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ALO LILLES

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School of Economics and Business Administration, University of Tartu, Estonia

The dissertation is accepted for the defence of the degree of Doctor Philosophiae (in Economics) on electronic voting from the 13th of July 2023 by the Council of the School of Economics and Business Administration, University of Tartu.

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Contribution of individual authors

All published studies are co-authored, and the contributions to each study were as follows:

In **Study 1,** the contributions consisted of the development of the research framework and the writing of the manuscript, the analysis of the results and concluding the findings under the guidance of the co-author and the corresponding author and in charge of the management and submission of the paper, as well as communication with the reviewers.

For **Study 2**, the author took the lead in writing the article, developing the concept, designing the research framework, and providing a theoretical foundation. The author also collected and processed the data, drew conclusions from the findings, and collaborated with the co-author on statistical analyses and writing. The co-author actively participated in the writing process and guided throughout. The author was responsible for submitting and improving the manuscript during the review process.

Similarly, in **Study 3**, the author took the initiative in developing the concept, designing the proposal, and providing a theoretical foundation. The author also collected and processed the data, drew conclusions from the findings, and collaborated with co-authors on methodology development and statistical analyses. The co-authors actively participated in the writing process and provided guidance throughout. The author was responsible for submitting and improving the manuscript during the review process.

INTRODUCTION

This dissertation is based on the following original publications, which will be referred to in the text by their respective numbers.

Study 1. Seppo, Marge; Lilles, Alo (2012). Indicators measuring university-industry cooperation. Discussions on Estonian Economic Policy, 20 (1), 204−225

Study 2. Lilles, Alo; Rõigas, Kärt (2017). How higher education institutions contribute to the growth in regions of Europe? Studies in Higher Education, 42 (1), 65−78

Study 3. Lilles, Alo; Rõigas, Kärt; Varblane, Urmas (2020). Comparative View of the EU Regions by Their Potential of University-Industry Cooperation. J Knowledge Economy 11 (1), 174–192

Europe is home to various regions with different innovation potentials and capabilities (Foray, 2016; Pelkonen & Nieminen, 2016; Grillitsch & Sotarauta, 2020). To increase competitiveness and regional performance, several authors have emphasised the importance of regional systems of innovation (Asheim & Isaksen, 1997; Cooke, 2001; Boschma, 2004; Tödtling & Trippl, 2005; Tödtling et al., 2021). However, as Tsipouri (2018) notes, past regional development policies have not helped the regions to converge, and new policy changes are necessary to meet expectations.

One solution proposed by the European Commission is the smart specialisation strategy. The smart specialisation approach identifies strategic areas for intervention based on analysing a region's strengths and potential (Smart Specialisation, 2023). It has led to improved innovation strategies and cooperation at all levels of the Triple Helix – between academia, industry and government. However, several authors (Foray & Van Ark, 2007; Teräs & Mäenpää, 2016; Tsipouri, 2018; Asheim, 2019) argue that smart specialisation strategies require design changes to serve regional needs better.

One of the significant difficulties in implementing it is a decrease in investment in research and innovation across various production sectors. This decline in investment can affect the collaboration between universities and industries. The evidence (Mascarenhas et al., 2021; Bukhari et al., 2021; Aksoy et al., 2022) suggests that smart specialisation measures have negatively affected university-industry cooperation and knowledge transfer. As regional strategies shift their focus from exclusively privileging high-tech sectors to considering lower-tech domains as sources of competitive advantage, there is a need to rethink and adapt university-industry relationships for innovation.

Additionally, while smart specialisation aims to build innovation systems through research and innovation frameworks, it may also increase regional disparities (Wøien et al., 2019). To fully execute smart specialisation strategies, regions must have certain capabilities, a regional innovation ecosystem to link

those capabilities, and cooperation between universities and industry to accumulate knowledge, create research and innovation, and provide a skilled workforce (Foray & Goenaga, 2013).

Traditionally, university-industry collaboration has been more focused on high-tech sectors. However, the shift towards smart specialisation calls for universities to engage with low-tech and high-tech domains as part of their regional innovation strategies. This change in strategy necessitates reevaluating academic engagement with local entrepreneurs and industries in different technological domains (Calza et al., 2019; Parmentola et al., 2021).

Topicality, research problem and motivation

Understanding the diverse capabilities that European regions possess to facilitate university-industry cooperation holds significant importance. This understanding constitutes a vital prerequisite, not only for the effective implementation of the smart specialization strategy and the equitable allocation of cohesion funds, but also for enhancing regional growth, mitigating regional disparities, and fostering increased cooperation among the participants of the Triple Helix.

Whether it is the potential of regions to support university-industry cooperation through the public sector, private sector, or universities, many regions need more support to benefit from the smart specialisation approach. This creates a research problem where the relationship between university-industry cooperation and regional capabilities provided by the Triple Helix parties needs to be sufficiently studied on the regional level in Europe.

The current literature on the relationship between university-industry cooperation and regional capabilities development in Europe highlights several gaps and limitations. **The dissertation aims to contribute to the existing knowledge on the complex relationship between university-industry cooperation and regional capabilities development in Europe.** By achieving this aim, the dissertation will make a valuable contribution to advancing knowledge in the field of university-industry cooperation, regional development and inform policy decisions.

Grillitsch & Sotarauta (2020) found that the main reason for regional disparities and their economic development depends on knowledge-intensive activities. Regions are expected to evolve as important hubs of knowledge production and exploit the absorptive capacity and knowledge accumulation (Magro & Wilson, 2013). However, Grillitsch & Sotarauta (2020) found that regions that are either specialised in manufacturing or traditional industries or located in peripheral areas need help to adapt to the knowledge-intensive activities of the modern economy.

As society's economic, political, and environmental pressures increase, universities' role in regional welfare and industry development becomes more crucial. Literature on knowledge transfer between universities and industry (Cunningham & Link, 2015; Kalar & Antoncic, 2015; De Wit-de Vries et al., 2019; Huggins et al., 2020) and channels/practices for this transfer (Franco &

Haase, 2015; Kalar & Antoncic, 2015; Fernández-Esquinas et al., 2016; Azagra-Caro et al., 2017; Happonen et al., 2020; Jussila et al., 2021) highlights academia's need to meet growing and diverse societal and industry demands.

To maximise the benefits of university-industry cooperation, all three stakeholders (universities, industry, and government) must be available and reach a certain critical mass. The current dissertation argues that all three stakeholders are equally important in providing the regional capabilities needed for economic development. The tax system, start-up visas, living costs, and the number of universities (in this dissertation, the term university is used to describe all higher educational institutions, as although both are used in the literature, the term university is more common) are all crucial for talent acquisition in national or regional innovation systems. Inadequate tertiary education hinders knowledge-intensive economic sectors, reducing productivity, innovation, and competitiveness. Thus, this dissertation examines the relationship between university-industry cooperation and regional capabilities through Triple Helix stakeholders. The focus on university-industry cooperation is justified on three grounds:

1. First, **filling a gap in the literature that illustrates the different types of university-industry cooperation** is necessary. Although the term "university-industry cooperation" is common, the rate and types of cooperation have not been given enough attention. Similarly, **a systematic framework to measure university-industry cooperation needs to be included**.

   The extant literature covers mostly the cooperation types of contractual research, publications and patents (Cassiman & Veugelers, 2002; Davey et al., 2011; Seppo & Lilles, 2012; Pavlin, 2016; Figueiredo & Fernandes, 2020; Tian et al., 2022), leaving aside other kinds. Cooperation is multimodal, but for that to be understood clearly, a better, more complete classification is required. Change at the European Union level has taken place gradually, as the more diverse and multifaceted perspectives were introduced in the 2018 report by Davey et al. (2018).

   The gap in the literature on the lack of a systemic framework was tackled in **Study 1**. It concentrates on empirical data and creates a theoretical framework for measuring university-industry cooperation and its inputs, outputs and impact. This firmly primed the research as the previous works published so far have focused mainly on the national level or, in some cases, also on the regional level within one country (Bencheva et al., 2011; Guerrero & Urbano, 2014; González-López et al., 2015; Pavlova & Burenina, 2016; Tunca & Kanat, 2019). Study 1 offers a valuable framework to evaluate university-industry cooperation effectiveness, highlighting the importance of using various performance indicators to measure inputs, outputs, and impact. Policymakers can rely on this framework to evaluate the impact of policies and predict future effects based on measurable criteria. Additionally, it can assist universities and enterprises in assessing the success of their cooperation and knowledge transfer efforts.

2. Second, **evidence of the link between universities and regional growth needs to be highlighted more**. Universities and other knowledge-boosting institutions have the fundamental role of supplying Europe with a highly qualified labour force and being the cornerstone of the lifelong learning process. The role of social and cultural development of academia needs to be recognised, as this has become an essential part of the rising regional development agenda (Hudson, 2006; Montesinos et al., 2008; Vorley & Nelles, 2009; Lima et al., 2021; Wurth et al., 2022). Academia has to meet the diverse growing needs of the client population. A flexible environment for life-long learning, locally-based universities and knowledge institutions, closer cooperation between research and teaching, and engagement with end-users is the somewhat new demands or obligations the academia has to start to fill. The lack of tertiary education generates hold-ups in the knowledge-intensive economic sectors and reduces productivity, innovation, and competitiveness.

   Europe has various regions with different innovation potentials and capacities (Foray, 2016; Pelkonen & Nieminen, 2016; Asheim, 2019; Fan et al., 2020). Policymakers and economic literature have widely accepted the idea of determining competitiveness and innovation at the regional and local levels (OECD, 2007). Despite the trend of internationalisation, with the decentralisation of innovation policy and the shift to give competencies and responsibilities to regions (Magro & Wilson, 2013; Hassink, 2020), regions have evolved as important hubs of knowledge production and exploitation with the absorptive capacity and knowledge accumulation remaining locally embedded and spatially concentrated (Scholvin et al., 2019; Crupi et al., 2020; Malik et al., 2021).

   The author's contribution to the literature with the findings of Study 2 is that other stakeholders are needed for the policy mix. The results showed that it takes time for human capital to contribute to economic development before providing its impact on society.
3. **Third, the difference between European regions and the potential of different actors of regional innovation systems to support university-industry cooperation at the regional level**

   To effectively implement smart specialisation strategies and improve university-industry cooperation at the regional level, it is essential to know different combinations of capabilities in the regions. However, despite various cohesion support measures, allocating resources through European regional policies and funding mechanisms has yet to yield satisfactory results. This is due to inadequate actors and policies that establish necessary regional collaboration preconditions, posing a threat to implementing the smart specialisation strategy. Moreover, each region and the stakeholders are of different sizes and impacts, and there might be several combinations of the strength of the stakeholders in the region.

   Radošević et al. (2017) highlight the importance of special attention and support towards knowledge translation capabilities in universities in weaker

regions to address this issue. By doing so, preconditions for the diffusion of knowledge produced in core regions can be created, and local firms can be informed about existing opportunities to use key enabling technologies.

In addition, Bonaccorsi (2009) and Hasche et al. (2020) reveal that regional inequality to support university-industry cooperation and create a well-functioning Triple Helix poses a challenge. The three actors do not always align their goals and constitute separate corners of a triangle, not strains in a dynamically active helix. To promote regional development through university-industry collaboration, bridging the gap between weaker and stronger regions is necessary. This can be achieved by supporting knowledge translation capabilities in universities within weaker regions, promoting collaboration between the public sector, universities, and the private sector, and identifying areas of interest for regional development, as indicated in the author's thesis.

The relationship between university-industry cooperation and regional capabilities has been studied through three publications. Study 1 establishes a theoretical foundation for measuring university-industry cooperation, discussing various indicators and methodological issues. Study 1 looks at the university and industry cooperation. Study 2 examines universities' contributions to regional economic development through R&D, increasing human capital, knowledge and technology transfer, and creating a favourable milieu environment. Study 2 looks at the relationship between university and regional capabilities. Study 3 examines the potential for university-industry cooperation in European regions and their capabilities.

Figure 1 illustrates the research problem, issues for assessment, research questions, and the connections leading to the research process's outputs and completion.

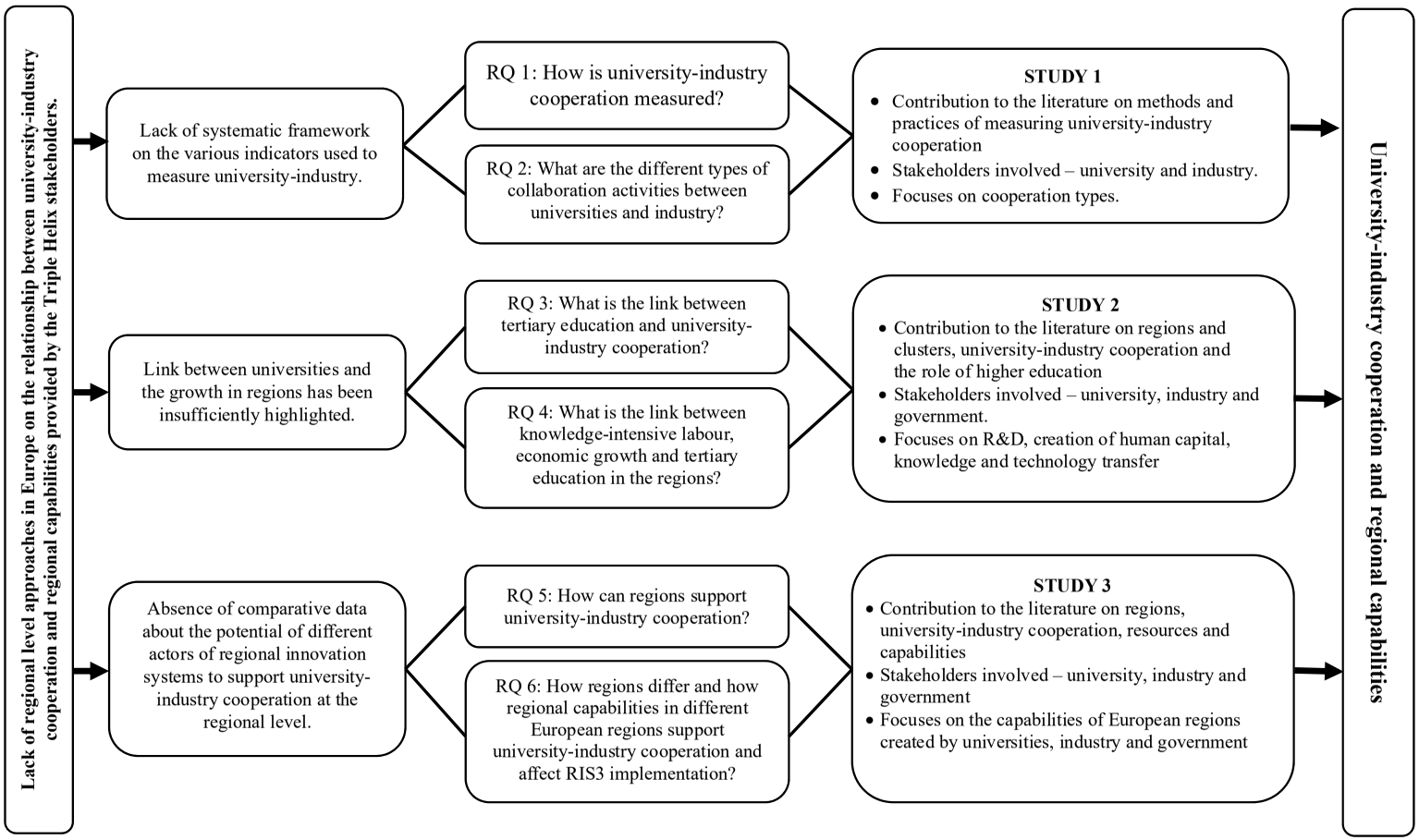

Figure 1. Concept map of the research compiled by the author

This dissertation structure includes three theoretical, empirical, and discursive chapters.

The first theoretical chapter presents an overview of the supporting role and capabilities shaped by academia, government, and industry. This will provide insights into the empirical part of the dissertation related to the different modes of cooperation, the importance of academia in workforce development and research, and regional capabilities to have valuable inputs for the region.

The second chapter consists of three empirical studies that provide the input to create a framework for university-industry cooperation and explain its importance in a regional context. These provide a theoretical framework on how to measure university-industry cooperation by different input, output, and impact indicators; investigate the relationship between tertiary education and economic growth in regions at the NUTS 2 level in Europe; and evaluate and compare the potential of different EU regions to engage and support university-industry cooperation as an important precondition for the implementation of the smart specialisation strategy, respectively.

The third chapter is an overview of the work's empirical findings, discussions, and conclusions of the work, as well as the implications and limitations, and suggestions for future research.

Research design and methodology

Methodology and other components of the philosophy of the research

The dissertation aimed to interpret, reflect and expand theories and contribute to various spheres of knowledge in sociotechnical pragmatic ways and modes of analysis available to the fields of university-industry cooperation and regional capabilities. The intention was to find useful, versatile and valid understandings – which is why it can be characterised as pragmatic and realistic research (Lancaster, 2005; Alghamdi & Li, 2013), driven by theory but with a quantitative emphasis. The research philosophy selected for the study was well-suited to its focus on subjective nature and the pragmatic view that truth is based on current actions. By adopting this approach, the study could effectively explore the selected fields and generate meaningful insights.

The research aimed to provide practical and useful explanations that can inform policy implications later. Table 1 presents an overview of the philosophical foundations of the study.

Table 1. Summary of the philosophical foundations of the research

Research Philosophy	Pragmatist and realist research philosophy
Overall research goal and components	- Exploration-interpretation-reflection-suggestion - Understanding and formulation - Theoretical and empirical components
Ontology	Interdisciplinary: built around regional development and growth theories, innovation, Triple Helix. and
Epistemology	- Mixed methodologies with a quantitative emphasis - Mixed reasoning techniques: descriptive and interpretive methodology. - Mixed methods: literature/deep content analysis, ground theory, for theoretical and factor, correlation and regression analysis for empirical
Logic and axiology	Principled, collaborative, dynamic, contextual
Mission and tools	Encourage changes in university-industry cooperation through regional capabilities and smart specialisation policy Propose policy measures for enhancing university-industry cooperation Propose policy measures for enhancing regional capabilities

Source: composed by the author

Methods, data collection and processing per output

In this section, the author will provide an overview of the data and methods utilised in Studies 1–3. The dissertation employs various data sources and methods to answer the six research questions. Study 1 comprehensively reviews the literature, while studies 2 and 3 rely on secondary data. Table 2 illustrates the data and methods used in each study.

Table 2. Data and methods used in Studies 2 and 3

Study	**Method**	**Data**
Study 2	Regression analysis • Fixed effect model • Least squares method	Eurostat
Study 3	Correlation analysis Factor analysis	Regional Innovation Scoreboard Eurostat Academic Ranking of World Universities

Source: Based on studies 2 and 3 by the author

For the second survey, the main data source was the NUTS 2 regional data available through Eurostat from 1998–2008. Data availability limited the period used, the expected time lag between entering and leaving the university, and the desire to reflect a sufficiently recent view. The number of students in higher

education was used as a proxy for measuring the relative size of the university and human capital.

Regression analysis was used to test the relationship between the proportion of students (tertiary level) and knowledge-intensive employment in European regions at the NUTS 2 level. The fixed-effect model and the least squares method were used to evaluate the data.

Similar to the second study, the third study relies on secondary data. The third study combined different data sets (Regional Innovation Scoreboard 2014 data, Eurostat, Academic Ranking of the World Universities) to fill current research gaps and identify regions' capacity to ensure successful collaboration between universities and businesses. In addition, the Regional Entrepreneurship and Development Index (REDI) developed by the Global Entrepreneurship Development Institute was assessed to see if it could replace different indicators and assess the capacity of regions. Unfortunately, the index was not suitable for assessing the prospects for cooperation between universities and companies – REDI measures certain dimensions, and the data used in the index only covers some of the three participants in the triple helix equally.

The Regional Innovation Scoreboard data combines Eurostat, regional data and the European Innovation Survey (CIS). The Academic Ranking of the World Universities database uses six performance indicators that assess universities for all their key functions – the quality of education, teaching quality, research, and per capita outcomes. The data established a link between the university and the location (at NUTS 1 or 2 level). A variable showing the number of the Top 500 universities in the region was obtained.

Due to the diversity and high correlation of the variables, it was decided to use factor analysis to reduce the number of indicators and show the region's capacity according to the factors developed during the factor analysis. Factor analysis was performed separately for different periods (2007 and 2010). A correlation analysis was also performed before the factor analysis to see if there were enough significant correlations.

Glossary of terms

- **Capability** refers to the ability or potential of an individual, organisation, or system to perform a particular task or achieve a specific goal. It involves various factors such as knowledge, skills, resources, technologies, infrastructure, and organisational systems that enable effective performance. Capabilities are often developed over time through learning, training, and experience and can be enhanced through investments in research and development, innovation, and infrastructure. In the context of regional development, capabilities refer to the skills, knowledge, networks, and other resources created by the region's universities, industry, and government to create economic growth and innovation. Fundamental skills and resources are available to achieve a specific goal (Martin & Sunley, 2015; Teece, 2018).
- **NUTS** (Nomenclature of Territorial Units for Statistics) is a hierarchical classification system used by the European Union (EU) for statistical purposes. It divides EU member countries into different levels of territorial units, ranging from large regions to small local administrative areas. The NUTS system collects, analyses, and disseminates regional data across the EU. The system is divided into three levels: NUTS 1, NUTS 2, and NUTS 3. NUTS 1 represents large regions, NUTS 2 represents smaller regions, and NUTS 3 represents local administrative areas. The NUTS system is updated periodically to ensure that it reflects the current administrative structure of the member countries (Eurostat, 2020).
- **A region** is a geographically defined area with specific characteristics that distinguish it from other areas. A region typically encompasses natural, cultural, economic, social, and political factors that interact within a particular geographic area. Regions can vary in size and scope, ranging from local communities to larger areas such as countries or continents. The boundaries of a region may be defined by natural features such as rivers or mountains or by administrative or political boundaries such as state or national borders. (Faludi, 2010; Paasi, 2013; Scott, 2018; Polyakova et al., 2018).
- **Regional capabilities** are the collection of resources, knowledge, skills, and networks created by universities, industry, and government in a specific region to promote economic growth and foster innovation (Asheim & Coenen, 2005; Martin & Sunley, 2015; Lazzeretti et al., 2022). Regional capabilities are often used interchangeably with regional innovation systems, regional knowledge systems, and regional innovation capabilities (Maskell & Malmberg, 1999; Cooke, 2001; Lundvall, 2007).
- **Regional Innovation Strategies for Smart Specialisation (RIS3)** are strategic planning processes to boost regional innovation and economic growth. They are based on the Smart Specialisation approach, which involves identifying a region's unique strengths and capabilities and focusing resources on areas with the most significant potential for innovation and growth. RIS3 processes typically involve various stakeholders, including regional authorities, universities, research centres, industry associations, and

other actors involved in the innovation ecosystem. The aim is to bring together a diverse group of stakeholders with different perspectives and knowledge to develop a shared vision for the region's innovation and economic development (European Commission, 2012; Foray, 2014; Capello, 2014; McCann & Ortega-Argilés, 2015).

- Cooke (1992) defines the **regional innovation system** as "*consisting of interacting knowledge generation and exploitation of sub-systems linked to global, national and other regional systems for commercialising new knowledge."* Asheim and Isaksen (2002) use the term cluster instead. Regional innovation system (RIS) is a broad concept that incorporates different aspects of the literature, from regional development, clusters, local learning, and innovation.
- **Smart specialisation** is an innovation-driven approach to regional economic development that focuses on identifying and building on a region's unique strengths and capabilities. The European Union developed the concept in the context of its Cohesion Policy, which aims to reduce disparities in economic development across EU regions. Smart specialisation involves a bottom-up approach involving stakeholders from academia, industry, government, and civil society in identifying a region's strengths and potential for innovation-led growth (Smart Specialisation, 2023). The smart specialisation approach involves three main steps: (1) the identification of a region's strengths and potential for innovation, (2) the prioritisation of areas for investment based on this analysis, and (3) the development of strategies and policies to support investment in these prioritised areas (Foray et al., 2009). The approach emphasises the need for collaboration among regional stakeholders to maximise the potential for innovation-led growth and development. Smart specialisation has been implemented in various regions across the EU and has positively impacted regional economic growth and development (Guzzo & Gianelle, 2021; Gianelle et al., 2022). However, challenges remain in the effective implementation of the approach, including the need for effective governance structures and mechanisms for stakeholder involvement (Suárez-Villa, 2016; Foray et al., 2021).
- **Triple Helix** is the Etzkowitz and Leydesdorff (2000) model that creates a broad and holistic approach to the interaction involving university, industry and government actors. Triple Helix and its variations of the quadruple helix and quintuple helix assume the free circulation of knowledge and promote the interaction among the different actors, helping to promote and develop the role of education (thus the knowledge and capacity building and transfer) in society.
- **University-industry cooperation** is a well-established mechanism to enhance innovation and competitiveness by facilitating knowledge and technology exchange between academic and industry partners (Etzkowitz & Leydesdorff, 2000; Crawley et al., 2020). This cooperation has become increasingly important in the knowledge-based economy, where the ability to generate and exploit knowledge is a key driver of economic growth (Laredo,

2007). University-industry cooperation is closely linked to the smart specialisation theory, which emphasises identifying and building on a region's unique strengths and capabilities to promote innovation-led economic development (Foray et al., 2009). Smart specialisation strategies often involve establishing partnerships between universities and industry partners to leverage their strengths and capabilities to pursue common goals (Guzzo & Gianelle, 2021).

1. THEORETICAL BACKGROUND

Over the past decade, regional economics, regional growth, and economic development at the local level have received significant attention from researchers and scholars (Crescenzi & Rodríguez-Pose, 2012; McCann & Van Oort, 2019; Zeibote et al., 2019; Malizia et al., 2020; Rodriguez-Pose, 2020).
The current dissertation demonstrates how academia, industries, and local governments can collaborate to empower regions and promote their growth. They can create a dynamic environment that fosters innovation, economic growth, and job creation (Etzkowitz & Leydesdorff, 2000; Davies et al., 2018).
Universities can contribute to regional development by providing education and training, conducting research and development, and fostering entrepreneurship. They can generate new knowledge, technologies, and innovations that can be transferred to industry and the wider community. By collaborating with industries and local governments, universities can address regional challenges and help create sustainable solutions (Etzkowitz & Klofsten, 2005; Todtling & Trippl, 2005; Boekema & Boschma, 2009; Salazar-Elena & Arboleda-Uribe, 2019).

Industries create jobs, generate income, and contribute to the tax base. They can access the latest research findings and benefit from university researchers' and students' expertise and knowledge through collaborations. They can also develop new products and services and improve their processes and operations (Peris-Ortiz et al., 2016; Trippl et al., 2019; Klofsten et al., 2019; McCann & Van Oort, 2019; Lew & Park, 2021; Mascarenhas et al., 2021).

Local governments provide the infrastructure, regulatory environment, and public services necessary to attract and retain businesses, talent, and investment. They facilitate collaboration between academia and industries, promote regional innovation and entrepreneurship, and foster a supportive environment for economic growth (Beer et al., 2019; Bolger & Doyon, 2019; Chaminade & Randelli, 2020; Thomas et al., 2021; Salmi et al., 2022).

Academia, industries, and local governments can work together to stimulate regional growth by investing in workforce development, innovation, and network creation. Such collaborative effort can lead to the creation of new or improved knowledge that can contribute to regional capabilities and drive economic prosperity (Boschma & Fritsch, 2009; Stimson & Stough, 2010; Szopa, 2017; Reichert, 2019; Schamp et al., 2020; Li, 2020).

1.1 Regional capabilities shaped by the public sector

Chapter 1.1 focuses on the supporting role of the public sector, the importance of regional space, and regional capabilities and preconditions. The author focused on this in Studies 2 and 3.

Regions are social constructs shaped by political, economic, cultural, and administrative practices and discourses, according to Paasi (2001). Mattes

(2013) further emphasises the importance of regional space for globally oriented companies, as they are embedded in specific regions. However, "regional space" is broader than just the physical space.

Despite the increasingly globalised world and innovation chains, the regional context and RIS approach still offer valuable insights into promoting regional socio-economic development, as Asheim et al. (2020) noted. However, Hedin (2009) notes that the highly competitive nature of the new globalised economy presents limited opportunities for local firms to thrive, with knowledge production becoming a crucial factor of production.

Asheim and Coenen (2005) highlight the importance of industry-university cooperation in promoting new economic activity in a region. Firms and organisations are embedded in specific regions and characterised by local interactive learning, with linkages between local industry and the knowledge infrastructure. Sharing locally produced knowledge between firms in local clusters, educational institutions, and public organisations establishes a foundation for local, national, and global collaboration, providing opportunities for reaping the benefits of such cooperation. Asheim and Isaksen (2002) identified four essential points regarding regional innovation systems based on three Norwegian regional clusters. These include the importance of external contacts, the immobility of regional resources, and the regional nature of innovation processes within regional clusters.

In summary, human resources and knowledge institutions play a critical role in creating environments for communication, cooperation, and knowledge production, with local universities becoming increasingly crucial for regional development. Successful regional development requires maintaining a high quality of life, a strong economy, low unemployment, effective regional planning, and cooperation between local actors (Bathelt et al., 2004). Collaboration across various sectors of society facilitates information exchange, knowledge creation, and transfer, which enables the building of appropriate innovation environments.

Investment

Research and development (R&D) investments are key factors in shaping the region's capabilities. R&D investments can lead to technological advancements and innovation, resulting in new industries, products, and services and improving existing ones. R&D investments can take various forms, including direct funding for scientific research (Azoulay et al., 2011; Broekel & Graf, 2012; Yazgan & Yalçinkaya, 2018; Dabić et al., 2021), grants for small and medium-sized enterprises (Cin et al., 2014; Economics, 2017), or tax incentives for businesses that conduct R&D (Cheng & Parra, 2018; Chen & Yang, 2019; Ehsan, 2021; Ziesemer, 2021; Jia & Ma, 2021). The public sector can significantly promote R&D investments by funding and supporting research institutions, universities, and businesses.

In addition to promoting technological advancements, R&D investments can have positive spillover effects in other areas (Archibug & Filippetti, 2015;

Aitken et al., 2021). For example, R&D investments in renewable energy can improve energy efficiency and reduce carbon emissions (Creutzig et al., 2015; Mazzucato & Semieniuk, 2018; Rosen, 2021), which can help mitigate the effects of climate change.

Moreover, R&D investments can help build regional capabilities by creating a knowledge-based economy (Audretsch & Thurik, 2000; Maassen & Stensaker, 2011; Coenen et al., 2015; Tödtling et al., 2016; Al-Laham & Alaqtash, 2018; Hameed et al., 2020; Tödtling & Auer, 2021). By investing in R&D, a region can attract businesses and entrepreneurs looking for a skilled workforce and an innovative environment. The effects of the R&D investments, in turn, can lead to clusters of related businesses and industries, creating a virtuous cycle of innovation, job creation, and economic growth. Therefore, R&D investments not only promote technological advancements but also have a significant impact on the overall growth and development of a region.

Workforce

Several recent studies highlight the importance of developing regional capabilities through learning processes that rely on knowledge residing in the region, as well as national and supranational influences on university-industry cooperation and innovation behaviour (Asheim et al., 2011; Stuart et al., 2021;). Collaboration with local educational and scientific institutions remains a key strategy for regional development, given their deep knowledge of the local context (Asheim et al., 2019). However, challenges remain in bringing different actors together and motivating them to collaborate effectively (Zhang et al., 2021).

Innovation

Recent research suggests that historical levels of knowledge and entrepreneurship continue to play a significant role in forming innovative new businesses (López-Rubio et al., 2020; Daspit et al., 2023). Regions with strong science-based industries and self-employment tend to have higher levels of entrepreneurial activity in innovative industries, supporting the knowledge spillover theory of entrepreneurship (Thai et al., 2023; Urbano et al., 2020). However, regions with technical or classical universities but weak science-based industries can still foster technology-intensive start-ups (Civera et al., 2020; Daspit et al., 2023). Developing entrepreneurial ecosystems at both regional and national levels is increasingly recognised as a key driver of economic growth (Sridharan et al., 2021; Audretsch et al., 2023).

Networks

The prominence of regional knowledge resources has also been brought to attention by Krätke and Brandt (2009). Their idea of regional knowledge resources and their interlinking as an essential part of interactive knowledge generation processes has been reinforced by newer studies. Zhang et al. (2021) demonstrated the positive relationship between regional innovation networks

and regional innovation performance, emphasising the need for regional collaboration and knowledge exchange among firms, universities, and research institutions. Additionally, Wang et al. (2022) found that university-industry collaboration networks positively affect regional innovation, especially in knowledge-intensive industries.

Markkula and Kune (2015) discussed smart specialisation and the role of universities in regional innovation ecosystems. They revealed that the active management of knowledge co-creation and exploitation, opportunity exploration, and capacity building makes the region more innovative and different from how we are stimulating business clusters, encouraging investments, or providing intelligent services to the citizens.

Other

Studies have continued to identify critical factors for the success of innovative firms in the region. For instance, Eriksen and Isaksen (2021) investigated the role of culture in new industry emergence and found that regional cultural assets can attract and facilitate the growth of innovative firms. Meanwhile, Looy et al. (2003) highlighted the importance of research institutes, endogenous knowledge-intensive start-ups, and a supportive business environment in stimulating entrepreneurship and innovation in the region. These findings suggest that various business environmental factors and capabilities are necessary to support innovative firm growth in a region.

Conclusion

Chapter 1.1 gave an overview of the supporting role of the public sector, the regional space and its capabilities, about the regional innovation system, and already touched on the importance of education and learning processes that are the prerequisites for absorbing the knowledge to the region. In conclusion, the public sector is critical in promoting regional development through investment in research and development, building regional capabilities, and ensuring a high quality of life. Regional space is vital for globally-oriented companies, and university-industry cooperation can promote new economic activity in a region. Collaboration across various sectors of society facilitates information exchange and knowledge creation, enabling the building of appropriate innovation environments. Human resources and knowledge institutions also play a crucial role in creating environments for communication, cooperation, and knowledge production, with local universities becoming increasingly crucial for regional development. Successful regional development requires maintaining a strong economy, low unemployment, effective regional planning, and cooperation between local actors. Investment in research and development promotes technological advancements and significantly impacts a region's overall growth and development. Therefore, the public sector must provide funding and support for research institutions, universities, and businesses to promote regional socio-economic development.

1.2 Regional capabilities shaped by the universities

Chapter 1.2 focuses on the importance of the universities and competence centres in shaping the regional capabilities, discussing their effect on university-industry cooperation and R&D/innovation performed in the industry. The author focused on this in all studies, but a more thorough analysis was made in Study 2.

The role of universities in the regional development process and as a supporting stakeholder for knowledge-intensive activities is expected to further increase given the development of a knowledge-intensive economy and society (Trippl et al., 2015; Ritzen, 2016; Wagner et al., 2021; Fonseca & Nieth, 2021). Subsequently, European universities have sought to intensify their engagement with regional development issues and the regional development community (Posselt et al., 2019). Benneworth and Fitjar (2019) point out that the universities can play an active role in regional engagement; however, there could be a risk that the activities are focused on the government's beliefs rather than the unanimity of other regional actors.

Investment

Etzkowitz and Leydesdorff (2000), known for the Triple Helix approach, not only point out the growing role of the universities in regional innovation systems but also underscore the increased interaction and cooperation between universities, industry, and government by acclaiming the rise of the entrepreneurial university. Furthermore, their approach has been reinforced by newer studies. For example, Yang et al. (2021) found that university-industry-government collaboration positively affects regional innovation performance. Additionally, universities are increasingly adopting the role of entrepreneurial universities, where there is greater interaction and cooperation between universities, industry, and government (Marques et al., 2018; Houston et al., 2021).

Investments by universities can have a dual meaning:

1. By providing academic programs that align with the needs of local industries, universities can help to develop the skills and knowledge necessary for the region to thrive (Chen et al., 2018; Veronica et al., 2020). Investments in education and training can also help to attract and retain talented individuals in the region (Glaeser et al., 2016; Tervo et al., 2019). As students and graduates gain valuable skills and experience through their studies, they may choose to stay in the region to pursue their careers (Wang et al., 2017; Jacob et al., 2019), which can help to strengthen the local workforce and promote economic growth. Moreover, universities can collaborate with local businesses and organisations to offer training opportunities and research projects to address regional challenges and opportunities (Fischer et al., 2021; Boldureanu et al., 2020; Grimaldi et al., 2021). These collaborations can foster innovation and entrepreneurship, leading to the development of new industries and the creation of new jobs.

2. Supporting entrepreneurship: Universities can support entrepreneurship and the formation of new companies, providing seed funding and support to help start-ups succeed and grow (Guerrero & Urbano, 2014; Szerb et al., 2018; Botelho et al., 2021). Universities are essential in contributing to the region's social and cultural development. Literature has found that stronger communities, better wealth distribution, and universities lead to stable and sustainable economic growth (Benneworth & Pinheiro, 2017; Bosma et al., 2018; Xu et al., 2020). Universities, as owners of intellectual and financial resources, act as major players in this process, but not only.

Workforce

In recent years, several studies have reinforced Gibbons' academic revolution theory (Gibbons, 2000). For example, Ranga and Etzkowitz (2013) argue that universities are now evolving into 'triple helix' institutions that combine the roles of education, research, and innovation. Similarly, Zhao et al. (2020) found that universities are becoming more entrepreneurial, focusing on commercialising research and developing relationships with industry.

Wissema's three generations of universities theory (Wissema, 2009) has also been further developed in recent studies. For instance, Heller (2022) argues that fourth-generation universities are emerging, with a strong focus on global challenges such as sustainability, social inequality, and health. Furthermore, a study by Asgari et al. (2021) found that fourth-generation universities tend to have a more diverse faculty and student body and emphasise interdisciplinary collaboration.

Universities' contribution to the local community is increasingly recognised, and several studies have explored this aspect. For example, MacNeil et al. (2021) found that universities significantly promote regional economic development and foster innovation. Additionally, Wiek et al. (2013) argue that universities' engagement with local communities can enhance their social impact and improve their relevance to society.

Recent studies have also emphasised the importance of tertiary education for employment and competitiveness. For example, Schneider et al. (2020) found that tertiary education levels are positively associated with regional economic growth and innovation. Furthermore, Fonseca & Nieth (2021) argue that universities can contribute to reducing regional disparities in education and employment opportunities.

Innovation

Studies support the idea that universities are important economic growth and regional development drivers. For example, a study by Huggings et al. (2020) found that universities can significantly impact regional innovation and knowledge spillovers, leading to greater economic growth. Ierapetritis (2019) also found that universities can drive regional development by fostering innovation and entrepreneurship.

Regional knowledge institutions such as universities can contribute to the quality of regional innovation strategy processes and create collective innovation assets, but they need agents with a more strategic view (Benneworth & Fitjar, 2019). A study by Reichert (2019) found that universities can play a key role in regional innovation ecosystems, acting as intermediaries between firms and other actors in the innovation process.

De Bruijn and Lagendijk (2005) highlight the growing impact of innovation-based growth and development and its influence on regional development. Universities are increasingly emphasising their role in knowledge transfer, in addition to teaching and research. Marques et al. (2019) found that university-industry knowledge transfer can lead to greater regional innovation and economic development.

Studies have found that regional knowledge institutions not only affect R&D and innovation in the industry but also lead collective learning processes such as workforce training, spin-off creation, R&D support for firms, and access to advanced equipment and services (Jaffe, 1989; Rosenberg, 1996; Agrawal & Cockburn, 2002; Lööf & Broström, 2008; Peykani et al., 2022). A recent study by Thomas et al. (2021) found that universities can play a key role in fostering innovation and knowledge transfer in regional innovation ecosystems, leading to greater economic growth and development.

Kempton et al. (2014) argue that universities are central to the emerging transformation of the economy and will play a key role in characterising the regional intelligent specialisation strategy by assessing the region's knowledge assets, capabilities, and competencies, including those embedded in university departments and local businesses. A recent study by Huggins et al. (2020) found that universities can drive regional innovation and development, particularly in regions with weaker innovation capabilities.

Networks

Benneworth and Fitjar (2019) state that although academia may contribute to the region, it depends heavily on their motivation, the local industry, and the willingness of highly skilled researchers to stay in the region. Zhao et al. (2019) state that universities significantly generate knowledge spillovers, foster innovation, and drive regional development. Similarly, a study by Kangas & Aarrevaara (2022) found that universities can act as knowledge brokers, connecting firms and other actors in the innovation process, thereby enhancing regional innovation ecosystems.

In addition to their traditional role in education and research, universities are increasingly becoming important drivers of socio-economic development in their surrounding areas. As stated in a study by van der Meer et al. (2022), universities contribute to developing local infrastructure, attracting talent, and creating new jobs, all of which enhance the region's attractiveness. Moreover, universities can acquire investments in ways that benefit the region beyond themselves, especially in less-favoured regions, as highlighted by a study by Reichert (2019).

The availability of local knowledge infrastructure and the ability to interlink to generate interactive knowledge is crucial for regional learning, as noted in a study by Reichert (2019). The quality of learning also depends on the human resources available and the community's reputation and value of knowledge with an impact on the region, as emphasised by a study by Olcay & Bulu (2017).

A region's collective identity binds people together, and a positive reputation correlates with high social capital, as highlighted in a study by Milton et al. (2012) and Hussain et al. (2022). Positive community development, a product of long-lasting positive collective action, can contribute to a region's reputation and identity, as noted in a study by Vargas et al. (2022).

Other

Regional clusters have been widely recognised as driving economic growth, innovation, and knowledge generation. Local cluster cooperation in a region can often lead to the creation of a new, more significant cluster. It means locally produced knowledge is being structured and transferred between the clusters. Close networking between the firms in the cluster and mutual knowledge sharing can benefit the local actors. (Bathelt et al., 2004).

Recent research highlights regional clusters' importance in promoting innovation and economic growth. For example, a study by Capello & Caragliu (2021) found that clusters of European innovative firms were associated with higher productivity and income growth. Another study by Tang et al. (2022) emphasised the role of regional networks in facilitating knowledge spillovers and innovation within clusters.

In this context, regional competence or competence research centres are becoming increasingly critical in creating research and technology policies in countries. Such centres promote knowledge transfer and collaboration between firms, universities, and other knowledge institutions in a region. For instance, a study by El Idrissi et al. (2020) explored the role of regional competence centres in promoting sustainable development in Italy and Morocco. The authors found that these centres facilitated the transfer of knowledge and best practices between firms and research institutions, thereby promoting innovation and competitiveness.

Regional competence centres or regional competence research centres are becoming increasingly critical in creating research and technology policies in countries. Tekin-Koru and Yilmaz (2021) found that regional innovation systems, including regional competence centres, are essential for enhancing firms' innovation capacity and increasing regions' competitiveness. Another study by Zmiyak et al. (2020) highlighted the importance of regional innovation ecosystems in fostering innovation and promoting economic growth.

Regarding government policies, there is a growing recognition of the need to support regional clusters and competence centres through targeted policies and investments. For example, the European Union's Smart Specialization Strategy emphasises the importance of regional innovation ecosystems. It encourages

member states to invest in regional competence centres to promote innovation and economic growth (European Commission, 2021). Similarly, the United States government's Regional Innovation Strategies program provides funding and resources to support regional innovation clusters and centres (U.S. Economic Development Administration, 2021).

The competence centre model's internal resource basis is addressed to broader issues of strategic concern to the enterprise base – for example, challenges for sub-suppliers concerning global specialisation. Institutional collaboration within the competence centre model has also made the competence centres – and thus the individual education and training centres – more visible as actors in the regional knowledge centres and vis-à-vis other actors such as regional business centres, tertiary professional colleges, universities, and specialised service providers.

Conclusion

Chapter 1.2 discussed the importance of universities in supporting regional development. Universities can contribute to the absorption of knowledge in the region by providing local learning opportunities, promoting knowledge creation, and fostering knowledge binding. By developing a highly educated and skilled workforce and promoting innovation and entrepreneurship, universities can shape a region's capabilities and competitiveness, attracting businesses, workers, and families.

Effective collaboration and interaction between universities, industry, and government are crucial for the success of regional innovation systems, and the trend of entrepreneurial universities is seen as a positive development. Universities can contribute to regional development by investing in education and training, collaborating with local businesses and organisations, and supporting entrepreneurship. Additionally, universities are important in promoting regional social and cultural development.

As triple helix institutions, fourth-generation universities, and increasingly entrepreneurial institutions, universities are expected to significantly impact regional innovation and economic growth in the future.

1.3 Regional capabilities shaped by the private sector

Chapter 1.3 highlights the significance of the private sector in shaping regional capabilities for successful university-industry cooperation and explores cooperation models for working with knowledge institutions, which are also the focal points of Studies 1, 2, and 3.

The private sector is critical in shaping regional capabilities and fostering economic growth and development (Rashed & Shah, 2021). Private sector investment in physical and human capital, research and development, and entrepreneurship can increase productivity and innovation and drive economic growth (Van Zanten & Van Tulder, 2018).

Investment in physical and human capital can improve the quality and availability of infrastructure, education, and healthcare, which are critical for economic development (World Bank, 2020). Additionally, private sector investment in research and development can spur innovation and create new industries and jobs, leading to increased economic growth (Tang et al., 2022).

Encouraging entrepreneurship is a way the private sector can contribute to economic growth. This can be achieved primarily by developing start-ups and small and medium-sized enterprises (SMEs) (Grazzi & Pietrobelli, 2016), which in turn can lead to increased job creation, productivity, and innovation, particularly in emerging industries (Van Stel et al., 2020).

Finally, the private sector can partner with universities, governments, and other stakeholders to foster collaboration and knowledge-sharing, leading to more significant innovation and economic growth (Rõigas et al., 2018; Schmitz & Nadvi, 2019). By working together, these groups can identify opportunities for growth and development and develop strategies to achieve them.

Investments

Physical capital investments, such as research centres, factories, and other production facilities, can enhance the region's technological capacity and competitiveness (Alcácer et al., 2016; Crescenzi et al., 2020).

The private sector can invest in a region in several ways, including:

- Setting up operations: Companies can invest in new factories, offices, or other regional procedures, creating jobs and economic activity (Mahalakshmi et al., 2017; Tőkés, 2019).
- Building infrastructure: Private companies can invest in the construction of transportation, communication, and other infrastructure to support their operations and the growth of the region (Hussain et al., 2019; Glaeser et al., 2018).
- Training and development: Companies can invest in employee training and development programs to build the skills of the local workforce and make them more competitive (Black & Lynch, 2017; World Economic Forum, 2019; Fibírová, 2020).
- Partnering with local organisations: Companies can collaborate with local organisations, such as schools, non-profits, and governments, to address regional development challenges and opportunities (Morsing & Rovira, 2011; Porter & Kramer, 2011; Doherty et al., 2014).
- Investing in research and development: Companies can also invest in research and development activities in the region, creating new products and technologies that can drive economic growth and create jobs (Criscuolo et al., 2012; Miozzo & Desyllas, 2017; Bloom et al., 2018).

These investments can drive economic development, create jobs, and improve the quality of life in the region, making it an attractive place for businesses, workers, and families to live and thrive.

Workforce

The private sector can attract and retain a skilled workforce by providing the necessary training and education. As one option, they can develop partnerships with educational institutions. Private sector companies can work with universities, vocational schools, and other educational institutions to develop training programs that align with their business needs (Euler, 2018). By working with academic institutions, companies can ensure that their training programs are up-to-date and relevant to the skills and knowledge in demand (Marques et al., 2019).

Apprenticeships and internships allow students and young professionals to gain real-world experience in industry or field (Holt, 2012; Schulte & Sullivan, 2020). Private sector companies can offer these opportunities to attract and retain talented individuals while providing the necessary training and education to boost regional capabilities.

Private sector companies can offer ongoing training and professional development opportunities to help employees develop new skills and stay current with industry trends and technologies (Apascaritei & Elvira, 2022; Martínez et al., 2023), which can include attending conferences, workshops, and online courses. Encouraging employees to take ownership of their professional development and creating a supportive environment for experimentation and innovation can foster a continuous learning culture within the company (Sanz-Valle et al., 2011; Lin & Huang, 2021). To attract and retain skilled workers, private sector companies can offer competitive compensation and benefits packages, such as salaries that match employee skills and experience, healthcare, retirement plans, and paid time off (Scullion et al., 2018; Hur et al., 2021).

Innovation

Innovation is an essential driver of economic growth, and the private sector can play a crucial role by investing in research and development activities and creating new businesses, stimulating entrepreneurship and job creation in the region. Temel et al. (2013) revealed that the literature on the rationales for cooperation in innovation activities abounds and usually distinguishes inter-firm collaboration, intra-firm, intra-country cooperation, and cooperation with research institutions. They also mentioned that collaboration between universities and industry had been extensively studied; however, the studies have led to mixed conclusions.

Recent research supports the positive relationship between R&D spending and economic growth at the national and regional levels. For example, a study by Kim et al. (2018) found that R&D investment by Chinese firms had a significant positive effect on productivity and economic growth. Similarly, a study by Schaffer and Turkina (2021) found that private R&D investment positively impacts regional economic growth in Europe.

The positive impact of R&D expenditure on regional economic growth, innovation, the strong influence of human capital on economic growth, and an effect on regional productivity has also been analysed and proven by various

authors (Frenken et al., 2007; Bronzini & Piselli, 2009; Petrariu et al., 2013; Wang & Wu, 2015). Consistent with previous research (Barnes et al., 2002; Enkel et al., 2009; Perkmann et al., 2013), collaboration and interaction between universities and industry benefit the two entities involved but also governments. Given the current context of intensified global competition and rapidly advancing technology, governments are keen on promoting practical cooperation between universities and industry to enhance innovation outcomes and stimulate economic growth in the country.

Research also suggests that high-technology sectors or firms generate more R&D spending, which leads to increased technological and economic productivity in those regions (Aitken et al., 2021). Larger, science-based firms with a strong R&D and absorptive capacity are more likely to engage with universities in collaborative R&D activities (Cockburn & Henderson, 2000; Cassiman & Veugelers, 2002; Belderbos et al., 2004). Moreover, Belderbos et al. (2004) concluded that university spillovers stimulate collaboration with universities and R&D collaboration with other partners. The growing importance of university research for better firms' innovation performance has also been confirmed by recent empirical studies (Veugelers, 2021; Atta-Owusu et al., 2021).

Networks

Establishing networks and partnerships with universities, governments, and other stakeholders can create an innovation-friendly environment, enabling the development of new ideas and technologies and the diffusion of knowledge throughout the region.

Interaction between universities and industry has a strong focus globally. Krätke and Brandt (2009) found that most innovations are created from the cooperation between firms or between firms and knowledge institutions. Therefore, universities, industry, and governments must find excellent and effective ways to promote collaboration between parties to maximise the benefits. This aligns with the findings of Cavusgil et al. (2003), who stressed the importance of tacit knowledge transfer on firm innovations. They found that "cooperation strength influences the extent of knowledge transfer, and the tacit knowledge obtained from partner firms affects firm innovation capability, which in turn influences firm innovation performance."

Conclusion

In conclusion, the private sector plays a crucial role in shaping regional capabilities, and its contributions can foster economic growth and development while also enhancing the competitiveness and sustainability of the region. By investing in physical and human capital, research and development, and entrepreneurship, the private sector can drive the region's innovation, productivity, and job creation. Private sector companies can also attract and retain a skilled workforce by providing necessary training and education, offering competitive compensation and benefits packages, and creating a culture of continuous learning. Finally, the private sector can partner with universities, governments,

and other stakeholders to foster collaboration and knowledge-sharing, leading to more significant innovation and economic growth. The private sector's contribution to regional development is essential for creating a vibrant and sustainable economy.

2. EMPIRICAL STUDIES

3. DISCUSSION OF RESULTS AND CONCLUSIONS

The three studies in the thesis focus on university-industry cooperation and regional capabilities development and look at university-industry cooperation from three different angles (academia, industry and government) for a single purpose – what is the relationship between university-industry cooperation and regional capabilities? Therefore, the empirical findings are structured according to these three studies.

3.1 Creating a theoretical foundation on the various indicators used to measure university-industry cooperation

The collaboration between academia and industry has been the subject of Study 1, focusing on identifying the different types of cooperation activities and indicators used to evaluate their effectiveness. The aim was to establish effective collaborations that benefit all parties involved. It is crucial to define and utilise useful indicators to evaluate the effectiveness of these collaborations and design appropriate policy measures.

Study 1 identified eight types of cooperation and integrated them into a framework of university-industry cooperation indicators. These indicators illustrate the relationship between indicators and various types of collaborations.

The types of outputs (research question 1) that could lead to specific economic development impacts were also brought out by Goldstein et al. (Goldstein et al., 1995), who counted several outputs and impacts of the university-industry cooperation. As pointed out in Study 2, universities help industries and regions generate human capital with tertiary education that contributes to economic development. Still, it takes time before human capital (students) can contribute to economic development.

However, knowing what to learn and how it matches the industry's needs is important. Lin (2004) studied the effects of higher education curricula on the labour force and economic growth in Taiwan and found that higher education positively and significantly affected Taiwan's economic development, with engineering and natural sciences majors playing a significant role in the process. This aligns with the findings of Study 1, which suggest that successful cooperation in curriculum development and student mobility should lead to a high rate of student recruitment.

Besides quantitative indicators, the impact of cooperation (research question 1) can also be measured by the satisfaction of graduates and employers. The development of human resources (curriculum development and delivery, student mobility, lifelong learning) should lead to improved performance and productivity of firms. In the case of lifelong learning, attendees' satisfaction should also be considered.

Academic mobility, R&D collaboration, and commercialisation of R&D results pertain to research activities. These can impact new products and processes derived not directly from the cooperation but due to the collaboration. The most important impact of cooperation is the increase in the income of firms and universities. For universities, the growth of industry funding indicates increased cooperation between universities and industry. The commercialisation of R&D also involves the formation of spin-offs; thus, the survival and growth of spin-offs can be considered an impact indicator.

Similarly, the impact of entrepreneurship is the growth of joint ventures. The impact of governance and other types of cooperation should be the cultural development of universities and industry, which can be evaluated by increased cooperation between universities and companies. Medium- and long-term impacts can be measured by indicators that evaluate increased knowledge intensity in the industry, the economy's overall productivity, the development of high-growth enterprises, employment, and national prosperity.

Accurate indicators are crucial in designing and evaluating R&D and higher education policies. Given the diverse knowledge transfer channels between academia and industry, it is important to analyse university-industry cooperation systematically. To gain an understanding of the collaboration and its economic impact, appropriate indicators should be utilised. While input factors such as the number of R&D personnel and staff supporting knowledge transfer are important, they only provide a limited view of the collaboration. Output factors like income from training, patents, licences, and R&D contracts offer more direct measures but still need to capture the full economic impact. Therefore, attention should be given to impact indicators, which may take time to manifest but are more significant in the broader economic context.

The use of appropriate indicators and how the uneven potential of regions toward the university-industry cooperation needs to be considered in implementing the EU smart specialisation strategy was also tackled in Study 3.

The perspective on university-industry cooperation underwent a significant transformation, particularly in the 2010s. Before this period, the understanding of cooperation was limited and needed a comprehensive framework. However, Davey's report in 2011 (Davey et al., 2011) played a crucial role in widening this perspective and drawing attention to the importance of efficiency in collaboration. Researchers began exploring these factors in subsequent studies by recognising that a border and more impactful cooperation requires consideration of input and impact metrics.

The introduction of smart specialisation in the European Union (EU) in 2018 (Davey et al., 2018) further emphasised the need to foster and evaluate the capabilities of different regions. Study 1, conducted earlier, emerged as one of the first articles to focus on the various factors influencing university-industry cooperation. Since then, several studies have further examined such collaborations' input and output factors.

Rybnicek and Königsgruber (2019) made a notable contribution to the field through their comprehensive literature review. They extensively analysed

university-industry cooperation projects to identify factors that influence the success of these partnerships. Their work synthesised the existing research and proposed a conceptual model, providing valuable insights for management practice.

Building upon this research, Ćudić et al. (2022) attempted to define the efficiency of university-industry cooperation by categorising “input factors" into institutional, human, linkage, and framework categories. They also defined “output factors" to measure university-industry cooperation in specific countries. Additionally, Šereš et al. (2019) focused on all three aspects—input, output, and impact factors—of university-industry cooperation, elaborating on the aims of Study 1.

These studies have collectively contributed to a deeper understanding of the dynamics and determinants of university-industry cooperation. They have offered valuable insights for policymakers, practitioners, and researchers seeking to enhance the effectiveness and impact of collaborative efforts between academia and industry. It is anticipated that further research in this area will continue to refine our understanding and provide evidence-based guidance for successful university-industry collaborations.

3.2 Human capital and regional development – analysing the link between higher education and regional growth

Study 2 focused on the academic side, describing how the share of tertiary students and the creation of human capital is combined with the region’s growth via increased GDP per capita, knowledge-intensive employment and R&D expenditures. It posed the research question (3): What is the relationship between students in tertiary education as a percentage of the population aged 20–24 and the employment in total knowledge-intensive services as a percentage of total employment in different NUTS 2 regions? In other words, what is the relationship between students in tertiary education and economic growth in the NUTS 2 regions of Europe?

As discussed in Chapter 1.3, universities and other knowledge institutions play an important role in university-industry cooperation – they are not only providers of the R&D/innovation performed in the industry but also have the fundamental role of providing the industry with a highly qualified and skilled labour force. Outputs like R&D, innovation, and labour force constitute the third role of universities and bring universities forward as an important part of the regional development agenda.

Study 2 provides an overview of the link between the teaching (outcome: tertiary students/human capital in the region) and engagement of the communities (outcome: knowledge-intensive employment in the regions) to investigate the relationship between students in tertiary education and economic growth in different regions.

Study 2 revealed a strong statistically significant relationship between knowledge-intensive employment and R&D expenditures if considering economic growth factors, knowledge economy and higher education. The significance of GDP per capita and the share of tertiary students depends on the model specification and estimation method. The study also concluded that there is a time lag (research question 4) between creating human capital and its influence on economic development – as found in the empirical analysis, it takes time for human capital to contribute to economic development – they first need to graduate the university before providing their impact to the society (industry and region). This was in line with the works of Neagu (2012) and Caniëls and Van den Bosch (2011), who had to find a positive and strong correlation between educational variables and economic growth. Unfortunately, this aspect is usually forgotten and often critiqued when establishing or measuring the impact of regional colleges, centres of excellence or other knowledge institutions.

Regions differ by the share of tertiary students across and within countries. This was seen in the cases of Italy and Greece. Although Study 3 does not include data about Greece, the Basilicata region in Italy had the lowest shares of tertiary students (Study 2). It was also one of the regions which needed to be stronger in all three factors describing the supporting role of the private and public sectors and universities toward university-industry cooperation.

Study 2 pointed out an important failure in most of the studies – the share of students in tertiary education varies across the regions, and it can differ a lot inside one country. Therefore, regional data was used. Moreover, although the average share of tertiary students across all analysed regions was around 52%, it also had a large standard deviation. For example, the share of tertiary students was the highest in one of the regions of Romania (București – Ilfov) and also the Czech Republic (Prague), while one region in Romania (Sud – Muntenia) and two of the regions of the Czech Republic had the lowest share of students (Northwest and Central Bohemia).

Regarding Sud – Muntenia, Study 3 found that this region is weak in all three factors describing the supporting role of the private and public sectors and universities toward university-industry cooperation. Northwest and Central Bohemia, however, were considered one of the weakest regions in Europe in Study 3 regarding the supporting role of the public sector and universities toward university-industry cooperation. The supporting role of the private sector is considered strong – this is associated with the fact that the headquarters of the car manufacturing company Škoda is located in the Central Bohemia region. We also have to consider that those regions (Sud – Muntenia and Central Bohemia) are bordering regions of the country's capitals, Bucharest and Prague, which makes it not viable to create universities there and rather source the knowledge directly from the capital.

Study 2 found that the share of knowledge-intensive employment is higher in regions of Sweden and Finland and lower in Romania, whereas the gross domestic expenditure on research and development as a percentage of GDP was higher in Nordic countries, such as Sweden and Finland, also in some regions of

the Netherlands and Belgium and the lowest in regions of Bulgaria and Poland. Study 3 tackled the employment or the industry side from another angle and concluded that the implementation of smart specialisation strategies is especially important in case of the catching-up countries from Central and Eastern Europe (Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic and Slovenia), as there is a strong diversity in the structure of the national innovation systems, innovation performance (Radosevic et al., 2017) and university-industry collaboration support mechanisms (Seppo et al., 2014). Furthermore, Radošević et al. (2017) also stated that we are seeing a lack of differentiation in approaches to smart specialisation and an excessive R&D or high-tech focus. Regarding GDP per capita, the variation between regions was also high, with regions like Romania and Bulgaria again being at the bottom of the regions.

Since the publication of Study 2, several theoretical and longitudinal studies regarding higher education systems and regional economic development have been published (Agasisti & Bertoletti, 2022; Garcia-Alvarez-Coque et al., 2021; Iqbal, 2021; Janzen et al., 2022; Bertoletti et al., 2022; Borges et al., 2022). The results overlap also with the findings of Study 3. The recent papers highlight the relationship between higher education systems, universities, and regional economic development by highlighting several key points.

Firstly, the region does not have to have the presence of top-ranked universities for better regional competitiveness. Instead, a combination of factors, including R&D expenditure, private research systems, inter-firm collaboration networks, and high levels of human capital, contribute to regional competitiveness (Garcia-Alvarez-Coque et al., 2021; Agasisti & Bertoletti, 2022).

Secondly, increasing the number of regional universities is positively associated with stronger economic growth, especially when accompanied by quality research and specialisation in STEM subjects. The effect is amplified when considering the size of the higher education system. Notably, the type of university funding (public versus private) does not significantly impact economic growth (Agasisti & Bertoletti, 2022; Janzen et al., 2022).

Thirdly, university-industry cooperation is an essential field that fosters knowledge and technology transfer, making companies more competitive. The authors (Iqbal, 2021; Borges et al., 2022; Bertoletti et al., 2022; Janzen et al., 2022) indicate a growing trend of cooperation between companies and universities, focusing on advancing scientific knowledge. Furthermore, they emphasise the importance of a comprehensive understanding of the diversity of higher education systems and their characteristics for regional economic development. Factors such as the size of the higher education system, internationalisation of students, and research productivity play crucial roles in driving regional economic growth.

3.3 Differences in the development level of university-industry cooperation across European regions

The third study focused on the governmental side, concerning the potential of different EU regions to support university-industry cooperation as an important precondition for implementing the smart specialisation strategy. It posed research question 5: What is the regional potential to create an environment to support university-industry cooperation, and what capabilities do the regions have to execute the smart specialisation strategies?

Based on the literature about the supportive environment for university-industry cooperation, several variables to measure regions' potential for university-industry cooperation were analysed. This resulted in three factors describing actors' supportive role in RIS toward university-industry cooperation.

First was the supporting role of the private sector toward university-industry cooperation – including R&D expenditure in the business sector, innovative SMEs collaborating with others, several EPO patents, SMEs introducing product or process innovations, employment in medium-high/high-tech manufacturing and knowledge-intensive services.

The second was the supporting role of the public sector toward university-industry cooperation, including the population having completed tertiary education, R&D expenditure in the public sector, tertiary sector employment from the total economy and R&D personnel.

Here we can see that the literature on university-industry cooperation and regional development is interlinked, and taking things out of context is complicated. Chapter 1 described the theoretical views on the capabilities shaped by the government and the industry. As mentioned by Benneworth and Fitjar (2019), universities can play an active role in regional engagement and are important in terms of the supporting role of universities and the supporting role of the public sector toward university-industry cooperation.

Furthermore, the final factor was the supporting role of universities toward university-industry cooperation, including the number of universities in the Top 500 based on the Academic Ranking of World Universities and the number of students at tertiary education levels 5 and 6.

Research question 6 was defined from the three factors: The strong and weak regions, and how do regional capabilities affect RIS3 implementation?

As already mentioned in Study 2 regarding the share of knowledge-intensive employment, the results showed that many regions within Eastern Europe are remarkably weak even compared with the stronger regions from the East. This can be attributed to generally weaker firms in those regions. In the case of the public sector, the East is even weaker compared with the West than in the case of the private sector. The deviations can be seen in the standardised means – there are several regions in the East, with the means being two standard deviations below the average.

The significance of the region and the regional innovation system was highlighted in all three studies. Study 1 emphasised the need for various performance indicators to assess the inputs, outputs, and impact of university-industry collaboration. As a result, policies aimed at promoting university-industry collaboration should not only focus on input and output measures, as is currently the case but should also anticipate the potential effects of such policies in the future.

In Study 2, the findings point towards the importance of the regional innovation system and tertiary-level education. The increase in knowledge-intensive employment is related to increasing levels of GDP per capita and R&D expenditures, and if we consider regional-level fixed effects, the share of tertiary students was not statistically significant until the lag was used – then the share of students five periods ago, a positive relationship with the knowledge-intensive employment. On the one hand, it shows that the universities are fulfilling their task of producing a qualified workforce, but in other terms, looking at the innovation process in catching-up regions of the EU, which often were among the lagging regions according to Study 3. It is largely based on the incremental innovation and adoption of existing technologies rather than on heavy investment into R&D (Radošević et al., 2017), which disables them from reaching higher levels in the value chain.

When looking at the development of the literature after Study 3, there are several authors (Huosong et al., 2019; Lopes et al., 2021; Figueiredo & Ferreira, 2022; Wibisono, 2022; Marczewska et al., 2023)—focusing on the various aspects of business dynamics, innovation capacity, regional innovation, knowledge transfer, and the role of universities in promoting knowledge diffusion and supporting Smart Specialisation strategies.

The findings highlight the importance of understanding technological advances, implementing effective regional development policies, leveraging research and innovation strategies, and fostering collaboration among academia, government, and industry. Their work contributes to theory and practice by offering recommendations for organisations, policymakers, and the triple helix actors to improve business performance, innovation outcomes, and regional competitiveness. Furthermore, these studies emphasise the need for continuous monitoring and evaluation of regional innovation efforts and the adoption of integrated approaches that combine education, research, and innovation to address societal challenges and drive economic growth—making the connection between the three studies of this dissertation even more relevant.

Based on the findings of the three studies in this dissertation, policy recommendations can be formulated to address the limitations identified and promote equitable regional development through university-industry cooperation. The following four policy recommendations are proposed:

- **Evaluate and improve the efficiency of university-industry cooperation on a broader scale.** This can be achieved by considering different types of collaboration and measuring input, output, and impact to maximise the

outcomes of policy developments. The new report by Davey et al. (2018) considers the author's suggestions in Study 1.

- **Create centres of competence and knowledge in the regions** to empower university-industry cooperation on applied and business-oriented research in strategic regional sectors. These centres should be created collaboratively with industry partners to maximise practical outcomes and intra-regional linkages. The Holst Centre in the Netherlands is an example of a successful collaborative research facility.
- **Strengthen the local ecosystem through the uptake of digital tools and training.** Regional university-industry collaborative initiatives can benefit from training models and digital tools to increase tacit regional knowledge and acquire, absorb, and diffuse regional knowledge. The Norra Mellansverige region in Sweden is an example of successful initiatives for regional sustainability and capability growth.
- **Create and empower technology-intensive start-ups with local universities to boost university-industry cooperation.** Start-ups have different mindsets and can bring fresh perspectives to regional development. Policy measures should focus on boosting technology-intensive start-ups from various sectors, such as biotechnology, space, and robotics, with the support of academia, industry, and local government. The Science to Business Launchpad program run by Tartu Science Park in collaboration with the University of Tartu and the city government exemplifies a successful initiative promoting technology-intensive start-ups.

Implementing these policy recommendations can lead to more equitable regional development and promote effective university-industry cooperation in different regions.

3.4 Conclusions

The dissertation aims to contribute to the existing knowledge on the complex relationship between university-industry cooperation and regional capabilities development in Europe.

To achieve this, university-industry cooperation modes, the contribution of higher education to regional development and regional capabilities related to different stakeholders were studied throughout three empirical studies. Each of which focused on a different aspect of university-industry cooperation. Study 1 was dedicated to the cooperation modes and inputs-outputs, Study 2 focused on the relationship between tertiary education and knowledge-intensive jobs/services in the regions, and Study 3 was devoted to the capabilities of European regions and their potential to create an environment to support the university-industry cooperation—whether and what capabilities the regions have to execute the smart specialisation strategies.

The three main conclusions from the dissertation are:

1. This dissertation contributes to the literature by understanding the limited perspective of **measuring cooperation between universities and industry** – one-sided measurement has distorted the image/understanding of cooperation between universities and industry and the regional capabilities needed to support this activity.

   Study 1 contributed to the discussion and brought out the types of university-industry cooperation and created a framework of university-industry cooperation indicators, which described the relationship between different indicators for measuring university-industry cooperation and different types of cooperation.

   The dissertation's findings indicate that the cooperation between universities and industry has been more variable and multifaceted than conventional models have shown or could show. What can be seen is also easier to measure, and unfortunately, before the 2010s, the perspective was limited and needed to be covered by Davey's report in 2011 (Davey et al., 2011). For the cooperation to be more broad-based, with a greater impact on both the participants and the regional space where this cooperation is implemented, input and impact metrics must also be considered. With the introduction of smart specialisation in the EU, there was greater pressure to create and measure the capabilities of regions, but different levels were only introduced in 2018 (Davey et al., 2018).

   To sum up, despite the availability of indicators, it remains challenging to determine the most suitable ones that accurately reflect the impact of state policies. Furthermore, it is crucial to clarify the desired outcomes of these policies. While input and output measures are commonly used for measuring state policies, they are quantitative metrics as they are more easily obtainable. However, from the state's perspective, the impact indicators should be the most important, as they provide insights into whether the allocated resources are being utilised effectively.

2. This dissertation shows how the **university contributes to the region's development through students**. Universities are associated with three activity streams – teaching, research, and knowledge transfer.

   The theory states (Coenen et al., 2007; Klofsten et al., 2019; Benneworth & Fitjar, 2019; Ardito et al., 2019; Son-Turan & Lambrechts, 2019) that universities are becoming a more important part of the local/regional economies as they participate in activities within their respective regional economies. Furthermore, triple and quadruple helix models indicate the challenge of the universities by developing the skilled workforce and training research personnel and by serving society in creating talent for the knowledge-intensive economy.

   Emphasising flexibility, speed, and the needs of companies, we see that tertiary education positively affects knowledge-intensive employment – university-industry cooperation benefits from smart, educated people who

contribute to the industry and regional development. To ensure a timely and positive impact after graduation, it is crucial to implement strategies and plan well in advance. This can be achieved by involving companies in the curriculum development process, offering industrial master's and doctoral programs, and gaining a thorough understanding of the needs of both companies and society. By doing so, the time lag for the emergence of a positive effect can be shortened.

The empirical studies during the dissertation addressed the research gap by looking at the indirect impact of the universities on regional development by finding relationships between tertiary education/tertiary students and economic growth at the NUTS 2 level in Europe. By looking at this, the aim was to show the significant relationship between tertiary education and regional development. The findings suggest that while universities are increasingly involved in regional economic activities, they can only partially be relied upon to transform innovation capabilities and knowledge-based economies in their regions. Other stakeholders are needed for the policy mix as the results showed that it takes time for human capital to contribute to economic development before providing their impact on society. This means that university-industry cooperation in the modes described in Study 1 and regional capabilities described in Study 2 must be in place.

3. **This dissertation demonstrates how regional capabilities can contribute to regional development.** Established innovation leaders and emerging innovators in Europe stand side-by-side as regions with varying capabilities are dispersed across different countries. Unfortunately, this diversity remains largely unexplored, and more regional data is needed to be available to researchers.

   The author stressed that the potential of regions toward university-industry cooperation needs to be considered in its implementation as the regions are unequal. Knowledge about different combinations of capabilities in the regions enables to implement the smart specialisation strategies more effectively and, through that, also improves university-industry cooperation at the regional level. To fully leverage the benefits of the EU smart specialisation strategy, it is crucial to adopt a region-specific approach that prioritises the development of knowledge translation capabilities. Policies that incentivise collaboration between leading research universities in core European regions and those in catching-up regions should be prioritised. Finally, there is a need to develop regional-level policymaking capabilities that support university-industry cooperation to promote the transformation of regional innovation capabilities and knowledge economies.

University and industry collaboration is an input in innovation processes, resulting in different outcomes (higher level of innovation, productivity, and competitiveness). During the collaboration, tangible technical results or intangible technical knowledge is transferred from university to industry. In this

process, universities and scientific research institutes are usually the main body of knowledge innovation, and enterprises are the main body of technology innovation. University and industry collaboration can effectively improve the innovation ability of enterprises and the whole region.

The findings of this dissertation showed that the context of the regional policies and regional capabilities play an influential role in university-industry cooperation, regardless of which stakeholders (industry, academia or government) are currently in focus. The results showed that regional capabilities and the university-industry cooperation in these regions depend on a large selection of elements, from entrepreneurship, governance, creation of human capital, knowledge and technology transfer, R&D expenditures, or by creating a favourable milieu.

The results of these studies are beneficial for understanding the context and designing policies for increasing regional capabilities to create better opportunities for university-industry cooperation and, thus, greater regional impact.

3.5 Limitations and ideas for future research

The main limitations of this dissertation are limited to the concept of the regional innovation system and the need for regional (NUTS3) data. There is a need to improve the availability and measurement of regional data across the European Union.

Study 1 emphasises the need for an in-depth empirical study to confirm the appropriateness of the indicators and specify them more precisely for different types of cooperation. Although the importance of these indicators was already emphasised in the 2018 report by Davey et al. (2018), future empirical studies would provide a more complete picture of the extent of knowledge transfer from universities to industry in the longer term. Longer-term data should be collected through specialised surveys to achieve this. Further research is also needed to understand the role of sector specifics in policies. As firms are heterogeneous, but policies are homogeneous, there may be different indicators for measuring the success of university-industry cooperation in different sectors.

It is important to address the need for more regional data to comprehensively analyse regional development and its related factors. In Study 2, incorporating data updates and new datasets could provide additional insights into the impact of universities and tertiary students on economic indicators at the regional level. Specifically, it could shed light on how regional disparities, crises such as COVID-19, and other factors have influenced the relationship between students and economic indicators and how these factors have affected competition between regions and countries for students and the quality of higher education.

In future research, it would be beneficial to further elaborate on the results of Study 2 by conducting an analysis of the curricula of universities and examining the relationships between students and regional economic indicators based on

the courses offered by universities. Additionally, exploring the engagement with key issues, such as competition between regions and countries for students, could provide more insight. Furthermore, a more comprehensive data-gathering approach on a regional level (NUTS3) would be useful to investigate the link between universities and industries within regions, as well as brain drain, circulation, and the contribution of local and international students to the regional community. This could involve examining local/international student populations, retention rates, engaged programs, and industries.

In study 3, the lack of regional data or comparable data, even on the NUTS2 level, would have helped to not only better conclusions for the regions in the study but also have a more holistic understanding of Europe. The lack of evidence and information not provided to the European Union will hinder the cohesion processes needed and does not guarantee the optimality and transparency of funding processes.

As presented in Chapter 1.2, the regions that host a classical or a technical university but who do not have strong science-based industries or science-based self-employment seem to be conducive to technology-intensive start-ups. Thus the next steps would be to map the different regional capabilities needed for different economic sectors – what are the necessary needs for start-ups, manufacturing companies, and ICT, and the proportion of each factor (government, industry, academia) to be successful.

A wider discussion on the framework of the knowledge triangle should have been included. The author saw the triple helix as a more broad and holistic approach to the interaction involving university, industry and government actors. Furthermore, the knowledge triangle framework has also been criticised for being a weak policy device at the European level, with its instability and a lack of academic research available (Lassnigg et al., 2017).

The conclusions of the dissertation may be general. However, the idea was to discuss and address the research problem from a large pool of theories associated with university-industry cooperation and regional capabilities.

Focusing on methodologies, data, and refinement in future studies is advisable. The dissertation's findings must be supported with more evidence and tested as the regions, policies, and Triple Helix stakeholders evolve. The development of research questions for studies in different countries or regional settings and sectors is advised.

SUMMARY IN ESTONIAN

Seos ettevõtete ja ülikoolide koostöö ja regionaalsete võimekuste vahel Euroopa regioonide näitel

Töö aktuaalsus

Maksimeerimaks innovatsioonipotentsiaali, tuleks koondada teadmus regionaalsele tasandile. Selleks on regionaalne ettevõtluse ökosüsteem, kus üksteisele pakuvad tuge kolmikheeliksiks nimetatud teadmust loova ja vahendava innovatsioonimudeli osalised: ettevõtjad, ülikoolid ja avalik sektor. Kuigi ülikoolid varustavad regioone ennekõike spetsialistidega, toimub läbi nende üha enam teadmussiiret, millega kantakse uusi tehnoloogilisi lahendusi ja muud teadmust ettevõtetesse.

Globaliseerumisest hoolimata on teadmuse ülekanne regioonides sageli geograafiliselt piiratud ja sõltub avaliku sektori võimekusest luua teadmuse vastuvõtuks ja tõlgendamiseks sobilik keskkond. Regionaalarengus tuleks arvestada ülikoolide kasvavat rolli mitte ainult teadmuse loomisel, vaid ka osaliste kaasamisel ja avaliku sektori tegevuse toetamisel. Olemaks edukas, tuleb leida oma tugevused ning tasakaal kohapeal loodava ning "sisse toodud" teadmuse vahel.

Olenemata sellest, kas kohalik omavalitsus või riik toetab ülikoolide ja ettevõtete koostööd, puudub paljudel neist võimekus (ressursid, teadmus, sobiv ökosüsteem) seda teha. Võimekus sõltub lisaks ka kohalikest ettevõtetest, valitsemistavadest, tööjõu tasemest ja saadavusest, inimvarast, teadmus- ja tehnoloogiasiirde korraldusest, teadus- ja arendustegevuse kulutustest või lihtsalt kohalikust miljööst.

Akadeemilised ringkonnad, poliitikud ja ettevõtjad pööravad teadus- ja tehnoloogiapoliitikale rohkem tähelepanu kui kunagi varem – mitte ainult teadmiste ja tehnosiirde tõttu, vaid ülikoolide ja ettevõtete koostöö edendamiseks laiemalt. Eelkõige Euroopas, mis on teadmussiirde protsesside "takistuste" tõttu rahvusvahelist konkurentsivõimet kaotamas, on ülikoolid, ettevõtted ja riik (regioonid) huvitatud usaldusväärsest ja tõhusast koostööst.

Euroopa koosneb erinevatest regioonidest, millel on väga erinev innovatsioonipotentsiaal ja innovatsioonivõimekus (Foray, 2016; Pelkonen & Nieminen, 2016). Vaatamata rahvusvahelistumisele on regioonid, tänu innovatsioonipoliitika detsentraliseerimisele ja suundumusele, suutnud tagada rohkem autonoomiat ning vastutust (Magro & Wilson, 2013), ja arenenud olulisteks teadmiste tootmise ja kasutamise sõlmpunktideks, kus teadmuse tõlgendamise ja rakendamise võime on tagatud kohapeal.

Mitmed autorid on viimastel aastakümnetel rõhutanud regionaalsete innovatsioonisüsteemide (RIS) rolli konkurentsivõime ja regionaalse võimekuse suurendamise vahendina (B. T. Asheim & Isaksen, 1997; Boschma, 2004; P. Cooke, 2001; Tödtling & Trippl, 2005). Läbiviidud uurimustele tuginedes toob Soete (Soete, 2011) võtmetegurina esile pideva pikaajalise majanduskasvu

teaduses, tehnoloogias ja innovatsioonis. Lisaks nendib ta, et teadmiste, tootlikkuse ja tehnoloogia erinevused regioonides võivad esile tuua riikide ja regioonide erinevusi majanduskasvu näitajates. Carayannis jt (Carayannis et al., 2011) rõhutasid riikliku innovatsioonisüsteemi tähtsust, väites, et ettevõtete ja riikide konkurentsivõime sõltub tugevast riiklikust innovatsioonisüsteemist. Autori seisukohad ühtivad ülaltooduga. Autor on töötanud kohalikus omavalitsuses ning ettevõtjate toetamine ja tegevused on vähemalt Eesti kontekstis vabatahtlik ülesanne. Seega, et olla edukas, peavad raamistik ja eeldused (antud juhul riiklik innovatsioonisüsteem ja regionaalne innovatsioonisüsteem) olema paigas. See aitab eriti regioonides, mille tegevus on piiratud või mis on sunnitud kasutama ülalt-alla poliitikat.

Autor nõustub Tsipouriga (Tsipouri, L, 2018), et viimaste aastakümnete jooksul kujundatud regionaalpoliitika ja toimunud toetusprotsessid ei ole aidanud regioone ühtlustada. Tsipouri toob välja, et järgmistel programmiperioodidel on vaja enam pingutada ning näitab, et tõhusa innovatsioonipoliitika jaoks ei piisa ainult ressursside ülekandmisest, et tagada nii riiklikul kui ka regionaalsel tasandil vastupidav, konkurentsivõimeline majandus. Innovatsioon tuleneb investeeringute (füüsilisse ja inimvarasse), tehnoloogia (tootmise ja juhtimise teadmised) ja institutsioonide (tõhus valitsemine) kombinatsioonina (Tsipouri, L, 2018).

Tsipouri (Tsipouri, L, 2018) rõhutab lisaks, et kuigi RIS3 ehk nutika spetsialiseerumise strateegiad on küll paigas ja pakuvad väärtust, vajavad need mõningaid kujunduslikke muudatusi olemaks vahend, mis hakkab regiooni vajadusi paremini teenindama (Foray & Van Ark, 2007; Teräs & Mäenpää, 2016). Wøien jt (Wøien et al., 2019) märgivad, et vaatamata pingutustele luua nutika spetsialiseerumise strateegiaid, et aidata regioonidel kasvada, võib RIS3 regionaalseid erinevusi ka hoopis suurendada.

Foray ja Goenaga (Foray & Goenaga, 2013) toovad välja, et nutika spetsialiseerumise strateegiat ei saa ellu viia ainult ettevõtjad, vaid aktiivsed peavad olema kõik asjaomased sidusrühmad, olgu selleks ettevõtted, ülikoolid, tehnosiirdebürood, regionaalarengut toetavad arenduskeskused jm, kel on võime aidata kaasa uute domeenide avastamisele. See tähendab, et avastamisprotsesside abistamiseks, alt-üles lähenemisviisi toetamiseks ja seeläbi nutika spetsialiseerumise strateegiate täielikuks elluviimiseks peavad regioonidel olema 1) teatud võimekused, 2) regionaalse innovatsiooni ökosüsteem, et need võimekusi üheks siduda, ja 3) teadmusasutus teadmiste kogumiseks, teadus- ja innovatsiooni loomiseks ning ettevõtjatele kvalifitseeritud tööjõu tagamiseks.

Seda on autor ka oma empiirilistes uuringutes käsitlenud. Euroopa Liidu erinevate regioonide võimekus toetada ülikoolide ja ettevõtete koostööd on nutika spetsialiseerumise strateegia elluviimise oluline eeldus. Olgu selleks regioonide potentsiaal toetada ülikoolide ja ettevõtete koostööd läbi avaliku sektori toetava rolli, erasektori toetava rolli või ülikoolide toetava rolli, on selge, et paljudel regioonidel ei ole piisavalt jõudu maksimeerida nutika spetsialiseerumise lähenemisviisist tulenevat kasu. Pealegi tekitab see regioonide vahel

veelgi suuremaid erinevusi mitte ainult hästi toimiva kolmikheeliksi loomisel, vaid ka ülikoolide ja ettevõtete koostöö toetamisel.

Seetõttu keskendub käesolev doktoritöö kolmele erinevale sidusrühmale ning selgitab ülikoolide ja ettevõtete koostööd ning regionaalset võimekust teha seda läbi kõrghariduse ja ettevõtluse vaatenurga. Kuigi valitsemise aspekt on võrdselt oluline, eriti regionaalse konteksti puhul, mõjutab valitsuse rolli nii regionaalsel kui ka riiklikul tasandil liiga palju muid tegureid, et koostööle otsest mõju avaldada.

Käesoleva doktoritöö eesmärgiks on panustada ülikoolide ja ettevõtete koostöö ning regionaalse võimekuste vahelisse teaduskirjandusse Euroopa regioonide näitel.

Grillitsch & Sotarauta (2020) leidsid, et regionaalsete erinevuste ja majandusliku arengu peamine põhjus tuleneb teadmusmahukatest tegevustest. Eeldatakse, et piirkonnad arenevad oluliste teadmiste loomise sõlmpunktidena ning kasutavad ära teadmiste kogumise ja selle tõlgendamise võimet (Magro & Wilson, 2013). Grillitsch & Sotarauta (2020) leidsid aga, et piirkonnad, mis on spetsialiseerunud tootmis- või traditsioonilistele tööstusharudele või asuvad äärealadel, vajavad abi, et kohaneda kaasaegse majanduse aluseks olevate teadmusmahukate tegevustega.

Ühiskonna majandusliku, poliitilise ja keskkonnaalase surve suurenedes muutub järjest otsustavamaks ülikoolide roll regionaalses heaolus ja tööstuse arengus. Ülikoolide ja ettevõtete vahelise teadmussiirde (Cunningham & Link, 2015; Kalar & Antoncic, 2015; De Wit-de Vries et al., 2019; Huggins et al., 2020) ja selle ülekande kanaleid kattev (Kalar & Antoncic, 2015; Franco & Haase, 2015; Fernández-Esquinaset al., 2016; Azagra-Caro et al., 2017; Happonen et al., 2020; Jussila et al., 2021) kirjandus tõstab esile ülikoolide rolli vastata nii ühiskonna kui ka ettevõtete kasvavatele nõudmistele.

Ülikoolide ja ettevõtete koostööst saadava kasu maksimeerimiseks peavad kõik kolm sidusrühma (ülikoolid, ettevõtted ja valitsus) olema kättesaadavad ja saavutama teatud kriitilise massi. Käesolevas lõputöös väidetakse, et kõik kolm sidusrühma on majanduse arenguks vajaliku regionaalse võimekuse tagamisel võrdselt olulised. Käesolevas lõputöös kasutatakse terminit ülikool kõikide kõrgkoolide kirjeldamiseks, sest kuigi kirjanduses kasutatakse mõlemat, on termin ülikool rohkem levinud. Ebapiisav kolmanda taseme haridus takistab teadmistemahukaid majandussektoreid, vähendades tootlikkust, innovatsiooni ja konkurentsivõimet. Seega uurib käesolev doktoritöö ülikoolide ja tööstuse koostöö ning regionaalse võimekuse seoseid kõrghariduse ja kindlate perspektiivide kaudu, keskendudes kolmikheeliksi sidusrühmadele. Selleks toob autor välja kolm peamist fookuspunkti:

- Ülikoolide ja ettevõtete koostöö on oluline teema, kuna see aitab suurendada innovatsiooni ja majanduskasvu ning parandada ettevõtete konkurentsivõimet. Siiski on selle koostöö eri vormid ja mõju hindamine olnud keeruline. Uuring 1 on oluline samm selles suunas, et luua süstemaatiline raamistik ülikoolide ja ettevõtete koostöö mõõtmiseks ja hindamiseks. See

raamistik võimaldab poliitikakujundajatel hinnata nende poolt kehtestatud poliitikate mõju ja aidata ülikoolidel ja ettevõtetel hinnata nende koostöö edukust. Tulevikus võiks selline raamistik aidata kaasa ülikoolide ja ettevõtete koostöö suuremale läbipaistvusele ja tõhususele. Koostöö on multimodaalne, kuid selle selgeks mõistmiseks on vaja paremat ja täielikumat klassifikatsiooni. Muutused Euroopa Liidu tasandil on toimunud järk-järgult, kuna mitmekesisemaid ja mitmetahulisemaid vaatenurki tutvustasid 2018. aasta aruandes Davey et al. (2018). Süsteemse raamistiku puudumist käsitleva kirjanduse lünka käsitleti uuringus 1. See keskendub empiirilistele andmetele ning loob teoreetilise raamistiku ülikoolide ja tööstuse koostöö ning selle sisendite, väljundite ja mõju mõõtmiseks. See andis uurimistööle tugeva aluse, kuna varasemad seni avaldatud tööd on keskendunud peamiselt riiklikule või mõnel juhul ka ühe riigi piirkondlikule tasandile (Lee et al., 2010; Bencheva et al., 2011; Julia Vauterin et al., 2012; Guerrero & Urbano, 2014; González-López jt, 2015; Pavlova ja Burenina, 2016; Tunca & Kanat, 2019). Uuring 1 pakub väärtuslikku raamistikku ülikoolide ja tööstuse koostöö tõhususe hindamiseks, rõhutades erinevate tulemusnäitajate kasutamise tähtsust sisendite, väljundite ja mõju mõõtmiseks. Poliitikakujundajad saavad sellele raamistikule tugineda, et hinnata poliitikate mõju ja ennustada tulevasi mõjusid mõõdetavate kriteeriumide alusel. Lisaks võib see aidata ülikoolidel ja ettevõtetel hinnata nende koostöö ja teadmussiirde edukust.

- Teine oluline aspekt on ülikoolide ja piirkondliku võimekuse/kasvu vaheliste seoste tõhustamine. Ülikoolid peavad tagama kõrge kvalifikatsiooniga tööjõu varustamise Euroopale ning toimima elukestva õppe protsessi nurgakivina. Samuti tuleb tunnustada ülikoolide sotsiaalset ja kultuurilist rolli, mis on muutunud oluliseks osaks kasvavast regionaalpoliitika agendast. Ülikoolid peavad vastama klientide erinevatele vajadustele ning pakkuma paindlikku elukestva õppe keskkonda. Kohalikud ülikoolid ja teadmusasutused, tihedam koostöö teaduse ja õppetöö vahel ning lõppkasutajatega suhtlemine on uued nõudmised, mida nad peavad täitma. Kolmanda taseme hariduse puudumine võib takistada teadmistemahukates majandussektorites tootlikkuse, innovatsiooni ja konkurentsivõime kasvu. Euroopa koosneb erinevatest piirkondadest, millel on erinev innovatsioonipotentsiaal ja -võimekus. Poliitikakujundajad ja majanduskirjandus leiab et regiooni konkurentsivõime ja innovatsioon sõltuvad piirkondlikust ja kohalikust tasandist. Innovatsioonipoliitika detsentraliseerimine ja piirkondadele pädevuse ja vastutuse andmine on suundumused, kuid teadmiste tootmine ja kasutamine jääb ikkagi lokaalselt manustatud ja ruumiliselt kontsentreerituks. Uuringu 2 järeldused näitavad, et poliitikate kombinatsiooni jaoks on vaja teisi sidusrühmi. Inimvaral kulub aega majandusarengu mõju avaldamiseks ühiskonnale. Seetõttu on oluline tugevdada ülikoolide ja piirkondade vahelist koostööd ning toetada elukestvat õpet ja kolmanda taseme hariduse kättesaadavust. See võib aidata kaasa piirkondade innovatsioonipotentsiaali ja -võimekuse suurendamisele ning majandusarengu edendamisele.

- Euroopa piirkondade erinevus ja piirkondlike innovatsioonisüsteemide erinevate osalejate potentsiaal toetada ülikoolide ja ettevõtete koostööd piirkondlikul tasandil. Poliitika kujundamiseks on oluline teada Euroopa piirkondade erinevaid võimekusi ülikoolide ja ettevõtete koostöö toetamiseks, kuna see on oluline eeldus nutika spetsialiseerumise strateegia rakendamisel ning piirkondliku kasvu parandamisel, regionaalsete ebavõrdsuste vähendamisel ja kolmikheeliksi osapoolte vahelise koostöö suurendamisel. Paljud piirkonnad vajavad aga veel rohkem tuge, et saada kasu nutika spetsialiseerumise lähenemisest. See tekitab uurimisprobleemi, kus tuleb piisavalt uurida ülikoolide ja ettevõtete koostöö ning kolmikheeliksi osapoolte poolt pakutavate piirkondlike võimaluste suhet Euroopa piirkondlikul tasandil. Hoolimata erinevatest ühtekuuluvusmeetmetest ei ole Euroopa regionaalpoliitika ja rahastamismehhanismide kaudu ressursside eraldamine siiski andnud rahuldavaid tulemusi, ning ebaadekvaatsed poliitikad ohustavad nutika spetsialiseerumise strateegia elluviimist. Lisaks on piirkonnad ja sidusrühmad erineva suuruse ja mõjuga, mistõttu on oluline pöörata erilist tähelepanu nõrgemates piirkondades asuvate ülikoolide võimekuse toetamisele ja teadmiste tõlkimisele (Radošević et al., 2017). See loob eeldused tuumikpiirkondades toodetud teadmiste levikuks ja teavitab kohalikke ettevõtteid olemasolevatest võtmetehnoloogiate kasutamise võimalustest. Lisaks on hästi funktsioneeriva koostöömudeli loomine erinevate võimekustega regioonides ülikoolide ja ettevõtete koostöö toetamiseks pea võimatu, kui piirkonnad on ebavõrdsed ja puudub hästi toimiv koostöö kolmikheeliksi osaliste vahel, nagu on näidanud Bonaccorsi (2009) ja Hasche et al., (2020).

Regionaalarengu edendamiseks ülikoolide ja ettevõtete koostöö kaudu on vaja ületada lõhe nõrgemate ja tugevamate piirkondade vahel. Seda on võimalik saavutada toetades teadmiste tõlkimise võimekust nõrgemate piirkondade ülikoolides, edendades koostööd avaliku sektori, ülikoolide ja erasektori vahel ning tuvastades piirkondliku arengu jaoks huvipakkuvad valdkonnad.

Töö eesmärk ja ülesanded

Käesoleva doktoritöö eesmärk on panustada ülikoolide ja ettevõtete koostöö ja Euroopa regionaalse regionaalse innovatsioonisüsteemi osaliste (valitsus, ettevõtted ja ülikoolid) kirjandusse ning nendevaheliste seoste paremaks mõistmiseks. Kõik käesolevas väitekirjas kasutatud artiklid keskenduvad ülikoolide ja ettevõtete koostöö erinevatele aspektidele. Esimene uuring vaatleb ülikoolide ja ettevõtete koostöö tüüpe ning loob teoreetilise aluse erinevatele ülikoolide ja ettevõtete koostöö mõõtmiseks kasutatavatele näitajatele. Teine uuring rõhutab kõrgkoolide olulisust regioonis ning toob välja nende panuse regionaalsesse majandusarengusse T&A, inimvara loomise, teadmus- ja tehnosiirde ning soodsa miljöö loomise kaudu. Kolmandas uuritakse Euroopa regioonide võimekust ja potentsiaali ülikoolide ja ettevõtete koostööks – kas ja millised võimalused on regioonidel nutika spetsialiseerumise strateegiate elluviimiseks.

Lühidalt, käesolev väitekiri annab ülevaate ülikoolide, ettevõtete ja valitsuse vastastikusest mõjust ning regionaalse tasandi tähtsusest koostöö edukaks toimimiseks. Uuringud 1–3 on juba panustanud Haridus- ja Teadusministeeriumi tellitud Eesti Teadus- ja Innovatsioonipoliitika Seireprogrammi erinevatesse aruannetesse. Lisaks on uuringud kaasa aidanud ja loonud rakendatavaid sisendeid Tartu linna ja regiooni tegevuskavade ja regionaalse võimekuse arendamiseks.

Töö ülesehitus ja teoreetiline taust

Doktoritöö koosneb kolmest peatükist. Esimene ehk doktoritöö teoreetiline osas annab lugejale teoreetilise ülevaate valitsuse, ülikooli ja ettevõtete võimekustest ja rollist regionaalse innovatsioonisüsteemi kujundamisel. Teine peatükk koosneb kolmest empiirilisest uurimusest. Uuring 1 annab teoreetilise ülevaate erinevatest sisend-, väljund- ja mõjunäitajatest, mida kasutatakse ülikoolide ja ettevõtete koostöö mõõtmiseks. Uuring 2 uurib üliõpilaste ja majanduskasvu vahelisi seoseid NUTS (statistiliste territoriaaljaotuste nomenklatuur) teise taseme regioonides Euroopa näitel ning kolmas uuring hindab ja võrdleb erinevate Euroopa Liidu regioonide potentsiaali toetada ülikoolide ja ettevõtete koostööd kui nutika spetsialiseerumise strateegia elluviimise olulist eeldust. Kõik kolm uuringut annavad sisendi, et luua raamistik ülikoolide ja ettevõtete koostööks ja selle tähtsuseks regionaalses ruumis.

Kolmas peatükk annab ülevaate empiirilistest leidudest, arutlustest, järeldustest ja tulemuste põhjal tehtud poliitikaettepanekutest, samuti esitatakse väitekirja piirangud ja ettepanekud edasiseks uurimiseks.

Metoodika ja andmed

Doktoritöö kolm uuringut kasutavad erinevaid andmeallikaid ja meetodeid oma uurimisküsimustele vastamiseks. Uuring 1 põhineb kirjanduse ülevaatel ning uuringud 2 ja 3 põhinevad teisestel andmetel. Tabelis 1 on toodud andmed ja meetodid, mida on erinevates uuringutes kasutatud.

Tabel 1. Uuringutes 2 ja 3 kasutatud andmed ja meetodid

Uuring	**Meetod**	**Andmed**
Uuring 2	Regressioonanalüüs • Fikseeritud efektiga mudel • Vähimruutude meetod	Eurostat
Uuring 3	Korrelatsioonianalüüs Faktoranalüüs	Regionaalse innovatsiooni tulemustabel (*Regional Innovation Scoreboard)* Eurostat Shanghai edetabel (*Academic Ranking of World Universities*)

Allikas: autori koostatud uuringute 2 ja 3 põhjal.

Teise uuringu jaoks oli peamiseks andmeallikaks Eurostati kaudu kättesaadavad NUTS 2 taseme regionaalsed andmed aastatel 1998–2008. Kasutatud ajavahemikku piiras nii andmete kättesaadavus ja eeldatav ajavahe ülikooli astumise ja lõpetamise vahel kui ka soov kajastada piisavalt hiljutist vaadet. Ülikooli suhtelise suuruse ja inimvara mõõtmise proksina kasutati kõrgkoolis õppijate arvu.

Testimaks seost üliõpilaste (kolmanda taseme üliõpilaste osakaal) ja teadmusmahuka tööhõive vahel Euroopa regioonides NUTS 2 tasemel, kasutati regressioonanalüüsi, täpsemalt hinnati andmeid nii fikseeritud efektiga mudeli kui ka vähimruutude meetodiga.

Sarnaselt teisele tugineb ka kolmas uuring teisestele andmetele. Kolmandas uuringus kombineeriti erinevaid andmekogumeid (Regionaalse innovatsiooni tulemustabeli 2014 andmed, Eurostat, maailma ülikoolide ehk Shanghai edetabel), et täita praeguste teadusuuringute lünki ja leida regioonide võimekus tagamaks ülikoolide ja ettevõtete edukas koostöö. Lisaks hinnati Ülemaailmse Ettevõtlusarengu Instituudi (*Global Entrepreneurship Development Institute*) poolt välja töötatud regionaalset ettevõtlus- ja arenguindeksit (REDI), et näha, kas see võiks asendada erinevaid näitajaid ning hinnata regioonide võimekust. Paraku ei sobinud indeks ülikoolide ja ettevõtete koostööperspektiivide hindamiseks – REDI mõõdab teatud dimensioone ja indeksis kasutatavad andmed ei hõlma kõiki kolme kolmikheeliksi osalist võrdselt.

Regional Innovation Scoreboard andmed on kombinatsioon Eurostati, regionaalsetest andmetest ja Euroopa Innovatsiooniuuringust (CIS – Community Innovation Survey). Shanghai edetabeli andmestik kasutab kuut tulemusnäitajat, mis hindavad ülikoole kõigi nende põhiülesannete osas – hariduse kvaliteet, õppejõudude kvaliteet, teaduskvaliteet ja tulemused elaniku kohta. Andmestiku põhjal tekitati seos ülikooli ja asukoha vahel (NUTS 1 või 2 tasandil) ja saadi muutuja, mis näitas top 500 ülikoolide hulka regioonis.

Muutujate mitmekesisuse ja kõrge korrelatsiooni tõttu otsustati kasutada faktoranalüüsi, et vähendada indikaatorite arvu ja näidata regiooni võimekust vastavalt faktoranalüüsi käigus kujunenud teguritele. Faktoranalüüs viidi läbi erinevate perioodide (2007 ja 2010) kohta eraldi. Enne faktoranalüüsi teostamist viidi läbi ka korrelatsioonianalüüs, et näha, kas on piisavalt olulisi korrelatsioone.

Kokkuvõte töö põhitulemustest

Käesoleva doktoritöö eesmärk on uurida ülikoolide ja ettevõtete koostööd regionaalse võimekuse arendamiseks Euroopa regionaalse innovatsioonisüsteemi osaliste (valitsus, ettevõtted ja ülikoolid) kontekstis.

Ettevõtted ja ülikoolid teevad koostööd, et nihutada teadmiste piire, muutudes võimsaks innovatsiooni ja majanduskasvu mootoriks. Mitmed autorid (Audretsch & Stephan, 1996; Henderson et al., 1998; Zucker et al., 1998; Shane, 2002; Siegel et al., 2003) on leidnud, et ülikoolide ja ettevõtete koostöö on aja jooksul järjest enam intensiivistunud. Regioonide jaoks on see oluline, sest vaatamata kasvavale globaliseerumisele, on mõju ning teadmiste ja tehno-

loogia ülekanne piiritletud sageli geograafilise piirkonnaga (Jaffe et al., 1993; Audretsch & Stephan, 1996) või naaberpiirkondadega (Bottazzi & Peri, 2003; Rodríguez ja Crescenzi, 2008).

Ülikoolide ja ettevõtete koostöö on innovatsiooniprotsesside sisend, mille tulemuseks on erinevad tulemused (kõrgem innovatsioonitase, tootlikkus, konkurentsivõime jne). Koostöö käigus kanduvad käegakatsutavad tehnilised tulemused või mittemateriaalsed tehnilised teadmised ülikoolidest ettevõtetesse. Selles protsessis on ülikoolid ja muud teadusasutused tavaliselt teadmiste innovatsiooni põhiosa ning ettevõtted on tavaliselt tehnoloogia innovatsiooni põhiosa. Ülikoolide ja ettevõtete koostöö võib tõhusalt parandada ettevõtete ja kogu regiooni innovatsioonivõimet.

Doktoritöös jõuti järelduseni, et regionaalpoliitika kontekst ning regionaalne võimekus tõlgendada, võimendada, kasutada ja luua sobiv regionaalne ruum kolmikheeliksi osalistele mängivad ülikoolide ja ettevõtete koostöös mõjukat rolli, olenemata sellest, millised sidusrühmad (ettevõtted, ülikool või valitsus) on hetkel fookuses. Doktoritöö tulemused näitasid, et regionaalne võimekus ning ülikoolide ja ettevõtete koostöö regioonides sõltuvad mitmetest elementidest, alustades ettevõtlusest, valitsemisest, inimvara loomisest, teadmus- ja tehnoloogiasiirdest, teadus- ja arendustegevuse kulutustest ja lõpetades soodsa miljöö loomisega.

Autor tõi antud doktoritöö esimeses peatükis välja, et valitsused, ülikoolid ja ettevõtted töötavad selle nimel, et saavutada tõhus koostöö, mis oleks kasulik kõigile osapooltele. Siiski on tõhususe ja tegevuste hindamiseks ning erinevate poliitikameetmete kavandamiseks oluline tulemuste mõõtmine ja terviklikuma mõõdikute süsteemi olemasolu, mis omakorda tähendab, et vaja on paremaid näitajaid. Esimeses uuringus leiti, et kuigi valitsused seda teevad ja otsivad võimalusi ülikoolide ja ettevõtete koostöö hõlbustamiseks, puuduvad neil endiselt näitajad ja protsessid ülikoolide ja ettevõtete koostöö mõõtmiseks, et teha poliitilisi otsuseid riiklikul ja regionaalsel tasandil.

Kirjanduse analüüsi põhjal leidsime kaheksa ülikoolide ja ettevõtete koostöö tüüpi: õppekavade arendamine ja elluviimine, elukestev õpe, üliõpilaste mobiilsus, akadeemiline mobiilsus, teadus- ja arendustegevuse tulemuste kommertsialiseerimine ning teadus- ja arendustegevuse, ettevõtluse ja valitsemine vallas tehtav koostöö. Koostöötüübid liideti ülikoolide ja ettevõtete koostöönäitajate raamistikku, mis kirjeldas erinevate ülikoolide ja ettevõtete koostööd mõõtvate näitajate seoseid erinevate koostööliikidega.

Väljundite tüübid, mis võivad potentsiaalselt viia konkreetsete majandusarengu mõjudeni, tõid välja ka Goldstein jt (Goldstein et al., 1995), kes lugesid kokku mitmeid ülikoolide ja ettevõtete koostöö väljundeid ja mõjusid. Nagu uuringus 2 märgiti, aitavad ülikoolid ettevõtetel ja regioonidel luua kõrgharitud inimvara, mis aitab seejärel kaasa majandusarengule. Siiski toodi välja ka see, et inimvara (üliõpilased) võimekuse kasv võtab aega, enne kui saab majanduse arengusse panustada.

Siiski on oluline ka see, mida õppida ja kuidas see vastab ettevõtete vajadustele. Lin (Lin, 2004) uuris kõrghariduse õppekavade mõju tööjõule ja seega

ka Taiwani majanduskasvule ning leidis, et kõrgharidus (eriti inseneriteadus ja loodusteadused) avaldas positiivset ja märkimisväärset mõju Taiwani majandusarengule. See tulemus on kooskõlas autori esimese uuringu järeldustega, et ülikoolide ja ettevõtete eduka koostöö mõju õppekavade arendamisel ja üliõpilaste liikuvuse arendamisel toob kaasa üliõpilaste madala töötusmäära pärast lõpetamist.

Uuringu 1 tulemused näitavad erinevate tulemusnäitajate tähtsust ja nende kasutamist ülikoolide ja ettevõtete koostöö sisendite, väljundite ja mõju mõõtmisel. Seega tuleks ülikoolide ja ettevõtete koostööl pöörata tähelepanu mitte ainult sisend- ja väljundmeetmetele, nagu täna enamasti tehakse, vaid vaadata ka tulevikku ja mõõta loodud poliitikate võimalikke mõjusid. Samuti peaksid ülikoolid ja ettevõtted hindama osapoolte vahelist koostööd ja teadmussiiret.

Kokkuvõtteks võib öelda, et hoolimata olemasolevatest näitajatest on raske eristada, millised on kõige sobivamad näitajad, mis annavad kõige täpsema pildi riigi erinevatest poliitikatest. Samuti on vaja eristada, mis on eesmärk, mida tahetakse saavutada. Erinevate poliitikate mõõtmine toimub sisend-, väljund- ja mõjumõõtmiste kaudu, kuid enamasti kasutatakse kvantitatiivseid sisendmõõdikuid, kuna nende näitajate kohta on kõige lihtsam andmeid saada. Riigi seisukohalt peaksid kõige olulisemad olema mõjunäitajad, mis toovad esile, kas ressursse jaotatakse õigesti.

Uuringus 2 vaatles autor kõrgkoolide kaudset mõju regionaalarengule, leides seoseid kolmanda taseme hariduse/kõrghariduse üliõpilaste ja NUTS 2 tasandi majanduskasvu vahel Euroopas. Uuringu 2 eesmärk oli näidata kolmanda taseme hariduse ja regionaalarengu vahelist olulist seost. Uuringu 2 tulemused näitasid, et kuigi kõrgkoolid on muutumas kohaliku/regionaalse majanduse oluliseks osaks, kuna nad osalevad aktiivselt regionaalse majanduse tegevustes, ei saa eeldada, et ülikoolid üksinda võtaksid enda kanda innovatsioonivõimekuse ja teadmistepõhise majanduse ümberkujundamise koormuse nende regioonides. Lisaks ülikoolidele on vaja ka teisi sidusrühmi – tulemused näitasid, et inimvaral kulub aega, enne kui see avaldab oma mõju ühiskonnale ja aitab kaasa majanduse arengule. See tähendab, et ülikoolide ja ettevõtete koostöö uuringus 1 kirjeldatud viisidel ja ka uuringus 2 kirjeldatud regionaalsed võimekused peavad olema paigas, et toimuks regiooni areng.

Uuringus 3 toodi välja Euroopa regioonide potentsiaal ülikoolide ja ettevõtete koostööks, uurides regionaalset võimekust ülikoolide ja ettevõtete koostööd toetava keskkonna loomisel – kas ja millised võimalused on regioonidel nutika spetsialiseerumise strateegiate elluviimiseks. Uuring aitas kaasa olemasolevale regionaalse ruumi ja regionaalse innovatsiooni kirjandusele, andes võrdleva ülevaate regionaalse innovatsioonisüsteemi erinevate osalejate (ettevõtted, ülikoolid ja valitsus) potentsiaalist toetada ülikoolide ja ettevõtete koostööd regionaalsel tasandil ning oma panuse nutika spetsialiseerumise strateegiate rakendamisele regioonides.

Autor rõhutas, et strateegiate rakendamisel tuleb arvestada regioonide potentsiaali ülikoolide ja ettevõtete koostööks, kuna regioonid on ebavõrdsed. Teadmised erinevatest võimete kombinatsioonidest regioonides võimaldavad

nutika spetsialiseerumise strateegiaid tõhusamalt ellu viia ning seeläbi parandada ka ülikoolide ja ettevõtete koostööd regionaalsel tasandil.

Uuringus jõuti järeldusele, et ELi nutika spetsialiseerumise strateegiast kasu saamiseks tuleks rohkem tähelepanu pöörata regiooni (koha)põhisele lähenemisviisile, eriti teadmiste tõlkimise (levitamise) võimekusele ning eelistada tuleks poliitikat, mis motiveerib Euroopa tuumikregioonide juhtivaid teadusülikoole tegema koostööd järelejõudvate regioonide ülikoolidega ning lõpuks tuleb arendada regionaalse tasandi poliitikakujundamise võimekust ülikoolide ja ettevõtete toetamiseks.

Nende uuringute tulemused on kasulikud konteksti mõistmisel ja poliitika kujundamisel regionaalsete võimekuste suurendamiseks, et luua paremaid võimalusi ülikoolide ja ettevõtete koostööks ja seeläbi avaldada suuremat mõju regionaalsele heaolule.

Töö piirangud ja soovitused tulevastest uuringuteks

Regionaalarengu ja sellega seotud tegurite põhjalikumat analüüsimist piirab regionaalsete andmete (NUTS3 tasand) ebapiisavus Euroopa tasandil. See on ka antud väitekirja peamine piirang. Autor on töös kasutanud kolmikheeliksi mudelit ja jätnud kõrvale teadmuse kolmnurga raamistiku – ühest küljest on seda juba sarnases kontekstis käsitletud (Rõigas, 2018), teisalt on see saanud kriitikat kui nõrk poliitikavahend, mis on ebastabiilne ja mille kohta puuduvad teaduslikud uuringud (Lassnigg et al., 2017).

Käesolev doktoritöö on vaid üks osa suuremast pildist. On mitmeid aspekte, millega tuleks edasi tegeleda, näiteks kolmanda taseme üliõpilaste mõju majandusnäitajatele regionaalsel tasandil, seosed üliõpilaste, regioonide majandusnäitajate ja ülikoolide õppekavade vahel, konkurents regioonide ja riikide vahel jne.

Nagu on kirjeldatud peatükis 1.2, soodustavad regioonid, kus asub klassikaline või tehnikaülikool, kuid kus ei ole tugevat teaduspõhist tööstust, tehnoloogiamahukate idufirmade teket. Seega võiks järgmiste sammudena kaardistada ka erinevatele majandussektoritele vajalikud erinevad regionaalsed võimekused – millised on vajalikud eeldused start-up'idele, tootmisettevõtetele, IKT-le jne, ning milline oleks iga teguri (valitsus, ettevõtted, ülikool) tähtsus regionaalse edukuse võrrandis.

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Education

2012–	University of Tartu, PhD in Economics
2009–2011	University of Tartu, MA in Economics
2004–2008	University of Tartu, BA in Economics
2000–2003	Pärnu Sütevaka Humanitaargümnaasium
1991–2000	Sauga Põhikool

Foreign languages: English, German

Work Experience

2023–	Guardtime OÜ, Project manager
2021–2022	TalTech, Senior Proposal Writer
2015–2021	Tartu City Government, Business development department, Head specialist and Head of department
2011–2015	Invent Baltics, Analyst
2008–2011	Axinom GmbH, Project manager
2007–2008	Postimees AS, Project manager
2006	Vorwerk AG internship in Germany
2005–2007	Äripäev AS, Project manager

Main research interest:

- University-industry cooperation,
- knowledge transfer,
- regional innovation and entrepreneurship,
- regional competitiveness,
- smart specialization,
- regional capabilities

Participation in research projects:

- The development of smart specialization strategy for Tartu and South-Estonia
- The path dependent model of the innovation system: development and implementation in the case of a small country
- The analysis of economic competitiveness and growth areas of Tartu and South-Estonia
- The impact of internationalization on the innovativeness of firms

ELULOOKIRJELDUS

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Haridus

2012–	Tartu Ülikool, doktoriõpe
2009–2011	Tartu Ülikool, majandusteaduskond, magistriõpe
2004–2008	Tartu Ülikool, majandusteaduskond, bakalaureuseõpe
2000–2003	Pärnu Sütevaka Humanitaargümnaasium
1991–2000	Sauga Põhikool

Võõrkeeled: Inglise keel, saksa keel

Töökogemus

2023–	Guardtime OÜ, Projektijuht
2021–2023	Tallinna Tehnikaülikool, vanemprojektikirjutaja
2015–2021	Tartu Linnavalitsus, Ettevõtlusosakond, peaspetsialist/osakonna juhataja
2011–2015	Invent Baltics, analüütik
2008–2011	Axinom GmbH, projektijuht
2007–2008	Postimees AS, projektijuht
2006	Vorwerk AG praktika Saksamaal
2005–2007	Äripäev AS, müügi spetsialist

Peamised uurimisvaldkonnad:

- Ettevõttete ja ülikoolide koostöö,
- teadmussiire,
- regionaalne innovatsioon ja ettevõtlus,
- regiooni konkurentsivõime,
- nutikas spetsialiseerumine,
- regionaalne ruum ja võimekus

Osalemine teadusprojektides:

- Tartu ja Lõuna-Eesti nutika spetsialiseerumise strateegia
- Innovatsioonisüsteemi rajasõltuvust arvestava mudeli loomine ja rakendusmehhanismi väljatöötamine väikeriigi näitel
- Tartu ja Lõuna-Eesti konkurentsivõime ja kasvualade analüüs
- Rahvusvahelistumise mõju ettevõtete innovaatilisusele
- Teadus- ja innovatsioonipoliitika seire programm TIPS

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