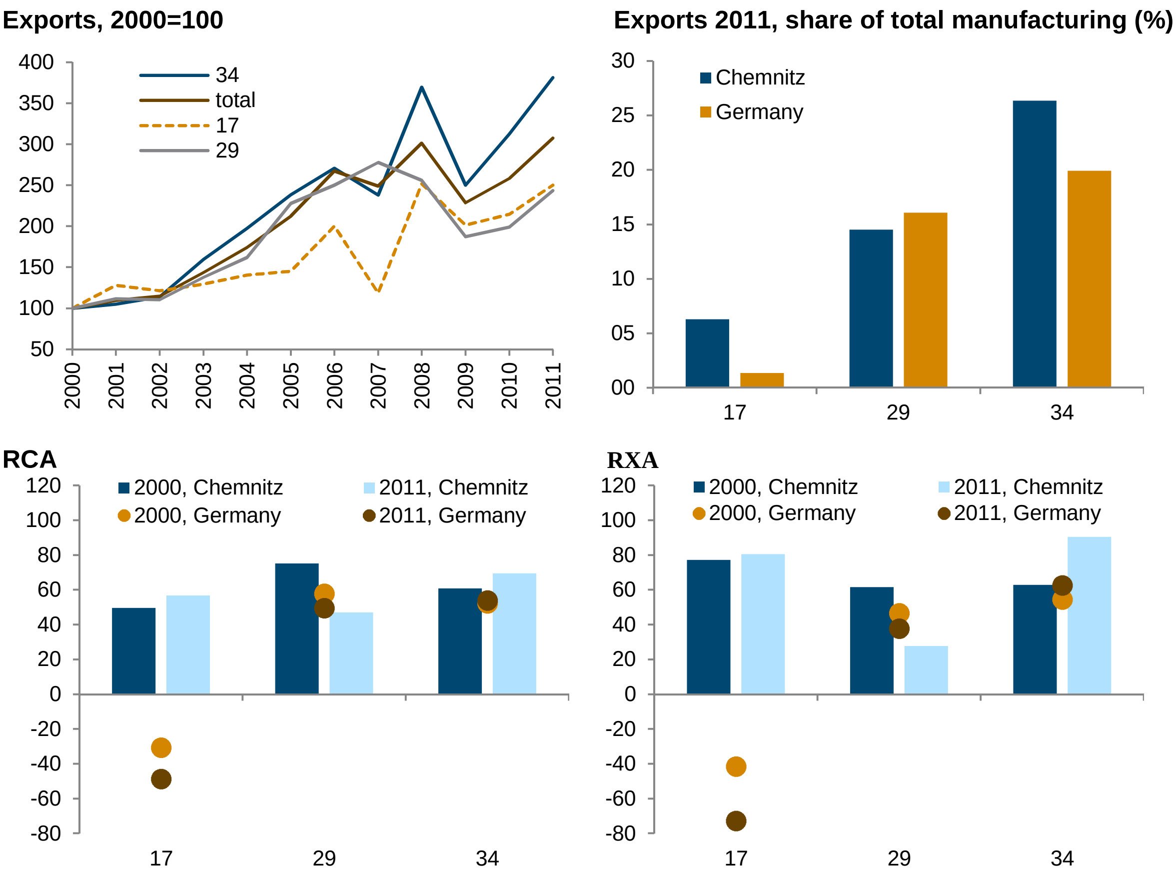
Because of the two major Volkswagen production plants located in the region, it is not surprising that Chemnitz reveals a strong international trade performance in the automotive industry (i.e. NACE Rev. 1.1: 34). As Figure 7.6 depicts, about a quarter of regional exports stems from the automotive industry (26.3%) compared to the German average of about one fifth (19.9%) in 2011. Moreover, the high specialisation indicators (RXA and RCA) further increased between 2000 and 2011. Besides, the region also shows above-average trade specialisation in the machinery industry (i.e. manufacturing of machinery and equipment, NACE Rev. 1.1: 29), and the textile industry (17). Whereas the positive trade specialisation in the automotive and machinery industries corresponds to the national German average, the positive trade specialisation in the textile industry is a specific regional characteristic.

While the export share of Chemnitz in textile products (6.3%) was markedly higher than the German average (1.4%) in 2011, the regional export share of 14.5% in the machinery industry was slightly below the German average (16.1%). However, in comparison to the EU average, Chemnitz' machinery exports are still above-average. Together, the export market shares of the three industries indicate that in terms of international trade performance, the region still profits from its traditionally strong regional industries. Thus, the previously prosperous industries are still relevant today. Merely 6.3% of all regional exports of the manufacturing sector are attributed to the textile industry in 2011 (Figure 7.6). Yet the regional exports in the textile industry are far above the German average of 1.4% in 2011.

Employment and patent intensity

The outstanding export performance of the automotive industry in Chemnitz (Figure 7.6) is also reflected in terms of employment. The industry's about 32,000 workers account for 4.6% of total regional employment. This share has even doubled since 2000, which is also expressed by an annual growth rate of 5.3%. Patent intensity in the automotive industry amounts to 6.7 per 10,000 employees, which is, however, slightly lower than in 2000 (8.5) and significantly lower than the regional manufacturing average (16.7 per 10,000 employees) (Table 7.11). This may be partly attributed to the fact that the regional automotive industry is mainly assigned to manufacturing activities, whereas R&D and thus also patenting is concentrated in group company enterprises in other regions. Furthermore, the large automotive plants are focused on the production of vehicle engines. In this context, R&D and innovation is often conducted by mechanical engineering suppliers, statistically found in the machinery industry.

Figure 7.6 / Trade indicators of Chemnitz



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

As opposed to the automotive industry, in the machinery industry the positive RCA and RXA values for Chemnitz continuously declined during the observation period. In parallel to that, the employment share in this industry also slightly decreased from 3.4% in 2000 to 2.8% in 2013, driven by negative absolute employment changes (-1.6% annually). Meanwhile, patent activity has even further increased, although also the initial intensity of 21.8 was already at a high level, and has recently grown towards twice that number (45.7) (Table 7.11).

The third industry in which Chemnitz realises an above-average trade specialisation is the textile industry. Here, the region certainly profits from its long tradition, reaching back to the times of industrialisation. In terms of employment, the industry accounted for a share of 2.2% of total regional employment in 2013 and the number of employees increased by nearly 1,000 or 0.5% annually between 2000 and 2013. As the textile industry classifies as a two-tech industry, it is not surprising that patent intensity is quite low. In the years 2009 to 2011, the annual number of patents filed in this industry amounted to 1.7 patents per 10,000 employees.

In general, the share of employees in the low-tech industries remained constant between 2000 and 2013, while the share of employees in the high-tech industry increased from 8.8% in 2000 to 9.6% in 2013.

Drivers of trade specialisation and regional growth

Economic structure

As outlined above, the positive trade performance of Chemnitz in the three industries is certainly based on the long regional tradition of these industries. Hence, in the early 20th century, nearly two dozen vehicle producing companies located in the region: some of the biggest were Horch, DKW and Wanderer, which merged in the 1930s, founding the Auto Union, which later reemerged as Audi (Scheuplein et al., 2007). Although the Auto Union works were seized after World War II and no longer existed in the former German Democratic Republic (GDR), the automotive industry in Southwest Saxony was still present with the ‘VEB Sachsenring’, producing the Trabant during the times of the GDR (Scheuplain et al., 2007). After the German unification, in 1990 Volkwagen built a new production plant just north of Zwickau and an engine works plant in Chemnitz, reinforcing the importance of the regional automotive industry in a new economic environment. Despite the fact that the two Volkswagen plants certainly account for the vast majority of the regional employment in the automotive industry, the regional automotive cluster encompasses 250 additional suppliers with more than 30,000 highly qualified specialists that are employed in the field associated with automotives (Günther and Bochow, 2005).

Table 7.11 / Regional key figures for Chemnitz

	Employment				Patent intensity	
Sector	**Number of employees**	**Regional employment structure (%)**		**Annual average growth rate of regional employment between 2000 and 2013(%)**	**Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)**	
	2013		**2000**	**2000-13**	**2000-02**	**2009-11**
Region total	688,900	100.0	100.0	0.0		
Manufacturing	157,500	22.9	22.1	0.3	10.3	16.7
High- and medium-tech	66,100	9.6	8.8	0.6	21.6	31.8
Low-tech	91,400	13.3	13.3	0.0	3.3	5.9
Knowledge-intensive services	174,300	25.3	19.1	2.2		
Other	357,200	51.8	58.8	-1.0		
Selected manufacturing industries:						
17	15,200	2.2	2.1	0.5	2.3	1.7
29	19,100	2.8	3.4	-1.6	21.8	45.7
34	31,900	4.6	2.4	5.3	8.5	6.7

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations.

Together with the automotive industry, machine building and machine tool production has traditionally been another strong pillar of Southwest Saxony's economy. Custom fabrication of specialised machines has nearly completely replaced mass production, and the firms are smaller and more flexible. Niles and Union, Karl Mayer Malimo, Schönherr or CSM are the largest firms operating in the Chemnitz machine building industry (Berka et al. 2007). The largest machine building company in Saxony is also located in the region of Chemnitz. It is the press maker MAN Plamag Druckmaschinen AG of Plauen in the regions southwest (IHK Chemnitz, 2015). In cooperation with these leading international companies, a great number of small and medium-sized firms arose from the remains of the old Eastern German enterprises. For these new companies, Saxony's large pool of highly skilled workers is central in their decision to locate here. Furthermore, they greatly benefit from the regional competencies in the field of mechanical engineering led by the Fraunhofer Institute for Machine Tools and Forming Technology (IWU) in Chemnitz (Bach, 2004). The region is also home to Germany’s first Innovation Cluster ‘Mechatronic Mechanical Engineering’, established by the Fraunhofer Society. Headed by the Fraunhofer Institute for Machine Tools and Forming Technology (IWU), the cluster connects companies involved in the development of mechatronic systems. The strongly increased patent intensity in the machinery industry may also be attributed to the success of these innovation networks.

With respect to the textile industry, Chemnitz is one of the four most important centres in Germany (Baum and Ziegenbalg, 2011). The regional textile and clothing industry does not only have a long-standing tradition but also shows a strong performance at present and has an excellent innovation potential. Modern products such as spacer fabrics, interlaid scrims for composite structures, medical textiles and high-quality functional textiles and technical textiles are produced in the region of Chemnitz (Baum and Ziegenbalg, 2011). Particular technical textiles have become increasingly important for the regional textile industry (Leo and Polte, 2013). They are important components for innovative products. The range of applications of these technical textiles reaches from airbags for cars, textile sealing and filters, fibre composites for sport equipment or aircrafts, to textile concrete in buildings and textile implants in medicine. The term technical textiles, thus, covers all those textile materials not belonging to clothing and home textiles in the classical sense (Leo and Polte, 2013). Technical textiles are mainly developed, produced and applied under the aspect of functionality. Given the existence of a substantial cluster (i.e. Sachsen!Textil), which was funded as an initiative for the regional textile industry, the preconditions for a sustained and extended strong performance of the textile industry in the region are given.

Moreover, knowledge-intensive services play an increasingly important role for the development of the regional economy. The share of KIS (as defined by Legler and Frietsch, 2007) increased from 19.1% in 2000 to 25.3% in 2013. The annual growth rate amounted to 2.2% (Table 7.11).

Regional innovation system

Science and business have traditionally been closely linked in Chemnitz. The region is characterised by four institutions of higher education, three universities of applied education, seven technology and start-up centres (e.g. the Technology Centre Chemnitz, TCC), about 20 non-university research facilities, and more than 1,000 technology companies. The region’s largest university is Chemnitz University of Technology, where about 10,000 students are enrolled. Being a technical university, the institute has a strong focus on engineering and natural sciences. Other university-level institutions in the region include the technical university of Freiberg, the colleges of higher education in Zwickau and Mittweida as well as the three universities of cooperative education in Glauchau, Breitenbrunn and Plauen, which focus on application-oriented research and close cooperation with companies. Several initiatives promote university-industry linkages in R&D. The Smart Systems campus on the site of the Chemnitz University of Technology is a prime example combining short, direct routes to scientific-technical facilities emphasising the promotion of start-ups and entrepreneurship. Thus, the region is endowed with qualified human resources (Bach, 2004).

The regional attempts to establish Chemnitz as an innovation hub are also reflected by growing regional patent activities. In spite of the relatively low patenting performance of the automotive industry, the number of patents per 10,000 employees rose from 21.6 to 31.8 in the high- and medium-high-tech manufacturing sector and from 3.3 to 5.9 in the low-tech sector. Still, in general, the regional innovation system seems to succeed in supporting the knowledge transfer between research institutions and the industry and in generating a dynamic innovation process for companies in the region. But, while Chemnitz' expenditures on Higher Education Research and Development (HERD) as a percentage of regional GDP accounted for 0.56% in 2011, thus being higher than the EU average of 0.46%, the respective share of business R&D expenditures (BERD) (1.02%) was still significantly lower than the EU average of 1.24%.

Political context and regional growth policies

In the German political system, the federal states (*Länder*) are the most important political entities regarding competencies in regional policy. Each federal state in Germany applies its own operational programme for the EU structural funds. In the case of Chemitz, the region is one of three NUTS 2 regions of the German federal state of Saxony (NUTS 1).

Like other regions in the East of Germany (former GDR), Chemnitz benefited from generous national support programmes aiming to support the transition of the new federal states to a market economy after the German re-unication in 1990. The main priority of these support programmes, many still in place today, has been the endowment with physical infrastructure and the relocation of business to foster regional employment and economic growth (Bach and Ziegenbalg, 2011). However, it was also the commitment of individual firms that played an important role for the development of the region after the fall of the iron curtain. The Volkswagen group, for instance, did not only open two major plants in the region, but also, together with the Fraunhofer society, founded a centre of excellence for automotive production, a VW research factory on the site of the Fraunhofer institute for machine tools and forming technology.

Chemnitz also benefited from its classification as an Objective 1 region in the preceding EU funding period. In the funding period 2007-2013, large amounts have been devoted to improvements in the regional infrastructure (40%) as well as research, innovation and technology (35%) (Sächsisches Staatsministerium für Wirtschaft, Arbeit und Verkehr, 2014). In the funding period 2014-2010, the focus on research, innovation and technology was extended (40%) and also the strengthening of the competitiveness of SMEs (Sächsische Staatskanzlei, 2014).

Conclusion

The case study of Chemnitz has shown that even though the region does not belong to the advanced European regions in terms of GDP per capita, it still reveals a strong trade specialisation in two high/medium-high-technology industries (automotive and machinery industries) and one low-technology industry (textile industry). The region clearly profits from its industrial tradition, which was already the regional economic backbone in times of the GDR. After German reunification in 1990, the region succeeded in re-vitalising these industries with the support of regional policies aimed at attracting firms to these traditionally strong regional industries. The positive regional economic development in recent years can also be attributed to the fact that firms operating in medium-high- and low-technology industries successfully implemented technological changes. Textile firms, for example, increasingly specialise on higher-quality industrial textiles that are more knowledge-intensive than the traditional clothing industry. The sufficiently large pool of qualified workers as well as the well-developed regional innovation system has been important preconditions for the positive regional development in recent years. The large number of regional universities and university-level institutions are important pull factors for attracting young people to the region. However, the demographic change and the decline in population constitute future challenges for the region.

Table 7.12 / Stylised industry-specific regression results for Chemnitz

Full sample

RXA (gross exports)	17	29	34
(log) patent intensity	6.402	-0.066	-0.699
(log) techn. innov., SMEs	27.861 **	8.621	-15.365
(log) non-techn. innov, SMEs	7.527	-17.662 *	-8.432
tertiary educ. < 35 yrs.	-1.103 ***	-0.287	0.289
(log) HERD	1.525	8.140 *	15.255 ***
(log) BERD	-9.059 ***	0.039	-1.687
GDP per capita	-0.001 **	0.000	0.000
(log) population density	12.071 **	-9.884 **	-7.907
cluster	41.453 ***	32.625 ***	48.705 ***
business services	-5.542	3.823	-15.138
ERDF innovation	0.281	0.655 ***	-0.151
(log) quality of governm.	-28.937 ***	-2.210	26.288 **
accessibility index	-0.077	0.375 *	0.858 **
R^2 within	0.065	0.018	0.043
R^2 between	0.407	0.336	0.228
R^2 overall	0.352	0.263	0.190
No. of observations	2,800	2,800	2,800
No. of clusters	250	250	250

Transition regions

	sf2 / p17	sf2 / p29	sf2 / p34
(log) patent intensity	-4.345	1.308	1.945
(log) techn. innov., SMEs	-17.930	5.330	48.040
(log) non-techn. innov, SMEs	-102.973 *	-34.718	-297.875 ***
tertiary educ. < 35 yrs.	-2.185 *	-0.934 **	-1.197 *
(log) HERD	-0.892	22.261 **	7.980
(log) BERD	-7.204	-8.275 **	0.006
GDP per capita	-0.004	0.000	0.003 *
(log) population density	5.641	-11.509	-29.389 *
cluster	107.204 ***	3.102	80.870 ***
business services	-14.061	23.174	48.129
ERDF innovation	1.332 ***	0.669 *	-0.239
(log) quality of governm.	-40.946 **	29.031 ***	109.085 ***
accessibility index	-0.298	0.924 **	2.788 ***
R^2 within	0.086	0.166	0.028
R^2 between	0.510	0.522	0.687
R^2 overall	0.328	0.419	0.542
No. of observations	494	494	494
No. of clusters	47	47	47

Note: * $p<0.1$, ** $p<0.05$, *** $p<0.01$. Manufacture of textiles (17), Manufacture of machinery and equipment n.e.c. (29), Manufacture of motor vehicles, trailers and semi-trailers (34). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

Comparisons with the regression results are difficult since similarities of the estimates between the three industries are rare. The most unambiguous result concerning Chemnitz is the presence of industrial clusters which clearly promote comparative advantages. This production orientation – rather than a functional specialisation on headquarter functions – is also expressed by the lower importance of non-technological (e.g. distributional or organisational) innovations by SMEs. Another point questioning the future perspectives of the location and its comparative advantages is represented by low dependency on skilled labour supply. Since also Chemnitz suffers from a remarkable population decline, human capital will hardly serve as a positive location factor in the medium term. However, policy issues prove to be relatively beneficial for the region as is also the case for population density, although the latter is not a decisive factor in the model. A further characteristic of Chemnitz which also fits the econometric results is the importance of a public research infrastructure as indicated by HERD. Given these favourable preconditions it will be necessary to maintain further infrastructure in times of demographic change.

7.3.5. Jihozápad

Regional background information

Jihozápad is located in the south-west of the Czech Republic, bordering on Germany and Austria. Geographically, the region is the largest NUTS 2 region of the Czech Republic, covering an area of 17,617 km² (22.3% of the Czech territory). However, with a population of 1.2 million inhabitants and a population density of 69 inhabitants per km^2, Jihozápad only represents 11.5% of the Czech population. Thus, the region is one of the less populated areas of the EU. Jihozápad can be characterised as a rural region with a large number of smaller municipalities. The two centres of Jihozápad are Pilsen in the west of the region and Budweis in the southern part of Jihozápad. Pilsen is the capital and industrial centre of the West Bohemian Region and Budweis the capital of the Southern Bohemian region.

In 2011, the region generated a GDP of 17,600 PPS per capita, which is 15% lower than the national average and 32% lower than the EU average. Still, per capita GDP has been growing steadily, by almost 50°%, from 12,600 PPS in 2000 to 18,400 PPS in 2007. After a setback owing to the crisis in 2008 and 2009, the region continued its GDP upswing from 2010 onward. However, Jihozápad is still a less developed region and therefore falls under structural fund category 1 in funding period 2007-2014 (EC/2014/99/EU). Regional economic performance is mainly based on the low- and medium-tech manufacturing sector. The contribution of knowledge-intensive services and high-tech industry is comparatively small. Within the Czech Republic, Jihozápad certainly profits from its geographic location and proximity to Germany and Austria in respect of business collaboration and the attraction of FDI in the region.

As opposed to the below-average performance of GDP, results for regional unemployment in Jihozápad are more favourable than the country average. In 2009, the regional unemployment rate amounted to 5.2%, while the national (Czech) unemployment rate added up to 6.7% in the same year.[18] However, the region experienced severe out-migration from the rural areas with poor job opportunities to the economic centres such as Pilsen.

[18] The unemployment estimate of the Czech Statistical Office is higher (i.e. 8% in 2009).

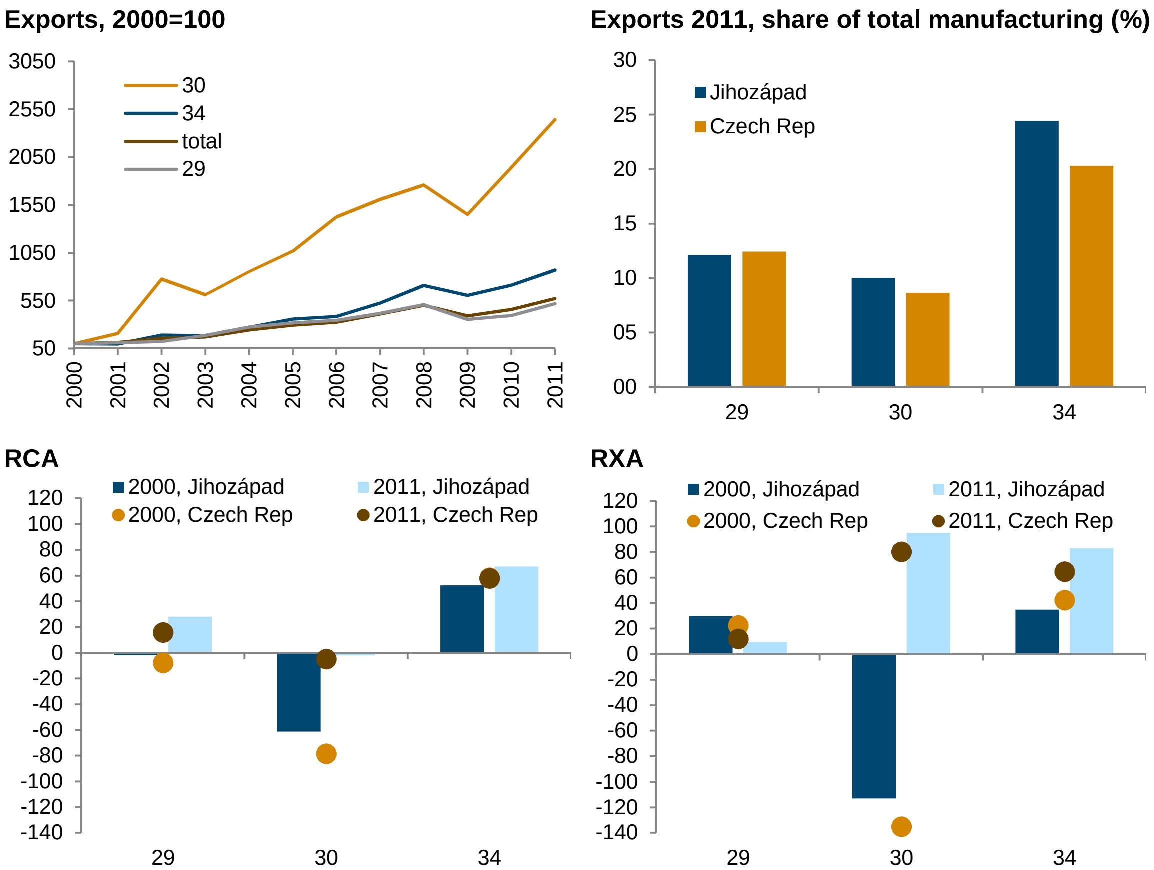
The Czech Republic has not adopted the euro, but kept the Czech koruna (CZK) that was introduced in 1993. The currency has been significantly appreciated against the euro, with the EUR-CZK exchange rate dropping from 36 CZK/EUR in 2000 to only 24 CZK/EUR in 2008. However, the Czech Central Bank has pursued a devaluation policy since mid-2008. The devaluation can make Czech exports to other EU countries increasingly competitive and, for instance, Škoda cars cheap on the European market. Jihozápad as a border region to Germany and Austria potentially benefits from its geographical position in this context.

Selected industries

International trade

Based on the selection criteria outlined above, Jihozápad shows an above-average trade specialisation in three industries: manufacture of machinery and equipment (NACE Rev. 1.1: 29), manufacture of office machinery and computers (30) and manufacture of motor vehicles, trailers and semi-trailers (34). It is important to note that in the case of Jihozápad, the remaining less developed EU regions (Structural Fund category 1) are taken as the reference group.

Figure 7.7 / Trade indicators of Jihozápad



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

The manufacture of motor vehicles is of great economic importance for the region due to its large contribution to regional exports (Figure 7.7). The automotive industries hold a share of 24% of the total regional exports in 2011, followed by the production of machinery and equipment (12%) and of office machinery and computers (10%). The automotive industry yields consistently high RCA values of over 40 and is, during the entire examination period, the region's most competitive industry. The regional performance resembles the country performance in terms of RCA. Also in terms of RXA the trade specialisation is rising, and the regional and national trends are quite similar.

The manufacture of machinery and equipment has been steadily gaining competitiveness as suggested by the development of the RCA value from -2 to recently 28. At the country level the RCA also experienced a positive development from a slight disadvantage to a positive RCA. Export specialisation measured by the RXA, however, shows a slight decline at regional and country levels. The RCAs of the regional office machinery and computer industry continue to reveal a negative value of -2 in 2011. The RXA values of the industry, nonetheless, suggest an increasing export specialisation. However, the trade volume in the manufacture of office machinery and computers is negligible and thus variance in RCA and RXA is possibly subject to level effects from small absolute numbers.

Employment and patent activity

Employment in Jihozápad strongly relies on the manufacturing sector. Representing 30.3% of the total workforce in 2000, the share even slightly increased until recently (31.2% in 2013). Manufacturing, however, underlies some structural changes: Employment is shifting from low-tech to medium- and high-tech manufacturing during the period 2000–2013 (see Table 7.13). While 20.2% of the workforce was employed in low-tech manufacturing in 2000, the share declined to 16.7% in 2013. In contrast, employment in high- and medium-tech manufacturing increased from 10.0% to 14.5% in 2013.

Table 7.13 / Regional key figures for Jihozápad

	Employment				Patent intensity	
Sector	**Number of employees**	**Regional employment structure (%)**		**Annual average growth rate of regional employment between 2000 and 2013 (%)**	**Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)**	
	2013		**2000**	**2000-13**	**2000-02**	**2009-11**
Region total	576,200	100.0	100.0	0.2		
Manufacturing	179,700	31.2	30.3	0.4	0.8	1.8
High- and medium-tech	83,500	14.5	10.0	3.1	1.7	3.4
Low-tech	96,300	16.7	20.2	-1.3	0.4	0.5
Knowledge-intensive services	97,000	16.8	13.5	2.0		
Other	299,500	52.0	56.2	-0.4		
Selected manufacturing industries:						
29	21,300	3.7	3.8	-0.1	2.5	2.9
30	0,800	0.1	0.1	2.4	0.0	18.1
34	25,600	4.4	1.7	8.0	1.7	1.4

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations.

Manufacture of machinery represents only 3.7% (2013) but contributed consistently to the regional employment over time. A very positive tendency is found in the automotive industry. The regional employment share of this industry increased from 1.7% in 2000 to 4.4% in 2013. However, the industry of office machinery industry only employed 0.1% in 2000 as well as 2013. This may be indicating this industry’s stagnation at a low level.

Patent intensity in the selected industries varies significantly. The computer and office machinery industry exhibits 18.1 patents per 10,000 employees (2009-2011). The machinery and automotive industries, in contrast, show moderate and stable patent intensities amounting to 2.9 and 1.4, respectively (cf. Table 7.13).

Drivers of regional trade specialisation and regional growth

Economic structure

Historically determined, today’s economic structure of the Czech Republic still shows traces of the former large investments in the development of heavy industry, engineering and exploitation of natural resources. Jihozápad was less a recipient of those investments owing to the region’s lack of notable natural resources, except for coal deposits in Pilsen, and its western geographical position (Technopolis group et al., 2012, p. 8). Accordingly Jihozápad has a tradition in light (automotive) engineering, food and beverage manufacturing and agriculture. Traditionally the food and beverages industry of Pilsen and Budweis plays an important role for employment. As the landscape and nature have been largely preserved, tourism has been steadily gaining importance in the sparsely populated region.

Clusters in the manufacturing branches can potentially be an explanatory factor for the good performance of the industries in Jihozápad. Šimon (2005) reports cluster structures in the electro-technical industry in the Pilsen region and comes to the conclusion that the manufacturing branches of electrotechnics, electronics and machinery perform best in the Pilsen region with the potential of forming a mechatronics cluster that harnesses the specialisation of the different industries. It can also benefit from the proximity of business partners in Bavaria and Austria. The cluster additionally can draw innovative potential from cooperation with the nearby University of West Bohemia, which offers programmes in mechanical engineering, electrical engineering and applied sciences.

Among the largest employers in Pilsen are the electronics manufacturers Panasonic AVC producing TV sets, and Škoda, operating traditionally as different independent mechanical engineering firms. Škoda JS a.s. produces components for nuclear plants and containers for atomic waste and provides services for the modernisation of nuclear power plants. Škoda Transportation a.s. is active in the development and production of locomotives, trams and busses. Historically, the Pilsen region has a long engineering tradition because heavy industry was privileged during the communist period.

The transport infrastructure to Germany and other parts of the Czech Republic provides a good framework for businesses. The common borders with Germany and Austria provide direct access to large markets and can facilitate the region's trade performance via international business connections. The region has a well-developed infrastructure and holds a strategic position on the north-south transportation axis.

Although the Czech koruna is closely tied to the euro, export-prone industries can benefit from the depreciating koruna at least on a small scale, possibly explaining a comparative advantage of the region. One can only draw limited conclusions from that since it is reasonable to assume that Czech companies are also importing many intermediate products from the European market which is setting off the advantage on the export side.

Regional innovation system

Expenditures on research may serve as an indicator for the region's innovation capabilities and knowledge base. R&D is financed and carried out by businesses, universities, private organisations and the government. Overall R&D expenditure significantly increased, from EUR 42.8 million in 2001 to EUR 215.5 million in 2011. Average total R&D expenditures in the Czech Republic amounted to EUR 319 million in 2011. Thus, despite its high growth rates, R&D activity in the region is low compared to other Czech regions.

The share of R&D employees in the total workforce and the share of R&D expenditure in the national GDP are lower than the country average. Historically, FDI has played an important role in the economic development of the Czech Republic since the 1990s. Companies were undercapitalised and needed FDI to adapt to free market competition. Most FDI was attributed to the automotive, electric and light engineering industry that focuses on employment in production in Jihozápad rather than on R&D-intensive departments as is indicated by the business structure.

The largest universities of the region are the University of West Bohemia in Pilsen and the University of South Bohemia in Budweis. The University of West Bohemia provides education in the fields of mechanical and electrical engineering. In Pilsen industry and university can mutually benefit from the proximity of the industrial cluster and the university campus. The industry and university in Pilsen are focused on engineering while the knowledge base in the South Bohemian region is specialised in natural sciences.

The region's knowledge base shows an ambiguous pattern: Despite low but rapidly increasing R&D expenditures and patent activity, there is a skilled labour force, supplied by the educational system. The Regional Innovation Scoreboard ranks the region as a moderate innovator below EU average. The prospects for a further positive development of the R&D sector seem promising due to the tertiary education in technical subjects and the institutional framework that has been gradually developed in recent years. The knowledge base is, however, not sufficiently utilised yet since too many graduates are trained in subjects that are not employable in the region.

Political context and regional growth strategies

After an administrative reform in 2000 the self-governmental regions at NUTS 3 level were re-established in 2001. Accordingly, the region had comparatively little opportunity to develop growth and innovation policies. The institutional infrastructure is still deficient and does not provide all networks to connect research, administration and businesses (Technopolis group et al., 2014c, p. 12). The NUTS 2 regions obtain funding from the EU but have only little influence on the regional implementation (Technopolis group et al., 2014c, p. 6).

At the national level, the investment and business development agency CzechInvest was founded to transform the Czech economic institutions and the former heavy engineering industry into a globally competitive industry. It is a public agency that supervises economic and industrial policies and was assigned the new task of facilitating FDI in 1997. FDI was regarded an apt policy to create spillover effects between competing companies, the foreign company and its local suppliers and customers, respectively. Those spillover effects occur when Czech firms adapt the quality standards of the foreign companies or imitate production processes of foreign companies (Benacek, 2010).

CzechInvest provides information to investors and facilitates the communication between investors and the public administration. The agency gives investors access to subsidies, EU funds and R&D and quality promotion. The OECD stated CzechInvest as exemplary since it acts as a 'one-stop-shop' for investors and thus lowers transaction cost for Czech companies as well as foreign investors (OECD, 2006, p. 63). Jihozápad is particularly successful in attracting FDI due to its attractive geographical position close to Bavaria and Austria. While CzechInvest operates at the national level there are several regional agencies such as the Business Innovation Centre Plzen and the Regional Development Agency Plzen Region which operate at a lower level.

The region has implemented one operational programme within the convergence objective 2007–2013 that comprised a total budget of EUR 729 million and EUR 620 million investments by the ERDF. The administration takes place at NUTS 2 and NUTS 3 level while the NUTS 2 region obtains the funding but has almost no influence on the actual implementation of the polices. The self-governmental region can pursue own strategies to foster growth and innovation. The West as well as Southern Bohemian regions have sought to facilitate innovation in their areas. The Southern Bohemian region seeks to adjust its specialisation to the educational and industrial sector so they can benefit from knowledge spillovers.

The operational programme in the region had four priorities: Accessibility of the centres was to be increased by improving the transport infrastructure. The second priority was to stabilise and develop the towns and municipalities in a balanced way. Further, tourism should be facilitated by enhancing the existing tourist infrastructure. Finally, the programme provided technical assistance to implement the objectives of the programme.

In the funding period 2007-2013, the EU also funded cross-border cooperation between Jihozápad and the German NUTS 1 region Bavaria. The programme focused on the development of the common labour market and economy, especially tourism. A second priority was to protect the environment. Approximately 62.5% of the total funds of EUR 135 million were invested in the first objective, 37.5% in the latter.

Conclusion

The case study has shown that in terms of trade Jihozápad is one of the highly specialised Eastern European and less developed regions, respectively. The three medium-high- and high-tech industries in question are manufacture of machinery and equipment, manufacture of office machinery and computers, and manufacture of motor vehicles, trailers and semi-trailers. In the automotive industry in particular, the region has experienced a dynamic development in terms of exports and employment during the last decade. This can mainly be attributed to the fact that the largest Czech automotive manufacturer, Škoda, is located in the region. Furthermore, the region commands a dense supply industry. Here, the region certainly benefits from its engineering tradition and its favourable location on the border to Germany and Austria. Hence, after 1990, the region could attract large foreign direct investments, especially from Germany. The export-prone regional industries also benefit from the depreciating Czech koruna. The regional industry, thus, relies to a large extend on foreign direct investments. The regional innovation system is quite underdeveloped, as indicated by comparatively low regional R&D expenditures as well as an underdeveloped innovation infrastructure.

Table 7.14 / Stylised industry-specific regression results for Jihozápad

Full sample

RXA (gross exports)	29	30	34
(log) patent intensity	-0.066	1.376 ***	-0.699
(log) techn. innov., SMEs	8.621	-23.853	-15.365
(log) non-techn. innov, SMEs	-17.662 *	-20.984	-8.432
tertiary educ. < 35 yrs.	-0.287	-0.282	0.289
(log) HERD	8.140 *	17.693 ***	15.255 ***
(log) BERD	0.039	2.867	-1.687
GDP per capita	0.000	0.000	0.000
(log) population density	-9.884 **	1.827	-7.907
cluster	32.625 ***	9.338	48.705 ***
business services	3.823	2.460	-15.138
ERDF innovation	0.655 ***	-0.210	-0.151
(log) quality of governm.	-2.210	44.922 ***	26.288 **
accessibility index	0.375 *	0.646 *	0.858 **
R^2 within	0.018	0.039	0.043
R^2 between	0.336	0.302	0.228
R^2 overall	0.263	0.234	0.190
No. of observations	2,800	2,800	2,800
No. of clusters	250	250	250

Less developed regions

	sf1 / p29	sf1 / p30	sf1 / p34
(log) patent intensity	-6.529	-7.422	-2.797
(log) techn. innov., SMEs	-1.394	-72.390 ***	-93.561 ***
(log) non-techn. innov, SMEs	-16.861	17.252	62.605 ***
tertiary educ. < 35 yrs.	-0.613	3.614 ***	-0.060
(log) HERD	1.526	9.549 *	11.409
(log) BERD	6.562 *	-1.286	-5.718
GDP per capita	0.003	0.014 ***	0.009 ***
(log) population density	27.259 *	6.804	67.462 **
cluster	9.906	158.860 ***	26.238 ***
business services	27.412	-5.243	19.094
ERDF innovation	1.774 ***	3.134 **	-1.199
(log) quality of governm.	-8.348	31.487	87.463 ***
accessibility index	-0.677 **	1.686 **	1.284
R^2 within	0.037	0.397	0.239
R^2 between	0.454	0.441	0.547
R^2 overall	0.351	0.414	0.479
No. of observations	674	674	674
No. of clusters	60	60	60

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of machinery and equipment n.e.c. (29), Manufacture of office machinery and computers (30), Manufacture of motor vehicles, trailers and semi-trailers (34). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

As the empirical results suggest, locations providing cluster structures, strong R&D engagement of HEIs and favourable policy conditions are the most relevant features correlating with trade specialisation in these industries. The structures found in Jihozápad meet these requirements only to some extent. On the one hand, there is a clear policy commitment towards FDI-based growth. The grown-up clusters are the most important consequence resulting from this policy. On the other hand, impulses from HEIs are not that pronounced as the empirical model suggests. Furthermore, the dependency on decisions made in the headquarters of the multinational companies in these industries needs to be overcome. Since these industries are equally present in more developed regions but under very different conditions, their part in the value chains is a less sustainable one than the technology level of the industries suggests. This is reflected, e.g., by the lower importance of innovation output (patents) and a broad firm base (innovation participation of SMEs). Therefore, the development of endogenous potentials stemming from complementary universities and a more dynamic business demography should be the next step of the restructuring process.

7.3.6. Middle Franconia

Regional background information

Middle Franconia is located in the west of Bavaria, and is known as a prosperous Bavarian region. Comprising the cities of Nuremberg, Erlangen and Fürth, Middle Franconia is one of the ten strongest technology regions in Germany (Regierung Mittelfranken, 2014). The regional population amounts to 1.7 million inhabitants (2011), representing 2.1% of Germany's population. The high population density (326 inhabitants per km²) corresponds to the region's classification as an agglomeration region (BBRS). The largest regional city is Nuremberg with a population of 498,900 inhabitants. The regional GDP per capita in Middle Franconia is markedly higher than the EU average (EUR 33,000 vs. EUR 27,300) but similar to the national reference value (Germany: EUR 32,600). In the EU funding period 2014-2012 the regions counts among the advanced regions. Following the unification of Germany and the expansion of the European Union to the East, Middle Franconia is now located in the centre of the European single market. Given its geographic location close to the border to the East European Member States, in 2005, the conference of ministers for regional planning therefore decided to admit the Greater Nuremberg area to the group of European metropolitan regions in Germany (Nehm and Veres-Homm, 2012).

Middle Franconia is still largely dominated by its traditionally strong industrial sector, although the employment share of the industrial sector has declined from 32.2% in 2000 to 23.5% in 2013. The region's traditional industries such as electrical technology and machinery manufacturing are still of high importance. Based upon initial strengths in electrical and mechanical engineering after World War II , the development in the last decade carved the way to a knowledge-based region (Heidenreich and Miljak, 2004). Other competitive industries include transportation and automation technology, medical technology, chemical, plastics processing, printing, sports equipment and food processing industry. Due to its central distribution location in Southern Germany and as a gateway to Southeast Europe, also the logistics industry in Middle Franconia has started to flourish in recent years. The historically grown business landscape is characterised by several large enterprises and units of German multinationals such as Siemens, Schaeffler, Bosch, AEG, MAN and Diehl. Hence, more than 30% of the regional employees work in firms with more than 1000 employees.

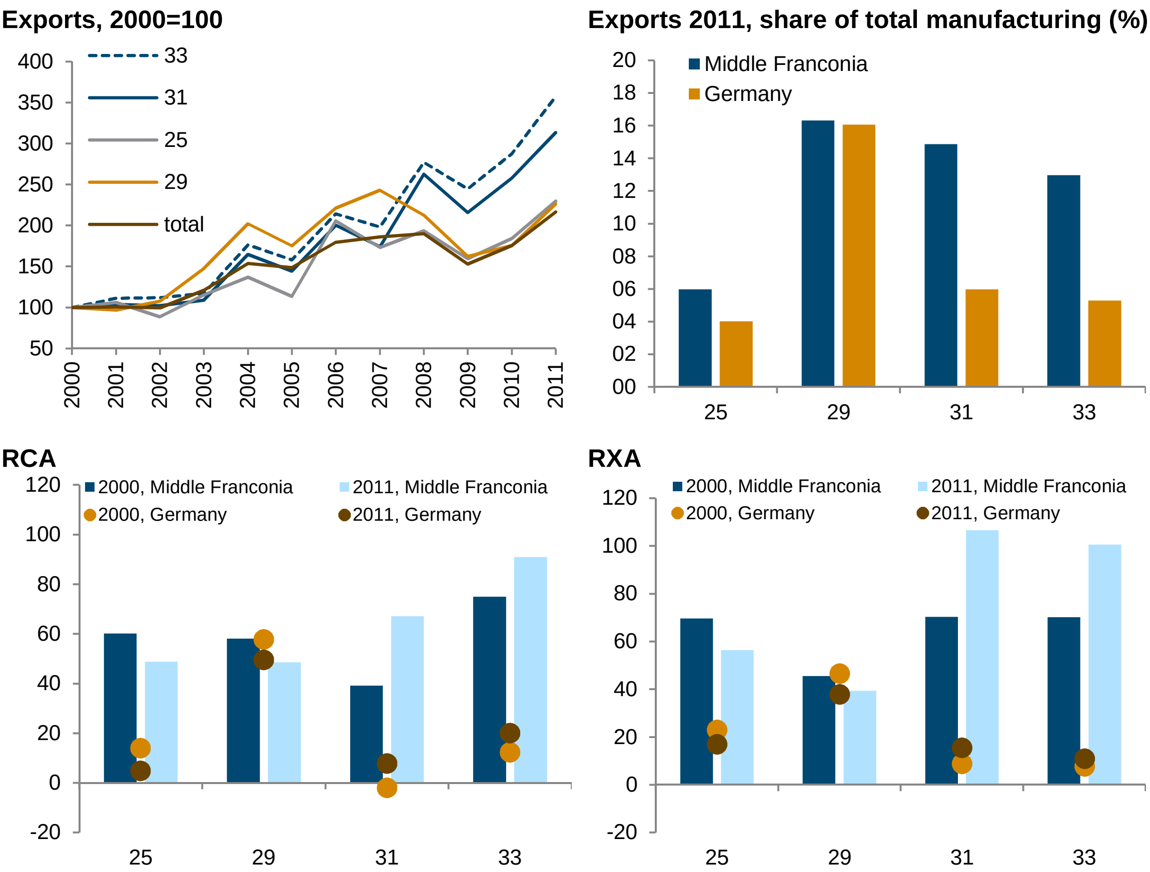
The region's main university is the Friedrich-Alexander University with its two campuses in Nuremberg and Erlangen. With approximately 40,000 students, it is the tenth largest university in Germany. The Friedrich-Alexander University is known for its strong focus in natural sciences, engineering, and medicine.

Selected industries

International trade

The region reveals above-average trade specialisation indicators (RXA and RCA) in four manufacturing industries: the rubber and plastic production industry (NACE Rev. 1.1 25), manufacturing of machinery and equipment (29), manufacturing of electrical machinery and apparatus (31), and manufacturing of medical precision and optical instruments, watches and clocks (33). In these industries, Middle Franconia does not only reveal export advantages compared to the EU but also compared to the German average (Figure 7.8). Furthermore, in all four industries, the region has continuously realised export volumes above the EU average in the period 2000 to 2011. Particularly the regional medical industry shows an especially strong trade performance in both the regional RCA and RXA values (Figure 7.8). In this industry, the RCA of 91 in Middle Franconia in 2011 exceeds by far the national and EU reference values (20 and 5, respectively). The region's electrical machinery industry also reveals comparatively high indicator values that continuously increased during the period 2000 to 2011: from 39 to 67 (RCA), and from 70 to 107 in the case of the RXA. Thus, in terms of RXA, the machinery industry even exceeded the medical industry in 2011.

Figure 7.8 / Trade indicators of Middle Franconia



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

In contrast to the electrical machinery industry, the machinery industry shows a moderate downward trend in terms of trade specialisation. Both the regional RCA and RXA values decreased between 2000 and 2011 but still exceeded the reference values and thresholds selected for the case study (see Figure 7.8). While the RCA decreased from a value of 58 in 2000 to a value of 49 in 2011, the RXA decreased from 46 to 39 in the same years. The machinery industry in Middle Franconia, thus, has lost some ground compared to its competitors.

The fourth industry in which the region of Middle Franconia shows an above-average trade specialisation is the rubber and plastic producing industry. Here, the region certainly benefits from its formerly strong regional performance. However, similar to the machinery industry, the regional RCA and RXA declined during the years 2000 to 2011 (Figure 7.8).

Employment and patent intensity

The downward trend in trade specialisation in both the regional rubber and plastic producing industry and the machinery industry is also reflected in declining employment in both industries (Table 7.15). Employment shares also decreased in the electronical machinery industry, from 5.4% in 2000 to 2.9% in 2013, and in the machinery industry, from 2.2% in 2000 to a share of 1.3% in 2013.

Table 7.15 / Regional key figures for Middle Franconia

	Employment				Patent intensity	
Sector	**Number of employees**	**Regional employment structure (%)**		**Annual average growth rate of regional employment between 2000 and 2013(%)**	**Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)**	
	2013		**2000**	**2000-13**	**2000-02**	**2009-11**
Region total	871,800	100.0	100.0	0.7		
Manufacturing	204,500	23.5	32.0	-1.7	52.9	86.2
High- and medium-tech	101,300	11.6	15.2	-1.4	91.7	150.6
Low-tech	103,200	11.8	16.8	-2.0	14.8	22.9
Knowledge-intensive services	277,800	31.9	21.6	3.8		
Other	389,500	44.7	46.4	0.4		
Selected manufacturing industries:						
25	11,100	1.3	2.2	-3.3	19.4	42.2
29	25,600	2.9	4.4	-2.3	72.9	178.4
31	25,200	2.9	5.4	-4.0	33.4	60.2
33	21,700	2.5	1.1	7.2	198.0	130.4

Source: Eurostat; OECD RegPat. – NIW and ZEW calculations.

In contrast, in the medical industry, employment shares increased from 2000 to 2013 (Table 7.15). The strong position of this industry in Middle Franconia is reflected in the comparatively high number of 130 patents per 10,000 employees. Yet, this figure is lower than ten years before. This nominal decrease in patent intensity since 2000-2002 (198) should, however, not be overinterpreted since the number of patents during that period nearly doubled and employment just increased at a higher rate than patents. In the remaining three industries of interest, patent intensity significantly increased between 2000 and 2011 while employment was reduced. This may indicate a structural shift towards tasks and functions of higher strategic importance (such as R&D and headquarter functions responsible for market exploitation). This becomes especially visible in the machinery industry, where patent intensity increased from an annual average of 73 patents per 10,000 employees in 2000-2002 to 178 in 2009-2011. In the electrical machinery industry, patent intensity nearly doubled from 33 to 60 patents, and in the plastic industry, patent intensity also increased from 20 to 42 patents per 10,000 employees (2009-2011), even though the industry does not belong to the high-tech manufacturing industries.

Drivers of regional trade specialisation and regional growth

Economic structure

Having identified the four regional industries with above-average trade specialisation indicators, it is now interesting to trace the reasons for the strong trade performance of these industries in Middle Franconia.

In the machinery industry and the rubber and plastic processing industry, the region has certainly profited from the establishment of several firms in the region after World War II. Back then the federal state of Bavaria was one of the poorest regions in West Germany, characterised by a rural and backward economic structure and comparatively low labour costs. The latter factor, however, attracted firms operating in the once labour-intensive industries with low skill requirements such as the rubber and plastic industry and the machinery industry (Abel et al., 2012; Schiffers, 2013). The location of large companies such as AEG, Grundig, Siemens, Schaeffler, Bosch, MAN and Diehl induced a successful economic development of the machinery industry within the region, as these large companies entailed a network of suppliers locating in the region.

In the course of increased competition from low-wage countries resulting in the emergence of global value chains and functional specialisation of regions, the labour-intensive industries faced considerable economic pressure, leading to the downsizing of large traditional companies such as AEG and Grundig. Yet, in order to compete with low-wage regions, the regional LMT industries successively transform into innovative industries by focusing on new developments. Hence, the regional rubber and plastic industry established new clusters and networks such as the Rubber and Plastics Competence Network of Western Central Franconia around Ansbach and research institutions such as the ATZ Development Centre in Sulzbach-Rosenberg engaged in applied materials research. The regional universities seem to respond to the changes in demand. Material Technology, for instance, is one of the main areas of research at the Ansbach College of Applied Sciences.

In contrast to the rubber and plastic as well as the machinery industries, the medical industry is a relatively new industry field. The city of Erlangen in particular has been established as a nationwide renowned centre of medical industries. The Medical Faculty of the Friedrich-Alexander University Erlangen-Nuremberg and the regional university hospitals are important actors and cooperation partners for the local economy (Heidenreich and Miljak, 2004). The leading company in the cluster is the Siemens Medical Solutions division. Approximately 700 small and medium-sized businesses of the medical and pharmaceutical industry are located in Middle Franconia, employing about 21,700 workers (2013). As the trade specialisation indicators have shown, in terms of international trade competitiveness, the regional medical technology is the most important competence field in the region.

A variety of regional initiatives has contributed to the strong trade specialisation of Middle Franconia especially in the medical industry, but also in the electrical machinery industry. In this context, cluster policies have been a crucial feature of the regional economic policy of Middle Franconia since the mid-1990s, when regional stakeholders and policy-makers initiated a network of competence in the field of medical industries in order to promote this industry and related technology fields in the region. By now, the network includes approximately 100 active members, of which half are company representatives and half are representatives of the cities, chambers, and scientific institutions. The main task of the initiative is to establish a well-functioning network among the companies as well as between companies and different regional institutions. Another prestigious, publicly funded project in the medical industry was the establishment of the Innovation Centre for Medicine and Pharmaceutics (IZMP) in the city of Erlangen, which functions as an incubator for companies in the medical sector, as well as accommodating the University Institute for Medical Engineering.

Regional innovation system

Middle Franconia is traditionally endowed with a strong regional innovation system which is also represented by comparatively high R&D expenditures and a high number of patents in the manufacturing sector (see Table 7.15). The share of total R&D expenditures in the regional GDP (3.63%) is above the German (2.8%) and EU (2.0%) average. The share of private R&D expenditures is with 72.8% comparatively high, demonstrating the innovativeness of regional firms. Another 17.6% of regional R&D expenditures are attributed to the regional universities, whereas the share of public R&D expenditures accounts for 9.4%.

The region's main university is the Friedrich-Alexander University Erlangen-Nuremberg with its two campuses in Nuremberg and Erlangen. Other regional university-level institutions include the University of Applied Sciences in Ansbach, the University of Applied Sciences in Nuremberg and the University of Applied Science in Weihenstephan-Triesdorf. Especially the Ansbach University of Applied Sciences with its strong engineering department has been heavily funded by the Bavarian government. Its research focus is based on the current market demand for highly qualified engineers, especially in the machinery and electrical machinery industry. With the Medical Faculty of the Friedrich-Alexander University already being a very important research and teaching centre and the growing importance of the electrometric division of Siemens, numerous smaller companies have developed in the field over the past decade. Together, the regional universities provide a strong pool of highly qualified human capital that match the demands of the regional industries.

The strong regional knowledge base is also visible in terms of the skilled employment share. In 2013, nearly 280,000 people were employed in knowledge-intensive services (KIS), representing one third of total regional employment. Compared to 2000, KIS employment rose by 10 percentage points. The regional share of human resources with tertiary education is 26.8%, twice as high as the German average (13%). Yet, the share of human resources with a tertiary education among the 30- to 34-year-old population amounts to 30.6%, which is still lower than in other German regions.

Political context and regional growth policies

In the case of Middle Franconia, the federal state of Bavaria is the relevant federal level for regional policy. The federal state is responsible for setting up regional growth strategies and the operational programme for the EU structural funds. In the last decade, the federal state of Bavaria has established a variety of regional growth policies aiming to foster innovation and establish technological competence. The region of Middle Franconia has been massively addressed by these measures, especially the 'High-Tech Offensive' established by the Bavarian government in 2000. This initiative, which was cross-financed by revenues from privatisation, aimed at sustainable investments and innovations in order to improve the competitiveness of the Bavarian economy. Investments included research and technology projects, promoting educational participation at the regional level as well as start-up initiatives, and measures to exploit new markets. The Bavaria Cluster Offensive is another policy imitative that supports cooperation between universities, research institutes and business.

Given the strong regional support programmes, the European Structural funds only play a subordinate role in Middle Franconia. Yet when looking at the allocation of the European Regional Development Fund (ERDF) by thematic priority, it becomes evident that in the funding period 2007-2013, the vast majority of funds were allocated to research and development, technological progress, and regional innovativeness. Hence, the region focuses its resources on very sustainable and future-oriented objectives, following the motto 'strengthen the strengths'.

Conclusion

The case study has shown that Middle Franconia is an advanced European region with a strong regional knowledge base, not least reflected in high levels of R&D expenditures, several universities and research institutes and a high share of high-skilled human resources. All these factors contribute to the comparatively strong economic performance of Middle Franconia. In terms of trade specialisation, the regional RCAs and RXAs have shown that the region is specialised in both traditionally labour-intensive low-technology industries (i.e. rubber and plastic industry) as well as in high-technology industries such as the machinery, electrical and medical industries. In the traditional industries, the region seems to succeed in engaging in new growth paths characterised by flexibility and innovation, rather than large-scale production. In the relatively new medical industry, the region has clearly benefited from public support programmes aiming to establish this industry within the region. Furthermore, the large and prestigious medical department of the Friedrich-Alexander University Erlangen-Nuremberg has certainly acted as a pull-factor for firms operating in the medical industry to locate in the region.

According to the locational requirements for specialisation in the selected industries which are derived from the econometric analysis, R&D efforts and clustering structures are also in the case study found to play a decisive role. The supportive function of the business services sector contributes to the international trade performance of Middle Franconia in the manufacture of medical instruments and machinery and equipment. Skill supply and SMEs' innovation behaviour do not show any relevant effects on RXA in the model. However, policy requirements (innovation focus, governmental quality) of some industries are also met in Middle Franconia.

To sum up, the strong innovation focus of regional industries, the regionally existing (socio-) economic structures and regional policy allow Middle Franconia to host a wide range of successful low-, medium-high- and high-tech manufacturing industries with extraordinary comparative advantages. Competitiveness in the manufacture of rubber and plastic products is hardly explained by the model and the case study results are an exception in this respect. The main conclusion from this example is probably the relevance of convincing innovation strategies in regional policy addressing established but adaptable industrial structures, complemented by the presence of a broad but still particular university landscape.

Table 7.16 / Stylised industry-specific regression results for Middle Franconia

Full sample

RXA (gross exports)	25	29	31	33
(log) patent intensity	0.047	-0.066	2.809 ***	-0.070
(log) techn. innov., SMEs	19.981 *	8.621	-32.045 ***	-32.252 ***
(log) non-techn. innov, SMEs	-4.045	-17.662 *	-5.744	-10.329
tertiary educ. < 35 yrs.	-0.635 **	-0.287	-0.660 ***	0.253
(log) HERD	5.522	8.140 *	3.406	7.268 **
(log) BERD	5.983 *	0.039	8.203 *	5.694 *
GDP per capita	0.000	0.000	0.000	0.000
(log) population density	-11.109 **	-9.884 **	4.824	-11.833 *
cluster	21.391 ***	32.625 ***	46.407 ***	22.107 **
business services	-19.719 **	3.823	0.409	18.416 ***
ERDF innovation	-0.052	0.655 ***	0.126	0.535 ***
(log) quality of governm.	-15.389 ***	-2.210	5.584	27.184 ***
accessibility index	0.184	0.375 *	-0.063	0.834 ***
R^2 within	0.015	0.018	0.013	0.036
R^2 between	0.138	0.336	0.306	0.589
R^2 overall	0.115	0.263	0.233	0.546
No. of observations	2,800	2,800	2,800	2,800
No. of clusters	250	250	250	250

More developed regions

	sf3 / p25	sf3 / p29	sf3 / p31	sf3 / p33
(log) patent intensity	-0.691	-0.153	3.003 ***	0.154
(log) techn. innov., SMEs	21.495	20.718	-8.447	-37.467 ***
(log) non-techn. innov, SMEs	2.949	10.245	29.965	53.050
tertiary educ. < 35 yrs.	-0.697 **	-0.026	-0.309	0.210
(log) HERD	-0.984	0.184	4.855	1.636
(log) BERD	5.489	2.010	9.341 **	1.055
GDP per capita	0.000	0.000	0.000	0.000
(log) population density	-10.092	-16.513 **	-1.793	-6.447
cluster	19.484 **	29.552 ***	30.077 ***	21.213 **
business services	-10.176	5.310	9.816	20.318 **
ERDF innovation	0.081	0.608 ***	0.429 **	0.596 ***
(log) quality of governm.	-13.814	-6.740	-15.988 **	36.170 ***
accessibility index	0.150	0.504	0.056	0.835
R^2 within	0.011	0.001	0.016	0.003
R^2 between	0.182	0.360	0.348	0.483
R^2 overall	0.151	0.294	0.286	0.472
No. of observations	1,632	1,632	1,632	1,632
No. of clusters	143	143	143	143

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of rubber and plastic products (25), Manufacture of machinery and equipment n.e.c. (29), Manufacture of electrical machinery and apparatus n.e.c. (31), Manufacture of medical, precision and optical instruments, watches and clocks (33). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

7.3.7. Norte

Regional background information

The Norte region is one of the seven NUTS 2 regions of Portugal. It is located in the North of Portugal and borders on Spain to its north and east, the Atlantic Ocean to the west, and the Centro region in the south. The region is spread over 21,300 km^2 and has about 3,7 million inhabitants. These numbers account for 23% of the country's total surface and approximately 35% of its total population. The population density amounts to 173 inhabitants per km^2. With the cities of Porto and Braga, the region includes the second and third largest metropolitan areas of Portugal after Lisbon. The region can be divided into a coastal area, which is predominantly urban and highly industrialised, and an inland area, where agriculture still plays an important role. In recent years, the Portuguese authorities have intensely promoted tourism as a means to attract external investment and further incomes in rural areas. In terms of industries, the region is characterised by traditional manufacturing industries (e.g. textiles, clothing, footwear and metallurgy), but encompasses also medium- and high-tech sectors, in particular industrial equipment, automotive components, pharmaceuticals and biotechnology (Porto, Braga), precision equipment, communication equipment and computers. The main public universities in the region are the University of Porto, the University of Minho (Braga) and the University of Trás-os-Montes and Alto Douro (UTAD). Increasing globalisation and the competition arising from developing countries have caused a significant pressure on the Norte region in the last years. The onset of the international financial and economic crisis in 2009 reinforced these structural challenges. Referring to the GDP per capita expressed in purchasing power standards (PPS), the Norte region achieved a per capita GDP of EUR 15,600 (2011), representing 62% of the EU-28 average and 80% of the national average. In the context of EU structural funds, Norte therefore fulfils the eligibility criterion of a less developed region. The unemployment rate has been steadily increasing during the past years, up to 17.1% in 2013 (Portugal: 16.1%; EU-28: 10.8%). Recently, i.e. in 2014, this negative trend has been stopped. In the pre-crisis period (2000-2007), the Norte region was among the 15 EU regions with the largest drop in manufacturing employment, with the strongest decline observed in the manufacture of textiles and textile products. Here, the region lost its former comparative advantages due to rising global competition (Technopolis group et al., 2014d, p. 7). In order to promote structural adjustments and recovery from the financial crisis, the political focus has been set on the labour market, implementing several measures to reduce labour costs and to raise productivity. Increased competitiveness has helped Portugal realise higher export market shares, both inside the EU, where it sells 60% of its products, and in developing markets, particularly Brazil, Russia and African countries. At the same time, higher-value industries including electronics, mechanical engineering and automobiles are becoming more and more relevant in the economy relative to traditional sectors such as clothing and food products. Furthermore, Portugal is attracting more overseas visitors. In 2013 a record tourism revenue of an estimated more than EUR 9 billion was registered, accounting for almost 14% of total exports.[19]

Selected industries

International trade

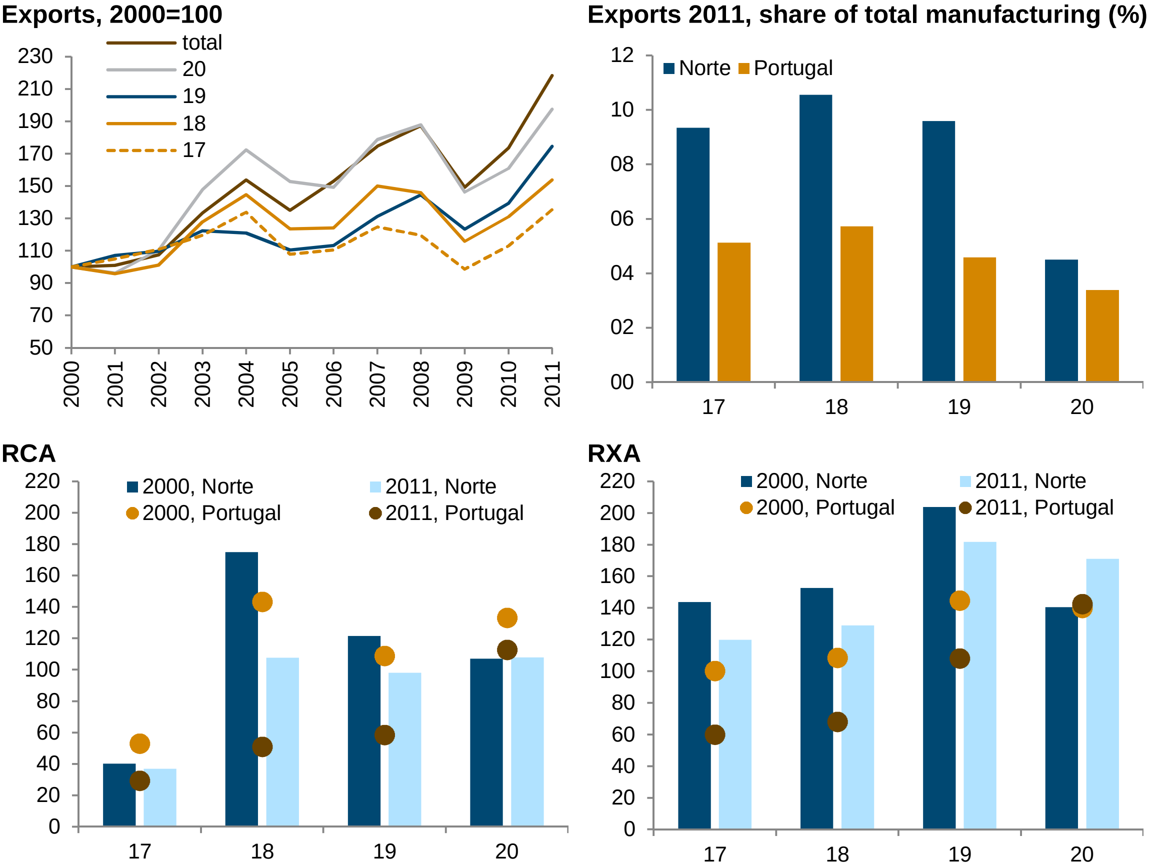
Norte is not only the most important Portuguese region in terms of population (35%), entrepreneurial and industrial tradition[20], but also in terms of exports. The region accounted for nearly 45% of the country's total manufacturing exports in 2011. Moreover, outstanding comparative trade advantages are found in four low-tech industries including textiles (NACE Rev. 1.1: 17), wearing apparel, dressing and dyeing of fur (18), articles of leather and footwear (19) as well as manufacture of wood and articles of wood and cork, straw and plaiting materials (20). Basically, the specialisation on the former three mentioned low-tech- and labour-intensive industries is typical of less developed regions, whereas the manufacture of

[19] Wise, P.: Portugal the surprise hero of Eurozone growth as exports and tourism proper, ft.com, 2014-02-16. http://www.ft.com/cms/s/0/440e4c36-9713-11e3-809f-00144feab7de.html#ixzz3Sjdnl9NP\

[20] Tavares-Lehmann (2011).

wood and articles thereof is mainly determined by resource availability. In the case of Portugal, this refers especially to large cork oak forests. Portugal is the world's largest producer of cork and the industry has a long tradition there. While the forests are concentrated in the southern Mediterranean region, cork manufacturing is spread all over the country, also in the Northern region.

Figure 7.9 / Trade indicators of Norte



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

Portugal as a whole also holds a high export specialisation (RXA) and high comparative advantages in all four industries, whereas the EU-28 as a whole shows negative specialisation indicators (RXA and RCA) in the three labour-intensive industries textiles, apparel and footwear (Figure 7.9). However, considering the growing price competition with Asian countries in particular, it is remarkable that Norte succeeded in keeping its high positive specialisation in those three industries, while the respective trade indicators for Portugal as a whole diminished significantly. As Figure 7.9 depicts, especially in the three low-tech industries in which the Norte region shows above-average trade specialisation indicators, the shares of exports in total manufacturing goods increased between 2000 and 2011, and are well above the Portuguese average. However, this increase in exports (both in relative and absolute terms) did not translate into increasing RCA or RXA values. Thus, in all three low-tech industries, the values of the two trade specialisation indicators decreased from 2000 to 2011, indicating that the region is gradually losing its comparative advantage in these industries. In contrast, the trade specialisation indicators of the regional wood and cork industry show a slight improvement between 2000 and 2011, even though the regional share of exports in this industry in the total of manufacturing goods (4.5%) amounts to only half the size of comparable values for the other three low-tech industries.

Employment and patent intensity

The four industries employ nearly 190,000 persons, accounting for 52% of the total manufacturing workforce, and 12% of the whole regional employment. Among these industries, the largest industry in terms of employment is manufacturing of textile products (74,000), followed by the manufacture of apparel (52,000), leather and footwear (36,600), and the manufacturing of wood and articles thereof (27,000). While employment in the manufacturing of apparel (-6.9% p.a.) and footwear (-3.5% p.a.) decreased significantly between 2000 and 2013, the manufacturing of wood and similar articles (-1.8%) and particularly the manufacturing of textiles (-0.2% p.a.) exhibited a rather moderate employment performance in the Norte region (see Table 7.17). Employment gains can be found in knowledge-intensive services.

Table 7.17 / Regional key figures for Norte

	Employment				Patent intensity	
Sector	**Number of employees**	**Regional employment structure (%)**		**Annual average growth rate of regional employment between 2000 and 2013(%)**	**Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)**	
	2013		**2000**	**2000-13**	**2000-02**	**2009-11**
Region total	1544,400	100.0	100.0	-1.0		
Manufacturing	364,300	23.6	30.8	-3.0	0.4	2.4
High- and medium-tech	50,700	3.3	3.4	-1.2	2.8	13.9
Low-tech	313,600	20.3	27.4	-3.3	0.1	0.6
Knowledge-intensive services	243,000	15.7	9.6	2.8		
Other	937,100	60.7	59.6	-0.9		
Selected manufacturing industries:						
17	74,100	4.8	4.3	-0.2	0.1	0.1
18	52,100	3.4	7.5	-6.9	0.0	0.1
19	36,600	2.4	3.3	-3.5	0.0	0.2
20	27,000	1.7	1.9	-1.8	0.0	0.4

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations

Overall, employment in high- and medium-high-technology manufacturing industries amounts to 3.3% of total employment (2013), which is comparable to the national average (2.9%), but significantly lower than the EU-28 average (5.6%). The employment share in knowledge-intensive services (in the broad OECD/Eurostat definition)[21] amounts to only 26.8% (2013) and is significantly lower than in Portugal as a whole (33.2%) and the EU-28 (39.2%). In the narrower NIW/ISI definition, only 15.7% of the workforce was employed in knowledge-intensive services. The share of employment in total manufacturing is 23.6% (Table 7.17).

[21] Including 61 (Water transport), 62 (Air transport), 70 (Real estate activities), 71 (Renting of machinery, equipment and personal) and 80 (Education) (see the respective KIS definition in EC Commission Staff 2009, 17f.), which are excluded in the more narrow NIW/ISI definition regarding only 64 (Telecommunications), 72 (Computer and related services), 73 (Research and Development), 74 (Other business services), 85 (Health and Social Work) and 92 (Recreational, cultural and sporting activities) (Legler, Frietsch 2007, 19f.).

Due to the industry mix involving only little innovation, the regional patent intensity in all four industries is very low. The average annual number of patents in the textile, clothing and footwear industry is lower than 0.2 patents per 10,000 employees (2009-2011). In the wood industry, the number is slightly higher (0.4). Overall, in terms of patent activities, the total number of patents across all technology fields in the region is below 50% of the EU average.

Drivers of regional trade specialisation and regional growth

Economic structure

The economy of the Norte region is characterised by comparatively high shares of primary production and low-tech manufacturing as well as a low share of knowledge-intensive services. Given this unfavourable structure, the region lags behind more advanced European regions. However, the region has experienced a significant growth of knowledge-intensive service activities, indicated by increasing employment shares. Thus, the share of employees in the so-called KIS sector has increased at an average rate of 2.8% per year between 2000 and 2013. Empirical evidence also suggests that there is an existing critical mass of high-skilled human resources, which provides good conditions for the attraction of more foreign direct investment. The share of persons with tertiary education in the Norte region has increased from only 6.4% (2000) to 16.3% (2011) and the share of persons aged 30 to 34 with tertiary education has increased from only 9.2% (2000) to 23.3% (2011). At the same time, hourly labour costs in manufacturing still constitute less than half of the EU-28 level. This indicates that the regional industries are still exposed to price and wage competition, presumably with Asian countries. In order to overcome the limitations in revenue and growth prespectives in these markets, the Portuguese companies in the textile industry have increasingly transformed themselves by investing in design, technology and branding. In the world of shoes, ‘Made in Portugal’ is now second only to ‘Made in Italy’ in terms of international prestige and the factory prices they command.[22] The comparatively strong regional trade performance of the textile industry is also reflected in the cluster activities in this industry. Here, especially the regional footwear and fashion clusters stand out. Furthermore, the country’s leading Textile and Clothing Technology Centre (CITEVE) as well as the Footwear Technology Centre (CTC) are located in the Norte region.

In the wood and cork industry, the regional industry certainly profits from the long tradition of the industry in Portugal in general, and the Norte region in particular. Nowadays the regional cork producers intensely employ advanced technologies, including lasers, robotics and computer-assisted automation exploiting economies of scale which were barely imaginable just a decade ago. The cork companies have also reversed their sector's decline during the first decade of the new century by moving into new markets, such as the emerging economies of China, Russia and Brazil. They have also diversified from cork stoppers, which suffer from the increasing application of synthetic bottle closures, into new uses that include home furnishings and construction, footwear and fashion accessories, and mopping up oil spills with cork grains.[23] These innovation strategies are also reflected in slightly growing patent intensities (patents per 10,000 employees) in this industry (Table 7.17).

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22 Wise (2014).

23 Associated Press (2011).

Regional innovation system

Even though the Regional Innovation System is less developed than the RIS in the highly innovative North European regions, from a Portuguese perspective, Norte ranks second (after the capital region of Lisbon) among the seven Portuguese regions with respect to its regional R&D expenditures. In 2011, the regional expenditure on R&D (as a percentage of regional GDP) amounted to 1.5%, which is equal to the national average, but still significantly lower than the EU-28 average (2.0%). Yet, the regional patent intensity in manufacturing is still extremely low (Table 7.17).

A share of 40.6% of the regional R&D expenditure is accounted for by university-level institutions, another 9.3% by private non-profit institutions, and merely 6.2% by the national government (2011). Norte hosts three main public universities (University of Porto, University of Minho, and University of Trás-os-Montes e Alto Douro), several private universities and four public polytechnic institutes. It has also renowned research centres not only in the traditional low-tech industries such as textiles and wood, but also in high- and medium-tech fields such as nanotechnologies, information and communication technologies, new materials engineering, and the automotive sector. Another positive recent trend is related to the growing attractiveness of the region in terms of world-class research and technological development (RTD) units and institutes. Two relevant examples here are the INL – International Iberian Nanotechnology Laboratory (in Braga), a joint investment of the Portuguese and Spanish governments envisaging 200 PhD researchers within a few years, and the European Excellence Institute for Tissue Engineering and Regenerative Medicine Research (in Guimaraes). The Fraunhofer Institute also established its first venture outside of Germany in Norte. A recent example of the rationalisation of the network of RTD institutions was the merger of three RTD institutes (IBMC, INEB and IPATIMUP) to the newly established Institute for Health Research and Innovation (I3S) in Porto, comprising about 600 researchers. According to the RIS 2014 report, further positive indicators of the Norte region are the comparatively high share of SMEs introducing product or process innovations, or in-house innovation activities, each representing 90-120% of the EU average. In contrast, the cooperation intensity among regional SMEs is quite low.[24]

Political context and regional growth policies

Since Portugal is a centralised country (except for the autonomous regions of the Azores and Madeira), the Norte region is only a territorial administrative subdivision of the country without any relevant political competencies. Regional development policies are implemented only by representatives of the central government. Furthermore, the Regional Coordination and Development Committees (CCDR), representing decentralised bodies of the central government with administrative and financial autonomy, are entitled to implement their own operational programmes (ROPs) in line with key national policies. The Norte Regional Coordination and Development Commission's (CCDR-N) main competencies are the implementation of governmental policies with regard to regional planning and development, environment, land management, and inter-regional and cross-border cooperation. Although some RTDI[25] initiatives have a regional dimension and may be delivered regionally, research and innovation policies are mainly defined at the national level.

24 Technolopolis group et al. (2014a) and European Commission (2015k).

25 RTDI: research, technological development and innovation.

The CCDRs also act as Regional Dynamic Observation Centres, carrying out strategic analyses of economic and social development, and monitoring the implementation of public policies in the respective regions, in particular those that are subject to EU funding. In the course of the last 15 years, the Norte region has carried out several initiatives in order to develop and implement innovation strategies, such as the first Regional Innovation Strategy (RIS Norte, 1998-2001), the Regional Programme of Innovative Actions (NORTINOV, 2002-2004), the regional strategy Norte 2015 (launched in 2006 and establishing a regional development strategy for the funding cycle 2007-2013), and the Regional Innovation Plan 2008-2010 (an output of the Norte 2015 regional strategy). Launched at the end of 2012, the 'Norte 2020' initiative has been developed in the framework of the EU's Europe 2020 growth strategy aiming to set the strategic guidelines for the new programming cycle 2014-2020. Norte 2020 has been the basis to establish a regional action plan, a smart specialisation strategy (RIS3 Norte) and a new regional operational programme (ROP) for the period 2014-2020.

Currently, the most important measures in the field of innovation are implemented in the framework of the regional operational programme ('Novo Norte 2007-2013'). The ROP budget dedicated approximately 30% of the total budget to the priority 'competitiveness, innovation and knowledge' (ROP Axis 1). This priority is to enhance the regional innovation system addressing issues such as investment in technological and scientific infrastructure, technology-based entrepreneurship (including investments in science parks and technology business incubators), incentive systems for business innovation (RTD, innovation and qualification/internationalisation activities), and networking/clustering activities.

Conclusion

The case study of Norte focuses on four low-tech industries with above-average trade performance. These industries include textiles, wearing apparel, dressing and dyeing of fur, articles of leather and footwear as well as manufacture of wood and articles of wood and cork, straw and plaiting materials. All four industries are characterised as being very labour-intensive industries. Given the comparatively low labour costs in Portugal, it seems likely that the regional trade specialisation in these industries can mainly be attributed to price competition. Furthermore, the presence of natural resources is a further favourable regional factor. Some of the regional low-tech industries have engaged in new growth paths. While the regional textile and clothing industry has invested in the development of new designs and the establishment of the internationally renowned brand 'Made in Portugal' for high-quality textiles, the regional cork industry has increasingly diversified its products in the past years. Both strategies certainly help to overcome competition that is solely based on prices. Still, the comparatively low levels of R&D expenditures as well as the relatively low skill level of the regional population demonstrate some challenges the region is still facing.

Corresponding to the econometric results, the selected industries rely on clustering and high population density as well as low income levels. To some extent, patenting is also found to be positively correlated with trade specialisation. However, supportive structures such as innovations by SMEs, the presence of business services clusters or a framing policy are no relevant location factors for these low-tech industries.

Overall, the results of the case study are generally in line with the empirical expectations. There are some indications with respect to an increasingly versatile firm structure which is certainly the most important trend in order to overcome the low-cost production trap. Therefore, the formulation of suitable policy measures and especially fortifying the role of local universities are necessary steps. However, as the case study also shows, structures have developed to promote the establishment of certain high-tech industries which are not necessarily related to the existing ones. Regional policy therefore follows a twofold strategy which supports the historical strengths but also seeks to establish industries and technologies of higher value which altogether seems to be a convincing strategy in order to transform into a more knowledge-oriented economy. However, development and attractiveness are possibly the major challenges on this way.

Table 7.18 / Stylised industry-specific regression results for Norte

Full sample

RXA (gross exports)	17	18	19	20
(log) patent intensity	6.402	9.556	27.153	20.384 *
(log) techn. innov., SMEs	27.861 **	6.287	-25.277	6.271
(log) non-techn. innov, SMEs	7.527	13.836	19.697	23.315
tertiary educ. < 35 yrs.	-1.103 ***	0.049	0.308	-0.590
(log) HERD	1.525	-9.127 *	-7.710	5.343 *
(log) BERD	-9.059 ***	-9.683 *	5.711	-4.404
GDP per capita	-0.001 **	-0.001	-0.006 ***	0.000
(log) population density	12.071 **	33.280 ***	-0.596	-33.800 ***
cluster	41.453 ***	77.373 ***	138.388 ***	46.975 ***
business services	-5.542	-11.197	0.804	-33.984 **
ERDF innovation	0.281	0.209	0.683	-0.530 *
(log) quality of governm.	-28.937 ***	-19.340 **	-34.600 **	-2.776
accessibility index	-0.077	-0.614 **	0.893 *	-0.163
R^2 within	0.065	0.029	0.026	0.004
R^2 between	0.407	0.417	0.299	0.532
R^2 overall	0.352	0.353	0.240	0.454
No. of observations	2,800	2,800	2,763	2,800
No. of clusters	250	250	250	250

Less developed regions

	sf1 / p17	sf1 / p18	sf1 / p19	sf1 / p20
(log) patent intensity	1.399	312.266 ***	252.980	27.752
(log) techn. innov., SMEs	41.239 ***	53.507 ***	-19.350	19.321
(log) non-techn. innov, SMEs	-15.798	-26.100	-11.298	-2.604
tertiary educ. < 35 yrs.	-0.931	-1.438 *	-1.739	-1.394 *
(log) HERD	5.926	4.201	-7.463	4.414
(log) BERD	-12.390 ***	-12.815 **	-9.180	1.981
GDP per capita	-0.005 ***	-0.012 ***	-0.008 ***	-0.002 *
(log) population density	8.845	-1.464	86.210 ***	-19.218
cluster	29.797 ***	62.739 ***	122.296 ***	47.767 ***
business services	-31.208	-3.994	95.635	-84.878
ERDF innovation	1.643 **	-0.034	1.566	-1.855
(log) quality of governm.	-43.495 ***	-52.076 ***	-24.352	-7.063
accessibility index	-0.320	-0.826 *	-0.634	-0.059
R^2 within	0.298	0.425	0.126	0.090
R^2 between	0.537	0.742	0.698	0.564
R^2 overall	0.483	0.665	0.570	0.519
No. of observations	674	674	673	674
No. of clusters	60	60	60	60

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of textiles (17), Manufacture of wearing apparel; dressing and dyeing of fur (18), Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19), Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

7.3.8. Overijssel

Regional background information

The Dutch region of Overijssel is located in the eastern part of the Netherlands and consists of three regions: Kop van Overijssel in the northwest, Salland in the centre of the province, and Twente in the east. The largest cities are the regional capital Zwolle (northwest) and the cities of Almelo, Deventer, Enschede and Hengelo. Overijssel shares a border with Germany in the east and the Dutch province Gelderland in the South.

With an area of 3,421 km², Overijssel is the fourth largest province of the Netherlands (8.2% of total surface). With about 1.14 million inhabitants (6.7% of the total Dutch population in 2014), the regional population density is comparatively high (324 inhabitants per km²).

In terms of GDP per capita expressed in purchasing power standards (PPS), Overijssel achieved EUR 28,400 in 2011, representing 113% of the EU-28 average and 87% of the national average. Thus, the region is characterised as an advanced developed region in the EU context. Unemployment (6.7% in 2013) equals the national average which is still significantly lower than the EU-28 average (2013: 10.8%), yet the unemployment rate has more than doubled since the pre-crisis year 2008 (2.6%; Netherlands total: 2.8%).

SMEs play an important role in Overijssel's economy, as 25% of the workforce are employed in companies with less than 10 employees and 60% in companies with less than 100 employees. Trade, healthcare, industry and construction are the leading economic sectors. The employment share of the manufacturing sector amounted to 14.4% in 2013. In the same year, the employment share in high- and medium-high-technology manufacturing industries was 4.3% of total employment and, thus, significantly higher than the country average (2.8%), but also lower than the EU-28 average (5.6%). In contrast, Overijssel’s employment share in knowledge-intensive services (in the broad OECD/Eurostat definition)[26] amounted to 44.2% in 2013. Thus, it was lower than the Dutch average (46.7%) but significantly higher than the EU-28 average (39.2%). Following the narrower NIW/ISI definition, 35% of the workforce was employed in knowledge-intensive services.

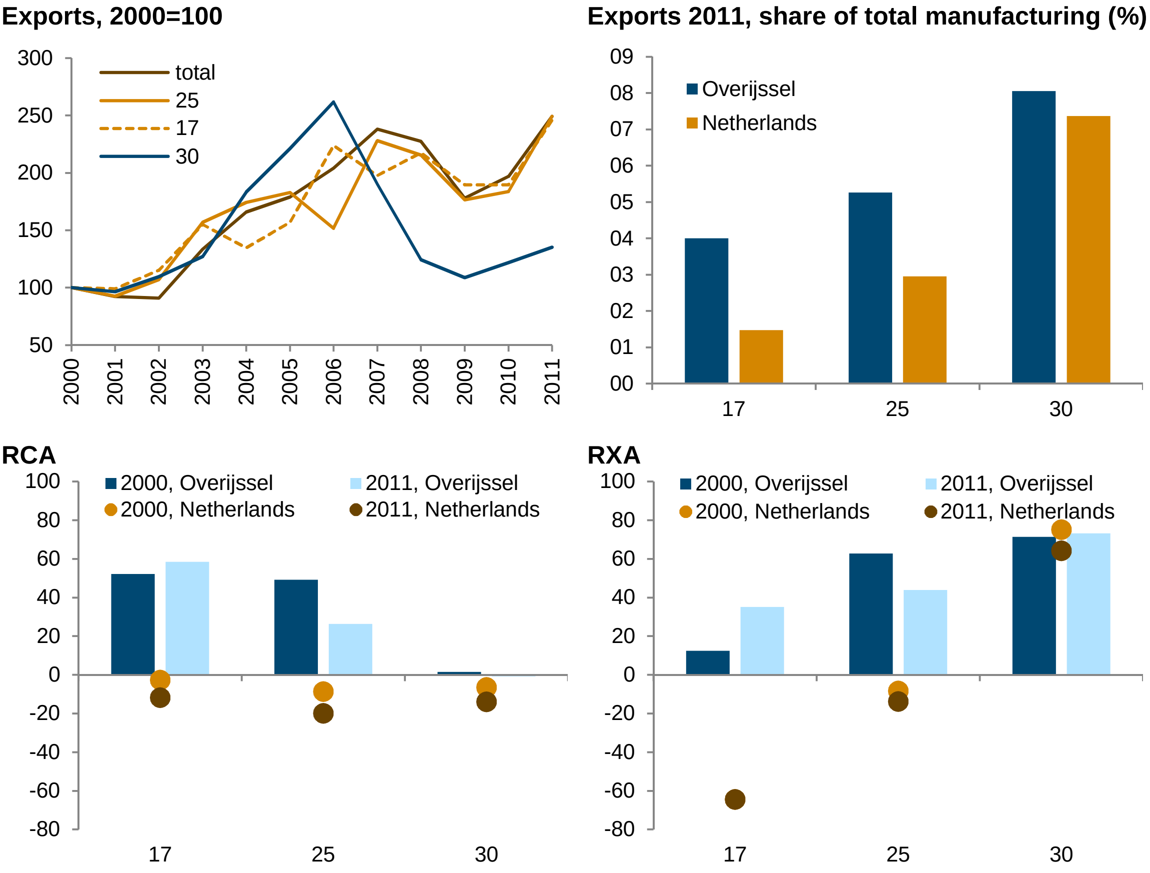
Selected industries

International trade

Overijssel was selected because it exhibits outstanding comparative trade advantages in three industries, namely the manufacturing of textiles (NACE Rev. 1.1: 17), the manufacturing of rubber and plastic products (25), and the manufacturing of office machinery and computers (30). While the first two industries are low-tech industries, the latter one qualifies as a high-tech industry. In all three industries, the region achieves above-average export shares that exceed the national (Dutch) average (Figure 7.10).

[26] including 61 (Water transport), 62 (Air transport), 70 (Real estate activities), 71 (Renting of machinery, equipment and personal) and 80 (Education) (see the respective KIS definition in EC Commission Staff 2009, 17f.) , which are excluded in the more narrow NIW/ISI definition regarding only 64 (telecommunications), 72 (Computer and related services), 73 (Research and Development), 74 (Other business services), 85 (Health and Social Work) and 92 (Recreational, cultural and sporting activities) (Legler and Frietsch, 2007, pp. 19f.).

Figure 7.10 / Trade indicators of Overijssel



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

Out of the three industries, the highest export share is found for the office machinery and computer industry (8.1% in 2011), while the national (Dutch) share was moderately lower (7.4%). While the regional RXA, indicating a region's export specialisation in a certain industry, remained relatively stable between 2000 and 2011, the regional RCA in the office machinery and computer industry decreased from a slightly positive value in 2000 to a slightly negative value in 2011, indicating that the region no longer holds a comparative advantage in this industry.

The regional rubber and plastic production industry accounts for a share of 5.3% in all regional exports of manufacturing goods, significantly exceeding the Dutch average (3.0%). When looking at the trade specialisation indicators, however, it becomes obvious that the region performs below the national average. Thus, both the regional RCA and the regional RXA in the rubber and plastic industry are below the national average in 2011. Still, both indicators exhibit positive values, showing that Overijssel is positively specialised in this industry and realises a comparative advantage in trade.

The textile industry, the third industry where Overijssel shows an above-average trade specialisation, made up 4% of the regional exports of manufacturing goods. This share is well above the national average of 1.5%. When looking at the dynamics, is becomes evident that both trade specialisation indicators (RXA and RCA) increased between 2000 and 2011, showing positive values. In contrast, the national RXA and RCA values are negative. This indicates that, as opposed to Overijssel, the

Netherlands as a whole is negatively specialised in the textile industry and holds a comparative disadvantage.

Employment and patent intensity

Regarding their employment weight, the three selected industries together employ 9,100 workers, representing 11% of the total manufacturing workforce, but only 1.6% of regional employment. More than half of those (5,000) are employed in the manufacturing of rubber and plastics products, 3,500 in the manufacture of textiles, and only 500 in the manufacturing of office machinery and computers (see Table 7.19).

Rubber and plastic manufacturing (-2.7% p.a.) as well as the textile industry (-2.3% p.a.) in Overijssel suffered from a marked structural decline between 2000 and 2013, which was significantly worse than in total manufacturing employment (-1.8% p.a.). By contrast, total regional employment grew at a rate of 0.4% p. a., mainly driven by knowledge-intensive services (2.2% p. a.). In terms of innovativeness, approximated via the number of patents per 10,000 employees, it becomes evident that patent intensity is quite low in the low-tech textile, and the rubber and plastic production industries. On the other hand, patent intensity in the office machinery and computer industry in the region is considerably higher, amounting to an annual average of approximately 170 patents per 10,000 employees. When comparing this number to the years 2000 to 2002, it becomes, however, obvious that the value slightly decreased during the first decade of the 21st century.

Drivers of regional trade specialisation and regional growth

Economic structure

The strong trade performance in the office machinery and computer industry is mainly attributed to imported computers, presumably from the assembling capacities in Asia. They have been mostly re-exported to other European countries via Dutch logistics companies (harbour effect). High patent intensities (patents per 10,000 employees) in the manufacturing of office machinery and computers (Table 7.19) indicate that the respective personnel in Overijssel is mainly employed for research and development. In this case, working with gross exports and imports leads to misinterpretations.

The favourable trade performance in the manufacturing of rubber and plastic products and in textiles is based on local comparative advantages in research and development. This becomes visible from the above-average and increasing patent intensities (Table 7,19) and in the manufacturing of innovative products. The good performance of rubber and plastic products can be attributed particularly to single larger companies such as Apollo Vredestein (tyres) or van Merksteijn Plastics (both located in Enschede). The tyre manufacturer Apollo Vredestein B.V. has its head office as well as a production plant located in Enschede. It designs, manufactures and sells high-quality tyres under the Apollo and Vredestein brand name via an extensive network of offices in Europe and North America and is one of the most important employers of the region. Van Merksteijn Plastics in Enschede is part of a large industrial group known for being production-driven and one step ahead of the competition. They manufacture a wide range of self-adhesive and static decorative film as well as various other industrial products.

Table 7.19 / Regional key figures for Overijssel

Sector	Employment				Patent intensity	
	Number of employees	Regional employment structure (%)		Annual average growth rate of regional employment between 2000 and 2013(%)	Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)	
	2013		2000	2000-13	2000-02	2009-11
Region total	559,800	100.0	100.0	0.4		
Manufacturing	80,700	14.4	19.4	-1.8	19.8	31.1
High- and medium-tech	23,100	4.1	5.5	-1.8	56.4	84.2
Low-tech	57,500	10.3	13.9	-1.8	5.2	9.8
Knowledge-intensive services	196,700	35.1	28.2	2.2		
Other	282,400	50.5	52.4	0.2		
Selected manufacturing industries:						
17	3,500	0.6	0.9	-2.3	0.6	3.4
25	5,000	0.9	1.3	-2.7	22.9	34.2
30	0,500	0.1	0.0		226.3	169.8

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations

Concerning the textile industry, the bulk of its former production in Overijssel (with the centre of Enschede) has moved to low-wage countries particularly in Asia. Only a few specialised production companies have been left in the region. In response to competitive challenges, the textile industry in Europe has undertaken a lengthy process of restructuring, modernisation and technological progress. Companies have improved their competitiveness by concentrating on a wider variety of niche products with a higher value added. Moreover, European producers are world leaders in markets for technical/industrial textiles (for example industrial filters, geotextiles, hygiene products, or products for the automotive industry or the medical sector). Overijssel (Almelo) is the Headquarter of Royal Ten Cate (TenCate), a Dutch multinational textiles technology company, producing functional textiles with distinctive characteristics for applications in the mobility sector (for vehicles, vessels, aircraft, helicopters and mobility concepts), infrastructure and water management (geotextiles and systems), defence (protection textiles for people and materials), personal protection (for persons in their employment and living environments), and sport and recreation (synthetic turf, outdoor fabrics, composites for sport applications). In 2011, TenCate employed 1,490 persons in the Netherlands and the rest of Europe and 4,350 worldwide.

Besides the three industries in which Overijssel is highly specialised, East Netherlands (thus also Overijssel) also plays a prominent role in the development of semiconductors, micro-electromechanical systems (MEMS), integrated circuits (ICs) and sensors. These industries are highly R&D dependent and are responsible for the comparatively high regional R&D expenditures. The largest regional firms operating in these industries are MESA+ in Enschede, NXP Semiconductors in Nijmegen (Gelderland) and roughly 80 small and medium-sized companies located in the Overijssel or the neighbouring region of Gelderland. Thales Nederland, the Dutch branch of the international Thales Group, also operates in the region with 2,000 employees working at branches in Hengelo (HQ), Huizen, Delft, Enschede and Eindhoven. Thales Nederland specialises in designing and producing professional electronics for defence and security applications, such as radar and communication systems. It has become the second largest naval radar producer in the world.

Regional innovation system

Overijssel is endowed with a number of outstanding universities and university-level institutions. The largest regional university is the University of Twente, which ranks 212 in the QS World University Ranking 2014/15. The University of Twente is specialised in technology and has an outstanding nanotechnology laboratory in the MESA+ institute. Together with the City of Enschede, the Region of Twente, the Province of Overijssel and the Saxion University of Applied Sciences, the university has initiated the Knowledge Park (Kennispark). It is the largest innovation campus in the Netherlands, with about 400 companies. The campus is second largest in terms of commercial jobs: 6,300 people work at Kennispark in Enschede, excluding 3,000 scientific positions at the University of Twente. The initiative supports businesses in all phases of development, startups as well as well-established companies. It aims at developing new activities at the campus of the Twente University and the adjacent Business and Science Park. Another initiative linked to the University of Twente is the High Tech Factory, located on the campus of the University of Twente, and accommodating many companies engaged in high-quality development and production. The production facility is located near the new NanoLab of MESA+, one of the world's largest research institutes in the field of nanotechnology. The NanoLab is open to the companies established in the High Tech Factory. Here researchers work on revelatory ideas, developing prototypes and even producing small-scale series.

Besides the University of Twente, there are several universities of applied sciences (Hogescholen). Saxion, located in Enschede, Deventer and Apeldoorn (Gelderland) is one of the largest universities of applied sciences in the Netherlands. Windesheim (Zwolle en Almerre, in Flevoland) focuses on the domains Education & Sports, Business, Media & Law, Health & Wellbeing, and Technology.

In terms of R&D expenditures (gross expenditures as a percentage of the regional GDP) Overijseel recorded a share of 2.3% in 2011. Thus, the regional share was slightly higher than the Dutch average of 2%. Private R&D expenditures accounted for 1.7% in Overijssel, while the Dutch average was 1.1% in 2011. The comparatively high R&D expenditures are mainly attributed to the presence of a technical university and related activities in engineering and industry.

The Regional Innovation Scoreboard has consistently ranked Overijssel as an innovation follower, i.e. Overijssel is performing between 90% and 120% of the EU average on various innovation indicators. Especially the indicators for R&D expenditures (business as well as government) are in the lower range, which is remarkable for a province with a technical university, and policy that focuses on intensifying ties between academy and industry. According to the Regional Innovation Report (Technopolis group et al., 2012), Overijssel is characterised as a 'region with a strong focus on industrial employment, business and/or public R&D'. The score for SMEs introducing product or process innovation is somewhat higher but does not stand out from the national scores. One has to bear in mind that these scores are based on 2010 data: This means that Overijssel's most recent innovation policy could not have had an effect on these scores. It does show however that the innovative capacity of the region is limited and that specific policy attention is justified.

Political context and regional growth policies

Overall, the Netherlands has a prosperous and open economy which depends heavily on foreign trade. The economy is known for stable industrial relations, fairly low unemployment and inflation, a sizeable current account surplus, and an important role as a European transportation hub. The country is one of the leading European nations for attracting foreign direct investment because of its favourable fiscal climate (low business tax rate). A lot of foreign, also non-European, companies have located their European headquarters here. Another reason for the attractiveness to foreign companies is the highly educated (40% possess a college or university degree) and multilingual (80% speak English) workforce and the internationally-oriented society. Thus, the Netherlands is also particularly attractive to foreign workers and immigrants from other European and non-European countries, and experienced a higher population growth (5.0%) than the EU-28 (3.7%) from 2000 to 2011. In Overijssel, the population increased at a rate of 5.3% during this period. Together Amsterdam (airport), Rotterdam (seaport) and Eindhoven (brainport) form the foundation of the Dutch economy. A further advantage is the outstanding IT infrastructure. In the Digital Economy Ranking (IBM, The Economist 2010), the Netherlands is classified as one of the most ‘wired’ countries in the world.

Like all Dutch provincial authorities, the province of Overijssel is an administration at intermediate level that focuses on regional development and keeps track of coherent spatial and economic planning, thereby assisting or steering the municipalities that fall under its jurisdiction. It invests in large, innovative projects of regional scale and maintains infrastructure (both physical and organisational) to foster the local economy.[27] Regarding innovation policies, most competencies falls under national policy, but specific regional policy exists to either fill in blind spots of national policy or foster and develop regional competencies. Overijssel does so with innovation vouchers for SMEs, networking initiatives around the technical university and participating in the regional development agency. Further regional strategies to foster regional growth include the Innovation Fund, which Overijssel launched in May 2013. The fund contained EUR 10 million initially, which were part of a total amount of EUR 42 million that the Province of Overijssel had made available for innovation in Overijssel. The focus of the fund is on entrepreneurs and joint initiatives in the sectors High Tech Systems, plastics and chemistry, life sciences and health and cross-overs. Furthermore, Overijssel cooperates with Gelderland on innovation programmes on Food and Health. The technical university and the East Netherlands Development Agency also bind Gelderland and Overijssel. As Overijssel hosts one of the Netherlands’ three technical unversities, Overijssel's innovation policy is geared towards including this institution in its regional economy and innovation policy mix. In addition, combinations with the province's historical expertise are sought for which Open Innovation Centres exist. SMEs are explicitly involved in the regional innovation ecosystem.

Furthermore, there are several initiatives that support advanced manufacturing independent of the regional government:

› The Polymer Science Park is an initiative promoting public-private partnerships for the development and production of advanced polymers, composites, engineering plastics, coatings and biopolymers. The facilities offered are supportive of product and process innovations, testing facilities for mechanical and chemical stress testing, knowledge, courses, coaching and project management. Facility sharing is also offered for participants, among which several large firms from the Province and the Netherlands at large. Financial support for projects and enterprises is given through already existing innovation support measures, such as innovation vouchers.

› The Open Innovation Centre for Advanced Materials is an independent foundation that aims to reinforce the innovative performance of enterprises. To support enterprises in their innovation

[27] European Commission (2015h).

efforts, the OICAM connects enterprises with students from the Twente Technical University and various universities of applied sciences in the region. The main topics that are addressed are high-performance materials, design and (production) technology.

› The Thermoplastic Composite Research Centre (TPRC) was founded by Boeing, Fokker, TenCate and the technical university. It is located in the proximity of the university and invites parties from different value chains in the thermoplastic composites sector (material suppliers, engineering and design bureaus, production organisations, machine suppliers, education and research institutes) to perform collaborative research. This research ranges from fundamental to applied, dealing with the topic of applying high-tech materials in the aerospace and automotive industries.

Table 7.20 / Stylised industry-specific regression results for Overijssel

Full sample

RXA (gross exports)	17	25	30
(log) patent intensity	6.402	0.047	1.376 ***
(log) techn. innov., SMEs	27.861 **	19.981 *	-23.853
(log) non-techn. innov, SMEs	7.527	-4.045	-20.984
tertiary educ. < 35 yrs.	-1.103 ***	-0.635 **	-0.282
(log) HERD	1.525	5.522	17.693 ***
(log) BERD	-9.059 ***	5.983 *	2.867
GDP per capita	-0.001 **	0.000	0.000
(log) population density	12.071 **	-11.109 **	1.827
cluster	41.453 ***	21.391 ***	9.338
business services	-5.542	-19.719 **	2.460
ERDF innovation	0.281	-0.052	-0.210
(log) quality of governm.	-28.937 ***	-15.389 ***	44.922 ***
accessibility index	-0.077	0.184	0.646 *
R^2 within	0.065	0.015	0.039
R^2 between	0.407	0.138	0.302
R^2 overall	0.352	0.115	0.234
No. of observations	2,800	2,800	2,800
No. of clusters	250	250	250

More developed regions

	sf3 / p17	sf3 / p25	sf3 / p30
(log) patent intensity	7.231	-0.691	1.506 **
(log) techn. innov., SMEs	19.252	21.495	-48.016 **
(log) non-techn. innov, SMEs	41.836	2.949	3.197
tertiary educ. < 35 yrs.	-0.503	-0.697 **	-1.778 ***
(log) HERD	0.888	-0.984	-1.762
(log) BERD	-4.105	5.489	-6.611
GDP per capita	-0.002 **	0.000	0.000
(log) population density	21.112 ***	-10.092	2.232
cluster	73.047 ***	19.484 **	17.665
business services	-18.997 **	-10.176	16.172
ERDF innovation	-0.176	0.081	0.024
(log) quality of governm.	-27.283 ***	-13.814	74.440 ***
accessibility index	-0.661 **	0.150	1.217 ***
R^2 within	0.036	0.011	0.088
R^2 between	0.438	0.182	0.341
R^2 overall	0.374	0.151	0.297
No. of observations	1,632	1,632	1,632
No. of clusters	143	143	143

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of textiles (17), Manufacture of rubber and plastic products (25), Manufacture of office machinery and computers (30). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

Conclusion

The case study of Overijssel describes an advanced European region with an above-average trade specialisation in the textile industry, the rubber and plastic production industry, and the office machinery and computer industry. Hence, the region is specialised in both, low-technology industries (textile industry and rubber and plastic production industry) and high-technology industries (office machinery and computer industry). In all three industries, the region exhibits comparatively high patent intensities, indicating that regional firms, even those that operate in the low-technology sector, compete based on their innovative strengths and niche products with a higher value added. In this context, regional firms clearly benefit from the well-developed regional innovation system that is characterised by high levels of R&D expenditures and a high-skilled labour force. Furthermore, many regional clusters provide the ground for industry-university linkages. The regional endowment with highly-qualified human resources and the emphasis of regional universities and research institutes on natural sciences and engineering has also attracted firms specialised in the development of semiconductors, micro-electromechanical systems (MEMS), integrated circuits (ICs) and sensors. These industries are highly R&D dependent and are responsible for the comparatively high regional R&D expenditures. Furthermore, these industries may provide high-paid jobs for workers and are important for ensuring future growth in the region.

These results prove to be very particular when compared with the econometric estimates. For example, patenting is found to be a distinctive feature only with respect to the manufacture of office machinery and computers. With regard to differences in trade specialisation of manufacturing of rubber and plastic products, the model generally performs weak. As is reported in the case study, challenges in these industries are addressed in particular by measures to improve the research infrastructure. These measures are region-specific and are less usual in other regions with high comparative advantages in rubber and plastic products. For office machinery and computers, the model predicts that only few regional characteristics are meaningful. An important exception is, corresponding to the econometric results for HERD, that competitive locations exhibit such an outstanding university and research landscape as in Overijssel. Finally, also the textile industry neither shares location requirements with the other two industries, nor does it fully match the effective structure of Overijssel, e.g. in respect of high-skilled labour supply, business services and quality of government. More generally, the different requirements concerning the innovation orientation are met without being particularly shaped for a certain kind of sector. With respect to manufacture of office machinery and computers, innovation efforts and output (HERD, patent intensity) are given characteristics but also innovative SMEs as they are required for the other two industries are found in Overijssel. The case study is thus an example for a very diversified specialisation pattern.

7.3.9. Sydsverige (Southern Sweden)

Regional background information

Sydsverige is situated in the southern part of Sweden and covers an area of 13,968 km2, representing 3% of the Swedish surface. The regional population amounts to 1.4 million inhabitants, which equals 15% of the Swedish population. The population density is therefore 100 inhabitants per km2. Sydsverige consists of two independent regions at the NUTS 3 level, the metropolitan area Skåne county and the smaller, rural Blekinge county, and is situated in direct proximity of the Danish capital Copenhagen. The largest cities of the area are Malmö, Helsingborg and Lund.

Sydsverige generated a per capita GDP of 26,800 PPS in 2011, which is less than in 2007 (28,400 PPS) but with an increasing trend in the recent years. The region was severely hit by the crisis with the GDP 14% lower in 2009 than in 2007. The reason behind is that the region is deeply involved in international trade. However, the decline in per-capita GDP was partly also caused by population growth. The region's per capita GDP amounts to 85.4% of the Swedish per capita GDP but is 6.8% above the EU average. Thus, Sydsverige ranks among the advanced developed regions in the current funding period (EC/49/2014).

Sydsverige has strong innovation capabilities in terms of R&D and tertiary education. In combination with the existing clusters and the institutional framework in the region, prospects for maintaining the entrenched position of competitiveness are good. The region's businesses engage in future important objectives such as sustainability, ICT and pharmaceutical research. Sydsverige frequently ranks among the most innovative regions in the EU.

Along with the regional GDP, the regional employment rates also decreased during the financial and economic crisis in 2008. Hence, the unemployment rate in Sydsverige rose from 7.4% in 2008 to 9.9% in 2013. In contrast, the national unemployment rate increased from 6.2% to 8.1% during the same period. In the recent decade the unemployment rate in Sydsverige was consistently 1-2% higher than the country average. The region accommodates comparatively many immigrants. The share of migrants in the total population ranges between 10% and 20% and reaches 40% in Malmö. The share of inhabitants with 3-year tertiary education in Skåne is above the national average. However, most people in this group are found in the university cities Malmö and Lund; in the rural parts of Skåne and in Blekinge the level of education is below the Swedish average (Technopolis group et al., 2014b, p. 9).

The integration of Sydsverige and the Copenhagen region has accelerated since the Öresund Link bridges the 14 kilometre narrow Öresund strait between the southern Swedish coast and Denmark. The joint venture of the Danish and Swedish governments pursues the creation of a single functional market of Greater Copenhagen, Sealand and Skåne, comprising about 3.2 million people. The Öresund was first bridged in 2000. The immense commuting flows illustrate the economic, social and structural implications of the project for the regions and their integration: 20,400 people crossed the Öresund on a daily basis in 2009. The number of commuters increased tenfold as compared to 1999, prior to the construction of the bridge (OECD, 2012, pp. 43f.).

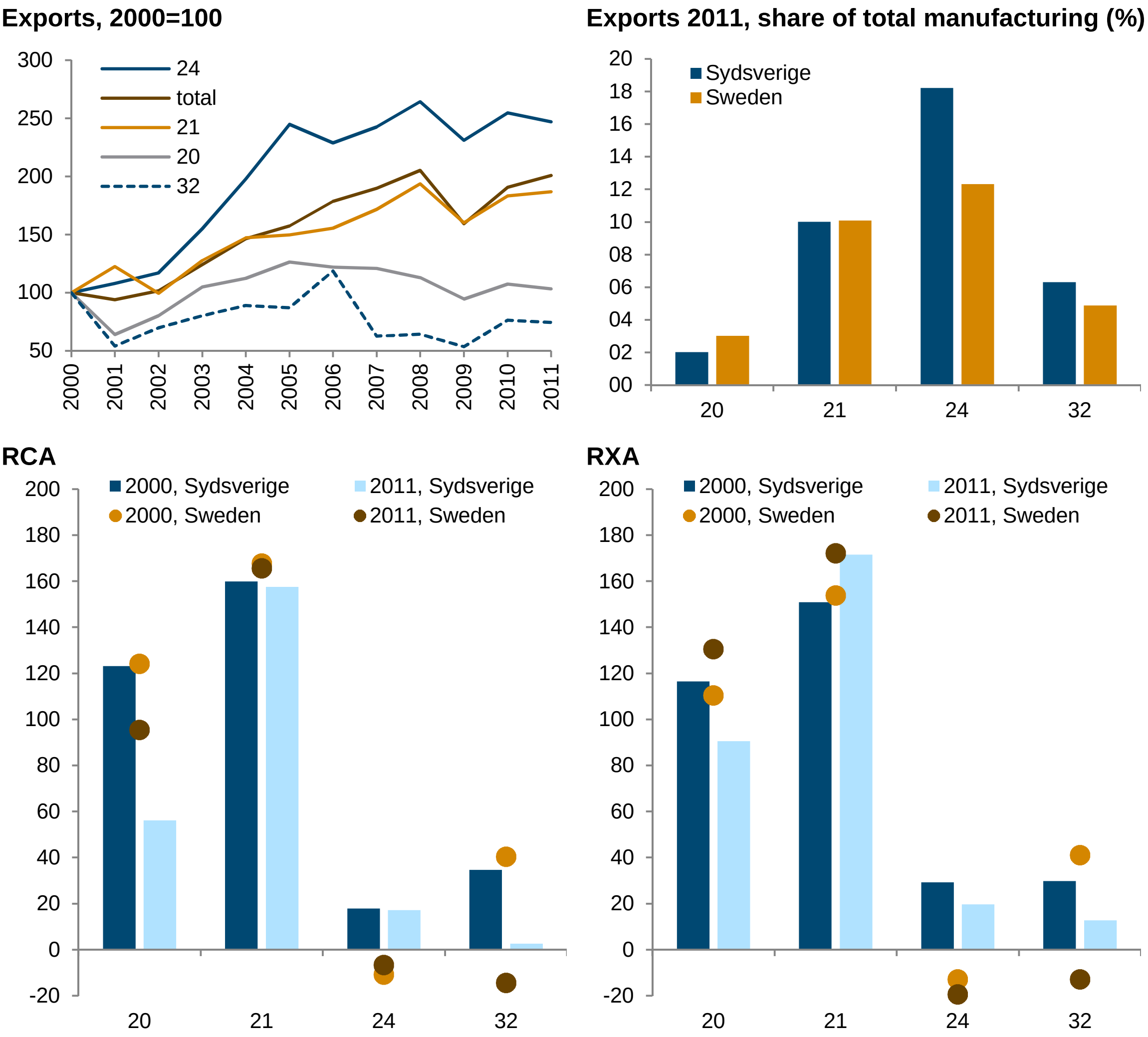
Selected industries

International trade

To determine well-performing industries in Sydsverige, foreign trade indicators that compare regional import and export values have been explored and several outstandingly competitive industries in the region have been identified. The analysis of RCAs and RXAs indicates that the region holds comparative advantages in the industry of wood and wooden products without furniture (NACE Rev. 1.1: 20) as well as in the industry of paper and paper products (21). Also in the chemical industry (24) and in the production of radio, television and communication equipment (32) the region is successfully engage in trade. The dynamics of RCAs and RXAs are quite stable over time so the regional industry seems to be relatively independent of other region, possibly due to its focus on R&D.

The chemical industry contributes most to the total regional manufacturing exports with a share of 18.2%. The production of radio, television and communication equipment contributes 6.3% to the regional exports in manufacturing goods. Both industries exhibit a higher importance for the regional exports than for the national exports (Figure 7.11). The production of paper holds a share of 10.0% and the paper industry produced 2.0% of the total regional exports.

Figure 7.11 / Trade indicators of Sydsverige



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

In Sydsverige the chemical industry shows a positive RCA value that is well above the national average. The RXA, an indicator for export specialisation, reveals the same picture.

The RCAs of the production of radio, television and communication equipment in Sydsverige and Sweden, respectively, are similar to the ones in the chemical industry. This indicates that the manufacturing branch in southern Sweden was not affected by the decline in production of communication equipment that can be observed for the EU as a whole.

The RCAs of the paper industry in Sydsverige are constantly at a very high level of over 150, similar to the values at country level, and vary only little over time. This indicates a remarkable comparative advantage in this industry. The corresponding RXAs are within the same high range. Forestry had a high initial RCA of 123 in 2000 but had to face decreasing RCA values until 2011. A similar trend can be observed for the country level. The corresponding RXAs are similar to those of the paper industry. The indicators, however, might be misleading because the trade volume in the industry is not very high.

Forestry and the production of pulp and paper are closely related. The high trade balance can be explained by the fact that the wood industry is part of the primary sector and naturally does not require much external input and only little imported intermediary products. The manufacture of paper mostly relies on local suppliers so its import figures are also low. Both forestry and paper manufacturing are resource-based low-tech industries. The trade volume is rather secondary for the local economy. The further analysis therefore will focus on ICT and the chemical industry.

These two industries achieve a positive trade balance and the region’s performance resembles the country trend. In the television and communication equipment industry a falling trend is to be observed at country and EU level. Sydsverige, however, has been able to maintain positive net exports in the sector – although the EU had a steeply rising trade deficit. The regional ICT sector seems rather robust, since it was able to largely resist the falling RCA, RXA and trade balance trends at the national and EU level. The trade volume of the chemical industry (NACE Rev. 1.1: 24) rapidly increased from EUR 2.4 billion in 2000 to EUR 6.3 billion in 2011 (Figure 7.11). The high trade volume of the chemical industry is largely generated by the pharmaceutical industry. It has been able to keep its high RCAs in the regional industry and thus participated in the growing sales markets in Asia and South America.

Employment and patent activity

In terms of employment the manufacturing sector has lost importance in Sydsverige. While in the year 2000, 18.5% of the labour force was employed in the manufacturing sector, the share declined at an annual rate of 1.6% to 12.2% in 2013. The remaining manufacturing sector shifted its focus more towards high- and medium-tech industries. Employment in low-tech production decreased on average by 2.0% annually, in medium- and high-tech manufacturing only by 1.1% (see Table 7.21).

The exceptional importance of the chemical industry, including biotech, pharmaceutical and medical businesses, is also reflected in the employment figures of the industry. In 2013, 7,200 people (1.1% of the region total) were employed in this industry. Even though a decline can be observed between 2000 and 2013, in Sydsverige, employment declined less than in other manufacturing industries (Table 7.21). The industry of radio, television and communication equipment faced a decreasing employment that declined from 0.5% to 0.2% between 2000 and 2013. Patent intensity, however, increased significantly, from 555 patents per 10,000 employees on average in 2000-2002 to 1,718 patents in 2009-2011, indicating that employment cuts mainly concerned production capacities but not R&D. The chemical companies also showed a high patent intensity with an increasing number of patents, from 139 patents to 163 patents per 10,000 employees.

Table 7.21 / Regional key figures for Sydsverige

Sector	Employment				Patent intensity	
	Number of employees	Regional employment structure (%)		Annual average growth rate of regional employment between 2000 and 2013(%)	Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011)	
	2013		2000	2000-13	2000-02	2009-11
Region total	671,700	100.0	100.0	1.6		
Manufacturing	82,100	12.2	18.5	-1.6		125.0
High- and medium-tech	35,500	5.3	7.5	-1.1	166.9	246.1
Low-tech	46,600	6.9	11.0	-2.0	25.3	32.7
Knowledge-intensive services	235,800	35.1	34.4	1.7		
Other	353,800	52.7	47.0	2.4		
Selected manufacturing industries:						
20	3,100	0.5	1.0	-4.2	1.9	10.7
21	3,200	0.5	0.7	-1.9	21.1	12.3
24	7,200	1.1	1.4	-0.5	139.2	162.7
32	1,500	0.2	0.5	-4.9	555.0	1717.7

Source: Eurostat; OECD RegPat. – NIW and ZEW calculations.

Drivers of regional trade specialisation and regional growth

Economic structure

In Sweden the cluster development is largely driven by governmental organisations and focuses on knowledge-intensive sectors. Employment in knowledge-intensive services increased from 34.4% in 2000 to 35.1% in 2013 which reflects an annual growth rate of 1.7%. Particularly in the pharmaceutical industry, the business structure is characterised by many smaller businesses which are not involved in production, but in basic research, and which provide services to large manufacturers.

Clusters can be one factor for explaining the strong export performance of the selected industries, as spatial concentration of businesses and research facilities can create mutually conducive effects such as knowledge spillovers. There are several clusters to be found in the region that have been branded and developed in recent years. Seven cluster organisations are located in Sydsverige, most prominently the pharmaceutical industry cluster Medicon Valley in the Öresund region and the mobile communication clusters Mobile Heights in Skåne and TelecomCity in Karlskrona, Blekinge. The Cluster Observatory finds a cluster in the IT sector with 3113 enterprises and also the pharmaceutical medical industry with 382 businesses in the region.

Along with the Danish-Swedish integration over the Öresund, the vision of turning the region into a hub for life sciences emerged. Governmental institutions first initiated the Medicon Valley cluster project that now consists of numerous biotech, pharmaceutical and medical companies. The cluster acknowledges the need to be visible and attractive as a regional cluster in the highly competitive global medicine and biotechnological market with only few centres worldwide. To promote the cluster the Medicon Valley Alliance (MVA), a member-financed non-profit organisation that seeks to facilitate R&D spending in the region, was founded. Its members include all important universities, healthcare organisations and most biotech and medical companies. The MVA has become an institutionalised forum and unified information and marketing provider. The MVA is also important for attracting investment in the cluster (Lundequist and Power, 2002, p. 693).

Currently the cluster includes 12 universities, 32 hospitals (many of which belong to universities) and over 300 life science companies. Among the major international companies that are active in R&D and maintain research centres in Sydsverige are the pharmaceutical and medical company Novo Nordisk, Lundbeck, LEO Pharma, Ferring Pharmaceuticals and AstraZeneca. The research intensity is also indicated by a very high number of patents.

Another cluster of the region is TelecomCity, located in Karlskrona in Blekinge county. The cluster initially was a project initiated by the governmental institutions when the region was facing decreasing population and employment (Lundequist and Power, 2002, p. 693). It had to be built from scratch since the region had not much tradition in the ICT sector. Similar to Medicon Valley, early on the cluster branding was emphasised. The Municipality of Karlskrona, the Blekinge Institute of Technology and the business network in Karlskrona agreed to develop the ICT sector of the region as TelecomCity in 1993 and marketed it as such. Around 50 firms of different size and specialisation are set in Karlskrona. Large firms in the city are Ericsson, Telenor, Fujistsu and CGI. The ICT sector is also strong in Skåne with companies such as Sony Ericsson and Ericsson. The focus is on mobile communication with Blackberry, Ericsson and Huawei as phone manufacturers. The Lund Institute of Technology and the University of Malmö cooperate with the local industry in the ICT sector.

Although there are cluster tendencies in the wood industry as well, the sector is rather small. The number of employees is decreasing slightly over time. Moreover, Skåne does not have much fellable woodland that could be utilised in the sector (Henning et al., 2010, pp. 53f.). The high trade balance stems only from small absolute trade volumes.

Other industries in Sydsverige are the food industry, which forms a cluster in the region, and the packaging sector, which is also of significance for the region with international companies such as Tetra Pak. The packaging and the food industries are functionally linked (Henning et al., 2010, p. 56). The large packaging companies Åkerlund&Rausing and Tetra Pak also contribute to the exports of the paper industry that exhibits high RCA-values as described.

Regional innovation system

Although the aforementioned industries perform well in the region of Sydsverige, they are not capable of raising employment and regional growth over the country average. The OECD (2012, p. 110) names the globalisation of value chains, insufficient entrepreneurship and weak SME innovation as explanations for the lacking ability to translate research and innovation into employment and income adequately. The challenge in Sydsverige, thus, is to move from a research and technology hub towards an inherently innovative region. Another factor that may lead to higher unemployment is represented by difficulties in integrating the above-average number of immigrants into the labour market.

The regional R&D expenditure of businesses in Sydsverige of 3.3% of the GDP is higher than in Sweden as a whole (2.3%) in 2011. Also the total expenditure on R&D is higher in Sydsverige (4.5% of the GDP) than the Swedish average (3.4%). Business accounted for 73% of the total R&D expenditures of

EUR 2.2 billion in Sydsverige in 2011. Higher education institutions contributed 24%. The high level of R&D investment by businesses and universities and the respective strong academic research certainly constitute regional strengths. However, the overwhelming part of development is carried out by a small number of multinationals.

There are deficits in publicly funded industrial research (2.8% of total R&D) and research institutes that cannot compete with the massive capital endowment of the large companies. Also smaller firms are not able to match the capital endowment required to gain market share and consequently remain small.

Table 7.22 / Stylised industry-specific regression results for Sydsverige

Full sample

RXA (gross exports)	20	21	24	32
(log) patent intensity	20.384 *	1.033	0.306	0.142
(log) techn. innov., SMEs	6.271	2.972	-18.206	-32.954 **
(log) non-techn. innov, SMEs	23.315	11.886	-14.674	-37.413 *
tertiary educ. < 35 yrs.	-0.590	0.561 ***	0.816 ***	-1.595 ***
(log) HERD	5.343 *	-2.625	0.767	15.152 ***
(log) BERD	-4.404	0.415	-0.666	16.467 ***
GDP per capita	0.000	0.000	-0.002 ***	0.001
(log) population density	-33.800 ***	7.156	4.353	-2.163
cluster	46.975 ***	56.477 ***	50.225 ***	26.107 **
business services	-33.984 **	9.485	16.498 **	8.008
ERDF innovation	-0.530 *	-0.345	0.202	-0.352
(log) quality of governm.	-2.776	13.064 *	15.208 **	28.330 ***
accessibility index	-0.163	0.195	1.026 ***	-0.171
R^2 within	0.004	0.012	0.013	0.054
R^2 between	0.532	0.254	0.461	0.160
R^2 overall	0.454	0.221	0.368	0.107
No. of observations	2,800	2,799	2,798	2,800
No. of clusters	250	250	250	250

More developed regions

	sf3 / p20	sf3 / p21	sf3 / p24	sf3 / p32
(log) patent intensity	15.758	3.263	0.402	0.310
(log) techn. innov., SMEs	13.375	-29.131 *	-37.916 **	-34.327 *
(log) non-techn. innov, SMEs	107.388 **	76.019 ***	-17.738	-42.311
tertiary educ. < 35 yrs.	-0.626	0.676 ***	0.186	-2.394 ***
(log) HERD	7.245	1.871	-7.139 *	1.690
(log) BERD	-1.807	-6.750 *	1.651	11.814 **
GDP per capita	0.001	0.000	-0.001 *	0.001
(log) population density	-37.947 ***	7.300	13.393	-16.750
cluster	38.298 ***	51.224 ***	52.111 ***	23.362 **
business services	-36.262 **	12.746	9.618	30.863 ***
ERDF innovation	-0.601	-0.136	0.042	0.139
(log) quality of governm.	-23.276 *	1.142	22.679 **	36.890 **
accessibility index	-0.478	-0.074	0.776 *	0.739
R^2 within	0.004	0.017	0.016	0.097
R^2 between	0.498	0.240	0.403	0.198
R^2 overall	0.401	0.215	0.316	0.135
No. of observations	1,632	1,632	1,632	1,632
No. of clusters	143	143	143	143

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20), Manufacture of pulp, paper and paper products (21), Manufacture of chemicals and chemical products (24), Manufacture of radio, television and communication equipment and apparatus (32). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

Particularly Skåne is dependent on external decisions of big research companies. For instance, the pharmaceutical manufacturer AstraZeneca closed its research facility in Lund, Skåne, in 2010 which caused the immediate loss of 900 jobs and their income in the region. The Skåne Research and Innovation Council in cooperation with the local Lund University turned the facility into the Medicon Village. Its concept is to encompass the entire value chain of research, innovation and business which makes it less vulnerable.

In the Sydsverige region the most important universities are the Lund University with its research focus on life sciences such as medicine and pharmacology, the Blekinge Institute of Technology, which has strengths in IT and telecommunication, and the Malmö University. The universities' focus is well-matched with the respective local clusters, for instance the Blekinge Institute for Technology in Karlskrona, which is closely related to the telecom cluster. The focus of the universities in life sciences, namely the Lund University, fits the specialisation of the pharmaceutical cluster.

Besides the good endowment with higher education institutions, the region is currently in the process of launching two new research centres, the MAX IV and the European Spallation Source, planned to be put into operation in 2015 and 2019, respectively. The two facilities will provide infrastructure for physics and materials research (OECD, 2012, p. 103).

The regional growth strategy in Sydsverige is centred on knowledge-intensive sectors, which can be a possible explanation for the robustness of the industry against the decreasing trade balance at EU level especially in the ICT sector. The Regional Innovation Scoreboard has ranked Sydsverige as a regional innovation leader.

Political context and regional growth policies

There are several institutions that intend to facilitate innovation and entrepreneurial activity and to support the establishment of start-up ventures. There are development policies at the national and regional level implemented by different governmental institutions (Technopolis group et al., 2014b).

The Agency for Innovation Systems VINNOVA is a governmental agency in charge of the administration of state funding. It finances research and innovation projects. VINNOVA also maintains an SME support network. The agency fosters collaboration of the public sector with universities and businesses and disposes of an annual budget to the equivalent of about EUR 300 million. Another important institution is the Swedish Agency for Economic and Regional Growth Tillväxtverket that operates under the Ministry of Enterprise and seeks to promote business activity. It also implements the structural funds programmes of the EU. From 2007 to 2013 there was one Regional Operational Programme for Skåne-Blekinge managed by Tillväxtverket and funded by EU and Swedish governmental institutions that each contributed EUR 70.7 million. Its objectives were to further strengthen the knowledge-based industries and particularly the ICT sector. The former Swedish Business Development Agency NUTEK, a partnership of private and public actors, was joined to Tillväxtverket and partly the Agency for Rural Development in 2009. NUTEK's objective was to build a partnership between regional and national policy-makers to improve the learning process in the network (Lundequist and Power, 2002, p. 690). To name one more, the agency ALMI was founded to foster entrepreneurial activity and is owned by the Swedish government as well. ALMI provides advisory services, loans and venture capital to start-up companies. It funds firms in an early stage to provide them with start-up capital. However, the loans have higher interest rates than market rates to avoid competition with banks. ALMI invests in companies when they still bear much risk and their access to capital would be rather limited otherwise. Another objective of ALMI is to offers consultancy for instance in mentor programmes, growth and innovation advice or seminars for entrepreneurs.

Conclusion

The case study has shown that even though the regional performance indicators of Sydsverige (GDP per capita, employment rate) are below the national average, the region still reveals above-average trade specialisation in two low-tech industries (i.e. the wood and paper industries) and two high-tech industries (chemical industry and manufacture of radio, television and communication equipment). Particularly in the latter two high-technology industries, Sydsverige benefits from its relatively well-developed regional innovation system, with the Lund University being a central actor. The university – with its strong focus on life sciences and its traditional role as a transfer agent – acts as a pull-factor for chemical and biotechnological firms locating in the region. Given the proximity to the Danish capital city of Copenhagen, regional firms also profit from business cooperation and knowledge exchange with Danish firms, particularly within cross-border cluster initiatives. Since the region has increasingly specialised in skill-intensive sectors, a future regional challenge is the integration of people with only low skills in the regional labour market. Here, education and qualification strategies should be expanded.

Despite their differences in terms of products and technological intensity, the results from the regression model have shown that in all four industries, clusters are positively related with a region's trade specialisation in that industry. Besides that, also HERD and governmental quality play a significant role, at least in three of the selected industries. Moreover, the requirement of high-skilled labour supply is relevant for such different industries as the manufacture of pulp, paper and paper products as well as the manufacture of chemicals and chemical products. More interestingly, non-technological innovations of SMEs are quite important for the low-technology-intensive industries while they play less of a role, especially concerning technological innovations, for the two high-technology industries. Similarly mixed are the results for HERD and BERD. There is thus no comprehensive explanation possible relying only on the econometric results. However, it can be concluded that specialisation in the two low-technology industries is based upon the natural forest resources and the structural preconditions that favour functional specialisation on headquarter functions. Against this background, comparative advantages in Sydsverige rely upon on an ideal combination of several location factors which have been steadily further developed. The mix itself, however, can hardly be explained empirically but rather from a qualitative long-term perspective.

7.3.10. West-Transdanubia

Regional background information

West Transdanubia (WT) is Hungary's westernmost region, located on the border to Austria, Slovenia, Croatia and Slovakia. The region is spread over 11,300 km^2 with about 985,000 inhabitants (2013), accounting for approximately 10% of Hungary's total population. The population density amounts to 87 inhabitants per km^2 which indicates the region's rural character. WT covers the three counties Győr-Sopron-Moson, Vas and Zala. The capital of the region is Györ with about 129,000 inhabitants.

Apart from Central Hungary as the leading income region in Hungary with a GDP per capita of EUR 27,600 in PPS in 2011, WT is the second leading income region of Hungary, with an income level that slightly exceeds the national average (EUR 17,100 compared to EUR 16,900). Amounting to less than 70% of the EU-28 average (EUR 25,500) WT is eligible for the structural funds dedicated to the less developed regions. Unemployment and activity rates exhibit marginally more favourable values than the Hungarian average (7.8% and 59.4% compared to 10.2% and 57.5% in 2013).

WT is particularly specialised in the manufacturing of automotive, electronics and machinery and equipment especially induced by foreign direct investment. Other important manufacturing sectors are the wood and furniture industries and agriculture and food industries, both related to the region's natural resources, as well as renewable energy and related technologies. Due to the strong export orientation of the foreign subsidiaries located in the region, WT was particularly exposed to the financial and economic crisis. GDP per capita declined from EUR 15,300 in 2008 to EUR 14,300 in 2009, while unemployment nearly doubled within two years (from 4.9% in 2007 to 9.2% in 2009). Yet WT succeeded in recovering faster than other Hungarian or European regions. In 2013, regional unemployment amounted to merely 7.8%, and was significantly lower than the national average (10.2%).

Typically of the Hungarian business structure, 4% (2,700 units) of registered businesses in WT are foreign-owned. For reasons of size and productivity, however, their contribution to revenues and employment is much higher. According to the Hungarian labour office MNH, foreign businesses accounted for more than 50% of total revenues and 25% of Hungary's active employees in 2011. Furthermore, foreign-owned companies carried out nearly half of all investments in Hungary.[28]

The regional employment in the service sector is driven by the tourism industry. Due to its favourable geographical characteristics, especially thermal tourism makes it to one of the most important sectors in WT, just behind the Central Hungarian region.

Selected industries

International trade

The four industries in which West Transdanubia (WT) holds a comparative advantage (when taking the average of the less developed EU regions as a reference point) are all classified as high- and medium-tech ones. These are the manufacture of office machinery and computers (NACE Rev. 1.1: 30), manufacture of radio, television and communication equipment and apparatus (32), manufacturing of medical, precision and optical instruments, watches and clocks (33), as well as the manufacture of motor vehicles, trailers and semi-trailers (34). In all these industries, the region achieves higher comparative advantages (RCA) and a more favourable trade specialisation (RXA) than the EU-28 or the Hungarian average. Nevertheless, the respective export shares of total manufacturing of these four industries are quite similar to the national average and account for more than half of total manufacturing exports (Figure 4.10). 28% of WT's exports in 2011 are attributed to motor vehicles, trailers and semi-trailers (34) and 19% to radio, television and communication equipment and apparatus (34). The favourable trade performance for office machinery and computers as well as for motor vehicle had already existed in 2000. On the other hand, the region achieved outstanding export growth for consumer electronics and

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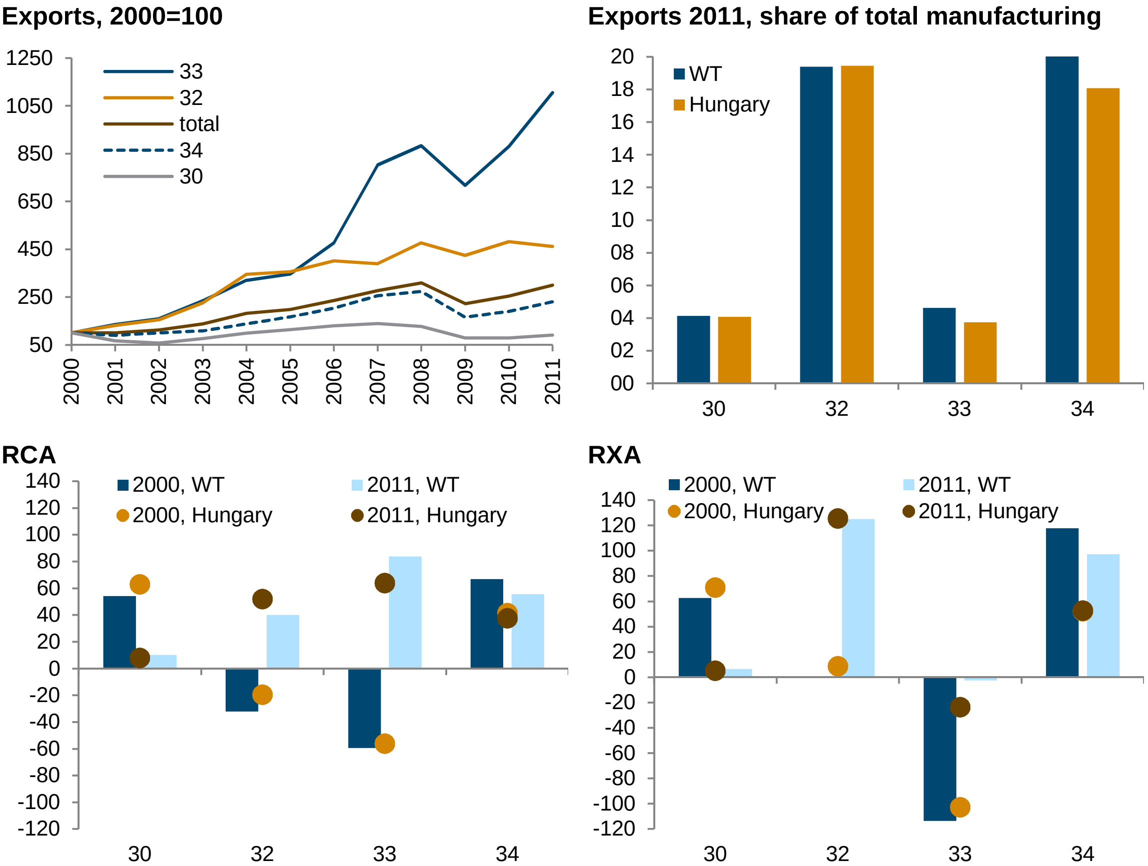
28 http://www.xpatloop.com/news/foreign_companies_employ_25_in_hungary

communication equipment (32) and instruments (33) from 2000 to 2011, and significantly improving its trade performance (RXA and RCA) in these industries. In contrast to this, the formerly highly positive trade specialisation for office machinery and computers has significantly decreased over time due to a substantial decline in exports since 2009. Compared to this, the positive trade specialisation for motor vehicles remained rather stable (Figure 7.12).

Figure 7.12 / Trade indicators of West Transdanubia (WT)



Source: UN Comtrade; Eurostat. – wiiw estimates and NIW calculations.

WT basically exhibits a similar trade performance as Hungary as a whole in terms of those four selected industries, although the indicator values (RCA, RXA) for the national average are quite lower, as a rule. Hence, both differ significantly from the EU-28 average according to the three electronic-based industries. Here, the EU-28 exhibits a highly negative and further deteriorating trade performance for office machinery and computers (30) as well as for consumer electronics and communication equipment (32) and a stable negative export specialisation for instruments (33).

Employment and patent intensity

Altogether, employment in the four selected industries amounts to 32,300 workers, representing 27% of total manufacturing (2013) and 8% of total regional employment. The automotive industry (34) accounts for more than the half (17,900), followed by consumer electronics and communication equipment (32) (13,500) while the size of the other two industries is negligible.

The employment in high- and medium-high-technology manufacturing industries amounts to 12.8% of total employment and is slightly higher than the national and average EU-28 average. In contrast, the employment share in knowledge-intensive services (in the broad OECD/Eurostat definition)[29] amounts to only 25.7% which is at least 10 percentage points lower compared to Hungary as a whole and in EU-28. In the narrower NIW/ISI-Definition only 15.1% of the workforce is employed in knowledge-intensive services. The share of employment in total manufacturing was 28.3% in 2013 (see Table 7.23).

In spite of the high employment share in high- and medium-tech industries, the patent intensity of these industries is rather low (see table 7.23). Particularly in the two largest industries of motor vehicles (34) and consumer electronics and communication equipment (32) show extremely low patent intensities, whereas the other two selected small industries exhibit significantly higher patent activities (Table 7.23).

Drivers of regional trade specialisation and regional growth

Economic structure

Being formerly shaped by state-owned industries, the regional economy successfully diversified since the transformation. Despite substantial regional restructuring processes, most of the established larger enterprises (e.g. Rábá, see below) maintained their headquarters in Györ. Altogether, these features made the region less vulnerable to the emerging crisis. A second favourable feature has been the comparably high educational level of the population, a result of the industrialisation in the 1970s and 1980s and the promotion of educational participation during the 1980s. Another advantage was the widespread proficiency of foreign languages, also a result of the relatively intense contacts with the West in the pre-transition area.

The beneficial geographical location and good accessibility by highways granted WT an advantageous competitive position for the rapid attraction of foreign direct investment (FDI). However, one of the main reasons for the region's high inward FDI is the low wage levels. Hourly wages in Transdanubia amount only to one third of the EU-28 average and are also below the wage levels in competing locations within the EU such as in the Czech Republic or Slovakia.[30]

Until today, national and regional policy provides refundable and non-refundable incentives for foreign investors in Hungary, regardless of whether they are already engaged in the country or not. The main instruments are subsidies (either from the Hungarian government or from EU Funds), tax incentives, low-interest loans, or provision of land for free or at reduced prices.[31] Another location factor is the highly skilled labour force, particularly in engineering, IT, pharmaceutical, economics, mathematics, physics and professional services sectors. Around two-thirds of the workforce in Hungary has completed a secondary, technical or vocational education and 90% of the students speak English. However, the share of employees with tertiary education in the region only amounts to 18.7% (2013) which is

29 Including 61 (Water transport), 62 (Air transport), 70 (Real estate activities), 71 (Renting of machinery, equipment and personal) and 80 (Education) (see the respective KIS definition in EC Commission Staff, 2009, 17f.) , which are excluded in the more narrow NIW/ISI-definition regarding only 64 (telecommunications), 72 (Computer and related services), 73 (Research and Development), 74 (Other business services), 85 (Health and Social Work) and 92 (Recreational, cultural and sporting activities) (Legler and Frietsch, 2007, 19f.).

30 Following the IW Competitiveness Index 2013, low costs are Hungary's single outstanding advantage in a European context (IW Köln, IW Köln Consult, Eds., 2015).

31 http://eugo.gov.hu/doing-business-hungary

significantly lower than the country and particularly the EU-28 average (24.8% and 32.1%, respectively). This indicates that the large foreign-owned subsidiaries are still more focused on (standardised) production rather than on knowledge-intensive tasks and services.

Table 7.23 / Regional key figures for West Transdanubia

Sector	Employment: Number of employees 2013	Employment: Regional employment structure (%) 2013	Employment: Regional employment structure (%) 2000	Employment: Annual average growth rate of regional employment between 2000 and 2013(%) 2000-13	Patent intensity: Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011) 2000-02	Patent intensity: Patents per 10,000 employees (average for 2000 to 2002 and 2009 to 2011) 2009-11
Region total	423,100	100.0	100.0	0.0		
Manufacturing	119,700	28.3	31.9	-0.9	0.4	1.8
High- and medium-tech	54,000	12.8	12.5	0.2	0.8	2.7
Low-tech	65,800	15.5	19.4	-1.7	0.2	1.1
Knowledge-intensive services	63,800	15.1	14.2	0.5		
Other	239,500	56.6	53.9	0.4		
Selected manufacturing industries:						
30	0,200	0.0	0.3	-15.4	8.8	41.8
32	13,500	3.2	3.6	-0.8	0.5	0.8
33	0,700	0.2	0.1	6.4	13.5	16.7
34	17,900	4.2	3.7	0.9	0.3	1.3

Source: Eurostat. OECD RegPat. - NIW and ZEW calculations

Although WT's share in total FDI stock has decreased in recent years, WT it still ranks second after Central Hungary, which is the most attractive region in Central and Eastern Europe as concerns FDI. The vast majority of investments went into business services and processing industries such as automotive, computing, electronics, optical products. More than 75% of all FDI to Hungary originate from EU countries, nearly 25% from Germany.

There are three automotive OEMs operating in WT: two foreign-owned companies, Audi and Opel, and the Rábá Automotive Holding Plc.:

› Rába is a traditional Hungarian company with three strategic business units. It engineers, manufactures and customises automotive components, specialty vehicles and axles for commercial vehicles, agri-machinery and earth-movers. The company is headquartered in Györ and employs about 2,000 people (2014). In the pre-transition era, Rábá has been the region's traditionally largest employer, producing a variety of industrial products including trucks and trucks components, train wagons and other engineering products. [32]

› Audi Hungaria Motor Kft. as a subsidy company of the German Audi AG has a large factory in Győr, where different car types and many engines are built. The factory opened in 1993, at first only producing engines. Later production expanded to assembling. Over 90% of Audi vehicle engines are made here. The company has been expanding since 2008 and finally established the world's second largest engine plant, complemented by an own R&D centre. Employment grew by 1,800

[32] Keune and Todt (2001).

ending up with 10,000 employed persons in Györ. Audi Hungaria thus counts to one of Hungary's largest exporters.

› Opel in Szentgotthárd (WT) was founded in 1990 as a joint venture between GM and Rábá (see above). Since 1992, Opel is engaged in the production of middle segment petrol engines, employing 680 workers. The plant is the sole producer of so called Family I (1.6 – 1.8 l) engine products for Opel's European car assembly plants, but also supplies engines and manufactured engine parts for other GM brands and produces the new generation of mid-size diesel and gasoline engines.

The large-scale investments by OEMs attracted numerous equipment manufactures and other suppliers. Local SMEs have also become stable and strategic partners of both locally based and Western car manufacturers and Tier 1 suppliers. Several larger foreign subsidiaries from German automotive suppliers are located in the region, for instance BOS Automotive, BPW-Hungary, Autoliv, LuK Savaria, Erbslöh or Rehau. Subsidiaries from other countries are Renault Logistics (FR), IB Andresen (DK), Nemak (Mex), SMR (Ind), DANA and Jabil (USA).

Similarly to the automobile industry, WT's electronics industry is also dominated by subsidiaries of foreign companies. The main foreign businesses are Shin-Etsu (J), Flextronics, GE and Delphi (USA), Provertha, Kromberg-Schubert and Epcos (D). In contrast, larger domestic companies are mainly found in low-tech manufacturing industries, such as mechanical engineering, timber, furniture, paper processing, textile, plastics, and food industry.

The exploitation of endogenous regional potentials is facilitated by 22 industrial parks, innovation and technology centres. Furthermore, local governments provide allowances related to the leasing and/or purchase of land, expanding existing infrastructure capacities on industrial areas, professional help in solving legal and public administration affairs or lobbying on regional and national political and economic levels in order to ease foundation and establishment of new enterprises.[33]

Regional innovation system

Starting from a low basis in the mid-2000s, West Transdanubia exhibits the most favourable development in terms of innovation performance among the Hungarian regions. Regional GERD still amounts to only 0.7% of regional GDP (compared to the national average of 1.2% and the EU-28 average of 2.0% in 2011), but increased have considerably since 2006. Also business R&D (BERD) is half the size of Hungary total (0.4% and 0.8%, respectively). Correspondingly, patent intensity (per 10,000 employees) in total manufacturing as well as in high- and medium-tech manufacturing is still very low despite the expansion of R&D activities in the course of the newly established Audi R&D centre and its intensified collaborations with local universities since 2007.

The Regional Innovation Monitor Plus characterises WT as a moderate R&D-intensive region, i.e. most of the region's innovation performance indicators are 50 to 90% of the EU average. However, particularly those indicators related to the performance of the business sector are comparatively low. As a matter of fact, companies in WT innovate mostly by adopting technologies developed elsewhere.[34]

33 http://hipa.hu/Region/Western Transdanubia/3

34 Technopolis group et al. (2014c).

Industrial clustering effects on innovation activities are concentrated on a small number of industries, although WT achieves high indicator scores concerning industry mix and specialisation. Referring to the European Cluster Observatory, the region has only one single so-called ‘accredited innovation cluster (ACI)’, the Pannon Wood and Furniture Industry Cluster (PANFA), whereas there are 26 ACIs in Hungary altogether.[35] However, only the automotive and electronics clusters are highly classified.

Most of the region's research centres are university-based. The key universities are Széchenyi István University in Győr and the University of West Hungary in Sopron and Mosonmagyaróvár. Industry-academia collaborations are concentrated at Széchenyi University, which has several (automotive industry related) knowledge centres, and the University of West Hungary (wood- and eco-industry-related centres). Other relevant institutions of higher education are the Pannon University in Keszthely (focus Agriculture) and the Berzsenyi Dániel College in Szombathely (W4T, 2012).

The key drivers of regional innovation performance as regional universities and businesses are co-financed by the EU structural funds and foreign direct investment.[36] The subsidiaries for foreign multinational companies, local enterprises and WT’s universities altogether have been addressed by EU funding. Foreign investors’ commitment to engage in local R&D activities and to collaborate with universities has also been supported, and universities’ research infrastructure was renewed and extended. Furthermore, EU support was used to increase the number of innovation intermediaries and other bridging institutions. However, R&D activities in WT still show an extensive concentration on single firms and sectors. Furthermore, foreign-owned firms mostly rely on R&D conducted outside Hungary (‘imported innovation’) and the intensity of innovation cooperation between foreign and local firms is still low.

In summary, despite significant convergence to the Hungarian average in terms of the key innovation performance indicators, and despite an unprecedented volume of investment in new technology and research infrastructure, innovation is still mainly driven by foreign enterprises’ activity. Furthermore, the region struggles with a mismatch between labour supply and demand (W4T, 2012).

Political context and regional growth policies

The Hungarian regional policy context is characterised by a ‘façade regionalism’[37] strategy design that is characterised by policy formulation at the regional level, but policy implementation at the central level. Following the parliamentary elections in 2010, conceptualisation and decision-making about the allocation on EU Structural Funds is centralised under the lead of the National Development Steering Committee (NDSC), constituted by the Prime Minister and its ministers for national development and economy, respectively and the minister of the state. Though as of 2014, NUTS 2 regions are no longer considered as the adequate basic unit of territorial development and are no longer in charge of preparing their own development plans and RIS3 strategies. Instead, the former managing authorities of

35 According to a tender of the Hungarian Economic Development Centre (MAG), following the strategic and economic guidelines of the New Széchenyi Plan, existing clusters in Hungary can become ‘accredited innovation clusters’ (AICs) if their submitted description of innovation-related activities and collaborations, together with a proposal how these activities and collaborations will be developed, are accepted. (MAG, 2014, Introduction of the Hungarian cluster aggregation scheme.)

36 Technopolis group et al. (2014c).

37 Szalavetz (2014).

Operational Programs (OP) became devoid of authorities, funding sources and responsibilities and are subordinated to NDSC. This restrains the RIS3 target of smart specialisation at the regional level implying that policy-making should be evolutionary and adaptive necessitating partnerships among representatives of different administrative levels (Szalavetz, 2014, p. 3).

Table 7.24 / Stylised industry-specific regression results for Transdanubia

Full sample

RXA (gross exports)	30	32	33	34
(log) patent intensity	1.376 ***	0.142	-0.070	-0.699
(log) techn. innov., SMEs	-23.853	-32.954 **	-32.252 ***	-15.365
(log) non-techn. innov, SMEs	-20.984	-37.413 *	-10.329	-8.432
tertiary educ. < 35 yrs.	-0.282	-1.595 ***	0.253	0.289
(log) HERD	17.693 ***	15.152 ***	7.268 **	15.255 ***
(log) BERD	2.867	16.467 ***	5.694 *	-1.687
GDP per capita	0.000	0.001	0.000	0.000
(log) population density	1.827	-2.163	-11.833 *	-7.907
cluster	9.338	26.107 **	22.107 **	48.705 ***
business services	2.460	8.008	18.416 ***	-15.138
ERDF innovation	-0.210	-0.352	0.535 ***	-0.151
(log) quality of governm.	44.922 ***	28.330 ***	27.184 ***	26.288 **
accessibility index	0.646 *	-0.171	0.834 ***	0.858 **
R^2 within	0.039	0.054	0.036	0.043
R^2 between	0.302	0.160	0.589	0.228
R^2 overall	0.234	0.107	0.546	0.190
No. of observations	2,800	2,800	2,800	2,800
No. of clusters	250	250	250	250

Less developed regions

	sf1 / p30	sf1 / p32	sf1 / p33	sf1 / p34
(log) patent intensity	-7.422	47.256 *	0.473	-2.797
(log) techn. innov., SMEs	-72.390 ***	-89.440 ***	-46.467 ***	-93.561 ***
(log) non-techn. innov, SMEs	17.252	19.009	-29.109 ***	62.605 ***
tertiary educ. < 35 yrs.	3.614 ***	0.917	-0.506	-0.060
(log) HERD	9.549 *	11.418 ***	7.985 **	11.409
(log) BERD	-1.286	1.868	1.847	-5.718
GDP per capita	0.014 ***	0.011 ***	0.006 ***	0.009 ***
(log) population density	6.804	28.835	-2.811	67.462 **
cluster	158.860 ***	133.967 ***	42.903	26.238 ***
business services	-5.243	-96.333	43.990	19.094
ERDF innovation	3.134 **	0.211	2.642 ***	-1.199
(log) quality of governm.	31.487	53.660 ***	13.888	87.463 ***
accessibility index	1.686 **	0.605	1.003 **	1.284
R^2 within	0.397	0.273	0.134	0.239
R^2 between	0.441	0.528	0.637	0.547
R^2 overall	0.414	0.446	0.534	0.479
No. of observations	674	674	674	674
No. of clusters	60	60	60	60

Note: * p<0.1, ** p<0.05, *** p<0.01. Manufacture of office machinery and computers (30), Manufacture of radio, television and communication equipment and apparatus (32), Manufacture of medical, precision and optical instruments, watches and clocks (33), Manufacture of motor vehicles, trailers and semi-trailers (34). Control variables for bordering and seaside location.
Source: NIW/wiiw calculations.

During the restructuring process, none of the former key actors and managing institutions kept its authorities or status. The West Transdanubian Regional Development Agency (Westpa), originally owned by the WT Regional Development Council, became first state-owned (2012) and two years later changed into the ownership of the three NUTS 3 counties. These institutional changes which have been associated with a loss of practical knowledge in program formulation and EU funding have slowed down the absorption of EU structural funds that, together with other EU programs, constitute practically the only funding sources of innovation policies in WT and other convergence regions.[38]

WT's RIS3 strategy, accompanied by three county-level strategies show both, continuity and change. Continuity is required in terms of support to innovation capacity building and applies to the improvement of the region's innovation potential, innovative economic actors' competitiveness, innovation and commercialisation performance, the strengthening of the institutional basis of regional innovation, and the increase of the amount of resources available for regional innovation. Policy measures are mostly supply-oriented and target mainly business enterprises and universities. They are characterised by a dominance of non-refundable grants and include investment in new technology, market-oriented R&D, development of higher education institutions' infrastructural, organisational and R&D capacities, innovation collaboration, and human resources development.

New targets of innovation policy address creative industries (e.g. design) and eco-industries which complement former high-tech fields such as automotive technology (technology development in traditional technology vehicles and electric cars-related R&D) and ICT as well as mature industries such as tourism, wood and furniture industry, logistics and transportation. Furthermore, demand-side instruments (e.g. innovation vouchers, support to the creation of start-ups and spin-offs, technology transfer, promotion of companies' foreign market access) have been implemented to a larger extent. Instead of direct cash transfers to companies, innovation services ought to be developed and diversified (e.g. business angels' networks, regional business incubation services, improved access to risk capital or micro-credits) to support the commercialisation of scientific and technological results.[39]

Conclusion

The case study has shown that West Transdanubia belongs to one of the most developed regions in the Central and Eastern European Member States (at least in terms of GDP). FDI, particularly from Germany (25%) and the remaining EU Member States, contributed substantially to the region's restructuring. The region succeeded in attracting FDI, partially due to its favourable geographic position on the border to Austria and good accessibility by highways as well as owing to the comparatively high educational level of the regional labour force. FDI has induced the establishment of many production sites in high/medium-high-technology industries and the successful integration of the region in global value chains. Hence, compared to the remaining less developed European NUTS 2 regions (i.e. regions with a GDP below 70% of the EU average), West Transdanubia shows an above-average trade specialisation in several high/medium-high-technology industries: the manufacture of office machinery and computers, manufacture of radio, television and communication equipment and apparatus, manufacturing of medical, precision and optical instruments, watches and clocks, and finally the

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38 Technopolis group et al. (2014c).

39 Technopolis group et al. (2014c).

manufacture of motor vehicles, trailers and semi-trailers. The regional multi-sector economy and the high-skilled labour force are two factors that enhance the regional resilience.

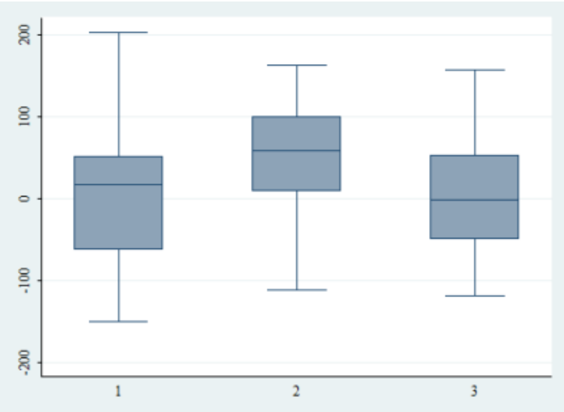
The role played by young tertiary educated is, however, not found in the econometric results. Also efforts on the part of SMEs are of significantly lower importance in these industries. In contrast, general innovation efforts by (typically larger) firms (BERD), clustering structures and governmental quality are a common factor. While the latter was a necessary precondition for the extraordinarily high attraction of FDI in WT, the first two (BERD and cluster) are a consequence of the successful establishment. The results for the group of less developed regions also show that in these cases, as it is also found for WT, higher regional income is positively correlated with trade specialisation. Other endogenous factors, however, such as the ones included in the model, generally play a less decisive role for the region's specialisation figures.

Since West Transdanubia is increasingly promoting its research infrastructure it has already been noticed that newly attracted companies need to be tied in the long term by providing other assets than only subsidies and low labour costs. The regional policy focus on innovation could probably contribute to establishing a richer innovation system. Since the diverse industry mix is another structural advantage of the region, the development of an SME base – which has proved to be sluggish until now – should be one of the major topics in regional development strategies if the region wants to maintain and strengthen its comparative advantages.

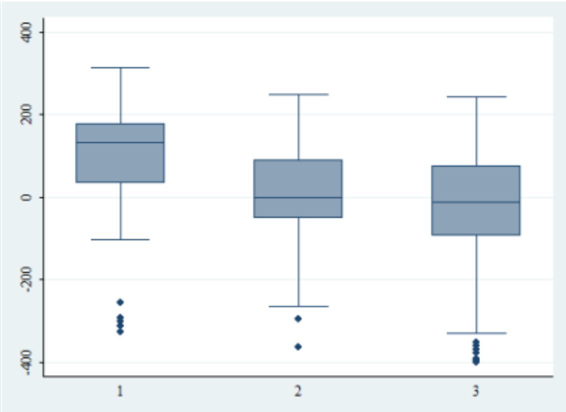
7.4. APPENDIX OF FIGURES

Figure A 1 / Distribution of industry-specific RXAs by structural funds category (box plots), 2011

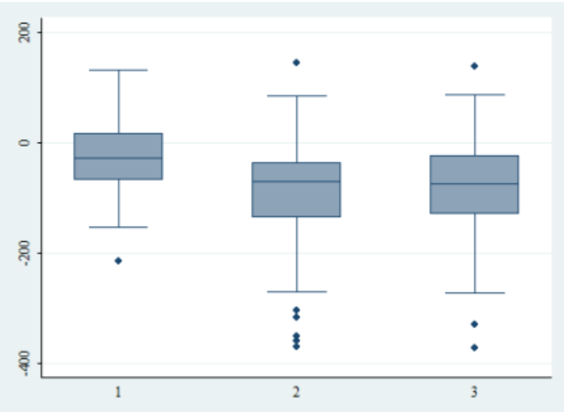
Manufacture of food products and beverages (15)



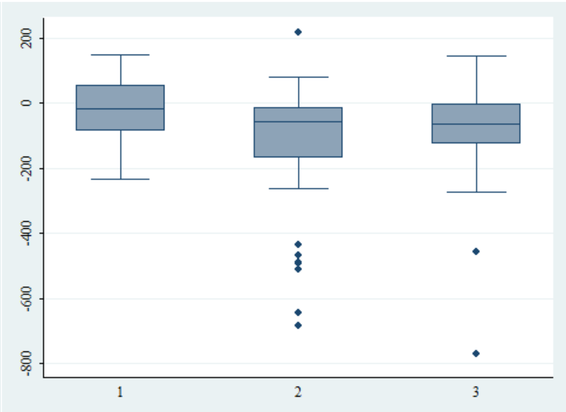
Manufacture of tobacco products (16)



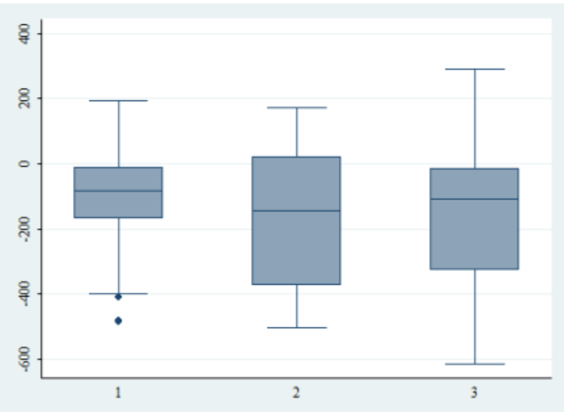
Manufacture of textiles (17)



Manufacture of wearing apparel; dressing and dyeing of fur (18)



Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)



Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)

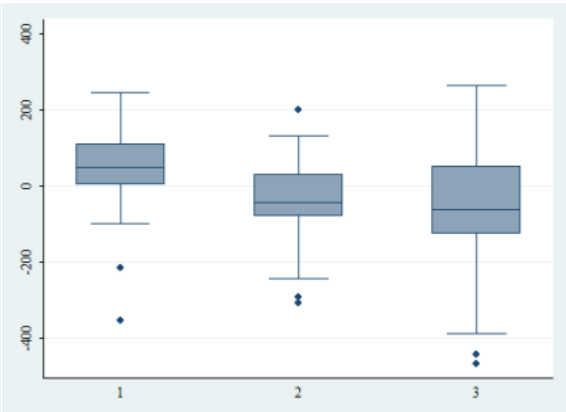
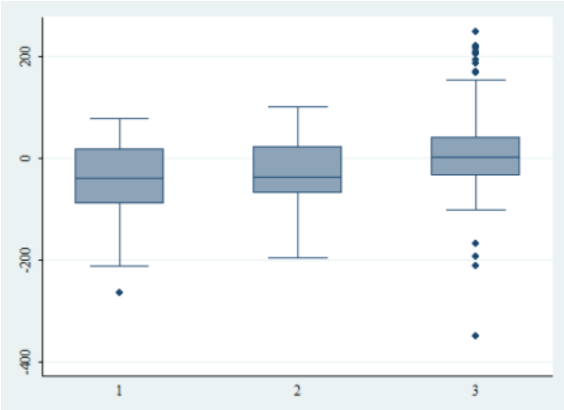


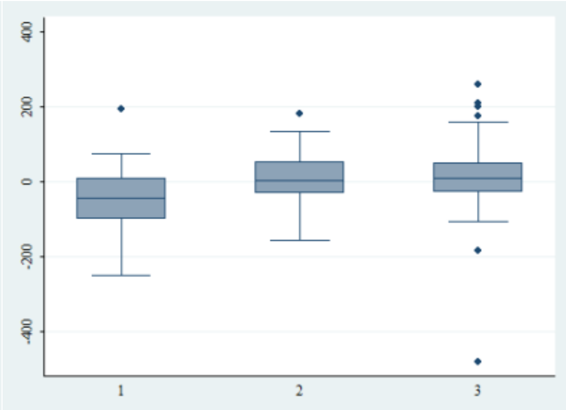
Figure A 1 / ctd.

Figure A 1 / ctd.

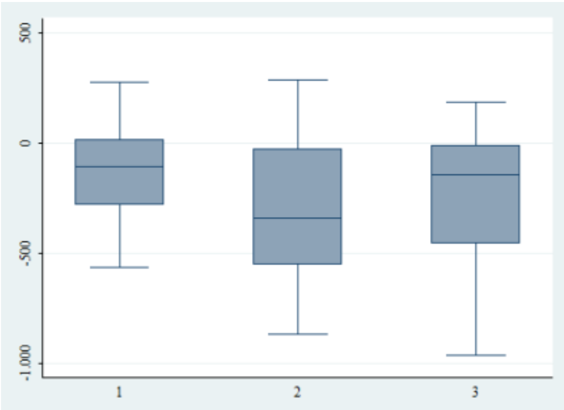
Manufacture of pulp, paper and paper products (21)



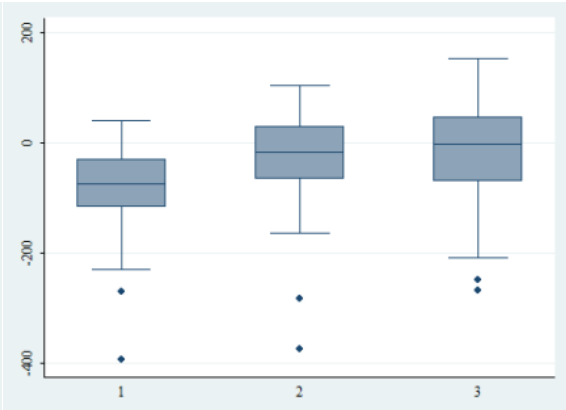
Publishing, printing and reproduction of recorded media (22)



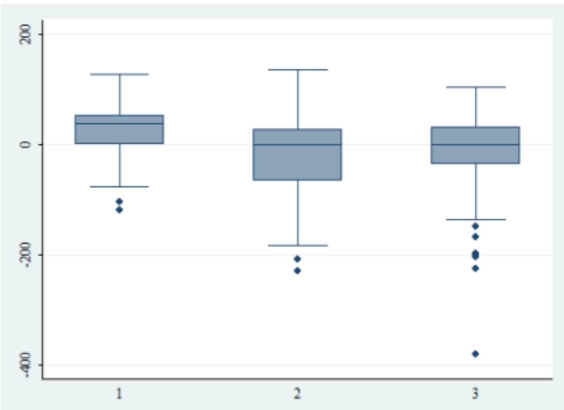
Manufacture of coke, refined petroleum products and nuclear fuel (23)



Manufacture of chemicals and chemical products (24)



Manufacture of rubber and plastic products (25)



Manufacture of other non-metallic mineral products (26)

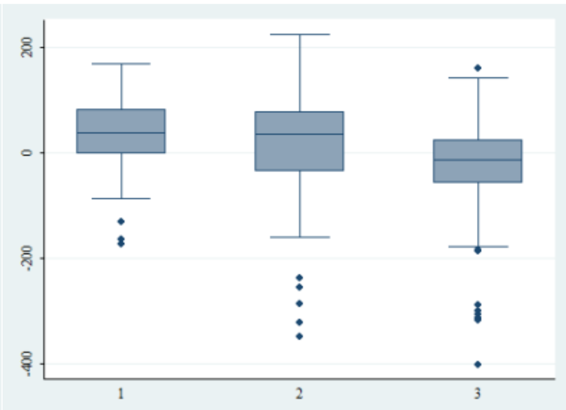
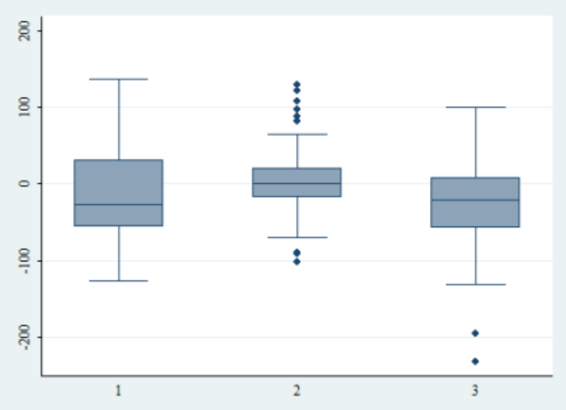


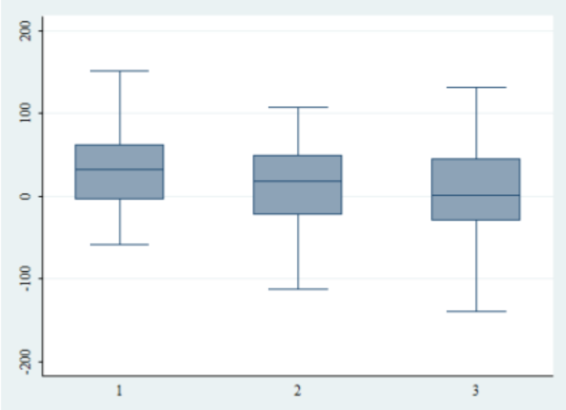
Figure A 1 / ctd.

Figure A 1 / ctd.

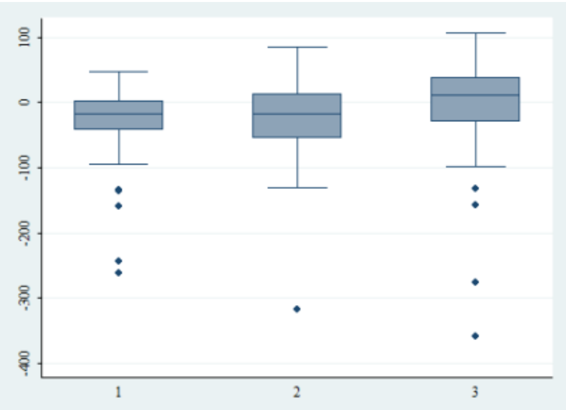
Manufacture of basic metals (27)



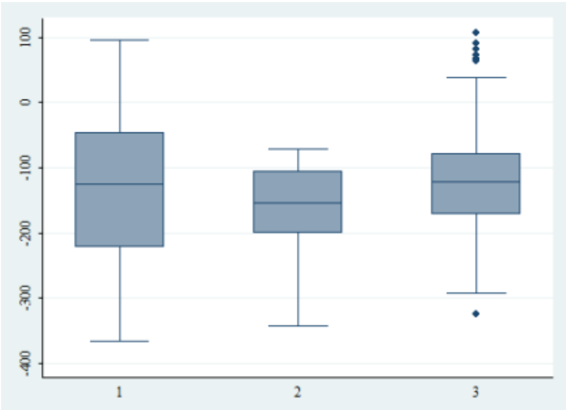
Manufacture of fabricated metal products, except machinery and equipment (28)



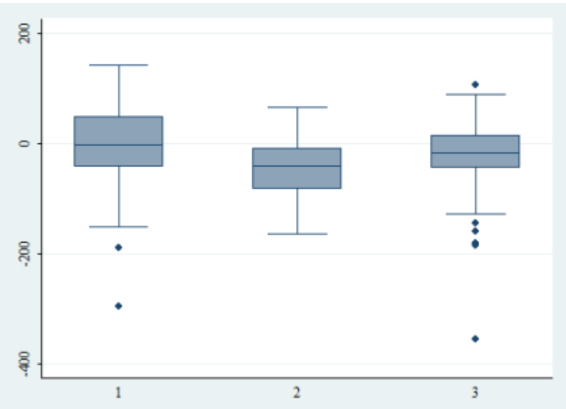
Manufacture of machinery and equipment n.e.c. (29)



Manufacture of office machinery and computers (30)



Manufacture of electrical machinery and apparatus n.e.c. (31)



Manufacture of radio, television and communication equipment and apparatus (32)

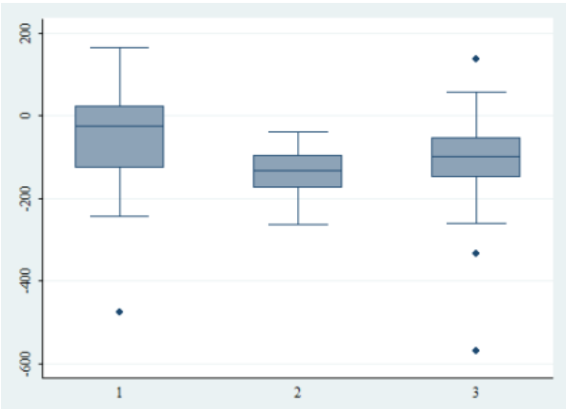
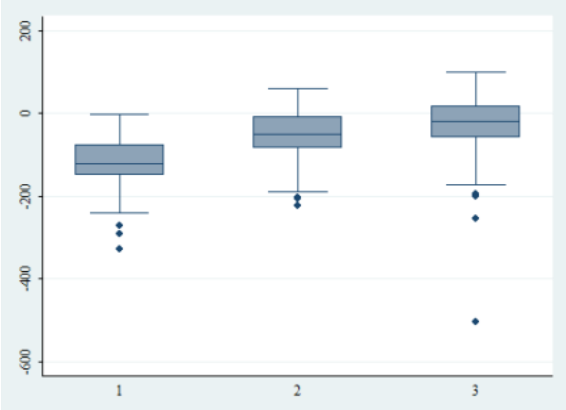


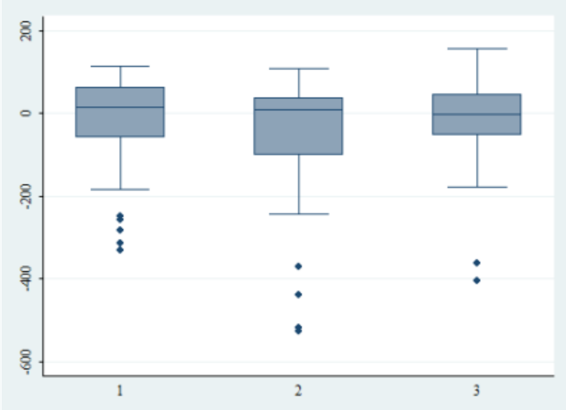
Figure A 1 / ctd.

Figure A 1 / ctd.

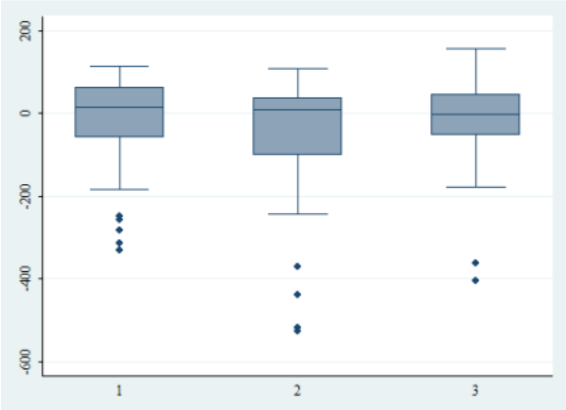
Manufacture of medical, precision and optical instruments, watches and clocks (33)



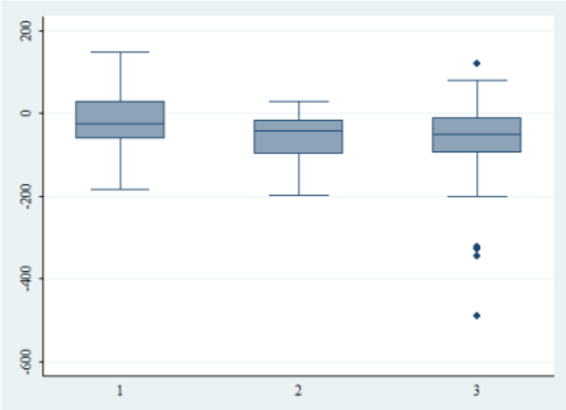
Manufacture of motor vehicles, trailers and semi-trailers (34)



Manufacture of other transport equipment (35)



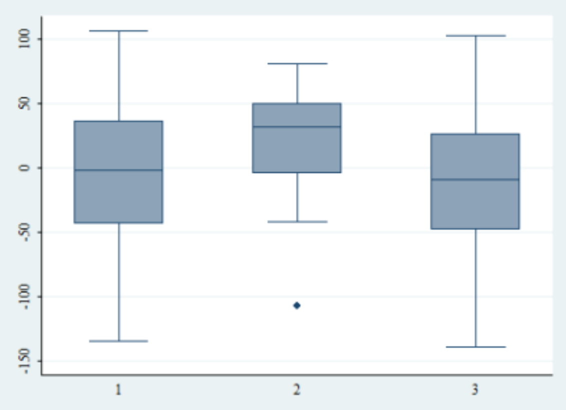
Manufacture of furniture; manufacturing n.e.c. (36)



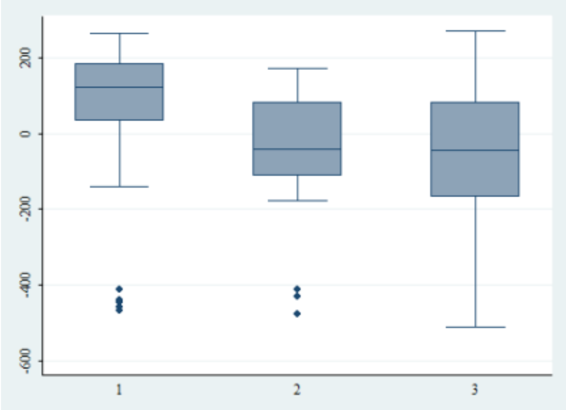
Source: NIW/wiiw calculations.

Figure A 2 / Distribution of industry-specific RCAs by structural funds category (box plots), 2011

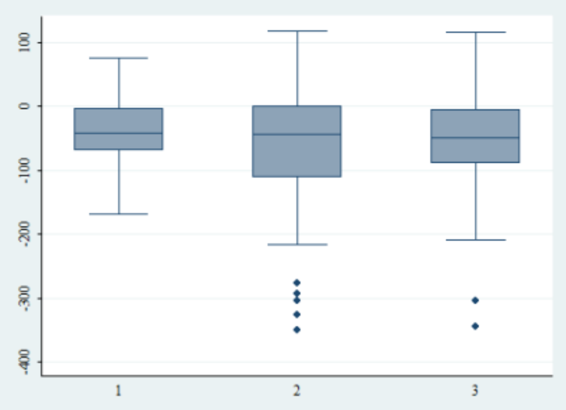
Manufacture of food products and beverages (15)



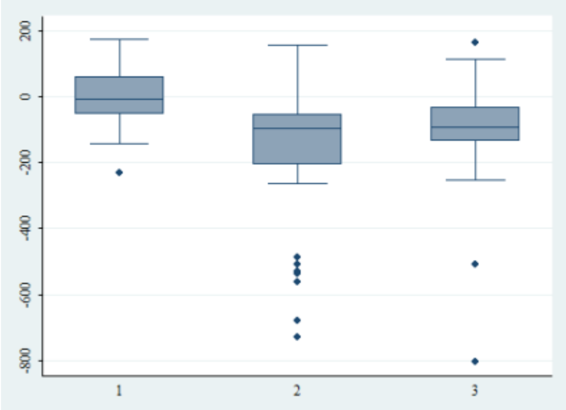
Manufacture of tobacco products (16)



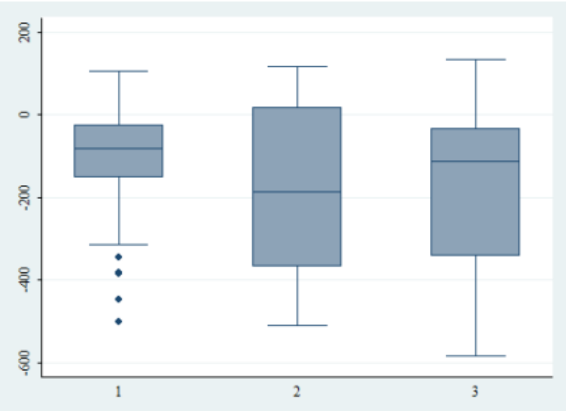
Manufacture of textiles (17)



Manufacture of wearing apparel; dressing and dyeing of fur (18)



Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)



Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)

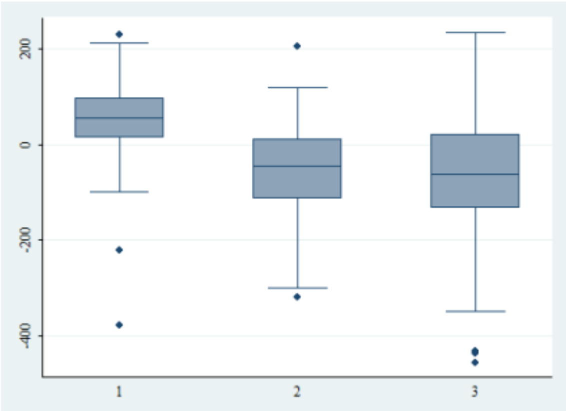
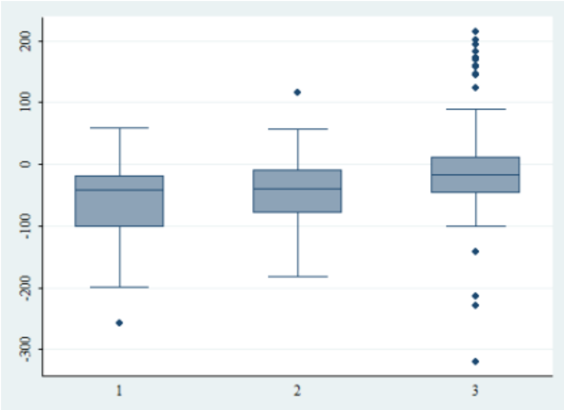


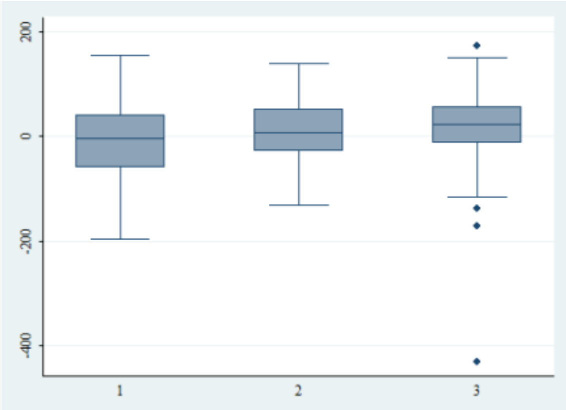
Figure A 2 / ctd.

Figure A 2 / ctd.

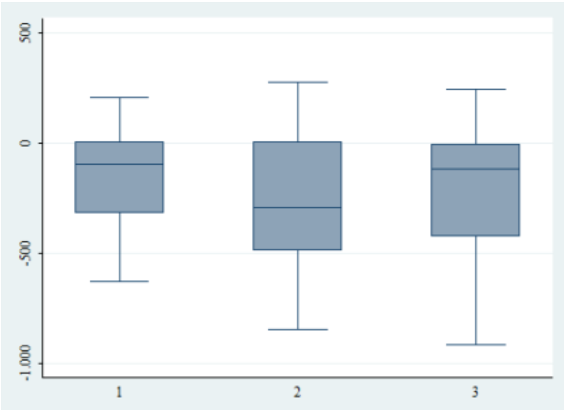
Manufacture of pulp, paper and paper products (21)



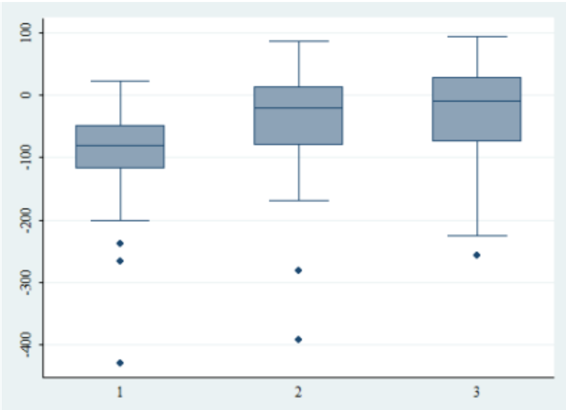
Publishing, printing and reproduction of recorded media (22)



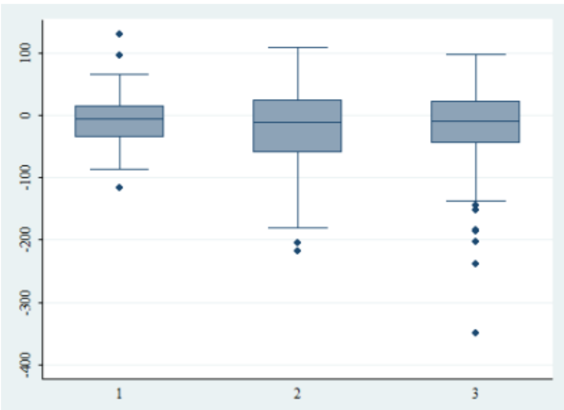
Manufacture of coke, refined petroleum products and nuclear fuel (23)



Manufacture of chemicals and chemical products (24)



Manufacture of rubber and plastic products (25)



Manufacture of other non-metallic mineral products (26)

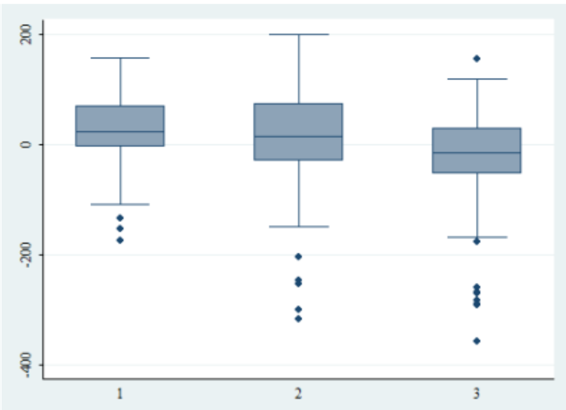
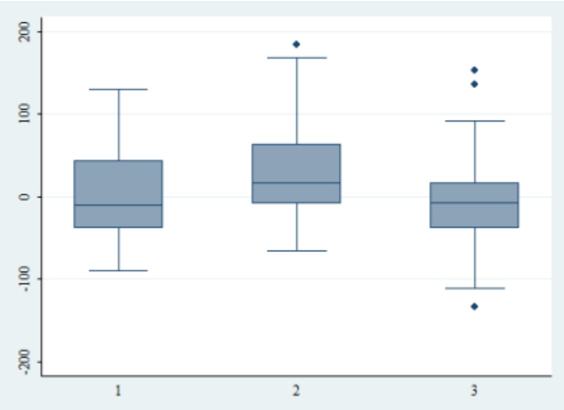


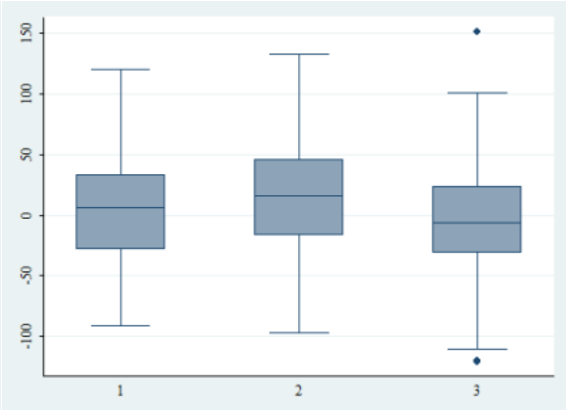
Figure A 2 / ctd.

Figure A 2 / ctd.

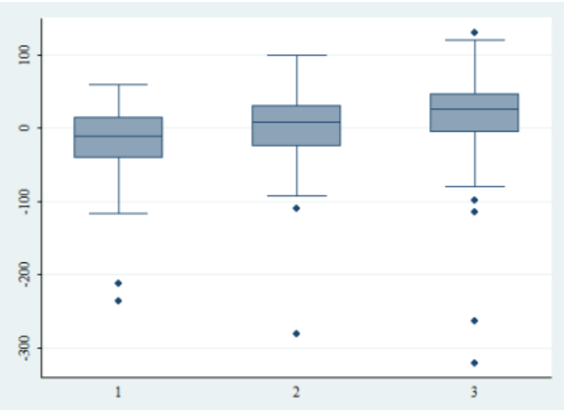
Manufacture of basic metals (27)



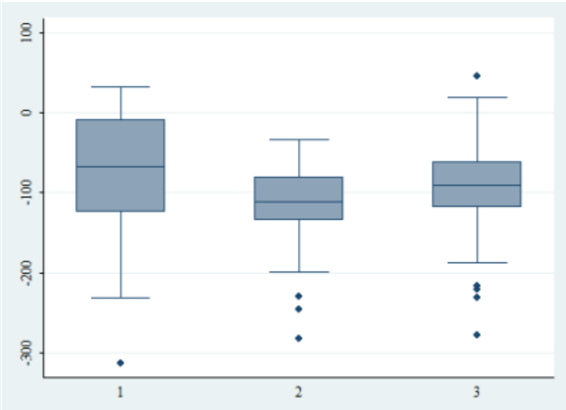
Manufacture of fabricated metal products, except machinery and equipment (28)



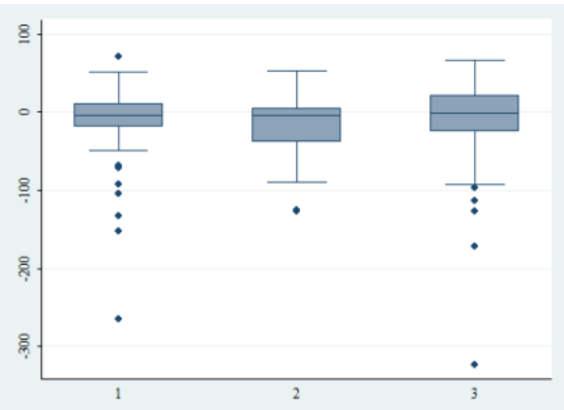
Manufacture of machinery and equipment n.e.c. (29)



Manufacture of office machinery and computers (30)



Manufacture of electrical machinery and apparatus n.e.c. (31)



Manufacture of radio, television and communication equipment and apparatus (32)

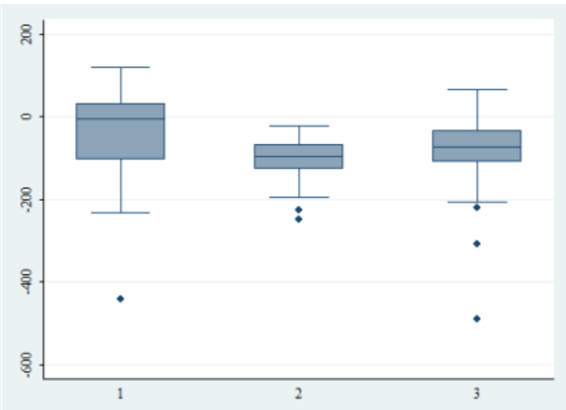
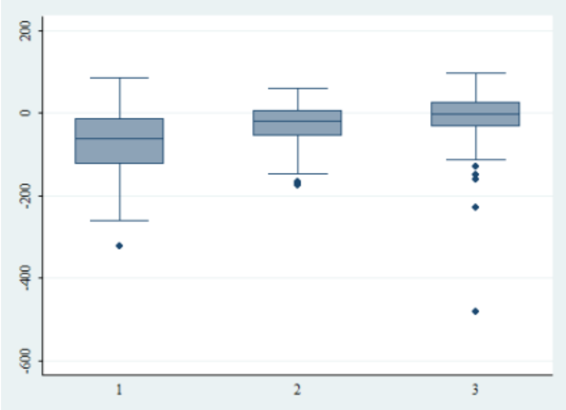


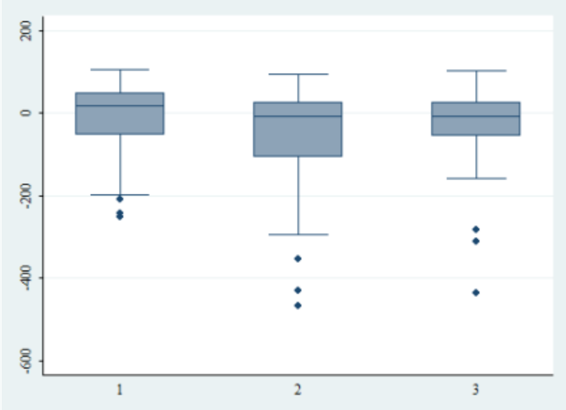
Figure A 2 / ctd.

Figure A 2 / ctd.

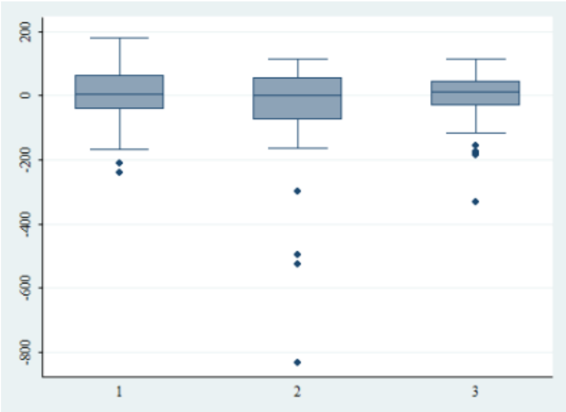
Manufacture of medical, precision and optical instruments, watches and clocks (33)



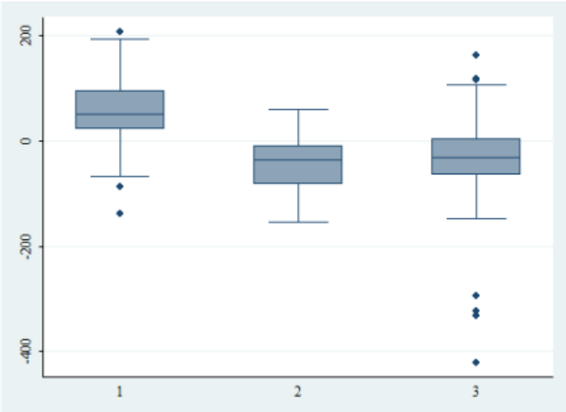
Manufacture of motor vehicles, trailers and semi-trailers (34)



Manufacture of other transport equipment (35)



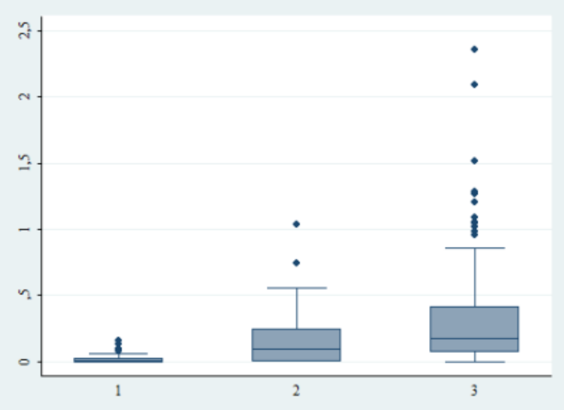
Manufacture of furniture; manufacturing n.e.c. (36)



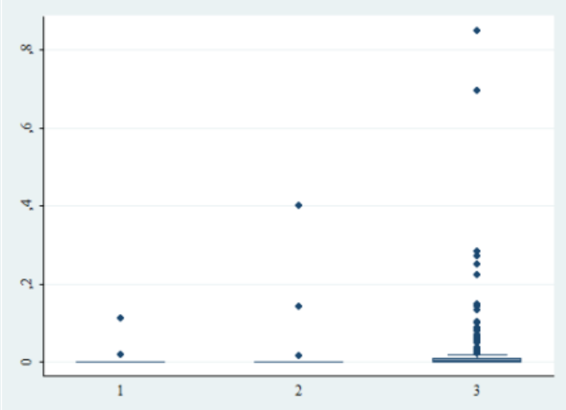
Source: NIW/wiiw calculations.

Figure A 3 / Distribution of industry-specific patent intensity by structural funds category (box plots), 2011

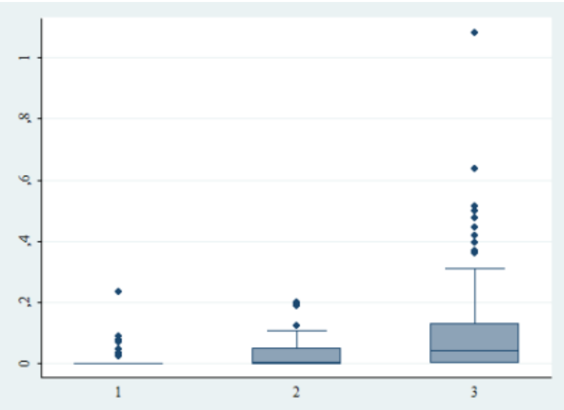
Manufacture of food products and beverages (15)



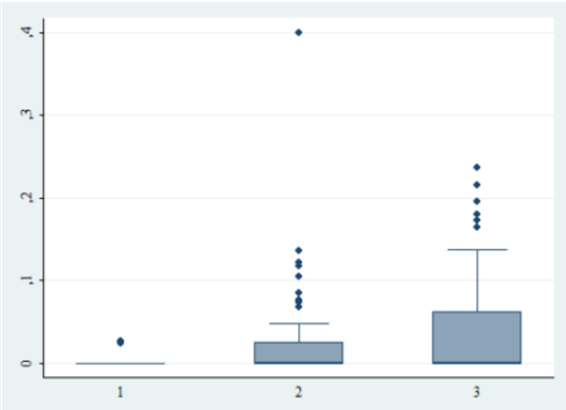
Manufacture of tobacco products (16)



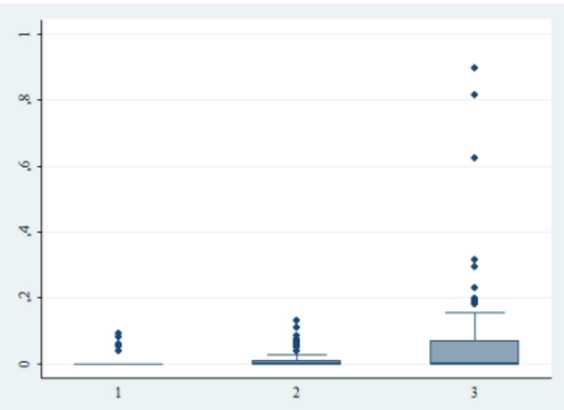
Manufacture of textiles (17)



Manufacture of wearing apparel; dressing and dyeing of fur (18)



Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)



Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)

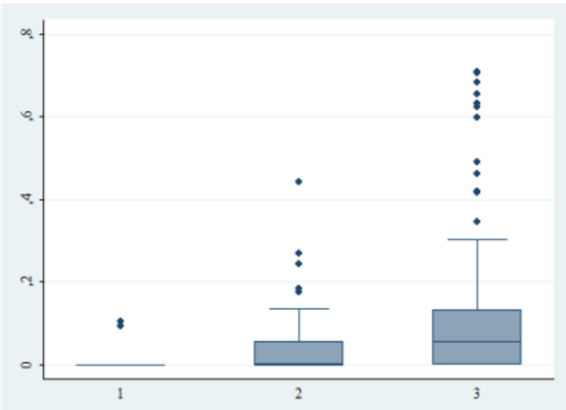
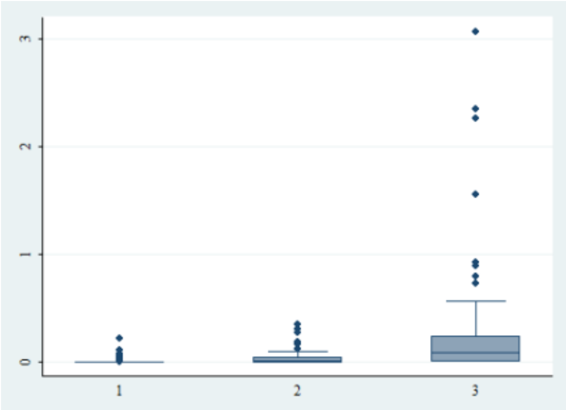


Figure A 3 / ctd.

Figure A 3 / ctd.

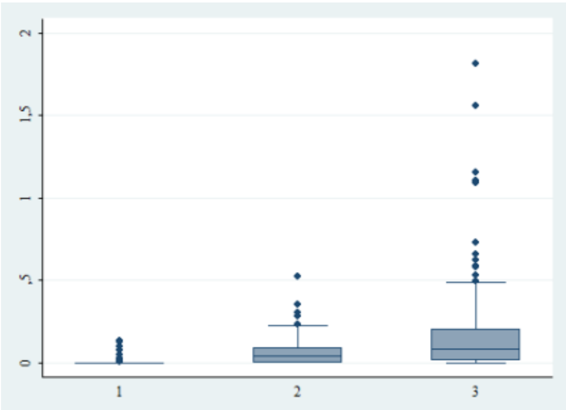
Manufacture of pulp, paper and paper products (21)



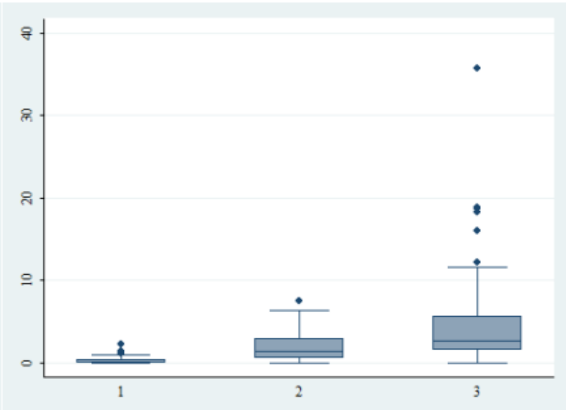
Publishing, printing and reproduction of recorded media (22)

n. a.

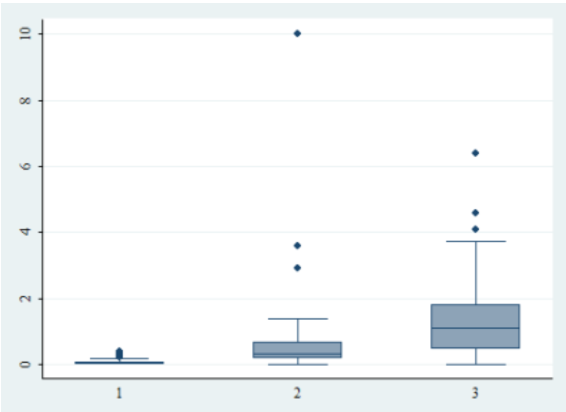
Manufacture of coke, refined petroleum products and nuclear fuel (23)



Manufacture of chemicals and chemical products (24)



Manufacture of rubber and plastic products (25)



Manufacture of other non-metallic mineral products (26)

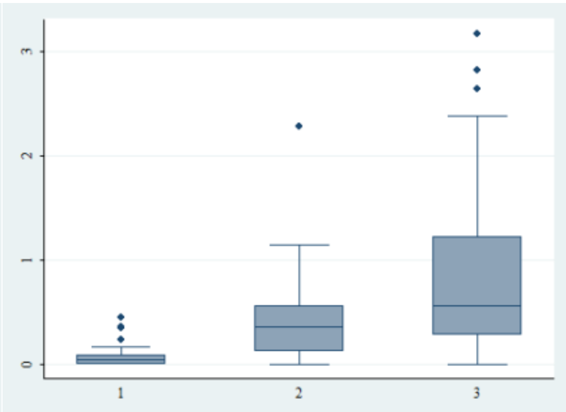
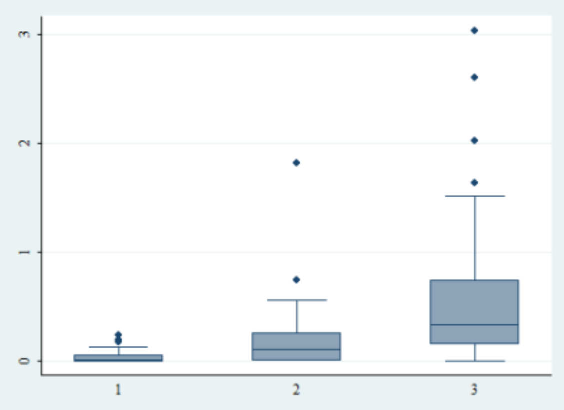


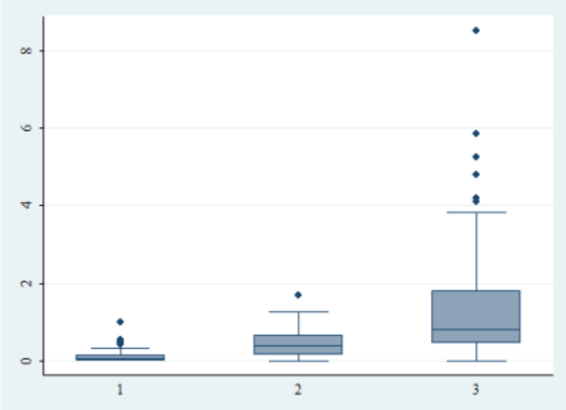
Figure A 3 / ctd.

Figure A 3 / ctd.

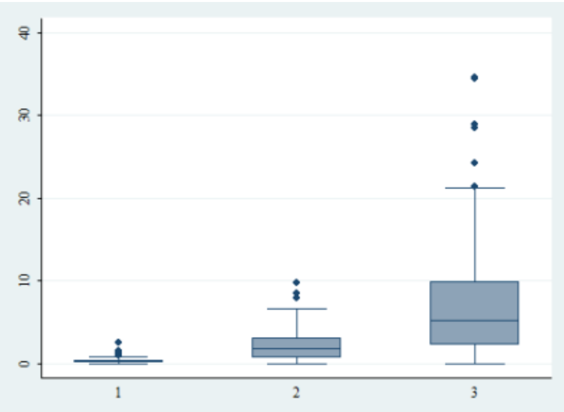
Manufacture of basic metals (27)



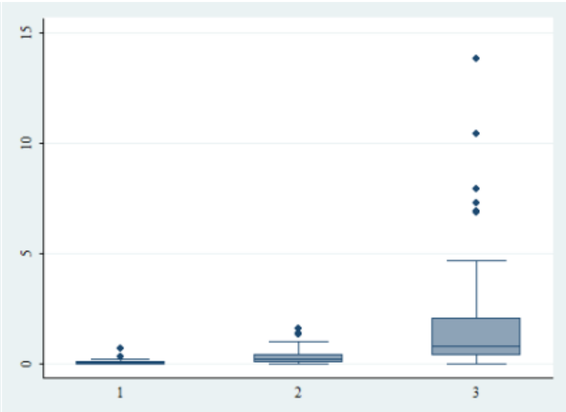
Manufacture of fabricated metal products, except machinery and equipment (28)



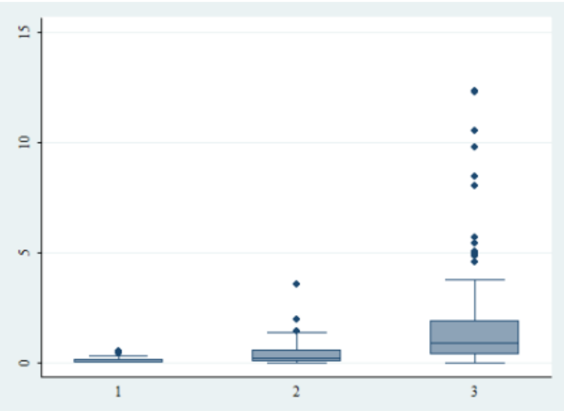
Manufacture of machinery and equipment n.e.c. (29)



Manufacture of office machinery and computers (30)



Manufacture of electrical machinery and apparatus n.e.c. (31)



Manufacture of radio, television and communication equipment and apparatus (32)

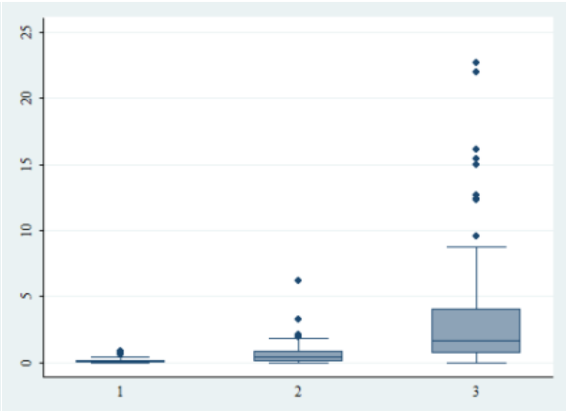
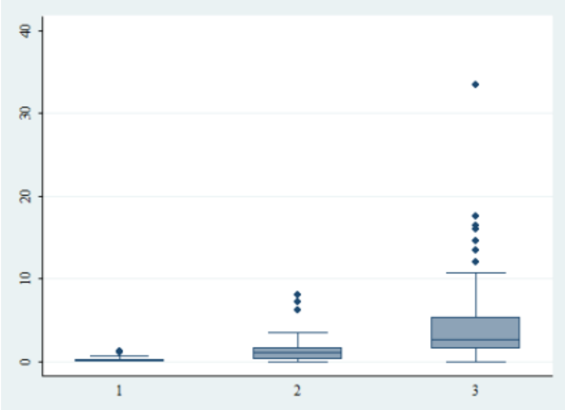


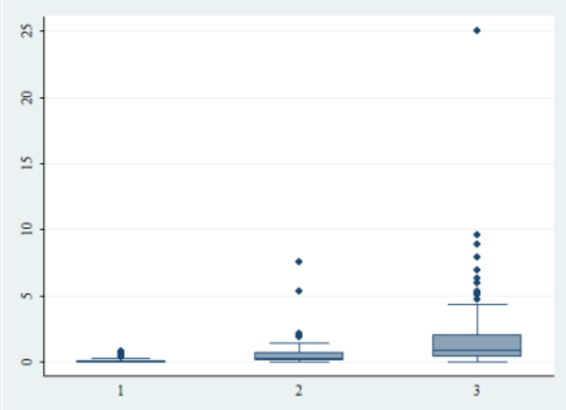
Figure A 3 / ctd.

Figure A 3 / ctd.

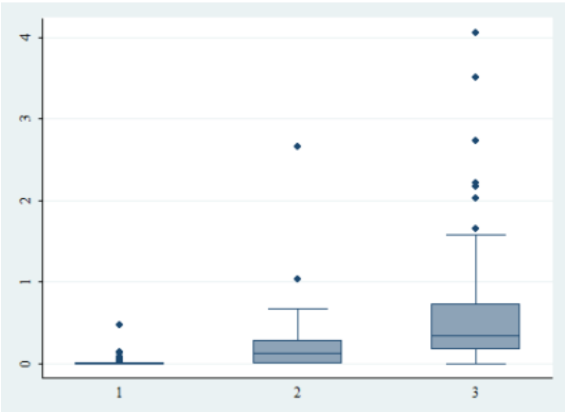
Manufacture of medical, precision and optical instruments, watches and clocks (33)



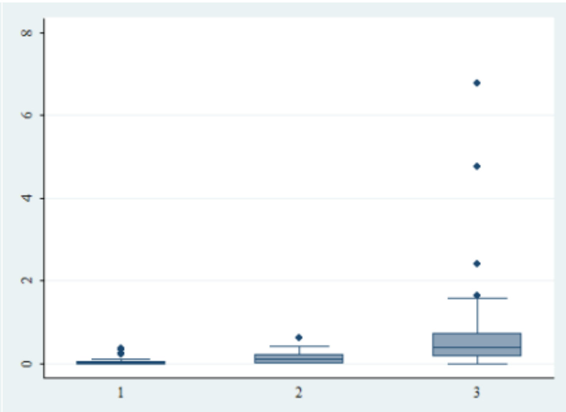
Manufacture of motor vehicles, trailers and semi-trailers (34)



Manufacture of other transport equipment (35)



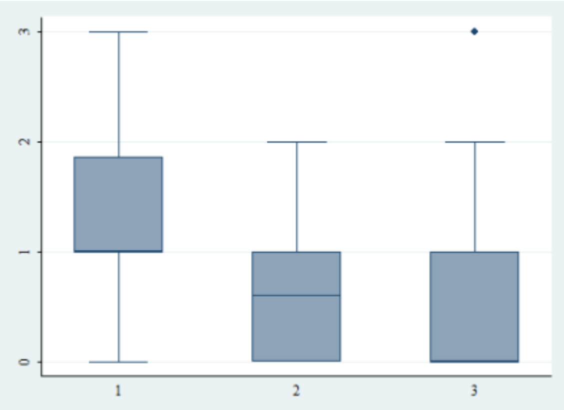
Manufacture of furniture; manufacturing n.e.c. (36)



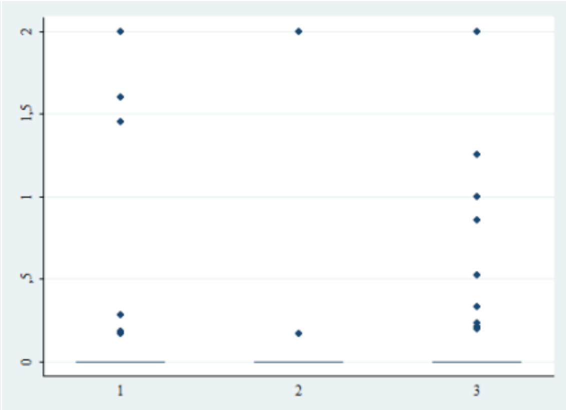
Source: NIW/wiiw calculations.

Figure A 4 / Distribution of industry-specific cluster ratings by structural funds category (box plots), 2011

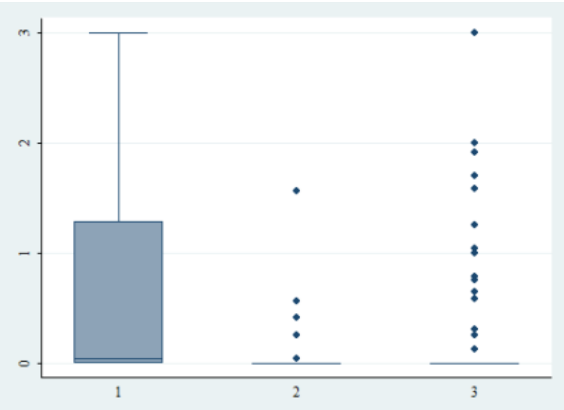
Manufacture of food products and beverages (15)



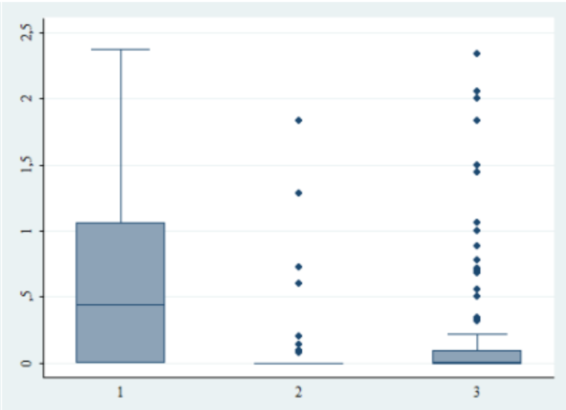
Manufacture of tobacco products (16)



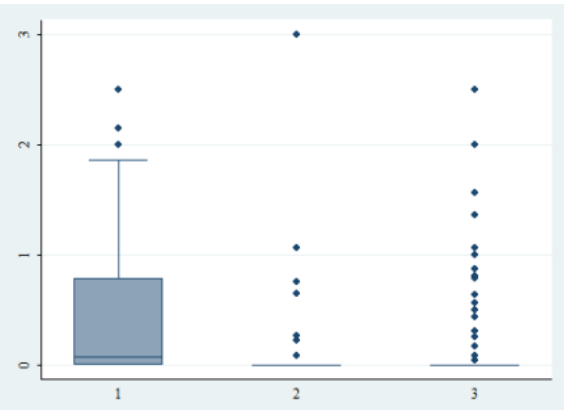
Manufacture of textiles (17)



Manufacture of wearing apparel; dressing and yeing of fur (18)



Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)



Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)

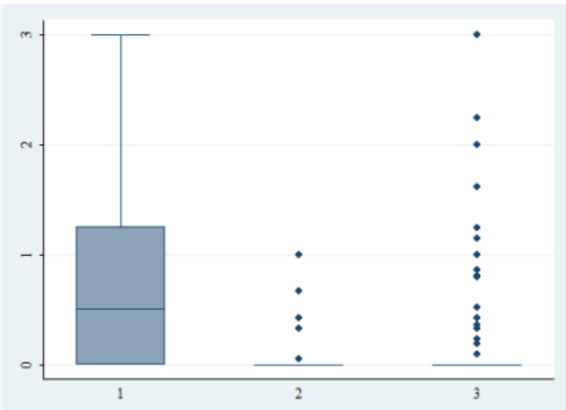
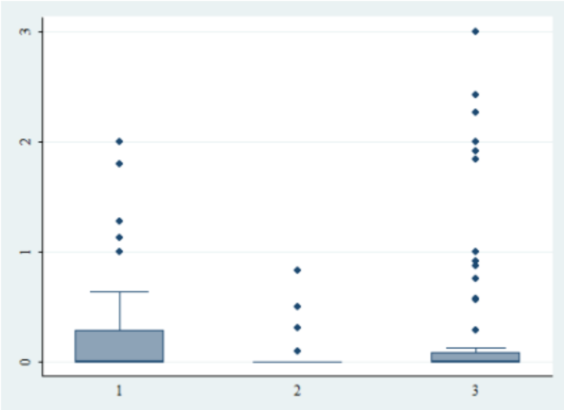


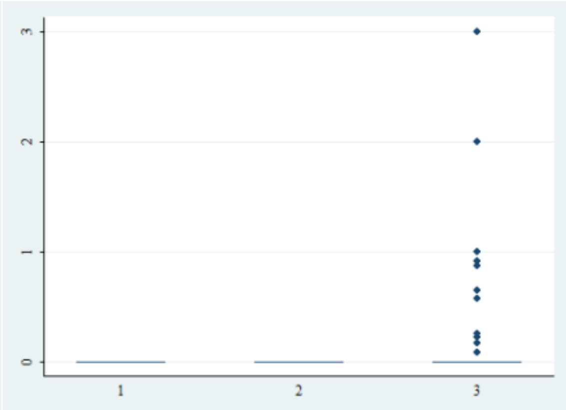
Figure A 4 / ctd.

Figure A 4 / ctd.

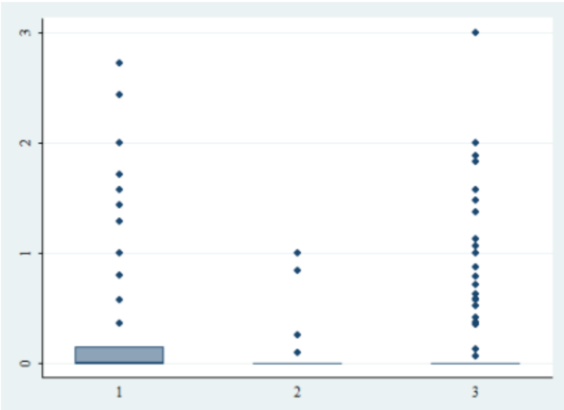
Manufacture of pulp, paper and paper products (21)



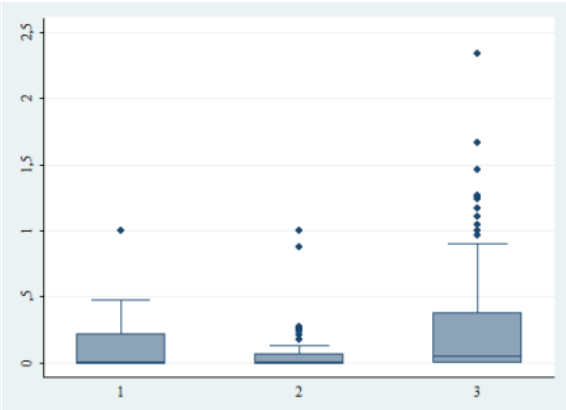
Publishing, printing and reproduction of recorded media (22)



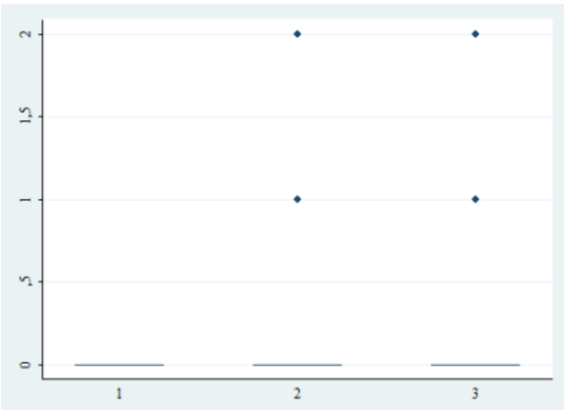
Manufacture of coke, refined petroleum products and nuclear fuel (23)



Manufacture of chemicals and chemical products (24)



Manufacture of rubber and plastic products (25)



Manufacture of other non-metallic mineral products (26)

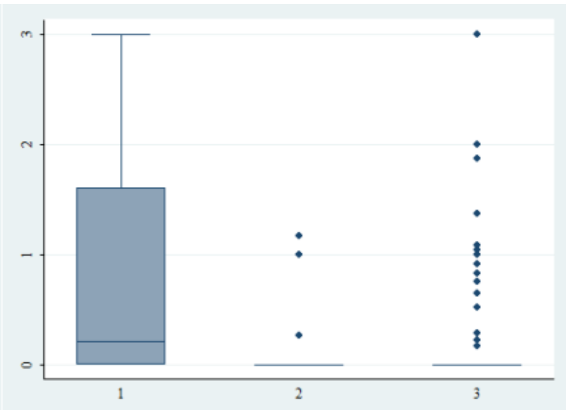
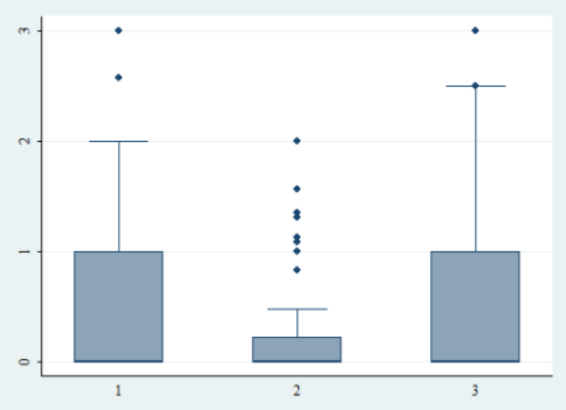


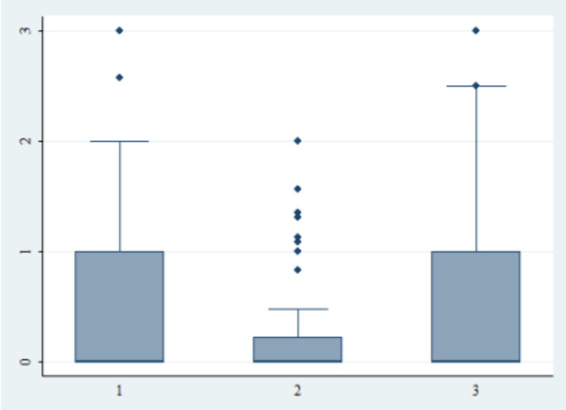
Figure A 4 / ctd.

Figure A 4 / ctd.

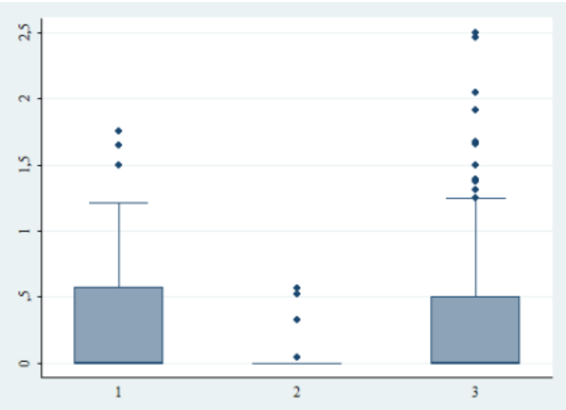
Manufacture of basic metals (27)



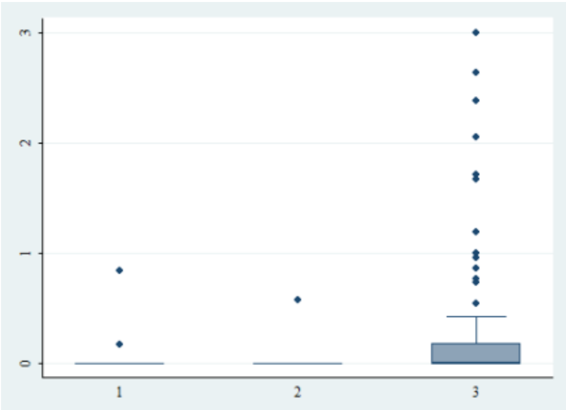
Manufacture of fabricated metal products, except machinery and equipment (28)



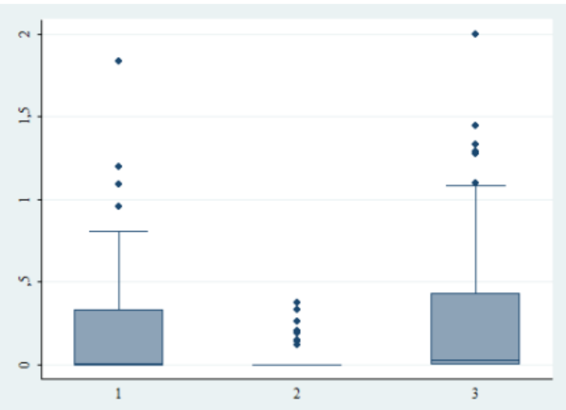
Manufacture of machinery and equipment n.e.c. (29)



Manufacture of office machinery and computers (30)



Manufacture of electrical machinery and apparatus n.e.c. (31)



Manufacture of radio, television and communication equipment and apparatus (32)

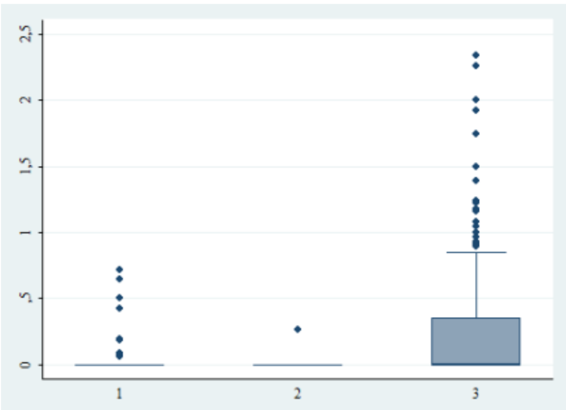
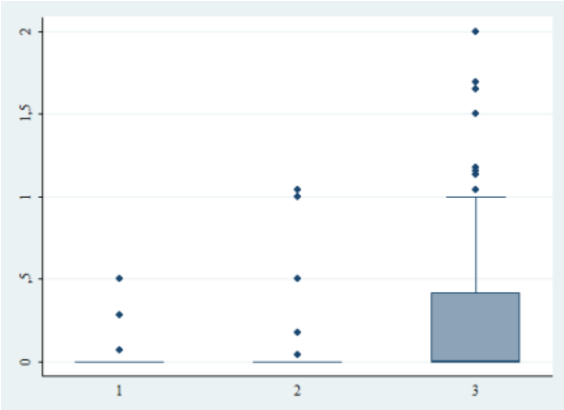


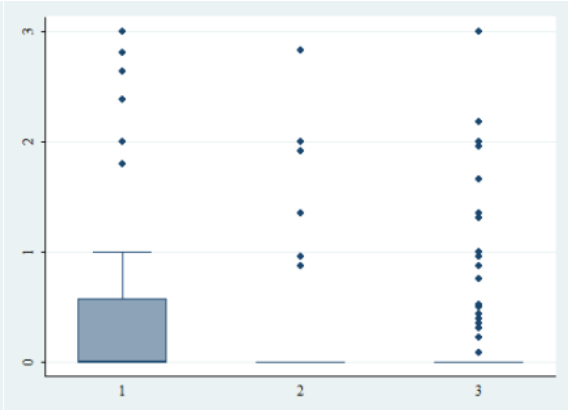
Figure A 4 / ctd.

Figure A 4 / ctd.

Manufacture of medical, precision and optical instruments, watches and clocks (33)



Manufacture of motor vehicles, trailers and semi-trailers (34)



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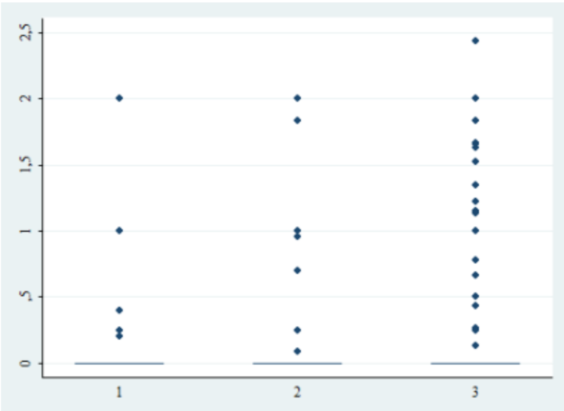

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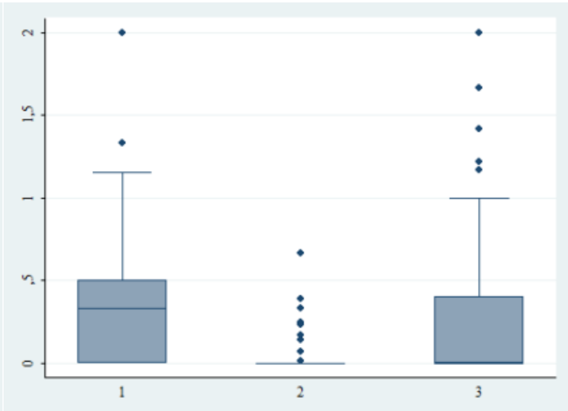

Source: NIW/wiiw calculations.

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