Role of graduate theses on regional development

Samet Kürşat Başol*
and Alptekin Durmuşoğlu

Industrial Engineering,
Gaziantep University,
Gaziantep, 27310, Turkey
Email: basol@gantep.edu.tr
Email: sametkursat@ttotarget.com
Email: durmusoglu@gantep.edu.tr
*Corresponding author

Türkay Dereli

Office of the President,
Hasan Kalyoncu University,
Gaziantep, 27010, Turkey
Email: turkay.dereli@hku.edu.tr

Abstract: Universities are developing strategies to increase the contribution of their activities to their regional and national economy, so the importance of universities in regional development-oriented studies is increasing. In this study, the relationship between universities and the most competitive industries in their regions is analysed with the graduate theses of universities focusing on those industries. Twenty-six universities in Turkey, which are regularly included in seven Entrepreneurial-Innovative University Index (EIUI) rankings, and their regions were selected. The strongest and the most competitive sectors in the manufacturing industry of the selected regions were determined by the Balassa RCA Index and Foreign Trade Balance Index. The number of graduate theses related to those sectors is divided by the number of academicians, and a score is obtained. Universities are ranked according to this score. As a result, this ranking was compared with the EIUI rankings of the universities, and the similarities were interpreted.

Keywords: smart specialisation strategies; regional development; competitive industries; entrepreneurial and innovative university index; graduate theses.

Biographical notes: Samet Kürşat Başol is a General Manager of Gaziantep University TargeT Technology Transfer Office and PhD student in Industrial Engineering Department at Gaziantep University, Turkey. His MSc was completed in the same department. His research interests include regional development, technology transfer, and smart specialisation strategy for higher education.

Alptekin Durmuşoğlu is an Associate Professor at the Industrial Engineering Department of Gaziantep University, Turkey. He received his MSc and PhD degrees in Industrial Engineering from Gaziantep University. His researches focus on technology/innovation management, data mining and knowledge discovery.

Türkay Dereli is Rector of Hasan Kalyoncu University in Turkey and he is a professor of Industrial Engineering Department at Hasan Kalyoncu University. He has published numerous technical papers in professional academic journals and conferences and has several textbooks on CAD/CAM, ICT and quality management. He is also an active referee for many professional journals and edited several conference proceedings. His current research interests include innovation and technology management, CAD/CAM, process planning, feature technology, TQM, agile and responsive manufacturing and management, soft computing, informatics and applications of artificial intelligence.

1 Introduction

The concept of a Regional Innovation System (RIS) has emerged with the idea of the National Innovation System (NIS) focusing on a particular region (Iammarino, 2005). Asheim and Coenen (2005) said that a region could be defined as the institutional infrastructure supporting innovation for the production structure. There are studies indicating that RIS has been developed as a tool to promote the innovative activities of national and regional policymakers (Almeida et al., 2011). Globally, regional development is progressively becoming a focus among priority policies towards achieving national development (Musa et al., 2020). In terms of supporting the role of regional competitiveness, the importance of these policies is increasing daily. With this increasing importance, clustering and incentives, and regional governance mechanisms that support the formation of the information needed help put the industry in a place geographically (Kramer et al., 2011). In the last quarter, the focus of regional innovation policies focused on the use of entrepreneurship and innovation in regional development activities and placed SMEs at the centre of the EU's development policy (Foray and Rainoldi, 2013; McCann and Ortega-Argilés, 2016; Foray et al., 2015). Developing a policy to ensure and sustain regional competitiveness through economic growth is called the Smart Specialisation Strategy (Foray, 2014). Sustainable development strategies are supremely important to reach national sustainable development goals (Maslova, 2020). The Smart Specialisation Strategy, ensures that stakeholders in the region create solutions for their sustainable development activities and innovative capacity for their regions.

In a knowledge economy, universities are increasingly expected to make vital contributions to the processes of regional innovation and economic development (Sánchez-Barrioluengo, 2014). The Organisation for Economic Co-operation and Development (OECD) proposes a systematic combination of universities to develop strategies towards achieving regional growth (OECD Publishing, 2007). In addition, the

European Union recommends regional development processes with smart specialisation strategies to be established, with a focus on universities (Pugh, 2014). Therefore, Etzkowitz et al. proposed the Triple Helix model to evaluate the information infrastructure of RIS together with university-industry-government relations (Etzkowitz and Leydesdorff, 1998; Etzkowitz et al., 2000; Etzkowitz, 2003). Unlike the traditional educational and research roles of the universities, the Triple Helix model defines the third task for the commercialisation of technology. Within the focus of technology commercialisation, universities that produce knowledge begin to build relationships with commercial industry and governments. "Entrepreneurial Universities" that have brought theory to life have become key components of RIS and have played a vital role in the development of the knowledge-based economy (Shane, 2004). These collaborations, which are becoming increasingly important today, benefit all participating parties for the country and the region. Government initiatives and changes in institutional frameworks have therefore been facilitated to enhance other collaborations (Franco and Haase, 2015). In the long term, it is important that the information needed for the development of a region is communicated through universities to be used in the innovation and development activities of other organisations. Also, it is critical to include sustainable development in higher education curricula, especially in disciplines such as engineering and medicine (Brahm and Kühner, 2019). Lastly, under the influence of these regional development policies, universities are working to carry out activities such as technology transfers, licensing, consulting, spin-off incentives, and commercial company formation along with their traditional teaching and research activities.

Although there are various theories on how to measure competitiveness at the regional level, policymakers expect innovation-based regional competitiveness strategies to be developed. As a result of smart specialisation strategies, regional stakeholders are expected to support their own specialised industries. Specialised industries should be selected from the strongest and the most competitive sectors. Universities are the stakeholders of these smart specialisation strategies to produce new knowledge.

In this context, Turkey is also developing strategies to increase innovative and entrepreneurial activities of universities. Within the framework of these strategies, the Entrepreneur and Innovative University Index (EIUI) was prepared by The Scientific and Technological Research Council of Turkey (TÜBİTAK) for the first time in 2012. The 50 most entrepreneurial and innovative universities of Turkey were ranked in this EIUI (TÜBITAK, 2013).

The purpose of this index is to rank universities according to entrepreneurship and innovation activities. EIUI ranking aims to increase the entrepreneurship and innovation performance of the universities. In addition, this ranking is thought to contribute to the academic studies of universities.

Turkish universities were ranked based on five main dimensions. These dimensions include the scientific and technology research competency, intellectual property pool, cooperation and interaction, and economic contribution and commercialisation. In addition, these four main dimensions consist of 19 sub-indicators (TÜBITAK, 2018).

Size 1: Scientific and Technology Research Competency Indicator Headings

- Weight Ratio: 23.75%

- Number of scientific publications

- Number of citations

- Number of Projects Received from R & D and Innovation Support Programs
- Fund Amount Received from R & D and Innovation Support Programs
- Number of National and International Science Awards
- Number of Graduate Students.

Size 2: Intellectual Property Pool Indicator Headings

- Weight Ratio: 18.75%
- Number of Patent Applications
- Number of Patent Documents
- Number of Utility Models / Industrial Designs
- Number of International Patent Applications.

Dimension 3: Collaboration and Interaction Indicator Headings

- Weight Ratio: 28.75%
- Number of R & D and Innovation Projects in University-Industry Cooperation
- Amount of Funds Received from R & D and Innovation Projects in University-Industry Cooperation
- Number of R & D and Innovation Projects with International Cooperation
- Amount of Funds Obtained from International R & D and Innovation Collaborations
- Number of Students in Circulation.

Size 4: Indicators of Economic Contribution and Commercialisation

- Weight Ratio: 28.75%
- Number of Active or Partner Companies of Academicians in Technoparks, Incubation Centers
- Number of Active or Partner Companies of University Students or Graduates in the Last Five Years in Technoparks and Incubation Centers
- Number of Persons Employed in Technoparks and Incubation Centers.

EIUI results are thought to raise awareness of entrepreneurial and innovative research activities of universities. In addition, as a result of this awareness, it aims to increase the amount of commercialised research in universities. Therefore, academic studies in universities are expected to contribute to both the regional economy and the national economy.

The manufacturing sector continues to be the main driving force of the economy in Turkey. As of 2018, manufacturing industry accounted for 93.9% of total foreign trade. The share of high technology products in the manufacturing industry's products exports was 3.5%, the share of medium high technology products was 36.4%, the share of medium low technology products was 27.6%, and the share of low technology products was 32.6% (TURKSTAT, 2019).

In this study, the relationship between universities and the strongest and the most competitive industries in their regions is analysed by the graduate theses of universities. For the analysis, 26 universities that are consistently included in the seven years (2012–2018) of Entrepreneurial and Innovative University Index (EIUI) rankings and their regions were selected. Also, it has been investigated whether universities in the seven years of EIUI rankings are similar to the ranking of universities according to the number of thesis performed in the strongest and the most competitive industries of their regions.

2   Literature review

Balassa and Noland (1989), analysed comparative advantage values (between 1967 and 1983) of 57 main products and 167 finished products of Japan and the USA. In addition, it was made clear that the US increasingly specialised in natural resource-intensive products. Also, it was stated that comparative advantage in high-tech products increased in both countries.

Vollrath (1991) examined the trade density measurements theoretically as an alternative to the revealed comparative advantage (RCA) index, which was created by Balassa. In his study, he suggested an alternative ten comparative advantage method and examined the transformational link.

Startiene and Remeikiene (2014) specified the competitiveness of industrial products of Lithuanian origin between 2007 and 2011 by using the RCA and revealed symmetric comparative advantages (RSCA) indices in their study. In this analysis, they interpreted the results of the Balassa index using the Balassa index classification, which was classified by Hinloopen and Marrewijk (2001). The competitiveness of the Lithuanian industry in global markets looked similar according to RCA and RSCA indices. Both index values showed that between 2007 and 2011, Lithuania had a strong advantage in food, chemical, wood, and textile industries in global markets.

Abbas and Waheed (2017) researched the international trade competitiveness of Pakistan in 14 main sectors in agriculture and manufacturing between 2013 and 2014 in their study. According to the RCA Index, the results of the analysis showed that Pakistan had a comparative advantage in raw cotton, cereals, rawhides, and fruits in the agricultural sector.

In another study, Muscio and Ciffolilli (2019) attempted to identify the competitive advantage areas of EU countries and regions in Industry 4.0 technologies. In that study, the projects developed and financed under Fp7 were classified by regionalising. They explained the results of this classification and identified Industry 4.0 technologies where countries and regions are competitive using the comparative advantage index. As a result of the analysis, they also proposed the establishment of strategies and the implementation of initiatives to effectively channel these technologies to reduce regional gaps between the EU Member States and regions.

Dinda (2018) attempted to identify the trade advantage of Asian countries in the sub-categories of Climate Friendly Goods and Technologies (CFGT) products between 2002 and 2017. According to the analysis, it was stated that China, Hong Kong, and Japan have a comparative advantage in Climate-Friendly Goods and Technologies trading, and other countries have a comparative disadvantage.

Rossato et al. (2018) analysed the competitive power of wood pulp in the United States, Brazil, Canada, Sweden, Finland, and China in their study, which is the focus of the cellulose industry. They explained the RCA index and the RSCA indices to determine the comparative advantage between countries. In addition to these index values, they used the TBI index to evaluate the balance of wood pulp trade-in analysis. According to the analysis results, it specified that all countries have comparative advantages according to RCA indices, except China. It was emphasised that Finland, Canada, and Sweden have the highest comparative advantages according to the RSCA index value. Brazil, Finland, Canada, Sweden, and the USA have a positive trade balance, which was evaluated according to the TBI, and it was specified that China has the biggest comparative disadvantage. That study concluded that the wood pulp industry has a highly positive effect on Brazil, Finland, Canada, and Swedish export economies.

Leng et al. (2019) measured China's long-term trend of wind power products' comparative advantages by using UN Comtrade data between 2007 and 2016 in their study. According to this study, the competition effect of China has played a dominant role in export growth. Also, the international competitiveness of China's wind power products increases continuously. China's export structure in wind energy products has been limited. The comparative advantage of its wind power products increased in the last decade, but nevertheless, still, the general comparative advantages are weak.

Pippinato et al. (2019) investigated the competitiveness of Italy in the honey sector with other European Union countries. According to the analysis results, the researchers stated that Italy is not competitive in honey exports and that it is oriented towards imports at a high rate. As a result, Italy has a significant disadvantage in honey exports compared to Romania, Spain, and Germany.

Maqbool et al. (2019) examined the comparative advantage of Pakistan in the cotton sector between the years 2003–2017 in their study. It was stated that while Pakistan has a comparative competitive advantage in cotton exports, it has a comparative disadvantage in cotton imports. In addition, it was noted that Pakistan has a net competitive advantage in the cotton industry.

Sagar et al. (2018) researched the factors determining intra-industrial trade between India and Australia in a study of the processed food sector. They studied the values of macroeconomic variables and more between 2003 and 2016 and also used the RSCA index for competitiveness indicators.

3 Materials and methods

3.1 Balassa's RCA index

The most famous index which is used to measure competitive advantage belongs to Balassa, and it is used as the RCA (Bilas and Bošnjak, 2015). The RCA index is measured by the proportion of the share in total exports of a country of any product, compared to its share of total trade in the world. The formula as describe in equation (1),

$$\text{RCA} = (X_{ij}/X_{it})/(X_{jw}/X_w) \tag{1}$$

X_{ij} shows j goods exports of country i

X_{it} shows total exports of country i

X_{jw} shows word export of product j

X_w shows total world exports.

RCA < 1 $\Rightarrow$ means that the country has a comparative disadvantage in the product j.

RCA > 1 $\Rightarrow$ means that the country has a comparative advantage in the product j.

RCA = 0 $\Rightarrow$ means that the country does not export j goods

Hinloopen and Van Marrewijk classified Balassa index values in this study (Hinloopen and Van Marrewıjk, 2001). They stated that this classification was helpful in interpreting the Balassa Index values. These classifications are shown in Table 1.

Table 1   The classification of RCA index values

0 < Balassa RCA Index ≤ 1	Revealed comparative disadvantage
1 < Balassa RCA Index ≤ 2	Weak comparative advantage
2 < Balassa RCA Index ≤ 4	Medium comparative advantage
4 < Balassa RCA Index	Strong comparative advantage

3.2   Trade balance index

Balassa and Noland (1989) defined the Net Export Index as the division of net exports by total exports and imports for a specified sector. Also, Lafay (1992) stated that a country's specialisation as a net exporter or a net importer for a particular product group would be used in the analysis. The formula as described in Equation (2)

$$\text{TBI}_{ij} = (X_{ij} - M_{ij})/(X_{ij} + M_{ij}) \qquad (2)$$

X_{ij} showed the j goods export of i country at t time,

M_{ij} showed the j goods import of i country at t time.

The index takes values between –1 and +1 (Balassa and Noland, 1989). Negative values indicate that imports are higher than exports in the analysed sector and show that country has a competitive disadvantage in the sector. Positive values indicate that exports are higher than imports in the analysed sector and show that the country is more competitive in that sector. A country is referred to as a 'Net Importer' in a specific group of products where the value of the TBI < 0, as a 'Net Exporter' where the value of the TBI > 0.

4   Experimental study

In this study, the universities that were included in the EIUI for seven years were identified, and a ranking was made among them by taking the trimmed mean of the index scores obtained for seven years. Then, the activity codes of the sectors of NUTS 2 regions where these universities are located, which are experts in the manufacturing industry, foreign trade, and a having strong comparative advantage, are determined according to 4 digit ISIC system and are determined with RCA Index and Trade Balance Index values. Then, the ISIC Code explanations of the activity codes determined for the regions were examined, and keywords related to the sectors included in the activity codes

were obtained. Finally, these keywords were searched through the Turkey Council of Higher Education Thesis Center (YOKTEZ) database (YOKTEZ, 2019) between 2011 and 2018, and the number of graduate theses completed by the universities in the sector activity in the relevant activity codes was discovered. These numbers were divided by the total number of academicians of universities in the relevant year in 2011–2018. Thus, the average number of graduate thesis per professor was calculated in the relevant activity code of the university—all processes as shown in Figure 1.

Figure 1 Process flow of methodology
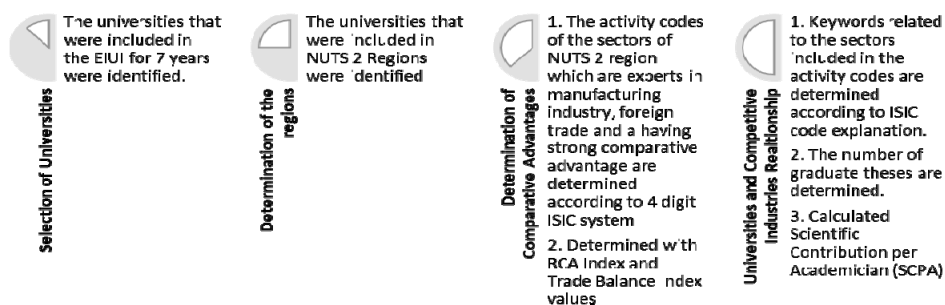
4.1 Selection of universities

Selected universities and their EIUI scores, rankings, and averages are shown in Table 2.

Table 2 Selected universities and EIUI index scores by years, their ranking, and their mean

Universities	2012	2013	2014	2015	2016	2017	2018	Avg. 2012– 2018
Sabancı University (Private)	84.0	85.8	81.4	88.4	95.0	91.0	85.5	86.9
Middle East Technical University (State)	83.0	86.0	83.1	86.0	85.8	87.3	93.2	85.6
İ.D. Bilkent University (Private)	70.0	82.7	75.0	78.1	82.6	81.6	84.4	80.0
Boğaziçi University (State)	65.0	76.3	76.3	79.7	80.1	82.2	83.3	78.9
Koç University (Private)	57.0	61.7	73.6	76.4	78.6	78.8	68.9	71.8
Ozyegin University (Private)	69.0	67.4	73.1	73.5	75.3	74.4	65.4	71.5
İzmir Institute of Technology (State)	58.0	68.1	67.8	70.5	68.7	77.5	75.6	70.1
Gebze Technical University (State)	57.0	54.7	56.8	60.4	77.8	85.2	77.8	66.0
TOBB ETU (Private)	54.0	57.0	69.3	66.6	63.8	68.0	61.8	63.4
Yıldız Technical University (State)	41.0	49.6	57.4	63.9	67.6	68.7	81.4	61.4
Selcuk University (State)	43.0	55.2	59.6	59.1	58.7	52.4	57.9	56.7
Hacettepe University (State)	49.0	56.7	53.5	54.4	51.6	52.5	75.9	53.7
Ege University (State)	47.0	53.0	49.7	54.3	55.2	54.0	70.7	53.2
Anadolu University (State)	30.0	47.9	54.5	53.2	50.4	50.9	57.0	51.4
Erciyes University (State)	46.0	44.5	42.7	56.4	52.9	51.4	61.4	50.2
Gazi University (State)	44.0	54.9	48.1	49.5	50.3	46.3	66.8	49.8

Table 2   Selected universities and EIUI index scores by years, their ranking, and their mean (continued)

Universities	2012	2013	2014	2015	2016	2017	2018	*Avg. 2012– 2018*
Atılım University (Private)	35.0	44.6	47.3	41.8	50.6	55.5	47.6	46.4
Gaziantep University (State)	33.0	41.7	40.8	42.9	51.6	52.7	51.6	45.7
Bursa Uludağ University (State)	37.0	39.9	43.2	46.9	45.3	47.4	54.5	44.5
Çankaya University (Private)	43.0	45.8	42.5	45.5	50.8	39.1	37.8	43.2
Cukurova University (State)	41.0	46.9	43.3	43.1	42.9	40.8	45.5	43.2
Yeditepe University (Private)	40.0	45.9	39.5	42.6	43.4	43.9	43.3	42.6
Kocaeli University (State)	37.0	44.0	41.8	41.3	41.8	43.3	50.1	42.4
Suleyman Demirel University (State)	45.0	44.5	42.8	40.6	39.2	33.6	43.4	42.1
Ankara University (State)	37.0	41.8	38.9	38.4	46.6	42.1	59.9	41.6
Dokuz Eylül University (State)	35.0	38.3	37.8	43.0	43.5	41.4	61.6	40.8
Akdeniz University (State)	39.0	42.0	35.9	40.3	42.1	37.0	51.1	40.1
Istanbul University (State)	30.0	32.4	38.1	39.4	42.5	40.6	67.1	38.6
Bahçeşehir University (Private)	43.0	42.5	39.3	35.8	38.8	34.6	34.0	38.2
Mersin University (State)	33.0	41.8	38.8	32.9	42.1	40.2	35.5	37.9
İzmir University of Economics (Private)	31.0	32.1	39.0	34.0	42.7	45.2	39.7	37.5
Karadeniz Technical University (State)	32.0	39.7	32.5	35.8	38.0	36.5	40.8	36.5
Pamukkale University (State)	29.0	29.8	28.8	33.2	40.9	42.1	42.6	35.0
Fırat University (State)	29.0	33.3	29.6	32.1	38.3	31.4	40.5	32.9

4.2   Determination of the regions where the universities are located

Statistical Regions Nuts 2 regionalisation of the cities where 34 universities are located is as follows in Table 3.

Table 3   Statistical regions nuts 2 regionalisation of the cities where 34 universities are located

Universities	City	NUTS 2
Sabancı University (Private)	İstanbul	TR10- Istanbul
Istanbul University (State)	İstanbul	
Yıldız Technical University (State)	İstanbul	
Boğaziçi University (State)	İstanbul	
Ozyegin University (Private)	İstanbul	
Koç University (Private)	İstanbul	
Yeditepe University (Private)	İstanbul	
Bahçeşehir University (Private)	İstanbul	

Table 3   Statistical regions nuts 2 regionalisation of the cities where 34 universities are located (continued)

Universities	City	NUTS 2
Ege University (State)	İzmir	TR31- Izmir
İzmir Institute of Technology (State)	İzmir	
Dokuz Eylül University (State)	İzmir	
İzmir University of Economics (Private)	İzmir	
Pamukkale University (State)	Denizli	TR32- Aydin-Denizli-Muğla
Bursa Uludağ University (State)	Bursa	TR41- Bursa-Eskişehir-Bilecik
Anadolu University (State)	Eskişehir	
Kocaeli University (State)	Kocaeli	TR42- Kocaeli-Sakarya-Düzce-Bolu-Yalova
Gebze Technical University (State)	Kocaeli	
Middle East Technical University (State)	Ankara	TR51-Ankara
İ.D. Bilkent University (Private)	Ankara	
TOBB University of Economics and Technology (Private)	Ankara	
Gazi University (State)	Ankara	
Atılım University (Private)	Ankara	
Çankaya University (Private)	Ankara	
Ankara University (State)	Ankara	
Hacettepe University (State)	Ankara	
Selcuk University (State)	Konya	TR52- Konya-Karaman
Suleyman Demirel University (State)	Isparta	TR61- Antalya-Isparta-Burdur
Akdeniz University (State)	Antalya	
Cukurova University (State)	Adana	TR62- Adana -Mersin
Mersin University (State)	Mersin	
Erciyes University (State)	Kayseri	TR72- Kayseri-Sivas-Yozgat
Karadeniz Technical University (State)	Trabzon	TR90-Trabzon-Ordu-Giresun-Rize-Artvin-Gümüşhane
Fırat University (State)	Elazığ	TRB1-Malatya-Elaziğ-Bingöl-Tunceli
Gaziantep University (State)	Gaziantep	TRC1-Gaziantep-Adiyaman-Kilis

4.3   Determining the comparative advantages of manufacturing industries in regions

Foreign trade values are an important indicator of the regional expertise in the manufacturing industry. This is one of the essential parameters of choice in determining the sectors in which one region has a comparative advantage over another. In addition, when examining foreign trade values, it is very important to evaluate the import capacity, as well as the export capacity of a sector. Sectors with greater import value than export

value adversely affect the development of the national economy, no matter how much comparative advantage they have.

In this part of the study, the manufacturing industry foreign trade data of the regions, the Rev3 4 digit values of International Standard Industrial Classification (ISIC) coding which is prepared by the United Nations Statistical Office and proposed to be used all over the world, are used. These data were taken from the Turkish Statistical Institute. Although Turkey's foreign trade data is recorded by various institutions depending on the city, region, and country, it has been concluded that using the ISIC Rev3 4 digit manufacturing industry data to make a regional assessment with a comprehensive dataset is more meaningful. For the purpose of the study, the ISIC Rev3 4 digit manufacturing industry dataset for 2011–2018 was used to cover the same period as the EIUI. The Balassa RCA index and The Trade Balance Index were used to determine the strongest and the most competitive sectors in the manufacturing industry, which covers 13 regions. The Balassa RCA values were then classified according to the Classification of RCA Index Value values proposed by Hinloopen and Van Marrewijk (Hinloopen and Van Marrewıjk, 2001). For the TR-10-Istanbul region, there are no sub-sectors with strong and moderate comparative advantage. Therefore for the rest of the 12 regions we have determined the strongest and the most competitive sectors.

4.4   The relationship between universities and the competitive industries of their regions

In this part, the relationship between the regions having the strongest and the most competitive sectors in the manufacturing industry and the universities determined in the regions are analysed.

In the analysis study, the activity content of the sectors was identified and examined with detailed explanations in the ISIC code system. Keywords are determined for each region and its sectors. According to the product and service definitions, the identified keywords were determined generally for some sectors, and on the basis of product for some other sectors. For this reason, differences were observed.

The determined keywords were thoroughly searched by taking all disciplines into consideration via the Turkey Council of Higher Education Thesis Center (YOKTEZ) database, where graduate studies of universities are published online. By using the advanced search option, thesis, titles, authors, supervisors, abstracts, keywords, years, universities etc. can be easily found. However, this scanning process was the most difficult and time consuming art of the analysis. The main reason for this difficulty is that the titles, abstracts, and keywords of some theses do not give clear information about the sectors. For this reason, the search criteria for keywords are determined as title, abstract, keyword, and university. Since the EUIE data covers the years 2011–2018, this date range has been used to determine the theses. Accessible theses were examined in studies where the focus of the thesis was not clear. Theses found to be related to the searched keywords were added to the score of the related university. Then, the number of professors (full, associate, and assistant) were found for each year between 2011 and 2018 in the YOKTEZ database. The number of theses obtained from the YOKTEZ database was divided by the number of professors, and the number of sector-oriented graduate thesis per professor was determined. These values were calculated separately for 26 universities, and the university scores were obtained in this manner. Finally, the number of theses obtained from the YOKTEZ database was divided by the number of

professors, and the number of sector-oriented graduate thesis per professor was determined. These values were calculated separately for 26 universities, and the university scores were obtained in this manner.

5   Results

In order to facilitate the interpretation of the analysis results of 26 universities, a score type named Scientific Contribution per Academician (SCPA) was found. The SCPA score is represented by the total average number of graduate thesis per professor, performed for the strongest and the most competitive sectors. In Table 4, the comparison of SCPA scores and EIUI scores showing between 2011 and 2018 are given.

Table 4   Comparison of EIUI and SCPA

EIUI				SCPA	
Avg. 2012–2018	*Ranking*	*Universities*		*Ranking*	*Score*
86.9	1	Middle East Technical University (State)		1	0.2458
85.6	2	İ.D. Bilkent University (Private)		4	0.0622
80.0	3	İzmir Institute of Technology (State)		24	0.0000
78.9	4	Gebze Technical University (State)		5	0.0575
71.8	5	TOBB University of Economics and Technology (Private)		2	0.2099
71.5	6	Selcuk University (State)		7	0.0516
70.1	7	Hacettepe University (State)		13	0.0249
66.0	8	Ege University (State)		20	0.0056
63.4	9	Anadolu University (State)		25	0.0000
61.4	10	Erciyes University (State)		9	0.0463
56.7	11	Gazi University (State)		11	0.0398
53.7	12	Atılım University (Private)		6	0.0552
53.2	13	Gaziantep University (State)		15	0.0214
51.4	14	Bursa Uludağ University (State)		16	0.0192
50.2	15	Çankaya University (Private)		12	0.0324
49.8	16	Cukurova University (State)		10	0.0409
46.4	17	Kocaeli University (State)		19	0.0085
45.7	18	Suleyman Demirel University (State)		8	0.0499
44.5	19	Ankara University (State)		14	0.0222
43.2	20	Dokuz Eylül University (State)		23	0.0019
43.2	21	Akdeniz University (State)		21	0.0034
42.6	22	Mersin University (State)		17	0.0179
42.4	23	İzmir University of Economics (Private)		26	0.0000
42.1	24	Karadeniz Technical University (State)		22	0.0030
41.6	25	Pamukkale University (State)		3	0.0727
40.8	26	Fırat University (State)		18	0.0089

Results showed that METU, which has the highest score in EIUI and SCPA rankings, carried out its graduate theses with the focus of selected high-tech manufacturing industry sectors in the TR51 Ankara region. In addition, graduate theses of METU contribute to the assessment dimensions for the EIUI score. Also, the TR51 Ankara region demonstrated that it is the region that has the most successful university that carries out the strategy of supporting the sectors specialised in export with academic knowledge.

Gebze Technical University, TOBB University of Economics and Technology, Selçuk University, Erciyes University, Gazi University, Gaziantep University, and Bursa Uludağ University are in the top 15 in EIUI rankings and contribute to the assessment dimensions for EIUI score. They can also support their activities in EIUI assessment dimensions with their graduate theses. Thus, thanks to the revised strategy, it can be assumed that the outcomes of the universities' graduate theses will increase their contribution to both the graduates and their regions.

Between 2011 and 2018 İzmir Institute of Technology, Anadolu University, and the İzmir University of Economics did not focus on the strongest and most competitive sectors. It is thought that the activities in the assessment dimensions of EIUI do not increase the number of graduate theses. In addition, it can be interpreted that the strategies of supporting the region's competitive sectors with academic knowledge should be reviewed urgently.

The postgraduate theses of Atılım University, Çankaya University, Çukurova University, Kocaeli University, Süleyman Demirel University, and Fırat University, can be considered as not contributing sufficiently to the EIUI scores. It can be thought that these universities should develop a strategy to transfer the results of their graduate theses to selected sectors.

Finally, another finding that needs to be emphasised is the EIUI and SCPA rankings of Pamukkale University. The SCPA results of Pamukkale University do not contribute to EIUI ranking. Therefore, it can be said that a strategy is necessary to increase the contribution of the results of its graduate theses.

6   Conclusion

Turkey's development of the regions is constructed on the basis of an innovation strategy that helps to reduce the difference in the levels of development between regions. For this reason, universities are encouraged to take an active role in ensuring the continuation of this process effectively. It is expected that the competitiveness of a region will be sustained by identifying the areas where the region has a comparative advantage and transferring information onwards from these areas. In this context, a region's dynamics are designed to convey the information produced regarding the economic advantages and to continue studies in these fields to maintain this advantage.

As a result, this we tried to analyse the relationship between universities and competitive sectors in their regions. Twenty-six universities in the EIUI rankings were selected for this analysis. The total number of graduate theses per academician for the selected sectors was determined as the analysis method. A ranking was created for the total number of graduate theses per academician in universities for the selected sectors (SCPA). The SCPA and EIUI rankings were compared. Thus, it aimed to measure universities' academic contribution to regional development, which is seen as a deficiency in EIUI evaluation dimension. We attempted to measure the contribution of

the universities to regional development by the number of graduate theses on the strongest and the most competitive sectors in the manufacturing industry. Although there is no dataset for the evaluation of all the theses produced by universities in this field, and were compared with SCPA based only on graduate theses, the findings of the study are remarkable.

As mentioned above, the EIUI and SCPA rankings of most universities vary. The knowledge transfer strategies applied by universities for the export-oriented manufacturing industry sectors also differ. Therefore, the reasons for these differences and the strategies to be implemented should be discussed in detail. The most important objective of this study is to make use of decision-makers in smart specialisation strategies to be developed within the scope of government-university-industry cooperation. In addition, this study is expected to provide a basis for future specialisation strategies for the regional development-oriented studies of universities.

References

Abbas, S. and Waheed, A. (2017) 'Trade competitiveness of Pakistan: evidence from the revealed comparative advantage approach', *Competitiveness Review: An International Business Journal*, Vol. 5, No. 27, pp.462–475.

Almeida, A., Figueiredo, A. and Rui Silva, M. (2011) 'From concept to policy: building regional innovation systems in follower regions', *European Planning Studies*, Vol. 19, No. 7, pp.1331–1356.

Asheim, B.T. and Coenen, L. (2005) 'Knowledge bases and regional innovation systems: comparing Nordic clusters', *Research Policy*, Vol. 34, No. 8, pp.1173–1190.

Balassa, B. and Noland M. (1989) '"Revealed" comparative advantage in Japan and the United States', *Journal of International Economic Integration*, Vol. 4, No. 2, pp.8–22.

Bilas, V. and Bošnjak, M. (2015) 'Revealed comparative advantage and merchandise exports: the case of merchandise trade between Croatia and the rest of the European union member countries', *Ekonomska Misao i Praksa*, Vol. 1, No. 1, pp.29–47.

Brahm, T. and Kühner, P. (2019) 'Faculty motivation as a key for integrating sustainable development in higher education curricula', *International Journal of Innovation and Sustainable Development*, Vol. 13, No. 2, pp.181–197.

Dinda, S. (2018) *Climate Friendly Goods and Technologies in Asia: Opportunities for Trade*, Springer, Switzerland.

Etzkowitz, H. (2003) 'Innovation in innovation: the triple helix of university-industry-government relations', *Social Science Information*, Vol. 42, No. 3, pp.293–337.

Etzkowitz, H. and Leydesdorff, L. (1998) 'The endless transition: A "triple helix" of university-industry-government relations: introduction', *Minerva*, pp.203–208.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B.R.C. (2000) 'The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm', *Research Policy*, Vol. 29, No. 2, pp.313–330.

Foray, D. (2014) *Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy*, Routledge, Switzerland.

Foray, D. and Rainoldi, A. (2013) *Smart Specialisation Programmes and Implementation*, S3 Policy Brief Series, 2.

Foray, D., McCann, P. and Ortega-Argilés, R. (2015) Smart specialization and European regional development policy', *Oxford Handbook of Local Competitiveness*, pp.458–480.

Franco, M. and Haase, H. (2015) 'University–industry cooperation: researchers' motivations and interaction channels', *Journal of Engineering and Technology Management*, Vol. 36, pp.41–51.

Hinloopen, J. and Van Marrewıjk, C. (2001) 'On the empirical distribution of the Balassa index', *Weltwirtschaftliches Archiv*, Vol. 1, No. 137, pp.1–35.

Iammarino, S. (2005) 'An evolutionary integrated view of regional systems of innovation: concepts, measures and historical perspectives', *European Planning Studies*, Vol. 13, No. 4, pp.497–519.

Kramer, J.P., Marinelli, E., Iammarino, S. and Diez, J.R. (2011) 'Intangible assets as drivers of innovation: empirical evidence on multinational enterprises in German and UK regional systems of innovation', *Technovation*, Vol. 31, No. 9, pp.447–458.

Lafay, G. (1992) 'Comparative advantages', *International Trade Modelling*, p.209.

Leng, Z., Shuai, J., Huang, F., Wang, Z. and Shuai, C. (2019) 'Comparative advantages of China's wind energy products: a belt-and-road perspective', *Quality and Quantity*, Vol. 53, No. 3, pp.1459–1478.

Maqbool, M.S., Rehman, H., Bashir, F. and Ahmad, R. (2019) 'Investigating Pakistan's Revealed Comparative Advantage and competitiveness in Cotton sector. *Review of Economics and Development Studies*, Vol. 5, No. 1, pp.125–134.

Maslova, S. (2020) 'Achieving sustainable development goals through public private partnership: critical review and prospects', *International Journal of Innovation and Sustainable Development*, Vol. 14, No. 3, pp.288–312.

McCann, P. and Ortega-argilés, R. (2016) 'The early experience of smart specialization implementation in EU cohesion policy', *European Planning Studies*, Vol. 24, No. 8, pp.1407–1427.

Musa, H.D., Yacob, M.R., Abdullah, A.M. and Ishak, M.Y. (2020) 'Urban sustainability and gross national happiness: a review of community well-being domains and dimensions', *International Journal of Innovation and Sustainable Development*, Vol. 14, No. 2, pp.157–184.

Muscio, A. and Ciffolilli, A. (2019) 'What drives the capacity to integrate industry 4.0 technologies? evidence from European R & D projects', *Economics of Innovation and New Technology*, pp.1–1.

Publishing, Oecd (2007) *Higher Education and Regions: Globally Competitive, Locally Engaged*, Organisation for Economic Co-operation and Development.

Pippinato, L., Di Vita, Giuseppe, and Brun, Filippo (2019) 'Trade and comparative advantage analysis of the EU honey sector with a focus on the Italian market', *Quality – Access to Success.*, Vol. 20, pp.485–492.

Pugh, R.E. (2014) 'Old wine in new bottles'*? Smart Specialisation in Wales. Regional Studies, Regional Science*, Vol. 1, No. 1, pp.152–157.

Rossato, F.G.F., Susaeta, A., Adams, D.C., Hidalgo, I.G., de Araujo, T.D. and de Queiroz, A. (2018) 'Comparison of revealed comparative advantage indexes with application to trade tendencies of cellulose production from planted forests in Brazil, Canada, China, Sweden, Finland and the United States', *Forest Policy and Economics*, Vol. 97, pp.59–66.

Sagar, K., Saxena, V. and Narula, S.A. (2018) *Intra-Industry Trade and Revealed Comparative Advantage: Empirical Analysis of Indian and Australian Processed Food Sector.*

Sánchez-Barrioluengo, M. (2014) 'Articulating the "three-missions" in Spanish universities', *Research Policy*, Vol. 43, No. 10, pp.1760–1773.

Shane, S. (2004) 'Encouraging university entrepreneurship? the effect of the Bayh-dole act on university patenting in the United States', *Journal of Business Venturing*, Vol. 19, No. 1, pp.127–151.

Startiene, G. and Remeikiene, R. (2014) 'Evaluation of revealed comparative advantage of Lithuanian industry in global markets', *Procedia – Social and Behavioral Sciences*, Vol. 110, pp.428–438.

Vollrath, T.L. (1991) 'A theoretical evaluation of alternative trade intensity measures of revealed comparative advantage', *Weltwirtschaftliches Archiv.*, Vol. 2, No. 127, pp.265–280.

Websites

http://www.tubitak.gov.tr/sites/default/files/EIUI_2013_bilgi_notu.pdf

http://www.tubitak.gov.tr/sites/default/files/18842/EIUI_gosterge_seti_2018.pdf

http://www.tuik.gov.tr/PreHaberBultenleri.do?id = 30652

Turkish Council of Higher Education Thesis Database (YOKTEZ). https://tez.yok.gov.tr/
UlusalTezMerkezi/tarama.jsp (Accessed 1 June, 2020).