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PhD dissertation

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## Acknowledgments

When I started my doctoral studies in the “new” training structure in September 2016, the dissertation phase seemed very far. The last 4 years, however, have almost flown away, densely weaving everyday life with doctoral studies, teaching, researching, publications, and dissertation writing period. Once I heard from someone that PhD years mean a “lonely” period in a person’s life as a PhD student has to travel through this journey on its own. I have been thinking about this a lot. Yes, on its own, that is true. But not alone! So many people were and still are around me who supported me to walk through this long journey. To whom I have been thinking with a grateful heart from the beginning and even now. Let me thank them now.

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“Life is a journey. It is up to us how we proceed:
we just flow with the tide or follow our own dreams.”
*Paulo Coelho*

## Introduction

The focus of my research is the study of competitiveness. Within this broad and rich literature area, my aim is to systematize meso-level competitiveness in the literature and to apply it within a selected industry, especially the dairy industry.

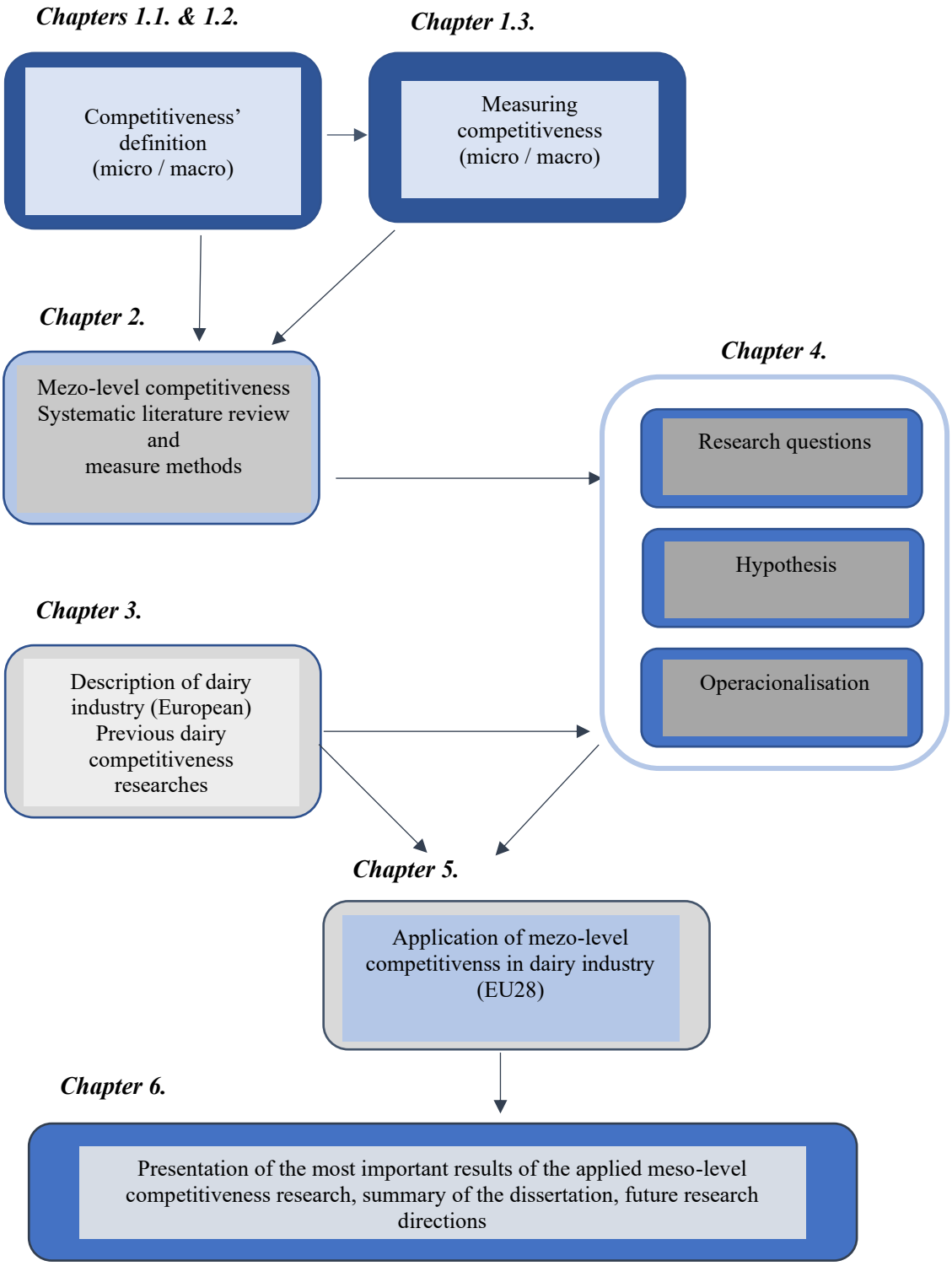
At what levels can competitiveness be interpreted? How is it possible to measure competitiveness? What makes an industry successful, or why does it fail? How is it possible to increase competitiveness at given level? In recent decades, a number of governments, national and international organizations, researchers have tried to answer above listed questions, and a number of scientific dissertations, papers and debates can be searched and read, so the available literature is very rich. There are many definitions, approaches and interpretations related to competitiveness. Due to the abundance of available scientific work, several researchers refer to the competitiveness literature as "fuzzy" (Markusen, 1999; Lall, 2001; Hall, 2007; Buzzigoli and Viviani, 2009), which stems from the complexity of the phenomenon.

In my Ph.D. dissertation, I am focusing on this multifaceted concept, especially, I undertake to define industry measurement, its measurement possibilities, and their empirical application and investigation. For the choosen industry to test empirically industrial competitiveness, I focus on defining and examining the competitiveness of the dairy industry, seeking answers to the following questions. How does the competitiveness of the dairy industry developing in the Member States of the European Union? What are the key factors affecting the competitiveness of the dairy industry in the Member States of the European Union?

Because of the phenomenon's complexity (competitiveness), I consider it essential to begin my thinking by examining the broader existing literature, which begins with an analysis of the literature on the two extreme levels, micro- and macro-level competitiveness. The two levels of competitiveness came to the forefront of economics and economics at the earliest, meaning the basis, so I consider it crucial to examine them firstly. I will place the theory of meso-level competitiveness in this broader conceptual system and define the meso-level competitiveness interpreted by my Ph.D. dissertation on the basis of the processed literature.

The dissertation is divided as follows. Following the introduction, the first chapter of the dissertation discusses the theoretical background of competitiveness from economics and management point of views. Then, in the same chapter, I present the definition and development path of the two different basic levels of competitiveness (micro and macro levels), and then the chapter ends with the measurement methods. The second chapter of the dissertation focuses on meso-level competitiveness. Following a more general literature analysis and measurement methods (which also covers interpretations within the meso-level), a systematic literature analysis of industry competitiveness is presented using PRISMA methodology. This analysis of the literature is based on the existing articles and studies in both Hungarian and international literature. In the third chapter, the literature review is followed by the presentation of the industry used for empirical research, namely the dairy industry, covering consumer habits and the regulatory environment, and a detailed summary of previous competitiveness research found in the dairy industry. The fourth chapter of the dissertation formulates the hypotheses and sub-hypotheses of the dissertation based on the research questions, as well as the presentation of the methodology used for testing them, as well as the inventory of the research limitations. This is followed by the chapter of empirical research, which aims to measure and compare the competitiveness of the domestic dairy industry compared to the EU28 Member States. The results of the methods used to test the hypotheses are presented and analyzed in Chapter 5. Finally, the dissertation concludes with a summary of the most important results of the dissertation and an outline of future research directions (Chapter 6). This logical structure of the disstertation is shown in Figure 1.

*Figure 1. – The logical structure of the dissertation*




Source: own construction, 2020

In the first chapter, therefore, I begin the presentation of the complex concept of competitiveness at micro and macro levels. The aim of this chapter is to provide a framework for the theoretical background of meso-level competitiveness which stands in the focus of the dissertation. Thus, using the findings made in the various fields of economics and management science fields, I present the main definitions in the chapter and then the measurement methods used.

# Chapter 1. Theory and concept of competitiveness

The complex concept of competitiveness can be interpreted at different levels, such as product, company, industry, region and country levels, as well as micro, meso, macro and even meta level competitiveness, and appears the both economic and management approach discussion of the phenomenon.

At the classical level of economic interpretation, the theory of absolute advantages by Smith (1776) and the theory of comparative advantages by Ricardo (1817) should be mentioned, which examined the question of the specialization of two countries in order to obtain an advantage. Next, it worths mentioning the researches of Heckscher (1919) and Ohlin (1935) and then Samuelson (1953) between the comparative advantages of a country and its factor supply. In the case of an management science approach, it is basically the work of Porter (1990) that needs to be studied, creating the theory of competitive advantages as well as the diamond model. In his study, Krugman (1994) sharply criticized the definition of country-level competitiveness due to management science approach.

In this chapter, the concept will be defined by focusing on the micro and macro levels, and then on each of the measurement methods.

## 1.1 Micro-level competitiveness

By micro-level-interpreted competitiveness, authors generally mean enterprise-level competitiveness, which can be defined as follows. The development of definitions is also emphasized by the presentation in chronological order.

In a relatively early work on thinking about competitiveness, Nelson (1992) summarized his scholarly work in the contemporary literature and formed different groups. In the first group, he gathered the findings of researchers on corporate competitiveness. He simply articulates corporate competitiveness in such a way that if companies “to pull up their socks”[1], they can become better, they can perform better compared to their competitors.

[1] The article originally contained the term “to pull up their socks” (Nelson, 1992: p. 127), which can best be translated in Hungarian as “to put on the gloves”.

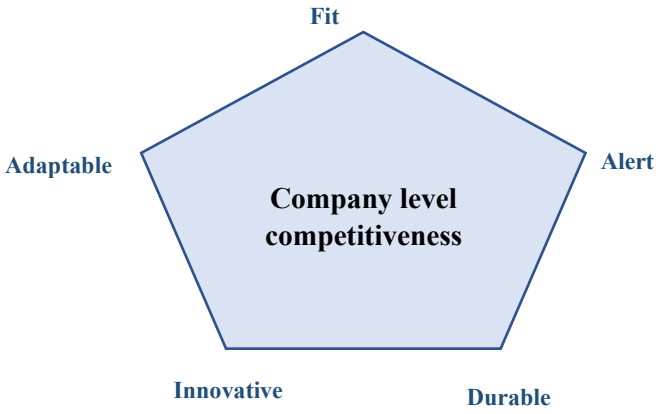
In another early work, Georghiou and Metcalfe (1993) argued that at the level of individual firms, competitiveness means the creation of excellent product and process characteristics over competitors and the explicit result of these benefits in market share and its increase.

Company-level competitiveness, according to Meyer-Stamer (1997), means nothing more than the success or failure of a company as a result of simultaneous measurement in the areas of efficiency, quality, flexibility, and propensity to change.

According to Török, competitiveness at the micro level *"means the ability to gain a position or stand in market competition between individual companies, each other's competitors, and from a macroeconomic point of view between individual national economies"* (Török, 1999: p. 74).

Connor (2003) summarized the characteristics of a competitive firm, abbreviated as FADIA, i.e. Fit, Alert, Durable, Innovative, and Adaptable. Fit is a competitive company in the sense that it has the right resources and the right autonomous organization. Appropriate resources for the production of a product or service produced by the company, and an appropriate organization for decision-making and operation. A competitive company is alert to its learning abilities and the quantity and quality of information gathered. By Durable, Connor means that the company not only has the right resources, but is also available in quality and on an ongoing basis. In order for these resources to be used effectively, it is important that clear goals are set for management. A competitive company must be Innovative, meaning that human capital and imagination must play an important role, as development requires creativity. Finally, the firm must have an adaptable feature, which means information processing and a propensity and willingness to change (Connor, 2003), as illustrated in Figure 2.

*Figure 2.- Main characterisitcs of company-level competitiveness*




Source: based on Connor (2003) own construction

Chikán and Czakó (2005: p. 13) define the phenomenon at the micro level as follows: *"Competitiveness is the ability of a company to offer consumers products and services on a lasting basis, while complying with social responsibility standards, that they are more willing to pay for than the products (services) of its competitors on terms that are profitable for the company. The condition for this competitiveness is that the company is able to perceive and adapt to changes in the environment and within the company, while meeting market competition criteria that are permanently more favorable than those of its competitors".* The emphasis is therefore on the success and durability of competition in the market.

Based on the definition of Chikán and Czakó (2005), Szerb (2010) formulates the concept of micro-level competitiveness. According to Szerb (2010: p. 23) *"enterprise-level competitiveness is based on available physical resources, human resources, networking, innovation capabilities and as competencies of administrative routines"*. This kind of approach is built on the company's internal resources and capabilities. It enables to ultimately create a product or service that is valuable to the consumer, meets its needs and in some way (price, quality, substitutability, availability, etc.) for its competitors. and also meet supply criteria.

Bonales Valencia and Delfín Ortega (2012) define company-level competitiveness in terms of whether a given company is able to create and sell a more attractive product,

service or market than its market competitors. According to this definition, competitiveness also means the ability for a company to compete in the market.

The following is a summary of the micro-level, ie the table summarizing the definitions of corporate competitiveness (Table 1), which presents the main message of each definition. Some conclusions can be drawn from the definitions. At the micro level, competitiveness and the competitiveness of products or services are closely linked, and competition, ability to compete and gaining positions relative to competitors appear in all definitions.

*Table 1. – Micro-level competitiveness definitions*

| **Author(s)** | **Year** | **Main message** |
|---|---|---|
| Nelson, R. | 1992 | • ability to better performance<br>• the company picks up the competition |
| Georghiou, L. és Metcalfe, J. | 1993 | • create a better product<br>• and parallely achieving a market share increase |
| Meyer-Stamer, J. | 1995 | • success or failure<br>• efficiency, quality, flexibility and the ability to change |
| Török Á. | 1999 | • ability to gain better position in market competition<br>• ability to stand up |
| Connor, T. | 2003 | • characteristics of a competitive company: fit, alert, durable, innovative, and adaptable |
| Chikán A. és Czakó E. | 2005 | • product or service production<br>• preferred by the consumer<br>• with profit<br>• adhers social norms<br>• is able to perceive and react to the environment and internal changes |
| Szerb L. | 2010 | • physical and human resources,<br>• networking,<br>• innovation skills and<br>• the set of competencies of administrative routines |
| Bonales Valencia, J. és Delfín Ortega, O.V. | 2012 | • ability to design, produce and sell more attractive products or services than the competitors |

Source: own construction, 2019

In determining enterprise-level competitiveness, it worths referring to and studying resource-based enterprise theory. According to company theory (Penrose, 1959;

Wernerfelt, 1984; Barney, 1991 and Grant, 1991), all firms have different resources and different capabilities. They lead the company to success and provide it with a competitive advantage if the given resource-capacity combination is difficult or impossible for competitors to copy and integrate into their operations, thus explaining the different characteristics of companies (Penrose, 1959; Wernerfelt, 1984; Barney, 1991). Each of the micro-level competitiveness definitions presented above indicates this capability. The ability to produce more attractive products and services than its competitors at the corporate level, which means definitely success.

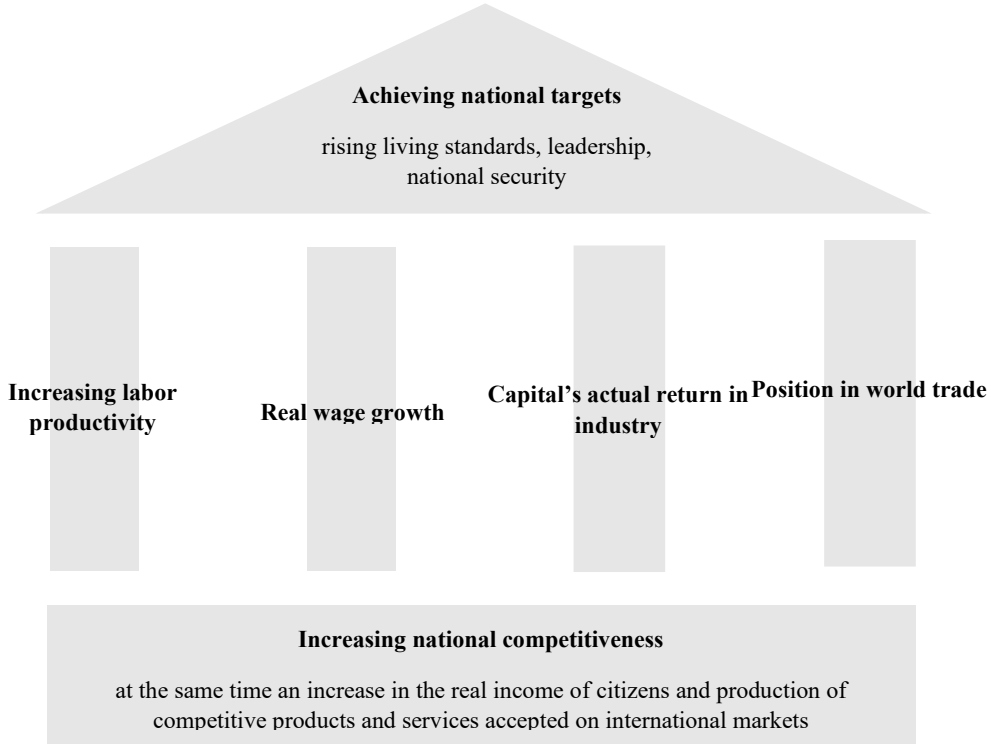
Based on the presented definitions, I use the following definition as a relevant term for my dissertation: *"means the ability to gain a position in the market competition or to stand up to each other's competitors"* (Török, 1999: p. 74).

## 1.2 Macro-level competitiveness

At the macro level, the very first definition of national competitiveness can be linked to the Presidential Commission on Industrial Competitiveness[2] (Competitiveness Commision, 1985: p. 5). The Competitiveness Commission defines the concept in its quoted report as: *„for a nation, competitiveness must be defined as the extent to which it is able to produce, under free and fair market conditions, products and services that meet the challenges of the international market while maintaining and further increasing the real incomes of their citizens". T*his definition, formulated by the Competitiveness Commission, is in line with key U.S. national goals, which are to achieve an increasing standard of living for Americans, U.S. leadership in the free world, and U.S. national security (President's Commission on Industrial Competitiveness, 1985). Increasing the competitiveness of the United States compared to other nations, their largest trading partners, was seen as a source of achieving these goals. This is illustrated in Figure 3.

[2] The Competitiveness Commission (originally known as the President's Commission on Industrial Competitiveness) was established under the chairmanship of Ronald Reagan (1981-1989) with the goal of finding a source to achieve key U.S. goals.

*Figure 2. - Interpretation of U.S. National Competitiveness by the Competitiveness Commission*




Source: based on President's Commission on Industrial Competitiveness (1985) own construction

In Porter's formulation, *"nation's firms must relentlessly improve productivity in existing industries by improving product quality, adding desirable features, improving product technology, and increasing production efficiency"* (Porter, 1990: p. 6). In this formulation, building from the corporate level can be strongly felt, i.e., the totality of the results achieved by companies can determine the competitiveness of a nation. Although Porter did not yet consider the concept of national competitiveness to be an appropriate term in his 1990 work, but rather identified it with productivity, this can also be deduced from the former definition.

In his work, Nelson (1992) summarized his work on contemporary literature about competitiveness and, in addition to corporate competitiveness, listed studies on macro-level competitiveness, arguing that macro-level competitiveness refers to the performance of national economies strongly influenced by government macroeconomic and monetary policy.

Krugman (1994) strictly criticized the study, research and conclusions[3] of researchers, professionals, various organizations, economic politicians that are about the competitiveness of a nation. Following the Ricardo view, starting from the comparative advantages, Krugman concluded that mutually beneficial agreements between nations can increase the income of countries, but completely rejects the macroeconomic interpretation of competitiveness (Somogyi, 2009). He considers the use of the term macro-level competitiveness to be misleading and dangerous as it has different content. He argues that defining competitiveness only at the firm level has a sense. A company becomes insolvent if it is unable to produce a product or service that consumers buy. And in the event of insolvency, it goes bankrupt, is liquidated, and has to close its business. One country cannot do the same. Krugman argues that it means nothing if a country is more competitive than the other. Even the non-competitive countries are not liquidated, so he considers it wrong to compare the operation of a nation to the operation of a large company (Krugman, 1994). Based on all this, based on Krugman's views can be said, that the use of the term *„national competitiveness"* is unscientific, instead he advocates the use of the term *„productivity"* for countries.

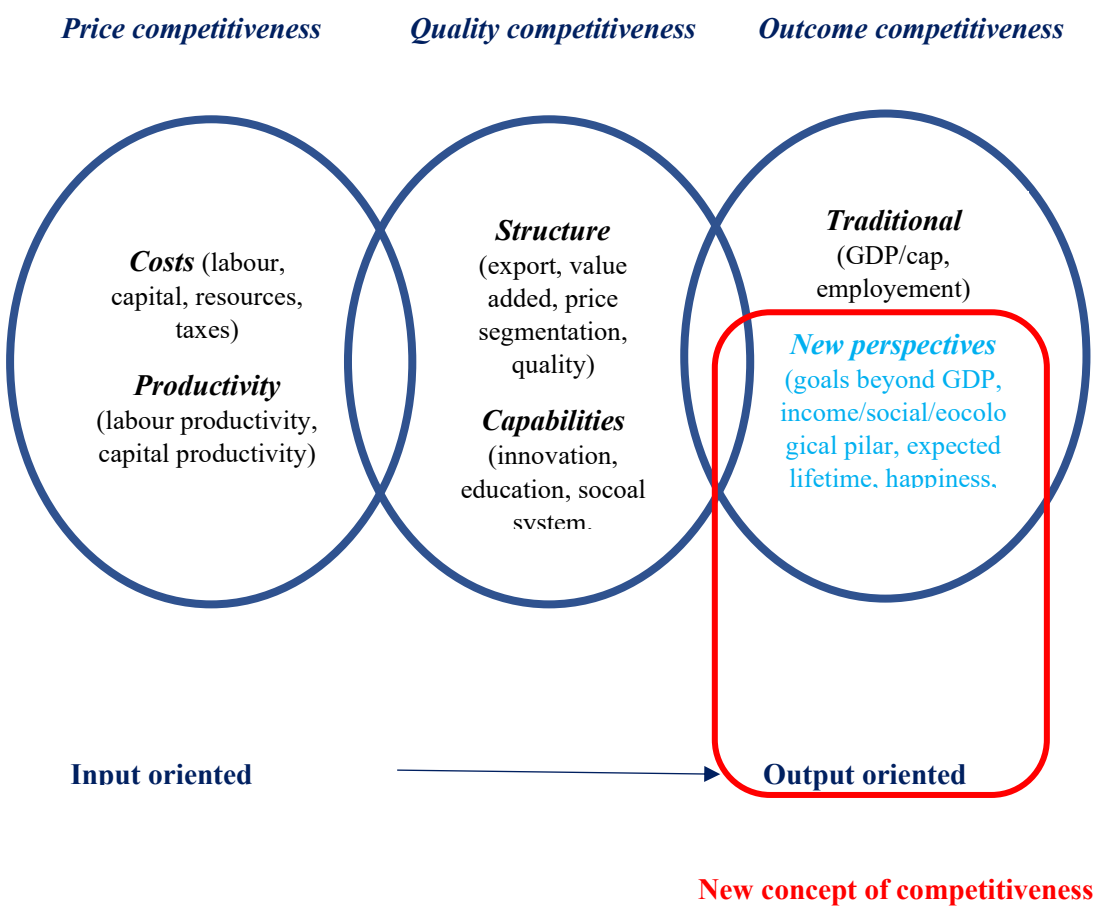
By incorporating and explaining Krugman's suggestions somewhat, the OECD has previously sought to define the complex content of competitiveness in a definition. According to this definition, *"competitiveness is the ability of companies, industries, regions and supranational regions to generate relatively high factor incomes and relatively high levels of employment on a sustainable basis in an environment of international competition"* (Lengyel, 1999: p. 13), which thus includes, that competitiveness is more than cost competitiveness.

According to a study published in 2013, *"competitiveness is the ability of a country (region, place) to achieve its goals beyond GDP today and tomorrow"* (Aiginger et al., 2013: p. 13). As a starting point, price competitiveness was examined, followed by quality competitiveness, and finally outcome competitiveness (Aiginger et al., 2013). The earliest

[3] In his 1994 article "Competitiveness: A Dangerous Obsession", Krugman sharply criticizes lectures and dissertations on competitiveness. Namely the speech of Jacques Delors (then President of the European Community) in Copenhagen in 1993, which spoke of unemployment, which is increasingly threatening Europe, and which he cited as the main reason for Europe's lack of competitiveness vis-à-vis the United States and Japan. Krugman had a similarly negative view of one of President Clinton's speeches in which he compared the operation of a nation to the operation of large corporations in global markets (Krugman, 1994).

thoughts on competitiveness were basically about the cost situation of a company or a country, and this term is still used today when there are low-cost competitors for a company, industry, country. This can be seen as a relatively narrow view of competitiveness, which depends solely on costs. According to a broader interpretation, it is not enough to measure and judge competitiveness on the basis of costs and revenues, but to determine the sources of competitive advantage of companies, industries and countries. The next level is the concept of output competitiveness, which deviates from a narrower (cost) or broader (ability) assessment of inputs and takes the results into account (Aiginger et al., 2013). This is illustrated in Figure 4.

*Figure 3. – Competitiveness from a new point of view*




Source: based on Aiginger et al. (2013) own construction

Similar to Krugman's (1994) point of view, Éltető (2003: p. 271) considers that "*it can be said that the competitiveness of a country does not exist in itself. However, in several dimensions, in certain areas, comparative analysis may be relevant"*, e.g. Éltető

recommends that the analysis be carried out in foreign trade with appropriate measurements.

The widely accepted definition of national competitiveness in Hungary, based on Chikán et al. (2006: p. 8), reads as follows: competitiveness is "*the ability of a national economy to create, use and sell products and services in the context of global competition while increasing the returns of its own factors of production and, at the same time, the well-being of its citizens in a sustainable way. The condition for this competitiveness is to promote the growth of resource productivity by continuously maintaining conditions that ensure the efficiency of companies and other institutions"*.

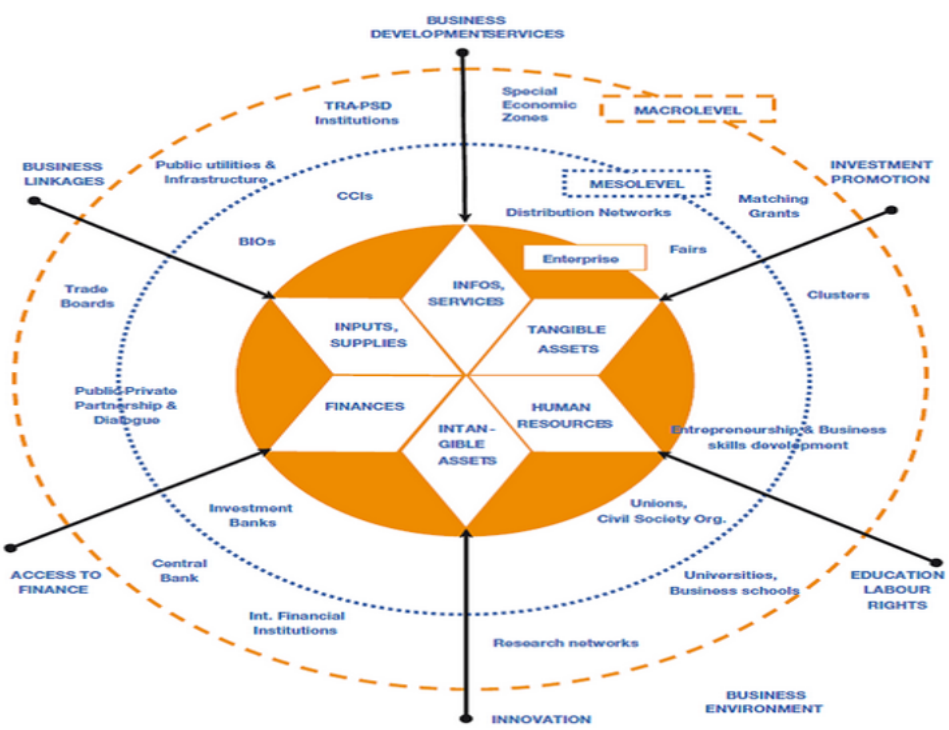
The World Economic Forum distinguishes and articulates micro- and macro-level competitiveness. According to this, macro-level competitiveness is nothing more than a set of different institutions, policies, and factors that determine a country's level of productivity (Schwab and Porter, 2007). In this definition, competitiveness is strongly linked to productivity, which is identical to Porter's mindset.

According to the definition and publication currently adopted and published by the European Commission, competitiveness is *"that a company, a sector or a country effectively sells and delivers products and services in a given market, takes advantage of the opportunities offered by globally integrated markets and takes advantage of international trade and benefits. This is determined by the level of productivity and diversification of the economy and the quality of the goods and services it provides"* (European Commission, International Cooperation and Development, 2019).

This wording also seeks to address the complexity of competitiveness together, but in contrast to the OECD wording, it does not take a new approach to achieving goals beyond GDP, but rather formulates it from a traditional perspective. The factors affecting competitiveness identified by the European Commission are divided into three levels, macro-, meso- and company-level factors, and each factor is represented on a so-called "*system map*". A total of 6 main groups of factors group the factors affecting competitiveness, namely: business development services, investment development, education and labor rights, innovation, access to finance, business relations (European

Commission, International Cooperation and Development, 2019). This structure is illustrated in Figure 5.

*Figure 4. - Systemic map of the European Commission's competitiveness factors*




Source: European Commision (2019)[4]

A summary table of definitions of macro-level competitiveness is shown in Table 2. The definitions collected seem to think very differently about the concept of national competitiveness. Numerous authors do not even consider it a proper wording, and they cannot even interpret „national competitiveness" as a concept. On the other hand, other authors and sources give exact definitions. Definitions that fall into the latter range generally refer to the production and sale of goods and services that compete successfully in international markets in a way that increases real incomes for the citizens of a given country.

[4] Source: downloaded: https://ec.europa.eu/europeaid/sectors/economic-growth/private-sector-development/competitiveness_en, 2019.08.13. In the Hungarian version, Figure 5. has been transformed and edited to Hungarian.

*Table 2. – Macro-level competitiveness definitions*

| **Author(s), sources** | **Year** | **Main message** |
|---|---|---|
| U.S. Commission on Industrial Competitiveness | 1985 | • ability to produce products or services<br>• under free and fair market conditions<br>• ability to compete successfully in international competition<br>• maintainance and further increase of the real incomes of their citizens |
| Porter, M. | 1990 | • used as a synonym for productivity |
| Nelson, R. | 1992 | • means the performance of the national economy<br>• influencing government |
| Krugman, P. | 1994 | • a misleading word and concept, which cannot be interpreted |
| OECD | 1999 | • it is a capability<br>• to relatively high factor income<br>• to create a relatively high level of employment<br>• on a sustainable basis, under conditions of international competition |
| Éltető, A. | 2003 | • a concept that cannot be interpreted on its own |
| Chikán A. et al. | 2006 | • ability of national economy<br>• to create, use and sell products and services in global competition<br>• meanwhile, the yield of its own factors of production<br>• menas the well-being of its citizens is growing in a sustainable way<br>• a condition to promote resource productivity growth<br>• continuos maintainance of conditions to increase efficiency |
| Word Economic Forum | 2007 | • a set of institutions, policies and factors<br>• which determine the level of productivity in a country |
| Aiginger, K. et al. | 2013 | • capability to<br>• achieve goals for citizens beyond GDP |
| European Commision | 2019 | • in a given market, take advantage of the opportunities offered by globally integrated markets<br>• take advantage of international trade<br>• the level of productivity and diversification of the economy, and<br>• determined by the quality of goods and services |

Source: own construction, 2019

When interpreting macro-level competitiveness, we define the ability of a national economy, in which the performance of the national economy, the success of competition in international competition (or vice versa) appears, and which enables its citizens to increase their welfare in a sustainable way and use resources as efficiently as possible. Based on these, for the purposes of my dissertation, I use the definition of Chikán and Czakó (2005: p. 15) as the interpretation of macro-level, that is national economic competitiveness. According to this, *"the ability of a national economy to create, use and sell products and services in the context of global competition while increasing the returns of its own factors of production and, at the same time, the well-being of its citizens in a sustainable manner. The condition for this competitiveness is to promote resource productivity growth by continuously maintaining conditions that increase the efficiency of companies and other institutions"*. The emphasis in the definition is not only on the internationalization of the produced products and services, but also on ensuring the well-being of the citizens and the efficient use of resources.

## 1.3 Measuring competitiveness at the micro and macro levels

In this sub-chapter, I have collected methods for measuring micro and macro level competitiveness. According to Bhawsar and Chattopadhyay (2015), each measurement method depends on the unit of analysis, it can be a firm or a country, at micro or macro levels. Researchers widely choose productivity, product quality, trade balance, various technological indicators, market share, profitability, or even growth rate as a solution to measure competitiveness (Bhawsar and Chattopadhyay, 2015) and a number of general methods[5] that can also be applied to measure competitiveness. Retaining the previous logical order, this time the methods of measuring micro-level competitiveness will be presented, followed by the methods of measuring macro-level competitiveness.

[5] Such generally applicable methods or procedures are for example the Data Envelopment Analysis (DEA), cluster analysis, or even the Multi-Criteria Decision Making (MCDM) model. These are suitable methods for group formation and ranking, for the wide-ranging examination of the emerging economic problems. However, the presentation of these methods is not part of the dissertation due to size limitations of it. Considering that they can also be considered as a suitable solution for measuring competitiveness.

### 1.3.1 Methods for measuring micro-level competitiveness

When formulating company-level competitiveness, the keywords listed in the definitions usually include the ability to stand up, create and sell a more attractive market product or service, maintain and increase market share, achieve profit, and achieve efficiency and economy. According to Buckley et al. (1988), the measurement of company-level competitiveness can be given by both quantitative methods along different cost factors, prices, profitability, while (even in parallel) and qualitative factors even non-price factors, such as quality, achieving better quality compared to competitors' products. Based on these, a number of indicators can be used to measure company-level competitiveness.

***Group of financial and accounting indicators***

One relatively simple solution for determining corporate competitiveness could be to calculate traditional financial and accounting indicators. This is the concept of competitiveness, narrowly interpreted by Aiginger et al. (2013), which basically measures corporate competitiveness on the cost side. The theoretical framework and measurements for measuring the performance of companies can be considered as a starting point based on the scientific work of Modigliani and Miller (1958, 1963). Groups of financial and accounting indicators include, for example, return on sales (ROE), return on assets (ROA), return on assets (ROI), average margin, interest, profit before tax and depreciation (EBITDA), interest and earnings before tax (EBIT), balance sheet, income statement and cash flow (Vigvári, 2015; Fellegi, 2010). According to the concept of dual value creation, a company creates value for two stakeholder groups in the same process, these groups are the consumers and the owners (Chikán, 2017). According to the theory of dual value creation, *"the basis of realization is cost efficiency, on which both consumer and owner value creation is based"* (Chikán, 2017: p. 469).

This logic is followed by Liargovas and Skandalis (2010) in their study, who interpreted and examined firm-level competitiveness based on firms' financial performance in their study. According to their interpretation, the advantages of this type of financial performance approach include uniformly mature system of definitions of different financial ratios and, consequently, the possibility of relatively easy quantification, calculation and interpretation (Liargovas and Skandalis, 2010).

***Market analysis indicators***

This group includes all the information that shows the results achieved in the market of the products and services produced by the company, so they can answer the question of the *"ability to stand on the market"* (Török, 1999: p. 74) of the company's competitiveness. These include, for example, the aggregate profit of a company's market share for a given product or service, its change (of course at the same price), the number of companies competing in the market, the market share of competitors for a given product or service (Bauer and Berács, 1998). Harrison and Kennedy (1997) suggest calculating market share and profitability to measure firm-level competitiveness, but the note in their study that *"best metrics"* (Harrison and Kennedy, 1997: p. 23) do not exist and it is appropriate to use multiple metrics simultaneously to be taken into account during calculation and analysis.

***Group of firm competitiveness indices***

Another group of measurement methods is the various corporate competitiveness indices (Chikán, 2006; Szerb, 2010; Márkus, 2011; Cetindamar and Kilitcioglu, 2013). Out of these, it has to be mentioned the so-called Firm Competitiveness Index (FCI) created by Chikán (2006). According to the index created by the author, its operability, variability and performance are the determining factors for corporate competitiveness.

To determine the FCI, the author conducted a firm level questionnaire survey. To calculate operability, the author takes into account cost-effectiveness, quality, time, flexibility, and services. To calculate adaptability, questions related to market relations, human tension, and organizational responsiveness were included. To determine performance of the firm, the author calculated the mean of return on sales and market share based on corporate double value creation (Chikán, 2006). The developed indicator evaluates and ranks the companies participating in the survey in its simplicity and transparency.

I thought we would discover a similar logic in measuring competitiveness in Buckley et al. (1988), in which the authors distinguished groups of competitive performance, competitive opportunities, and management processes to measure competitiveness (not exclusively at firm level).

Szerb's (2010) research focused specifically on micro, small and medium-sized enterprises (SMEs), the essence of which was to examine the competitiveness of the domestic SME sector based on 21 variables and 7 pillars in a statistically large sample size (695 companies were included in the analysis). The 7 pillars for which Szerb developed its competitiveness index were: physical resources, human resources, innovation, networking, pillars of administrative routines, and their fits along were (consumer) demand and (relative to competitors) supply. Compared to the previous competitiveness indices, which are calculated by the indicators on the basis of averaging, Szerb (2010) argues that the same line of reasoning cannot be used for the SME sector, as the characteristics of the SME sector differ significantly from those of large companies. According to the author, *"competitiveness is determined by the weakest element, which also has a negative effect on other, relatively better factors"* (Szerb, 2010: p. 24), and thus the author used as unique method of punishing bottlenecks in its analysis.

Márkus (2011) undertook to develop a further firm competitiveness index, who created the Competitiveness Index of the Complex South Transdanubian Regional Competitiveness Research (CSTRCR). Also based on a questionnaire survey, research and development, development of target markets, relationship to change, proportion of marketing budget, participation in strategic alliance, and fluctuation emerged as variables. The index was used to measure the relative competitiveness of the companies in the sample (Márkus, 2011).

Cetindamar and Kilitcioglu (2013) also developed a model for measuring firm-level competitiveness. The authors created their firm competitiveness index for the parameters that can be interpreted at the corporate level, starting from the national level, complex competitiveness models and indices[6]. According to their theory, it is essential to consider the interplay between the macroeconomic and micro business environments, so it is essential to examine both environments. Competitive and non-competitive companies can be found in the same macroeconomic environment. According to the authors' model, the corporate competitiveness index is to be found in the triad of output indicators, resources and management, governance processes and capabilities, which are included in the final index with a weight of 40-30-30%. The group of output indicators includes growth, exports, value added, profit and consumer and society indicators. Resources include

[6] These complex competitiveness indices measuring competitiveness at the national level are presented in the following sub-section (1.3.2) "Methods for measuring macro-level competitiveness".

indicators on human resources, financial resources and technological, innovation and design performance. The third group includes management-related outcomes such as leadership skills, sustainable strategy, and process development skills. Within each indicator group, the model tries to show a more complete picture of the company's achievements and competitiveness with a number of indicators.

### 1.3.2 Methods for measuring macro-level competitiveness

There are very different views in the literature on the definition of macro-level competitiveness, so accordingly the measurement possibilities can be drawn from a very wide range.

A significant part of the measurement methods deals with sequencing, since in the case of the competitiveness of a nation, the determination of its relative competitive position is very significant compared to the results achieved by other nations (Önsel et al., 2008). According to Önsel and his co-authors (2008) the competitiveness of a nation can be interpreted as a result achieved in the international market (due to the presence of a globalized market) in comparison with the results achieved by other nations, consequently we get the competitiveness of a given nation by ranking. Based on the definitions, we also find the range of financial indicators to measure national competitiveness, but the range of international trade indices as well as the group of complex competitiveness indices should be highlighted. These are presented now.

In their study, Fertő and Hubbard (2001) note that does not exist a generally accepted measurement method for measuring macro-level competitiveness in the literature, and that there are several studies focusing on price and cost structure, for example, to examine the competitiveness of domestic agriculture.

Interpreted on the market side, so to measure demand competitiveness, the *Real Exchange Rate (RER)* is based on Török (2003), which is the quotient of the price index of traded goods and services and the price index of non-traded goods and services in a simple form.

A version of this rate is the so-called *Real Effective Exchange Rate (REER)* (Latuffe, 2010), which states that if export becomes more expensive, it leads to the deterioration in competitiveness, and vice versa is still true. If import becomes cheaper, it also leads to the deterioration in competitiveness of a country.

The measurement of country-level competitiveness is closely related to the results achieved in international trade. Among these methods stands out the *Revealed Comparative Advantages Index (RCA)* developed by Balassa (1965), and the *Revealed Trade Index (RTA)*, the *Logarithm of Relative Export Competitiveness Index (LnRCA)*, the *Revealed Competitiveness Index (RC)* and the *Revealed Symmetric Comparative Advantage Index (RSCA)* (Vollrath, 1991; Dalum et al., 1998).

Based on the RCA indicator presented above, Török (2003) formulates a so-called a *Sectoral Specialization Index (SSI),* which gives a country's level of national competitiveness in relation to its total exports for only one target market (such as the European Union market or a country's largest trading partner). Based on the formula created.

It also serves to measure national competitiveness based on the results of international comparisons. Another known option can be linked to the Constant Market Share (CMS) model. The model is based on the assumption that the market share of a country's exports remains constant as long as its level of competitiveness or the level of competitiveness of its competitors remains unchanged. Thus, it can be concluded that any change in a country's exports can be traced back to a change in the competitiveness of the country or its competitors (Poor, 2009; Ahmadi-Esfahani, 2006).

***Group of complex competitiveness indices***

In the literature, in addition to simpler indicators and indicators and indices analyzing the results achieved in international trade, we can also find complex competitiveness indices for measuring macro competitiveness. The group of these complex indices can be said to serve as a ranking, to establish a ranking between the individual nations on the basis of certain predefined criteria and evaluation system, this kind of ranking training is also interpreted in the work of Önsel et al. (2008). It is worth returning to Aiginger et al. (2013) for interpreting competitiveness. It distinguishes between the interpretation of input-oriented (price competitiveness), partly input-oriented (quality competitiveness) and output-oriented competitiveness (output competitiveness). Complex competitiveness indices in general can be said to use the complexity of this triple division in ranking, so to some extent the consideration of cost, capacity, and output factors appears.

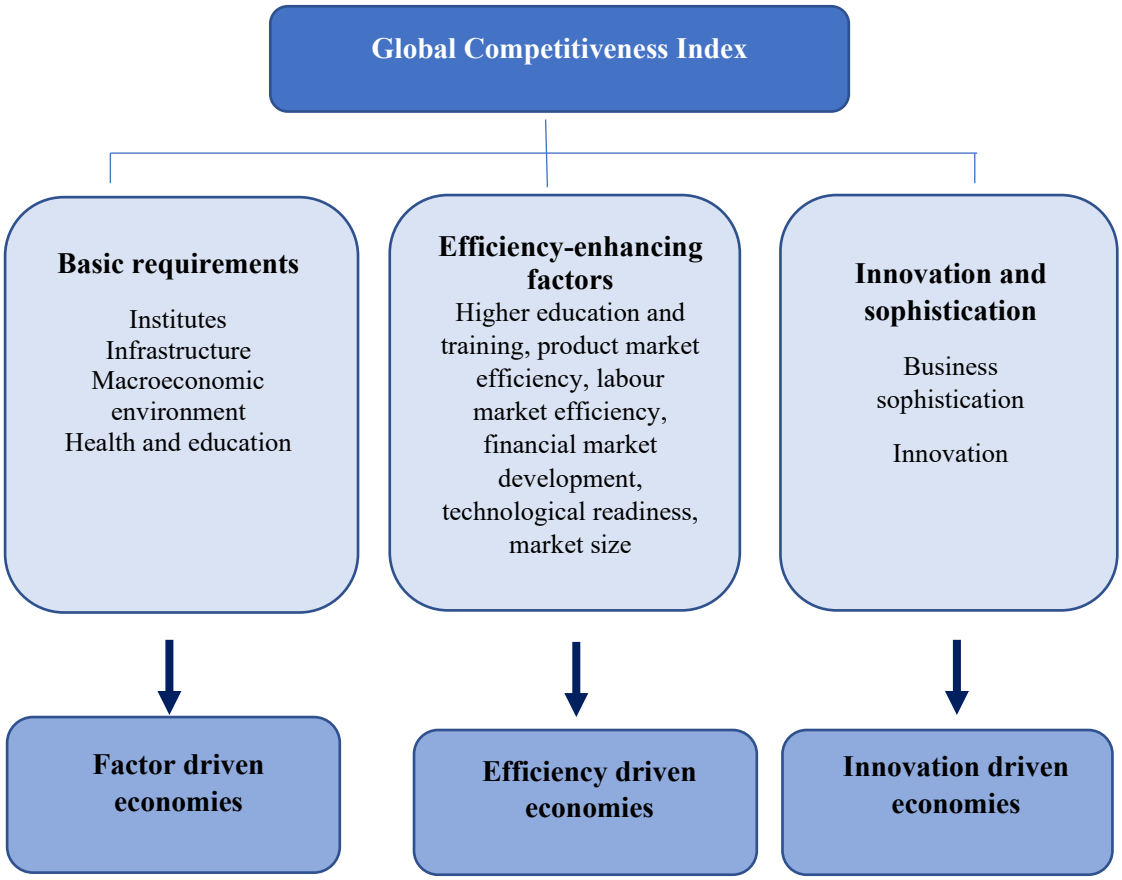
Among the indicators belonging to the group of complex competitiveness indices, it is worth highlighting the Global Competitiveness Index (GCI) developed by the World

Economic Forum (WEF) and the complex competitiveness analysis index of the International Institute for Management Development (IMD), which is published annually. published in the World Competitiveness Yearbook (WCY).

The Global Competitiveness Index (GCI) is an annual analysis defined by a framework based on the 12 pillars of the World Economic Forum and performs a complex analysis and ranking of the nearly 140 countries[7] surveyed (WEF, 2017). The GCI relies on the following 12 pillars, divided into 3 subgroups (basic requirements, efficiency-enhancing factors, innovation, and sophistication) using more than 120 variables. The countries analyzed are divided into 3 groups based on their development, factor-driven economies, efficiency-driven economies, and innovation-driven economies (Figure 6).

[7] The number of countries included in the annual analysis prepared by the WEF varies from year to year, 144 in 2016, 137 in 2017, 140 in 2018, the reason for this change varies based on the available data (WEF, 2016, 2017, 2018).

*Figure 5. – The theoretical framework of Global Competitiveness Index until 2017*



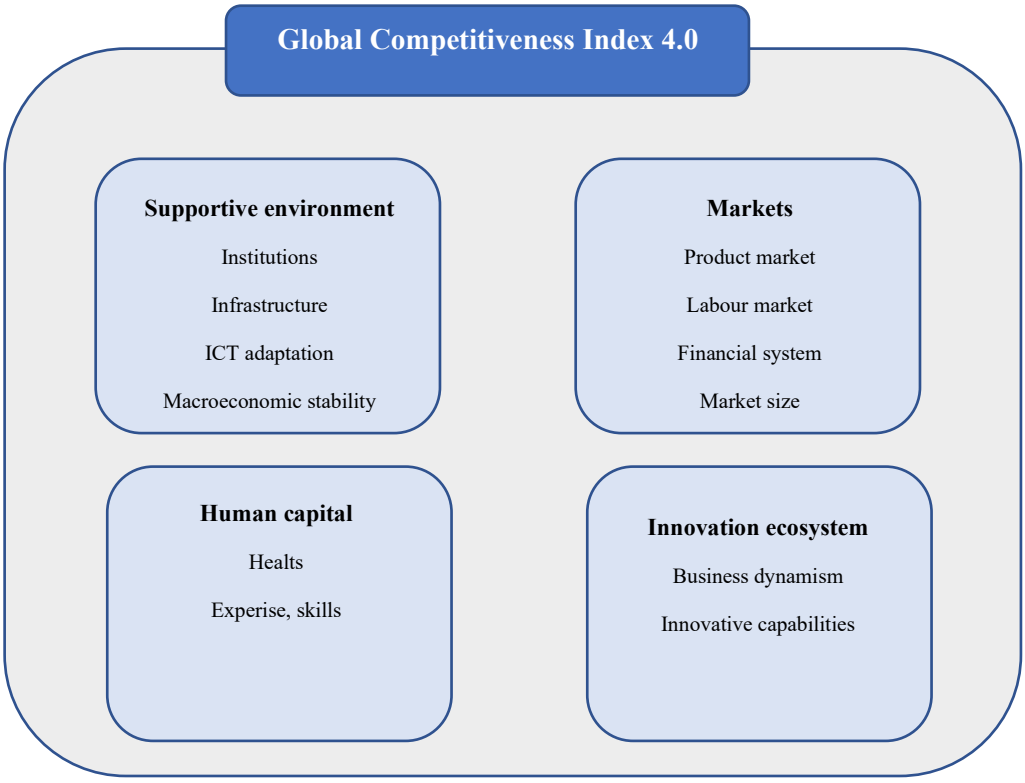

Source: based on World Economic Forum (WEF, 2017)

The WEF recognized the protracted effects of the 2008 global economic crisis (e.g., on productivity) and the growing role of the 4th Industrial Revolution (e.g., rapidly changing business models), which resulted in a new framework for the 2018 version of the GCI. It changed the previous 12-pillar factor groups and grouped the pillars around 4 themes from the previous 3 sub-indices[8]. The 4 keywords for successful economies have become resilient, agile, innovation ecosystem, and human-centric (WEF, 2018a). According to the WEF (2018a), economies need to be resilient to financial crises, mass unemployment and external shocks, to be able to respond flexibly to change, to focus on innovation and

[8] These sub-indices were basic requirements, efficiency enhancers, and innovation and sophistication (WEF, 2017).

people-centeredness at all levels to achieve economic growth, prosperity creation. The 12 new pillars of GCI 4.0 are located in the theoretical model as follows (Figure 7).

*Figure 6. – The theoretical framework of Global Competitiveness Index from 2018*




Source: based on World Economic Forum (WEF, 2018a)

The World Competitiveness Yearbook (WCY), like the WEF GCI index, is a widely used and used national competitiveness index. The essence of the index is to rank each country according to how well it is able to create a business environment for companies to help them maintain and increase the competitiveness of their businesses. The IMD World Competitiveness Center (IMD WCC) was established in 1989 and began work in the field of country-wide competitiveness calculations, and from 1996[9] onwards it continued to work under the name of the World Competitiveness Yearbook (IMD WCC, 2019). The index developed by the IMD WCC is based on 4 main factors, economic performance, government efficiency, business efficiency and infrastructure. These are broken down

[9] Until 1996, in collaboration with the WEF, they jointly published their analysis of world competitiveness indices, after which both institutions developed their own competitiveness indices and methodologies (IMD WCC, 2019).

into an additional 5-5 sub-factors, so that in total the 20 sub-factors include the 332 criteria used to calculate the index (IMD WCC, 2019).

There are other country-level competitiveness indices, e.g. the European Competitiveness Index (ECI) (ECI, 2006), which, like these two previously presented global indices, generally measures national competitiveness in a smaller sample and with fewer variables, of course, also ranking the countries surveyed. The pillars of ECI are based on creativity, economic performance and infrastructure and access to it (Balzaravičienė and Pilinkienė, 2012). Szilágyi (2008) performs a more detailed comparative analysis of the individual global competitiveness indices.

# Chapter 2. Interpretation, measurement and systematic literature analysis of meso-level competitiveness using PRISMA methodology

The introduction of the dissertation and Chapter 1 dealt with the presentation of the complex concept of competitiveness, including the definitions of two major levels of analysis, the micro and the macro level. In this chapter, focusing on the meso level of competitiveness, I present the possibilities of examining the interpretation and measurement of meso-level competitiveness using a systematic literature analysis based on the explored literature, using a PRISMA approach. To do this, I first present the concept of competitiveness interpreted at the meso level, its measurement methods. This is followed by the presentation of the methodology of the PRISMA approach to systematic literature analysis, the steps of my literature research, and then the studies analyzed during the literature search. Finally, as a result of the literature analysis, I provide a definition of industry competitiveness used in the remainder of my dissertation.

## 2.1 The concept of competitiveness at meso level

In the interpretation of meso-level competitiveness, basically 2 directions seems to appear. On the one hand, the directions of regionally interpreted competitiveness, and on the other hand, the directions of industrial and sectoral competitiveness. Thus, we can say that regional and industry approaches are the unit of analysis in the study of meso-level competitiveness (Serb, 2010). The following studies briefly present these two directions, first some of the distinguished definitions of regional competitiveness (Huovari et al., 2002; Lengyel, 2003; Meyer-Stamer, 2008; Dijkstra et al. 2011), followed by work defining industry competitiveness.

Huovari et al. (2002) differentiates regional competitiveness from that of companies and countries, stating that *"regional competitiveness is the ability of regions to stimulate, attract and support economic activities and to enjoy the relative prosperity of their citizens economically"* (Huovari et al., 2002: p. 121). According to their view, firm competitiveness differs from regional and national competitiveness in the sense, that at the corporate level, individual companies compete with each other to gain and increase market shares. Buti n case of regions and countries (at their own level, of course) compete for different mobile production factors (e.g. labor, capital, innovation). (Huovari et al., 2002).

According to a renowned expert of Hungarian regional competitiveness researchers, Lengyel (2003), regional competitiveness can be interpreted from the microeconomic level as the sum of companies' competitiveness, but it can also be interpreted as the competitiveness of a regional unit of a country (as a specific territorial unit). In the latter case based on macroeconomic results and taking these into account. Taking into account and formulating the European Union's definition of uniform competitiveness, Lengyel (2003: p. 256) defines regional competitiveness as *"essentially a capacity for sustainable economic development"*. In its formulation, regional competitiveness is *"the ability of regions to create relatively high incomes and relatively high levels of employment in an open economy"* (Lengyel, 2000: p. 975).

In Meyer-Stamer's (2008: p. 138) formulation, in the case of meso-level competitiveness, *"we can define the competitiveness of a region as the ability of a locality or region to generate high and growing incomes and improve the livelihoods of the people living there"*.

In a study for the European Union, Dijkstra et al. (2011), although somewhat broadening the previous definition, are worded similarly, as by definition, regional competitiveness should provide an attractive and sustainable environment for businesses and residents to live and work in the daily lives of those who live there. The word regional, on the other hand, poses additional interpretive challenges, as the precise definition of this term also offers many possibilities. After all, a region cannot clearly mean the aggregation of firms in a given area, nor a scaled-down version of a nation (Gardiner et al., 2004). Dijkstra et al. (2011) in their work place regional competitiveness between micro-level and macro-level competitiveness, so in their interpretation, regional competitiveness means competitiveness for an area smaller than one country.

In addition to the concepts of regional competitiveness presented above, Capello's (1994) definitions of industry competitiveness also classify sectoral competitiveness into a meso-level group. The third group of Nelson's (1992) work already mentioned (also in the conceptual definition of micro- and macro-level competitiveness) includes studies that examine and interpret competitiveness at the industry level. Thus, competitiveness on the part of the government is affected by industry-specific measures and economic policy itself. According to other authors, the interpretation of competitiveness at the meso level can be interpreted at the industry level or, for example, as clusters according to Szanyi (2008).

According to Czakó (2005: p. 15), *"we interpret industry competitiveness in relation to foreign industries. This could mean the industries in the most important sales markets of the domestic industry and the industries of the internationally leading countries that determine the world trade"*.

Bhawsar and Chattopadhyay (2015: p. 667) interpret it as a competitive industry, a set of interregional or internationally competitive companies, and, *"if it includes companies that bring a profitable return on investment"*. This was also derived from the line of thought

that successful competition in international competition results in competitiveness, and the concept of dual value creation also appears in it (Chikán, 2017).

In another approach, according to Czarny and Zmuda (2018: p. 121), meso-level competitiveness *"leads to the formation of competitive industries and sectors"*, so they share the view that the competitiveness of a given industry, based on the company level, stems from the sum of industry corporate successes.

Overall, it can be said that the conceptual system of meso-level competitiveness, similarly to the national level competitiveness, is a concept disputed in the literature, its boundaries are blurred and often difficult to interpret. Depending on whether you approach it from a company level or a national level, its interpretation may vary. There are two major directions, one is to define it at the industry level and the other is to interpret it at the regional level. These are not mutually exclusive, but rather have side-by-side or even complementary features. The following table lists regional and industry competitiveness definitions within meso-level competitiveness (Table 3).

*Table 3. – Regional and industrial competitiveness definitions*

| **Author(s), source** | **Year** | **Regional / industrial** | **Main message** |
|---|---|---|---|
| Huovari et al. | 2002 | Regional | • encourage, support and attract various economic activities<br>• citizens achieve relative prosperity |
| Lengyel, I. | 2003 | Regional | • to achieve a relatively high income and a relatively high level of employment |
| Meyer-Stamer | 2008 | Regional | • the ability of a locality or region<br>• to achieve high and growing incomes<br>• and to improve the livelihoods of those living in the region |
| Dijkstra et al. | 2011 | Regional | • to provide an attractive and sustainable environment for businesses<br>• to provide an attractive and sustainable environment for those living in the region |
| Czakó, E. | 2005 | Industrial | • should be interpreted in relation to foreign industries |

| | | | |
|---|---|---|---|
| | | | • the industries of the most important sales markets of the domestic industry, and the industries of the leading countries in world trade |
| Bhawsar and Chattopadhyay | 2015 | Industrial | • a set of interregional or internationally competitive companies in which the companies bring a profitable return on investment |
| Czarny and Zmuda | 2018 | Industrial | • the overall success of companies means the development of competitive industries and sectors |

Source: own construction, 2019

## 2.2 Measuring meso-level competitiveness

In the case of measuring meso-level competitiveness, they represent the scope of the two large groups mentioned above, industrial and regional competitiveness. Based on the literature, in case of measuring industry competitiveness, it can be said that do not exist uniformly accepted and applied separate measurement methods. In order to measure the competitiveness of an industry, besides the use of certain traditional financial and accounting indicators, the measurement methods originally used in international trade are used, interpreted and applied to a specific industry.

Among the traditional financial indicators, it is worth highlighting, for example, the calculation of unit labor costs. Török (2003) distinguishes between demand and supply competitiveness indicators. In the case of supply (i.e. on the production side) competitiveness, the Unit Labour Cost (ULC) is used, which divides the sum of wages and salaries and other wage costs in the given industry and sector by the value added of the industry.

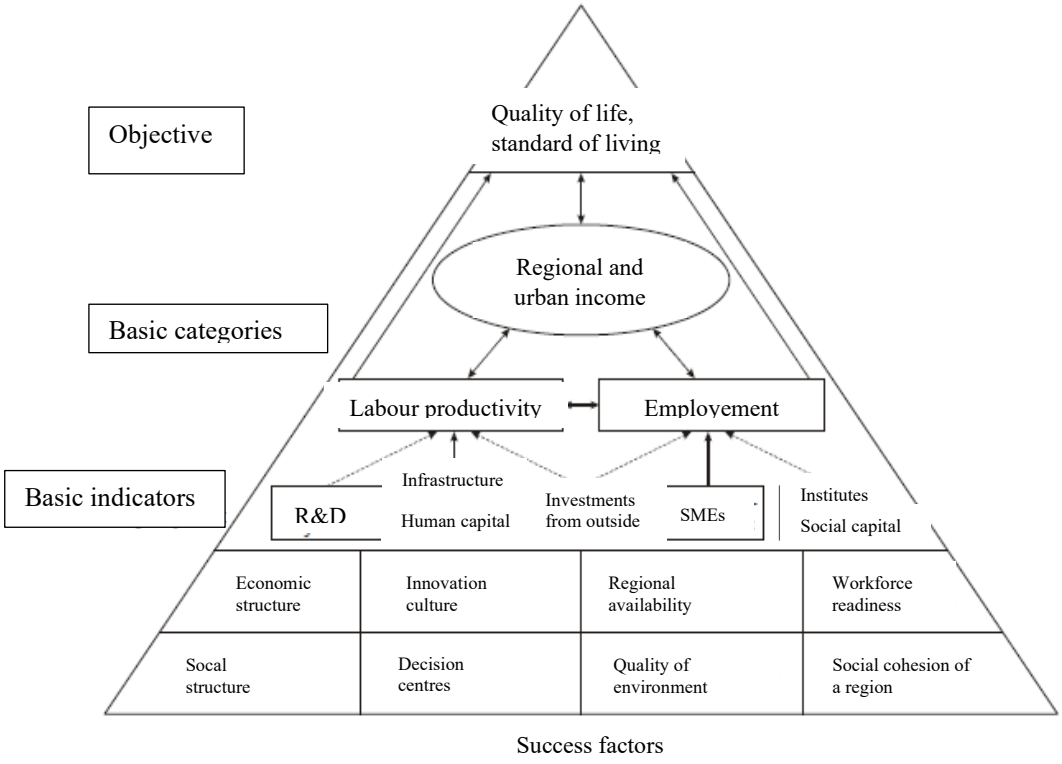
The Unit Value Index (UVI) is used to measure demand (on the market side) competitiveness. It compares the change in the unit of exports of an industry or sector of a given country with the change in the unit value of exports of the industry or sector weighted by the share of the destination country or group of countries (for example the European Union) in world imports. The index shows whether the unit value of a given country's exports has not been able to increase more, stagnantly or at all compared to the market under study.

In the case of measuring regional competitiveness, Lengyel (2003: p. 258) states that *"the methods developed for measuring the competitiveness of countries cannot be applied"*, so automatically using country-level measurement options leads to the wrong path. But the same is true if we approach from a corporate level. It seems logical to interpret regional competitiveness as the totality of companies operating in the region under study. As there are companies operating and having very different standing capacity, productivity, efficiency in a region, this kind of aggregation and evaluation could also be misleading (Lengyel, 2003). To solve the above problems, Lukovics and Kovács (2008) propose the development of a measurement method that relies on a widely accepted theoretical framework, such as the definition of uniform competitiveness. In line with the European Union's definition of competitiveness, regional competitiveness per capita size and growth rate, level and growth rate of labor productivity in the region, employment rate and change in the region can be used as indicators to measure regional competitiveness (Lengyel, 2003, 2006). The aggregation of the various indicators and the various factors of improving competitiveness are called the pyramid model (Lengyel, 2006), as shown in Figure 8.

The essence of the model is to organize into a single framework the definition of regional competitiveness, the determining factors and the measurement methods. According to the unified definition of competitiveness, the aim is to raise the living standards of the citizens of a given region. The path to this is based on determinants such as economic structure, innovation culture, regional accessibility, workforce readiness, social structure, decision centers, environmental quality and social cohesion in the region. These are all essential to achieving long-term development. The basic factors on which the basic categories, ie the indicators measuring regional competitiveness, are based are based on these determining factors. Key factors include research and development, infrastructure and human capital, as well as external investment, which determine your labor productivity. In addition, employment is affected by small and medium-sized enterprises, institutions and social capital, as well as external investment. The basic categories of labor productivity, employment and regional (both regional and urban) income also influence each other and influence the goal to be achieved, the quality and standard of living of the people living in the region, its growth opportunities (Lengyel, 2003, 2006; Lukovics and Kovács, 2008).

Figure 8 shows the relationship between the regional, regional, urban income, labor productivity and employment rates measured on the output side, as well as the relationship between the factors influencing these outputs. This figure is also consistent with Aiginger et al. (2013) with the conceptual framework of output competitiveness as a new approach to competitiveness.

*Figure 7. - Structure of the pyramid model to measure regional competitiveness*




Source: Lengyel (2006: p. 139)

## 2.3 Methodology of systematic literature analysis in PRISMA approach

In this chapter of the dissertation, based on the secondary sources, I would like to present the way and the results of the search for the literature, the aim of which is to map the literature of the meso-level, and within that, industrial competitiveness. Several ways of implementing the literature analysis are known. The “snowballing method”, the essence of which is that it is necessary to explore the relevant literature based on some pre-selected and defined scientific work, using their references (Goodman, 1961). Another method is the implementation of the so-called “systematic literature review”, in the application of which the researcher collects the literature material necessary for the researchers’ topic in databases based on keywords and phrases. Another option is a combination of the

former two, in which case a systematic database search is complemented by a snowball method or a search solution based on the researcher's own existing knowledge (e.g., of a given author, of a given scientific journal) (Jalali and Wohlin, 2012).

The history of systematic literature analysis does not look too long. At the end of the 20th century were published the first studies in the field of medicine, where the aim was to collect the most important results of the previous researches, as widely as possible, without bias and in a systematic way (Transfield et al., 2003). The study selects, collects, filters, and analyzes scientific work according to a pre-defined protocol, which is greatly increased, which greatly increases the need for transparency, reproducibility, and avoidance of bias (Rousseau et al., 2008).

The abbreviation "PRISMA"[10] means a very important methodology for literature research and analysis, which is of outstanding importance in certain fields of science (such as medicine) (Moher et al., 2010; Liberati et al., 2009; Knobloch et al., 2011). In addition, a PRISMA literature research was conducted for the application of sustainable agriculture (Nascimento et al., 2017), DEA modelling in supply chain management (Soheilirad et al., 2018), and for different supply chain types between logistics partners (Nisrine and Rhizlane, 2019).

The essence of the method is to give the reader a clear and transparent picture of the literature research carried out, thus avoiding the appearance that the researcher has biasedly selected scientific works to establish his or her own research. In a PRISMA-based literature review, the author demonstrates the milestones of his choice of transparency and bias through strict checkpoints. PRISMA research can basically consist of a systematic literature analysis and / or in addition a so-called meta-analysis. The latter involves the use of different statistical techniques in which the results of the selected studies are integrated and summarized.

Systematic literature analysis attempts to gather and analyze all available empirical evidence that meets the previously identified research question and the criteria derived from it (Liberati et al., 2009). It uses a transparent, explicit, systematic framework designed to minimize bias and bias. Accordingly, as a result of systematic literature

[10] PRISMA is an abbreviation generated from the term Preferred Reporting Items for Systematic Reviews and Meta-Analyzes, was previously more commonly known as QUOROM, i.e., Quality of Reporting of Meta-Analyzes (Moher et al., 2010; Knobloch et al., 2011).

analysis, reliable conclusions can be drawn and decisions can be made (Page and Moher, 2017).

Many systematic reviews include meta-analysis, but this is not a mandatory element, and in many cases depends on the discipline (Moher et al., 2010; Liberati et al. 2009; Page and Moher, 2017).

According to Liberati et al. (2009), the essence of systematic literature analysis can be divided into 4 main points:

1. The objectives of the analysis must be clearly stated, with a methodology that allows it to be reproducible.

2. A systematic literature search should attempt to identify all studies that meet the criteria in the previous section.

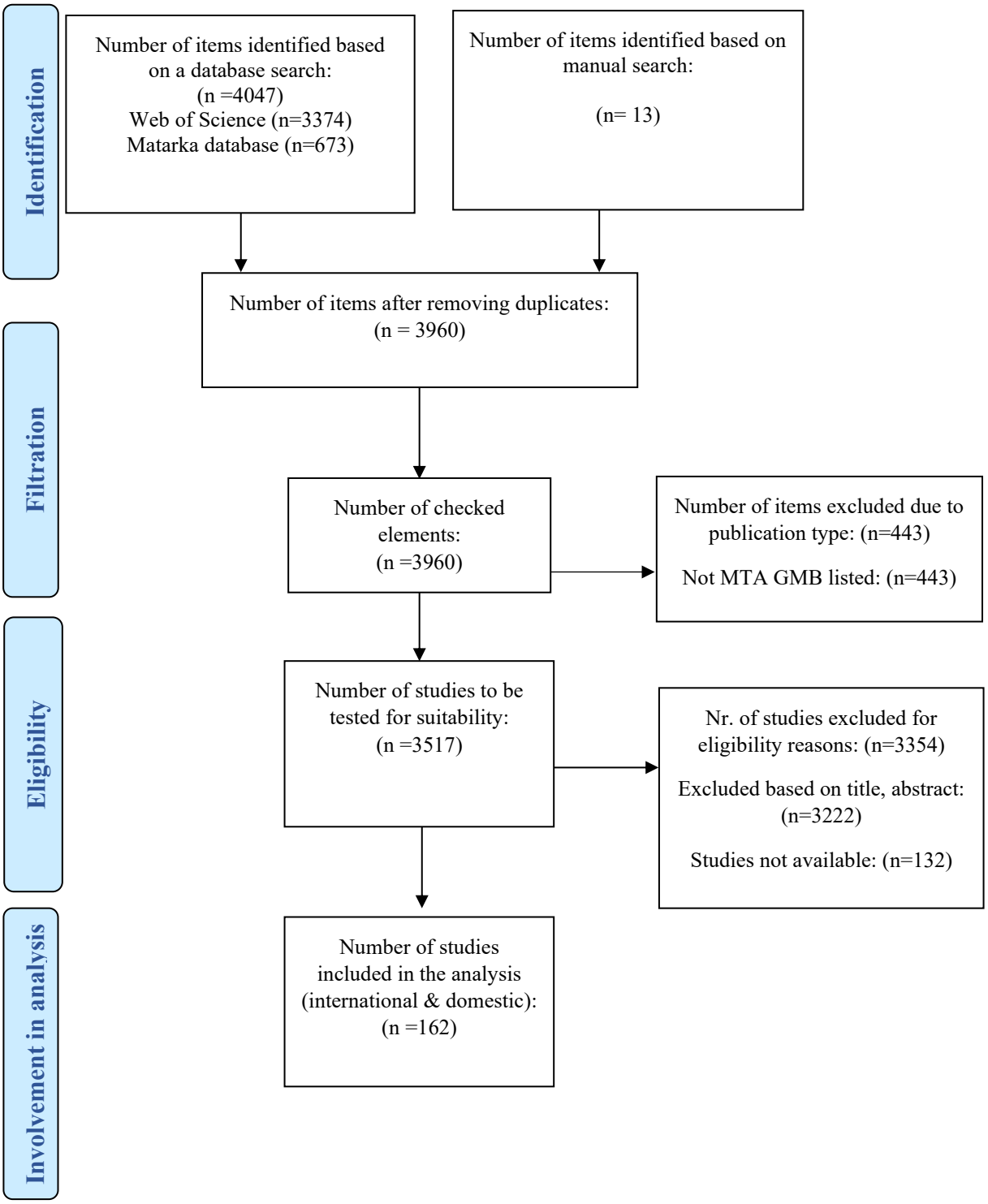
3. The validity of the findings of the selected studies needs to be assessed without the risk of bias.

4. Analysis of the selected studies, systematic presentation and synthesis of their characteristics and findings.

For research following the PRISMA framework, the researcher (s) should go through a multi-step checklist. These steps are, of course, necessary in order to meet the conditions indicated earlier, it increases transparency and reliability. In addition, as a unified form of systematic literature analysis, there is an information flow diagram that is selected and shows narrowed studies step by step, thus enhancing reproducibility (Liberati et al., 2009).

Using this logic, I created a diagram showing the information flow of my systematic literature analysis in the presentation of the systematic literature analysis of the dissertation, showing the number of the four major phases, identification, screening, suitability, and final selected studies (Figure 9).

Figure 8. - *PRISMA flowchart of systematic literature analysis of meso-level competitiveness research*




Source: based on Liberti et al. (2009) own construction

Based on the flowchart, the scope of the studies included in the analysis can be divided into 4 large parts, which means the steps of identification, filtering, eligibility, and involvement in the analysis.

***Identification***

In the first phase, ie during the identification, I decided to search in an international and domestic database. To examine this, I analyzed the international and domestic literature separately. This is due to the lack of a common database as well as the ability to set search terms in different databases. For international journal articles, I used the Web of Science (WoS, 2019) Core Collection database, which is one of the largest scientific search engines in the world, in the form of journals, books, conference proceedings in many disciplines, including management and economics areas. Only highly listed scholarly works are listed in the WoS database, so I was able to access a zero-step filter by selecting the database. The database contains scientific works from 1975 to the present day, this period I also kept for completeness. However, I was forced to introduce several other restrictive conditions due to the high search results, this was the duration, the type of scientific work, the language. The search focused on studies and articles in scientific journals from 1975 to the end of May 2019. In addition, I filtered out all other scientific works (such as books, book chapters, conference materials) from my search system, and the search language was English. To search, I selected keywords and then searched for them in the titles, abstracts, and keywords of published journal articles. With this step, I tried to avoid a work falling out of the hit group that, although more deeply concerned with competitiveness, was not included in the title of the work. My keywords were as follows:

- *industrial competitiveness*
- *sectoral competitiveness*
- *meso competitiveness*
- *mezo competitiveness*
- *mezzo competitiveness*

With the keywords I chose, I tried to focus from the vast literature on competitiveness to industry competitiveness, the meso level, which interprets and examines neither product or corporate, nor national, or above levels. The first two versions of the keywords try to

search for the sector, industry, sector itself, and the next three for the middle level, which is located between the micro and macro levels.

The search results for the above keywords were as follows. For *industrial competitiveness*, WoS returned 2986 hits, *sectoral competitiveness* 331 hits, *meso competitiveness* 53, *mezzo competitiveness* 3, and finally *mezo competitiveness* 1, bringing a total of 3374 journal articles to the group as a first step in the search. The large number of hits thus obtained also explains my decision to search exclusively for journal articles for literature analysis, deleting all other types of scientific work (such as books, lecture materials, etc.) when setting search criteria.

The analysis of the Hungarian literature also followed a similar logic, but of course my search had to be adapted to the different database and its different search criteria. For the analysis of the Hungarian literature, I chose the Matarka database. The Matarka database is a database managed and supervised by the Matarka Association (Matarka, 2019), which is a searchable collection of table of contents of Hungarian journals, the most complete database in Hungary with 2 and a half million processed articles and more than 1800 journals (Matarka, 2019). Although it is possible to search for complex terms in the search interface, I did not consider it appropriate to use them due to word usage and possible loss of results. Thus, I considered the use of the *competitiveness* keyword only to be appropriate, and then several rounds of screening followed. I did not have any additional restrictions on the search period and disciplines, all of which I wanted to provide a wide range of search options. Thus, a total of 673 results were found in the database after searching for the keyword *competitiveness*. With a manual search, an additional 13 studies entered the identification phase, resulting in a total of 4060 hits.

### *Filtering*

The next phase involved filtering out the large number of hits received in the first round. This type of filtering can be divided into two steps. On the one hand, due to the overlapping of search terms in the international literature, some duplicates were created, which were also filtered out (100 pieces), so the number of items after removing duplicates became 3960 studies (see Figure 9 above).

After filtering out the duplicates, it became important to include an additional step at this stage. During the Hungarian literature search, the number of hits in Matarka's database also became quite high, so further screening became necessary. The original results include studies in scientific journals, but educational articles, studies and written opinions were also included in the results. These were selected according to the following logic. In the next step, the Hungarian Academy of Sciences (MTA) IX. I called on the journal list of the Doctoral Qualification Committee (DQC) (MTA, 2019) of the Department of Economics. I compared all category A, B, C, and D journals accepted by the DQC committee with a list of journal articles found in the Matarka database. All other types of journal articles (not category A, B, C or D journals) have been deleted. Thus, out of the previous 673 results, a total of 230 journal articles remained; 20 A-category, 90 B-category, 65 C-category and 55 D-category studies. Thus, the number of items excluded due to the type of publication was 443 works. Finally, a total of 3517 studies were included in the next phase of the systematic research, suitability examination (domestic and international literature works) (see Figure 9 above).

***Suitability***

In the next phase of the systematic study, a range of studies excluded and screened for duplicates and publication type were examined for suitability. In the course of the suitability test, the main argument for the analysis of the literature is how a given work interprets and applies the concept of meso-level, industry competitiveness in the study. The suitability test of the international and domestic literature was again performed independently of each other, but along the same logical thread. That is, all studies that only partially discuss, merely mention, or analyze competitiveness from a different perspective (e.g., technical, technological, human resources), or not at the meso level, have been screened out based on titles and abstracts. Thus, articles examining competitiveness with corporate competitiveness or at the level of the national economy were also excluded from the circle. Furthermore, even at this stage of the aptitude test, all studies (both in the domestic and international literature) that are not available in their entirety (eg due to lack of an online version or limited access) through any database (eg University Library of Corvinus University of Budapest, Google Scholar, or the archive of the given journal). These are usually limited to studies that have only been in print and

their electronic version is not (yet) available. As a result of the two steps of the aptitude screening, 132 international studies and 30 studies in Hungarian remained, thus a total of 162 works entered the analysis phase. These were further grouped by content (see Figure 9 above).

***Analysis of the studies included***

The groups formed on the basis of the results included in the analysis (162 studies, which are also shown in Figure 9) as well as its analysis are included in the following subsections (2.4 and 2.5).

## 2.4 Analysis of international literature

Before analyzing the articles presented, it is important to mention that the articles analyzed do not always belong to only one group, as the grouping criteria include a number of topics (eg trade and cluster, services and trade) that have been used in combination in the studies. authors in their research. For each group, the presentation of the authors' studies follows a chronological order for easier traceability, while the summary tables at the end of each group contain the alphabetical order of the authors for easier retrieval.

***Theoretical***

In this subchapter of the dissertation I would like to present the theoretical studies in terms of the examined dimension and the most important results.

In his work, Nelson (1992) basically seeks and interprets the concept of competitiveness among the scientific ideas and dissertations published in the USA in the early 1990s, in the decade before that. In his study, he classifies the work examining competitiveness into 3 large groups, as he puts it in a *"cluster"* (Nelson, 1992: p. 127): company, national economy, and industry. The writings in the first cluster focus on companies competing with each other for their products for consumers. From a microeconomic point of view, this approach usually examines the various factors that strengthen or even weaken a

company's capabilities. The second group of works is competitiveness studies interpreted from a macroeconomic perspective, which examine the macroeconomic performance of national economies and the factors behind strong or weak economic performance. This second group focuses on examining the macroeconomic environment of a firm in which firms operate. Writings in this group also examine the impact of individual public policies (e.g., education and its impact on the labor market), which greatly influences corporate competitiveness. The works in the third group examine competitiveness at the industry level, in a comparative manner, where the intervention and regulation of the state at the industry level and the development of the economic environment are emphasized. Nelson interprets the 3 perspectives not as competing but as complementary perspectives that, on the whole, interpret the complex phenomenon of competitiveness.

In the year following Nelson's (1992) work, Georghiou and Metcalfe (1993) examine and attempt to provide an accurate definition of competitiveness and establish key principles for measuring it. Competitiveness, its different levels, are derived from the phenomenon of "competition", which has 3 elements: competitors and their behavior, established rules that define legitimate competitive behavior, and the definition of criteria for success or failure. Based on these, it is possible to define the essence of competitiveness at different levels. These levels in the authors' formulation are the transformation process, the corporate and national levels, accepting additional intermediate levels of analysis (such as the industry or regional level of analysis).

Chaudhuri and Ray (1997) also sought to define competitiveness in its complexity by processing studies discussed in the literature. Two dimensions were considered, the interpretation of competitiveness at different levels (corporate, industry or national) and the different types of variables that explain competitiveness (company, industry or the economy as a whole). Based on this, each literature work on the interpretation and measurement of competitiveness is classified into a 3 x 3 matrix and their definition of competitiveness is given for each category. Thus, competitiveness at the industry level relevant to the present dissertation means the ability to export or the substitutability of imports in their view (the other two major main groups are the traditional levels of interpretation at the national and company levels). They suggest that the phenomenon, due to its complexity, should be evaluated and analyzed along several schools of thought and several measurement lines, and Table 4 illustrates the levels of interpretation of industry competitiveness important for their dissertation and literature research.

*Table 4. - Definition and measurement of industry competitiveness*

| **Category** ***level of interpretation*** *– gourp of indicators* | **Definition of competitiveness** | **Measurement** |
|---|---|---|
| 4th category ***industry*** – *whole economy* | Possibility of export or import substitution. | Price difference between domestic and international market prices of products, share of the industry in world trade, penetration rate of imports in the domestic market, productivity of the total factor. |
| 5th cathegory ***industry****-industry* | | |
| 6th category ***industry****-company* | | |

Source: based on Chaudhuri & Ray (1997) own construction, 2019

Hoff et al. (1997) also focused their research on the interpretation of industry competitiveness. Their research concluded that an overly narrow interpretation of competitiveness (as based on natural resources, labor costs, or exchange rates) does not lead to adequate results in many industries. A kind of complex approach is needed to determine the industrial structure and the competitiveness of the company, which includes both industry and company characteristics. An effective competitiveness model that should include a variety of indicators such as product information, factors of production, industry structure, consumer demand, information on marketing channels, manufacturing processes, quality issues, and related services.

Lall (2001) questions Porter's (1990) use of the concept of national competitiveness in interpreting competitiveness. He argues for Krugman (1994) and sees that talking and arguing about national competitiveness is misleading, similarly Lall interprets it as synonymous with productivity. On the other hand, it has a raison d'être to examine and evaluate industry or even corporate competitiveness. With regard to its measurement, he emphasizes that claims and indices for quantifying competitiveness need to be more moderate, as the phenomenon is too diverse and complex to be easily measured.

Siggel (2006) examines the complex concept of competitiveness through literature analysis and breaks it down into different dimensions. It interprets competitiveness according to four main groups of characteristics: micro - macro; a static - dynamic; the positive - normative; ex ante - ex post competitiveness characteristics. It separates the notion of competitiveness from the notion of comparative advantage, but uses the terms

competitiveness and competitive advantage as synonyms. This export success of a given country can be considered as a competitiveness rather than a comparative advantage, as this advantage realized in exports can reflect the results achieved by subsidies and incentives, so a given country has a competitive advantage but not a comparative advantage in a given area. By micro-competitiveness Siggel means the competitiveness of a manufacturer or industry, by macro-competitiveness the competitiveness of national economies is understood.

Similar to the research of Chaudhuri and Ray (1997), Hurley (2018) used an matrix to draw boundaries between otherwise difficult-to-define levels of competitiveness to interpret the complex concept of competitiveness. Along one axis the so-called. history or influencing factors, on the other axis are the competitiveness results (levels). Each type of antecedents and competitiveness outcomes listed corporate, industry, and national or regional factors, so it can be seen that in his interpretation, corporate competitiveness is micro, industry competitiveness is meso, and regional and national competitiveness is macro. By regional competitiveness is meant macro-level competitiveness, which has the possibility and ability of economic growth compared to other regions with a similar level of economic development (typically within a country or a given continent). By meso-level competitiveness is meant the competitiveness of a given industry, which can be described by the average aggregate productivity of a given industry and the value produced per unit of labor or capital employed.

Vlados and Katimertzopoulos (2018) derived the analytical dimension of meso competitiveness from the micro and macro levels. Mezo competitiveness refers to the study of factors that traditionally determine the structural dimensions and intermediate size of the economic system under study, such as the sector of economic activity, concentration, market entry, and evolving forms of competition and innovation in interiors. Overall, therefore, it can be interpreted both industrially and regionally. The authors suggest the coordinated use of all levels of analysis to design appropriate economic policies.

In the work of Manuylovych (2013) and Bliznyuck (2018), they also used macro, meso, and micro levels in interpreting competitiveness, but their classification is slightly different from others. Micro-competitiveness, like other authors, falls within the conceptual scope of product and firm competitiveness. It places the competitiveness of

industry and clusters on meso competitiveness, while in the case of macro competitiveness, in addition to national competitiveness, it also lists the competitiveness of an area or a region.

*Table 5. - Interpretation of industry competitiveness in the international literature*

| Authors | Year | Dimension examined | Main message |
|---|---|---|---|
| Chaudhuri and Ray | 1997 | complex interpretation of competitiveness | Competitiveness definitions and measurements arranged in a matrix based on the level of competitiveness (enterprise, industry, national economy) and types of variables (variables belonging to a company, industry or the whole economy). |
| Georghiou and Metcalfe | 1993 | complex interpretation of competitiveness | Derived from the concept of competition, which consists of 3 elements: competitors, rules, success / failure criteria. 3 basic levels of analysis are defined: transformation process, company and nation. |
| Hoff et al. | 1997 | industrial competitiveness | The too narrow interpretation of competitiveness is no longer appropriate for examining many industries. Develop a competitiveness model that includes both corporate and industry characteristics. |
| Hurley | 2018 | complex interpretation of competitiveness | Interpretation of competitiveness in the form of a matrix based on different levels of background or influencing factors (company, industry, national / regional) and levels of competitiveness (company, industry, national / regional). |
| Nelson | 1992 | firm, national economy, industrial | The 3 groups examined are complementary perspectives that together can capture the complex concept of competitiveness. |
| Siggel | 2006 | definition and measurement of competitiveness based on different dimensions | Along various characteristics:<br>• micro (corporate, industry) vs. macro (national economy),<br>• static vs. dynamic,<br>• positive (what, in fact, related to micro theories) vs. normative (as it should be, related to macro theories),<br>•ex ante (identify the source of the competitive advantage, even if it has not been realized) vs. ex post (realized competitive advantage) |

Source: own construction, 2019

***Trade, international trade***

In many cases, the competitiveness of an industry is measured and evaluated by the authors with the results achieved in commerce. As a result, nearly one-third of the studied included into the literature review (24%, 32 out of 132 articles) explained the competitiveness of a given industry in terms of trade, especially in international trade. It can be observed that these international trade studies either examine competitiveness from a theoretical point of view or, in the case of empirical research, use only a quantitative research methodology.

In their research, Kim and Marion (1997) basically test the Porterian hypothesis. According this that intensity of competition in the domestic market has a positive effect on the results achieved in international markets (net export share, relative trade performance index). To test this, the authors evaluate the trade data of the US food industry to measure international competitiveness and conclude that there is indeed a link between the competition perceived in a particular domestic market and the results achieved in international markets.

Aswicahyono and Pangestu (2000) examine the degree of export competitiveness at the sectoral level in Indonesia and other countries in East Asia in the 20th century. in the last decade of the twentieth century. It also uses descriptive statistical tools and an index of revealed comparative advantages (RCA). It concludes that low-skilled, labor-intensive sectors have a competitive advantage, while high-skilled or high-tech sectors have a competitive disadvantage.

Bilalis et al. (2006) examine the competitiveness of the Italian, Spanish and Greek textile industries in their work. For this, an industrial excellence model is used and the available data are analyzed as a case study. Thus e.g. key performance indicators for the textile sector are analyzed, including quality, flexibility, supply chain management, strategy formulation and strategy implementation. It was concluded that despite significant textile export activity, there are a number of development opportunities to improve the competitiveness of the sector, in particular in the areas of human resources and knowledge management.

Ahrend's (2006) research focused on the examination of the Russian economy as a whole and its changes at the sectoral level, which sought to examine the impact and results of

the industrial structural changes that took place in the 1990s in terms of the efficiency and competitiveness of individual sectors. To do this, it calculated and analyzed the results of labor productivity, unit labor costs, and revealed comparative benefits (RCA) indices. Ahrend concluded that there has been a large improvement in labor productivity since the last years of the 1990s. This improvement applies to almost all sectors, not to those where public involvement has remained high. Labor productivity has increased more significantly in the less productive sectors, so there is a kind of adjusting and rearranging effect in the industrial structure.

Cooper (2006) compares the product groups of some of Russia's medium and high-tech industries with its largest commercial competitor, such as China, Brazil, India, Turkey, and the US, and finds a revealed comparative disadvantage of Russian product groups. The author used the Revealed Comparative Advantage (RCA) index to perform the analysis. Taking into account the available data and, consequently, the limitations of the index, it concludes that a trend is emerged using the index. This trend demonstrates the need for specialization in trade and the importance of moving towards knowledge-based economic activities while reducing dependence on hydrocarbons and other minerals.

Kilduff and Chi (2006a and 2006b) presented their research findings in a two-part, longer study conducted on the world's 30 leading textile countries over the 42 years between 1962 and 2003. The aim of the research was to examine the long-term trade position and specialization of the largest textile and clothing exporting countries in different sub-sectors (e.g. textile, textile clothing sectors). The Revealed Comparative Advantage (RCA) index was used and the results were compared by classifying the countries included in the research into different income groups. It was found that higher-income countries tend to have a stronger competitive advantage in more capital-intensive sub-sectors, while lower-income countries tend to have a competitive advantage in labor-intensive sub-sectors.

Faria et al. (2009) examined the competitiveness of the Chinese manufacturing industry, examining the relationship between oil prices and its export activity. In their research, they used the Autoregressive Distributed Lag (ARDL) model for the period 1992–2005. Their study finds that although China is a net importer of oil, its export activity is less sensitive to changes in oil prices due to increased demand for oil, which is caused by the

large volume of labor acting as a substitute. This means an advantage over your competitors and a strong competitive result.

Han et al. (2009) examine and analyze the competitiveness of the Chinese woodworking and furniture industry in their study, as China has become the world's leading exporter in this sector based on its export trade performance. Examining the period from 1993 to 2007, the authors observed that the Chinese furniture industry had a comparative disadvantage during the period, based on the results calculated by the market share index, the Revealed Comparative Advantage (RCA) and the Trade Competitiveness (TC) indices. at the beginning, then it changed and became a comparative advantage. The investigation was carried out against its largest competitors (based on export market share), so that Italy, Germany, Poland, Vietnam, Brazil, the USA, Malaysia, Indonesia and Canada were among the countries examined. The results show China's growing competitive advantage, which has not yet reached the level of the Italian and German furniture industries, and there seems to be a clear trend over the period in terms of deteriorating competitiveness in higher-income countries and improving competitiveness in lower-income countries.

In his work, Albaladejo (2010) analyzed the canned fruit and vegetable sector in the 20th century in Spain. His research is descriptive, supported by available statistics. The importance of this Spanish sector lies in the fact that it has had a significant export activity (more than 50% of production) for decades, so its competitive advantage in trade contributes greatly to the sector's success. The author concludes that low labor and raw material costs as well as significant European demand have helped the sector succeed.

Heckova and Chapcakova (2011) measured the competitiveness of the Slovak manufacturing industry between 1998 and 2008, also using the Revealed Comparative Advantage (RCA) index and its further alternatives (e.g. Michaely index), as well as the market segmentation method. It found that due to the use of the national economic measurement tool used to measure sectoral competitiveness, there is an overlap in the assessment of macro- and meso-level competitiveness.

Koneczna and Kulczycka (2011) used the revelaed comparative advantage method (RCA) and alternatives to examine the range of Polish environmental goods & services for the period 2004–2007 for 9 different manufacturing sectors, mainly in the markets of developing countries. The authors concluded that Poland does not have a comparative

advantage over OECD countries in terms of products and services in developing countries. Furthermore they noted that additional spending on environmental protection and technology development could increase the competitiveness of the analyzed product ranges in international markets.

Savic et al. (2012) examined the competitiveness of the Serbian food industry using the Revealed Comparative Advantage (RCA) index for the period 2001–2010. They concluded that the focus of economic policy should be on the Serbian food industry in order to maintain and further increase its results. The structure of food products intended for export must be adapted to the needs of the receiving market (primarily the EU) in terms of both quality and product range.

In his research, Cimpoies (2013) examined the state and competitiveness of Moldova's food economy for the period between 2007 and 2011. To this end, it examined, on the one hand, the level of intra-industry trade and, on the other hand, the level of trade between industries. To measure intra-industry trade, the so-called He calculated and evaluated the Grubel – Lloyd index[11], Balassa's comparative advantage (RCA) and its variants (e.g., revealed trade advantage index, RTA) for inter-industry trade. It was found that in the structure of Moldova's exports, the range of agro-industrial products is twice as large as in the food industry, much of the former (showing a real deteriorating trend, but) has a comparative advantage. The author proposes to focus on increasing production efficiency, technological development of food production and quality production in order to improve competitiveness.

Cavallaro et al. (2013) compared the industrial competitiveness of Central and Eastern European countries with the industrial competitiveness of the previously acceded Member States of the European Union based on econometric estimations. The authors explain the sectoral differences in export trade and the increase in market share through specialization in capabilities. This specialization will enable companies specializing in high qualifications and skills to perform better in the process of European integration than companies with lower qualifications and skills in quality markets. At the same time, companies specializing in lower capabilities are forced to compete on price in international markets. The authors concluded that the unit value ratio gives a good result

[11] Grubel and Lloyd (1971) developed the Grubel - Lloyd Index (GL index), which is named after them, and is used to measure its intra - industry trade in a given product (ie exports from and imports of the same product).

for approaching the quality of trade, and that the market share of capacity-intensive industries is significantly correlated with the high-quality market requirements of high-income EU Member States.

In their study, Costantini and Crespi (2013) examined the export competitiveness of the former and newly acceded Member States in certain sectors of the internal market enlarged by previous EU enlargements. The study used a technology-enhanced gravity model to examine the impact of economic integration and technological capabilities across Member States. In conclusion, it was concluded that accession had a positive impact on the export activities of the new Member States and that this increase was not limited to the low technology sectors. Furthermore, the importance of the level of technological capabilities was identified as an unquestionable factor in the enlargement of the EU.

Ignjatijevic et al. (2013) examined the competitiveness of a range of products from the primary and secondary sectors in the Danube countries, using the RCA (Index of Revealed Comparative Advantages), LFI (Lafay index) and GL (Grubel - Lloyd index) indices. The authors found that the production and export structure of the Danube region is not favorable, integrated development, supply of raw materials of the same quality, low-cost and efficient production process would further increase export competitiveness.

In their study, Chen and Whalley (2014) analyze the competitiveness of trade in services using descriptive statistical tools in China. They note that, although the growth rate of trade in services is high, it still lags behind trade in goods, and measures are proposed to further encourage this sector.

Kordalska and Olczyk (2014) intent to measure the competitiveness of the EU economy in the research of the EU19 manufacturing industry. The study examines how the competitiveness of exports is affected by the level of foreign and domestic demand, the level of unit labor cost (ULC) in the sector, the degree of openness of the sector to foreign markets, labor productivity, intra-industry trade and intermediate consumption of the sector. The authors examined the period between 1995 and 2009 using a spatial panel data model and concluded that the range and activity of neighboring countries is a significant factor that positively affects both the total export value and the share of exports affected by imports. touch. Overall, this means that an increase in the export value of

neighboring countries will also have a positive effect on the export growth of a country's industry

Remeikiene et al. (2015) examined the competitiveness of the Baltic countries in different industries between 2007 and 2012, using a number of indices (revealed comparative advantage index, symmetric revealed comparative advantage index, export competitiveness index). The authors examined the preceding period with a literature review and compared it with his own empirical results. It has been concluded that the Baltic States were able to maintain and increase their comparative advantage in the food, raw material processing, beverage and tobacco industries after their accession to the EU and during the crisis.

The aim of the research of Sujova et al. (2015) was to analyze the Slovak and Czech wood processing industries between 2003 and 2012, finding that the extent and quality of international trade significantly determines the competitiveness of a given sector. The growing export performance of the wood processing industry has a positive impact on the economic performance of countries. Based on the analysis of the Revealed Comparative Advantage (RCA) index and the contribution to foreign trade indicator (FTI), the authors conclude that the performance of the sector is affected by changes in the structure of the trade balance of industry.

Visser and co-authors (2015) examined the competitiveness of a region, Mpumalanga (South Africa), using the Revealed Comparative Advantage (RCA) index. Examining the agricultural sector, 15 product groups were analyzed and based on the results, it was concluded that for 8 of the 15 product groups, the region has a comparative advantage.

In their work, Obadi and Korcek (2016) compared the trade of the world's two leading trading partners, the EU28 as a whole, with that of the US to examine the balance of power between the two trading partners at the industry level. To this end, the Revealed Comparative Advantage (RCA) and its various alternative indices were used and it was concluded that the US has a competitive advantage over the EU-28 in a number of significant sectors.

Alam and Natsuda (2016) examine the competitiveness of the Bangladeshi garment industry by conducting a questionnaire survey (involving 70 companies) among manufacturing companies. Clothing exports account for more than 80% of Bangladesh's total export activity, so a study of the competitiveness of this industry will also

significantly determine the country's competitiveness. As a result of the research, the authors concluded that the level of labor costs, technological development, and the success of the country's market access policy have significantly improved the competitiveness of the industry.

In her study, Fojtikova (2016) aimed to identify the most competitive sectors in each EU Member State, using the Revealed Comparative Advantage (RCA) index for her research. The research concluded that the competitive sectors of the Member States could not be identified in terms of their earlier and later accession, but similarities could be identified based on the size and economic development of each Member State.

The competitiveness of the service sector is examined by Kung et al. (2016) in their research on the relationship between China and the founding members of ASEAN[12]. The results obtained by the revealed comparative advantage (RCA) and trade competitiveness (TC) indices allowed the authors to conclude that China can be considered less open in terms of its service sector, which is also more solidly competitive compared to the 5 states studied. In addition, the openness of the sector and the degree of competitiveness were found to be positively correlated in all 6 countries.

Beno (2017) examines the competitiveness of livestock trade in the Visegrad countries between 2004 and 2013, using the Balassa Index (RCA) and its 3 other versions (developed by Vollrath) for his research. The author concluded that although the results should be treated with caution, despite the relatively small size of the countries, both V4s have a comparative advantage in the production and trade of certain live animals, it is worth continuing to compete with the world's largest exporters.

Asada and Stern (2018) examined the competitiveness of bio- and fossil-based resources in some regions of the world using constant market share (CMS) analysis for the period 2000–2014. The regions were formed partly traditionally on the basis of continents (Europe, Asia) and partly modified to ROW (Rest of the World) regions, which include China, the USA and the rest of the world. As a result of his research, he found, interpreting a long-term trend, that the ROW region has been able to increase its competitiveness in

[12] The founding members of ASEAN are Singapore, Malaysia, the Philippines, Indonesia and Thailand, followed by Brunei, Vietnam, Laos, Myanmar and Cambodia. Source: https://asean.org, download time: 12/07/2019.

recent years (except, of course, during the economic crisis) for both bio-based and fossil-based resources. It also found that there was less competition in bio-based resources.

Cai et al (2018) examined the relationship between intellectual property and the international competitiveness of high-tech industries (especially the pharmaceutical industry) in their study. Their aim is to examine the impact of intellectual property protection on the competitiveness of the Chinese pharmaceutical industry. To this end, a multivariate time series analysis was carried out for the period 1995-2014, using the Ginarte - Park index[13] modified for the protection of intellectual property rights, the revelaed comparative advantage index (RCA) for the competitiveness of the pharmaceutical industry. To examine the relationship between the two, a multivariate time series analysis was performed. The authors concluded that strict protection of intellectual property rights would not increase the international competitiveness of the Chinese pharmaceutical industry. Rather, a finding is intended to indicate that it would be more appropriate to adopt a lighter intellectual property protection regime for the Chinese pharmaceutical industry, thus increasing its international competitiveness.

Lyashenko and co-authors (2018) also used the Index of Revealed Comparative Advantages (RCA) to examine and evaluate the competitiveness of the Ukrainian mining industry. This was examined for the period 2010-2017 and found that in order to improve the competitiveness of the Ukrainian mining industry, it is necessary to increase energy efficiency, reduce material intensity and improve the quality of marketing activities.

Loo (2018) wants to help Canadian business in his study in which sectors it is worth establishing closer trade relations with ASEAN member states. Porter uses the theory of the competitiveness of nations as a theoretical framework for this, and for his empirical research he conducts a comparative analysis of the annual reports of the World Economic Forum for Canada and ASEAN member states for the period 2000-2017. Based on the results, the author outlines the ASEAN member states and the investment opportunities that can be promising for Canadian companies in the future.

In their research, Olczyk and Kordalska (2018) examined the competitiveness of Czech and Polish exports in 13 different sub-sectors of the manufacturing industry between 1995

[13] The Ginarte-Park index shows which factors and characteristics of the economy determine it primarily, as well as the extent to which patent rights are protected (Ginarte and Park, 1997). A modified version of this was used by Cai et al. (2018) in their research.

and 2011. Their study performed a time series analysis of sectoral manufacturing data and concluded that the positive trade balance continued to improve due to the increase in demand. The success of the Czech manufacturing sub-sectors is due to increasing labor efficiency, while the improvement in Poland was due to lower unit labor costs.

In his research, Wilson (2018) examines the export competitiveness of manufacturing industries in small island nations, including Trinidad and Tobago, by calculating and analyzing revealed comparative advantages (RCA) and constant market share (CMS) indices. Based on the obtained results, the author proposes to calculate the indicators in a different breakdown, instead of the aggregated form, it is worth focusing on specific product groups. As a result of the soft data communication rules, the possibility of using and interpreting the obtained results can be felt very strongly. Finally, the author concludes that it is worthwhile to examine the degree of export competitiveness and further development opportunities at the company level.

The following Table 6 summarizes the articles presented so far, showing the order of the authors for ease of reference, the year of publication, the field of study (industry, country), the method used, and the most important results of the article.

*Table 6. - Summary of competitiveness as interpreted by international trade in the international literature*

| Authors | Year | Examined area | Method | Main result |
|---|---|---|---|---|
| Ahrend | 2006 | Productivity and competitiveness analysis of Russian industrial sectors | labour productivity, unit labor costs and revealed comparative advantages (RCA) indices | Labour productivity has increased significantly, especially in less productive sectors with less state influence. |
| Alam and Natsuda | 2016 | Examination of the competitiveness of the garment industry in Bangladesh | questionnaire survey involving 70 Bangladeshi garment manufacturing companies | The level of labour costs, technological advances, and the success of the country's market access policy will significantly help improve the competitiveness of the industry. |
| Asada and Stern | 2018 | Examination of the competitiveness of bio- and fossil-based resources in the world | constant market share analysis (CMS) | There is less competition in the trade of bio-based resources, the ROW region has increased its market |

| | | | | |
|---|---|---|---|---|
| | | | | share in both bio- and fossil resources. |
| Aswicahyono and Pangestu | 2000 | Sectoral examination of Indonesia and East Asia | descriptive statistical analysis and revealed comparative advantage (RCA) index | The region needs to move towards the development of sectors requiring higher education or higher technological development. |
| Albaladejo | 2010 | Examination of the Spanish canned fruit and vegetable sector | descriptive statistical analysis, case study | Low labour and raw material costs, foreign demand have largely determined the success of the sector. |
| Beno | 2017 | Examination of the livestock sector in V4 countries | revealed comparative advantage (RCA) index and its alternatives | Each of the countries studied has a comparative advantage in the production of certain live animals. |
| Bilalis et al. | 2006 | Examination of the Italian, Spanish and Greek textile sectors | a case study model of "industrial excellence" | There are many development opportunities, especially in human resource and knowledge management. |
| Cai et al. | 2018 | Examining the relationship between the competitiveness of the Chinese pharmaceutical industry and intellectual property rights. | Ginarte - Park index (intellectual property), RCA index (pharmaceutical competitiveness) and multivariate time series analysis between the two | It would be more appropriate to have a lighter intellectual property system in China that would increase the competitiveness of the pharmaceutical industry. |
| Cavallaro et al. | 2013 | Export competitiveness between Central and Eastern Europe and EU Member States is the ability for intensive specialization | econometric estimate, unit value ratio calculation | The market share of higher capacity specialized companies correlates with higher income EU Member States. |
| Chen and Whalley | 2014 | Analysis of China 's competitiveness in trade in services | descriptive statistical analysis | Despite its importance, trade in services lags behind trade in goods. |
| Cimpoies | 2013 | Examinetion of Moldova agro - industry, food industry | GL index, revealed comparative advantage index | Moldova tends to have a competitive advantage in the agro-industrial sectors. The |

| | | | | |
|---|---|---|---|---|
| | | | (RCA) and alternatives | technological development of food production and the increase of production efficiency must be realized. |
| Cooper | 2006 | Examination of Russia's medium and high technology product groups in trade | revealed comparative advantages index (RCA) | It is worth specializing in the trade of certain product groups and moving towards high-knowledge-intensive activities. |
| Costantini and Crespi | 2013 | It examines the impact of EU enlargement on Member States' export competitiveness | gravitation model | Enlargement has had a positive impact on the new Member States and is not limited to low-tech sectors. |
| Faria et al. | 2009 | Examination of China's manufacturing exports in the light of changes in the world oil market | autoregressive distributed delayed (ARDL) model | Maintaining China's strong export competitiveness, despite rising oil prices, is caused by the fact that the resource is largely substitutable for human labor, making it less vulnerable than its competitors. |
| Fojtikova | 2016 | Sectoral competitiveness of EU members | revealed comparative advantages index (RCA) | The timing of accession does not show characteristics, but the size and economic development of a given Member State determine in which sector it has a competitive advantage. |
| Han et al. | 2009 | Examining the competitiveness of China and the 9 largest furniture exporting countries | market share, revealed comparative advantage index (RCA), trade competitiveness index (TC) | During the period considered, China's comparative disadvantage became a comparative advantage. Higher-income countries are deteriorating, while lower-income countries are improving competitiveness. |
| Heckova and | 2011 | Measuring the competitiveness | revealed comparative | Measuring sectoral competitiveness is |

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| Chapcakova | | of Slovakian manufacturing industry | advantages (RCA) and its alternatives (Michaely index) | possible with a tool for measuring the competitiveness of the national economy. |
| Ignjatijevic et al. | 2013 | Investigation of the competitiveness of agricultural products and processing industries in the countries along the Danube | revealed comparative advantages (RCA), Lafay indexes, GL index | Romania and Bulgaria have a comparative advantage among primary products, while Austria, Germany, the Czech Republic, Hungary and Slovakia have advantage in industrial goods. |
| Kilduff and Chi | 2006 (a; b) | Examining the competitiveness of the 30 leading textile producing countries in the world | revealed comparative advantages (RCA) | Higher-income countries have a greater competitive advantage in capital-intensive, lower-income countries in labor-intensive sub-sectors. |
| Kim and Marion | 1997 | Examination of the U.S. food industry | net export share, relative trade performance index | Intense competition in the domestic market also has a positive effect on the international competitiveness of an industry. |
| Koneczna and Kulczycka | 2011 | Examination of Polish environmentally friendly products through its trade with developing countries | revealed comparative advantages (RCA) and its alternatives (Michaely index) | Poland does not have a comparative advantage comparing to OECD countries. |
| Kordalska and Olczyk | 2014 | Examination of the EU19 manufacturing industry | spatial econometric method | The export activity of the neighboring countries also has a positive effect on the export growth of the country's manufacturing industry. |
| Kung et al. | 2016 | Service sector competitiveness study of China and ASEAN Member States | Revealed comparative advantages (RCA), revealed trade index (TC) | China has a comparative disadvantage in the services sector due to the state's closedness. |
| Lyashenko et al. | 2018 | Examination of the Ukrainian mining industry | Revealed comparative advantages (RCA) | Ukrainian industry at a disadvantage vis-à-vis Brazil and Turkey. |
| Loo | 2018 | Examination of Canada and | Comparative result based on a report | In some Member States, Canada has a |

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| | | ASEAN Member States | published by the World Economic Forum. | competitive advantage in a number of sectors. For Malaysia and Singapore, this benefit is declining or unclear |
| Obadi and Korcek | 2016 | Examining EU28 and US competitiveness at the sectoral level | Revealed comparative advantages (RCA) and its alternatives | The US has a competitive advantage over the EU28 in many sectors. |
| Olczyk and Kordalska | 2018 | Analysis of Polish and Czech export competitiveness in manufacturing sub-sectors | time series analysis | The improvement is due to an increase in labor efficiency in the Czech Republic and a decrease in unit labor costs in Poland. |
| Remeikiene et al. | 2015 | Examining the sectoral competitiveness of the Baltic countries | Revealed comparative advantages (RCA) and its alternatives | The Baltic countries have maintained and even increased their comparative advantage in the food, beverage and tobacco industries. |
| Savic et al. | 2012 | Examination of the Serbian food industry | Revealed comparative advantages (RCA) | A change in the product structure of food exports is needed, which must be in line with the EU market. |
| Sujová et al. | 2015 | Examination of the Czech and Polish wood processing industry | Revealed Comparative Advantage Index (RCA) and Foreign Trade Contribution Indices | The growing export performance of the wood processing industry has a positive impact on the economic performance of countries. |
| Visser et al. | 2015 | Investigation of the competitiveness of the Mpumalanga (South Africa) region | Revealed comparative advantages (RCA) | In the agricultural sector, the region has a comparative advantage in 8 of 15 product groups. |
| Wilson | 2018 | Examining the export competitiveness of the food sector in Trinidad and Tobago | Revealed comparative advantages (RCA) and constant market share (CMS) | Due to the loose reporting obligation, unreliable results, it is worth examining the breakdown of competitiveness at the company level instead of aggregated data in a specific product group breakdown. |

Source: own construction, 2019

***Cluster***

In this subchapter, the articles and studies of the international literature that examined and analyzed the industrial competitiveness from the cluster perspective are presented. A range of selected articles (15 articles out of a total of 132) focused on the key role of clusters in competitiveness.

The aim of this subchapter is to continue to show the competitiveness of the industry, but with a certain geographical concentration. Thus, although the field of regional competitiveness appears during the analyzed studies, the goal is to measure and evaluate industry competitiveness.

In his research, O'Donnellan (1994) examined Porter's industrial clustering in the Irish manufacturing industry, the extent to which clusters are present in the country, and examined the relationship between these clusters and industrial performance. The author concludes that the extent of national relationships between different manufacturing sectors is not significant. Two spatial concentrations can be seen as the impact of urban economies rather than the impact of individual sectoral relationships. The author notes that there is very little relationship between the existence of clusters in Ireland and industrial performance.

Padmore and Gibson (1998) shared the results of an early research on the competitiveness of industrial clusters. The aim of their research was to develop a model for measuring industry competitiveness at the regional level (compared to previous models for measuring industry competitiveness developed exclusively at the national level). The basis of their model (Groundings, Enterprises, Markets, ie GEM) is based on 6 key elements: resources, infrastructure (the "Groundings" pillar), supplier and related industries, corporate structure, strategy and competitors (the "Enterprises" pillar). , the local market and access to foreign markets (the "Markets" pillar). The elements include the incorporation of Porter's diamond model, as well as the importance of research and development and innovation in the model. GEM analysis can be considered a good starting point in the development and rethinking of economic development strategies.

In their research, Costa-Campi and Viladecans-Marsal (1999) examined the competitiveness of industrial companies in Spain. They sought to answer whether companies' existence in a cluster increases their competitiveness compared to their isolated competitors. Using the development of an econometric model (taking into account geographical and sectoral variables), it was concluded that the degree of geographical concentration has a positive effect on the competitiveness of companies operating in the same sector.

It measures and evaluates the performance and competitiveness of Spanish industrial clusters in the work of Camisón (2004), for which he conducted a questionnaire survey (835 companies, 35 clusters) in the early 2000s. It examined the embeddedness of each company in a given industrial cluster, the impact of shared competencies in the cluster on the performance of each company. As a result of his empirical research, he concluded that the performance and degree of competitiveness of a given company is greatly influenced by the use of competencies that differentiate the given company and the combined effects of shared competencies in a given industrial cluster (so all members in the cluster can benefit). The author also found that the more a company is embedded in a given cluster, the greater the impact of its distinctive capabilities on corporate performance, as it can better take advantage of the benefits provided by the cluster.

Akoorie and Ding (2009) examined the competitiveness of a knitwear cluster found in Datang city[14] through a qualitative methodology to which the case study method was applied. The aim of the study was to examine the impact of the performance of an industrial cluster operating in the city (without a company producing a large brand name or huge volumes) on the economic development of the region. He concluded that even in regions with a lower level of development and a labor-intensive production structure, industrial clusters could emerge that could make a major contribution to increasing the region's economic development and competitiveness by specializing in the needs of foreign markets, mainly overseas.

Albaladejo (2010) examines the success of the 20th century competitive advantage of the Spanish canned fruit and vegetable sector, among other factors (growing demand in foreign markets, domestic market constraints, state aid) in that geographically

[14] Datang is considered a small-town city in China's Zhejiang Province, one of the least developed regions in the country, with one of the country's largest-volume (approximately 20 billion pairs per year) socks-producing industrial clusters (Akoorie and Ding, 2009).

concentrated production has given producers an absolute cost advantage (raw materials, wages, economies of scale). In addition, the knowledge sharing of the cluster participants had a further positive effect on maintaining the competitive advantage of the industry.

Brachert et al. (2011) based their research on the assumption that industrial clusters significantly increase the competitiveness of a given region, so the identification of industrial clusters is key for a given region. The different methods that exist try to answer this question in many forms, yet the clustering process in each industry can be quite different, and one-dimensional solutions are emerging. To identify the horizontal and vertical dimensions of clusters, the authors developed a multidimensional approach in their work using input-output method and spatial concentration. Despite the limitations of the method, it seems promising, which raises additional theoretical questions.

The work of Malakauskaite and Navickas (2011) focuses on the impact of clusters on different sectors. Clusters are referred to by the authors as "networks," which include both traditional and high-tech industries. Their research is carried out by literature analysis and then following the deduction process using graphical methods. It was concluded that for a business, the cluster has an important contribution in terms of innovation, productivity and entrepreneurship. In addition, in many cases, individual models assessing competitiveness either do not take clusters into account at all or only treat clusters separately from other factors.

In its research, Przygodzki (2012) compared the cluster policies of the Visegrad countries and Germany (representing Western Europe) and examined how corporate potential can be helped by organizing and promoting cluster competitiveness. To this end, it carried out a comparative analysis for the V4s and Germany, taking into account the information contained in the available EU databases. He concluded that the application of a systematic cluster policy in Western Europe is also important in less developed countries, with the help of which clusters can become key sources of economic development. Another important finding is that cluster policy needs to be aligned with innovation policy objectives.

Titze et al. (2011) performed a qualitative analysis of vertical clusters emerging between related industries in their research for NUTS3 regions in Germany. Of the 439 regions examined, the existence of vertical clusters could be identified in only 27 cases, of which only 11 could identify strong vertical cluster results, and in a further 16 cases regions with

signs of vertical cluster formation could be identified. All of the strong vertical clusters are located in major German cities and their agglomerations.

In their work, Zhu and Han (2013) present an evaluation model for the competitiveness of the aviation industry cluster. Theoretical basis of their research is Porter's diamond model and the so-called They developed their assessment model using "gray incident analysis" and put the model into practice and tested it on the example of Xi'an Yanliang Aviation Park. To develop the evaluation system, a qualitative-quantitative index system was created starting from the 5 Porter aspects. Testing through the example of the aerospace industrial park, the model was found to have a strong competitiveness of the industrial cluster.

Partiwi et al. (2014) examined fish processing in Indonesia with the aim of supporting the development of clusters, measurement of performance and competitiveness of the sector by developing an appropriate and uniform KPI indicator system. To this end, following a literature search, the issue was explored using interview and brainstorming data collection techniques as a case study, and then a final KPI system showing cluster performance was developed using Delphi and analytical hierarchy. It evaluates the operation of clusters from the perspective of 4 basic aspects of the final KPI system: social, environmental, economic and internal business processes. In the indicator system, the social aspect is the CSR index and cluster membership indicator, the environmental aspect is the corporate environment responsibility indicator; in the economic aspect, the cluster profit, market share, and revealed comparative advantage index; and finally, aspects of internal business processes include indicators of output, yield, customer satisfaction index, and producer efficiency.

Vorozhbit et al. (2018) examined the impact of industrial clusters on national competitiveness in a study using a mixed methodology. The aim of their study is to develop a methodology that allows the formulation of measures to support the efficient development of industrial clusters based on a quantitative assessment of their competitive advantages. The theoretical basis of the research is provided by Porter's rhombus model. The study also included a focus group survey (which explored the competitive advantages of the cluster) as well as a questionnaire survey (related to the measurement of competitive advantages). By modifying the model, the authors developed a methodology that quantifies the prospects for industrial cluster development, which consist of

integrated indicators that characterize the competitive advantages of cluster development. In addition, the model made it possible to identify priority measures needed to develop cluster policy.

Table 7 summarizes the cluster studies; based on the author (s), year of publication, area studied (cluster, region, industry), method used, and key findings.

*Table 7. - Summary of the competitiveness of the cluster as interpreted in a theoretical approach in the international literature*

| Authors | Year | Examined area | Method | Main result |
|---|---|---|---|---|
| Akoorie and Ding | 2009 | Investigation of the performance of the knitwear industry cluster in Datang city and the impact of the cluster on regional economic development. | case study | A successful industrial cluster can be created even with a lower level of development and a low-skilled, labor-intensive production structure. |
| Albaladejo | 2010 | Examining the competitiveness of the Spanish canned fruit and vegetable sector. | descriptive statistical analysis, case study | Concentrated geographical production and cluster knowledge sharing have significantly increased the sector's competitive advantage. |
| Brachert et al. | 2011 | Identification of industrial clusters during application in Germany. | input-output method and spatial concentration method | A theoretical framework designed to apply a multidimensional approach to identify vertical and horizontal industrial clusters for all industries. |
| Camisón | 2004 | The impact of companies and industrial clusters on each other, thus examining their competitiveness | questionnaire survey | A company better embedded in an industrial cluster can make better use of the shared competencies offered by the cluster, thus increasing its competitiveness. |
| Costa-Campi and Viladecans-Marsal | 1999 | Comparative analysis of the competitiveness of clustered and isolated companies in Spain. | econometric model | Geographical concentration has a positive effect on a company's competitiveness. |
| Malakauskaite and Navickas | 2011 | The contribution of clusters to increasing the | systematic literature review | Clusters make a significant contribution to a business in terms of |

| | | | | |
|---|---|---|---|---|
| | | competitiveness of a given sector | | productivity, innovation and entrepreneurship. In many cases, the contribution of clusters is treated separately in other models of competitiveness assessment. |
| O'Donnellan | 1994 | Examination of industrial clusters in the Irish manufacturing industry, its impact on industrial performance. | cluster diagram and spatial concentration measurements | Due to the small size of the country and its peripheral economy, the formation of clusters is not significant, they are organized around urban economies. The relationship between clusters and industrial performance is not significant. |
| Padmore and Gibson | 1998 | Development of a new theoretical model for the study of cluster competitiveness | GEM model | The 6 defining elements in the model are: resources, infrastructure (G), supplier and related industries, corporate structure, strategy and competitors (E), local market, foreign market access (M). |
| Partiwi et al. | 2014 | To develop a KPI indicator system for Indonesian fish processing clusters to improve the competitiveness of the sector. | case study (interviews, brainstorming data collection, development of KPI indicator system using Delphi and analytical hierarchy method) | The set of KPI indicators of the indicator system is grouped around 4 aspects: social, environmental, economic and internal business process aspects. |
| Przygodzki | 2012 | A comparative analysis of cluster policy in V4 and Germany | case study (with descriptive statistical analysis) | Clusters are a key source of economic growth, and the development of a systematic cluster policy is needed, which must be in line with the objectives of innovation policy. |
| Titze et al. | 2011 | Identification of vertical clusters along related | qualitative input-output analysis (QIOA) | Examining NUTS3 regions, out of the 439 regions examined, only 27 regions were identified |

| | | | | |
|---|---|---|---|---|
| | | industries in Germany | | (of which 11 are strong vertical clusters, 16 have features indicative of vertical clusters). |
| Vorozhbit et al. | 2018 | Investigation of Russian cluster development and cluster policy by further development of the Porter rhombus model | focus group, questionnaire research | A modified model based on which the prospects of industrial cluster development can be identified, the competitive advantages of cluster development. |
| Zhu and Han | 2013 | Development of a competitiveness assessment model for Chinese aerospace industry clusters based on the diamond model | grey incidence analysis (GIA) | A quantitative evaluation system has been developed from a qualitative evaluation system. The aviation cluster has a strong competitive advantage. |

Source: own construction, 2019

## 2.5 Analysis of Hungarian literature

In the Hungarian literature, we can say about the studies dealing with meso-level competitiveness in general, that in the last 20 years approx. A study on this topic has been published every 1-2 years in A - D category journals. When grouping the studies, I distinguished the following categories: studies with theoretical or empirical analysis, and groups of interpretations of competitiveness at regional or industry / sectoral level. Most of the studies deal with the provision of theoretical frameworks and the clarification of the concept of competitiveness.

An early study by Török (1989) is comparing the concept of competitiveness with the structure of comparative advantage and market functioning. In his study, he evaluates each measurement tool based on interpretations of demand-side, supply-side, and foreign trade market theories. In his work, Csermely (1994) examines the competitiveness of the domestic manufacturing industry under the influence of exchange rate policy, in which he distinguishes, defines and calculates price, cost and export competitiveness. The author concludes that increasing the export activity of the Hungarian manufacturing industry,

and thus the competitiveness of exports, is possible if it has a comparative advantage in the industry in the production of a given product.

Éltető's (2003) work focuses on the concept and indicators of revealed comparative advantages and intra-industry trade, and examines the foreign trade competitiveness of the Central and Eastern European region in its study through literature analysis. It concludes that the changed trade structure in the region has been accompanied by a change in comparative advantages, with an increased level of trade within the industry. In their work, Pupos et al. (2015) seek to clarify concepts (such as efficiency, productivity, competitiveness, strategy, and employment) on a theoretical level and their interrelationships in a sector that can be considered special, agriculture. In their work, they state that the competitiveness of agriculture is basically developed at the level of the production process, but it is further influenced by the applied strategy and the human resources, which as a whole provide several possible solutions.

The interpretation of competitiveness at the meso level can be basically divided into two groups, on the one hand studies on regional competitiveness research and analysis, and on the other hand studies on industrial competitiveness. Researches by Besze (2009), Brandmüller and Faluvégi (2007) are in relation with regional competitiveness, urban competitiveness and metropolitan competitiveness. Other studies are connected to regions, regional and territorial competitiveness (Barna et al., 2005, Bodnár, 2012; Dinya, 2005; Farkas and Lengyel, 2001; Fenyővári and Lukovics, 2008; Kósa, 2006; Kölcsei, 2005; Lengyel, 2006; Lukovics and Kovács, 2008; Málovics and Ván, 2008; Palkovits, 2000; Pola, 2007). In the following, the articles dealing with the phenomenon interpreted at the industry level are presented.

***Industrial, sectoral competitiveness***

Fertő and Hubbard (2001) examined the competitiveness of the food economy (ie the products of agricultural products used and processed in the food industry) in Hungary vis-à-vis the EU in the pre-accession period. Applying the method of revealed comparative advantages, they came to the conclusion that despite the changes that took place in the last decade of the 20th century, the structure of comparative advantages in the Hungarian food economy did not change.

Coltea (2006) carried out an analysis of the printing industry in Central and Eastern Europe, including Romania, using statistical data to compare the competitiveness of the printing industry and many of its sectors, mainly with Western Europe, from a cost-effectiveness and labor productivity perspective. The result was that the Eastern European region lagged far behind Western Europe by the early 2000s, with many developments (management, technology), specialization and concentration within the industry, and capital needed to increase the industry's competitiveness in Eastern Europe.

Madarász and Papp (2006), somewhat differently, used a qualitative research methodology and explored the conditions of the competitiveness of Hungarian tourism at the micro-regional level through in-depth interview data collection. Their study concluded that each micro-region values tourism as a sector that improves competitiveness, as well as the need for competition and cooperation, of which the micro-regions themselves are active participants and shapers.

In a later study, Fertő (2008) narrowed his research to the food industry and concluded that based on market structure, a concentrated market has a contradictory effect on competitiveness (price and quality competitiveness), but foreign trade openness has a positive effect on competitiveness.

In his study, Major (2015) performed a descriptive statistical analysis of the Hungarian beer market based on available domestic and international statistical data. The author has examined competitiveness from both the supply and demand side, and has come to the conclusion that domestic beer production can be a stimulus and a catalyst for the growth and development of other industries, so it is recommended to support this industry.

Balogh, J. M. (2016) examined sectoral competitiveness, in which between 2000 and 2013 he examined the export competitiveness of the world's largest wine-producing countries. It uses the theory, indices and regression estimation of the revealed comparative advantages, takes the wine product as homogeneous and does not differentiate between the different wine types. He concluded that both European and non-European countries are among the most competitive countries in the wine sector, and that certain natural endowments and WTO membership also have a positive effect on a country's competitiveness.

Jámbor et al. (2018) examined international cocoa trade between 1992 and 2015 and concluded that both cocoa supply and demand for cocoa are quite concentrated in the

growing cocoa trade, with producers (mainly from Africa) appearing in the majority (developing countries). Ivory Coast, Nigeria), while processed cocoa is already sourced more from industries in developed countries (e.g. the Netherlands, Belgium and Germany).

Table 8 summarizes the Hungarian research presented above in relation to industry and sectoral competitiveness, listed in alphabetical order for easier traceability, as well as the most important results of the studied country, the applied method and the studies.

*Table 8. - The topics, applied methods and the most important results of the studies presenting the empirical research of the Hungarian literature*

| Authors | Theme | Country | Method | Main results |
|---|---|---|---|---|
| Balogh J. M. (2016) | determinants of competitiveness in the wine sector | the world's largest wine-producing countries (38) | revealed comparative advantages and regression estimation | France, Italy, Spain, Chile, Australia and the USA are the most competitive countries. |
| Coltea (2006) | examining the competitiveness of the printing industry | Eastern Europe, especially Romania | descriptive statistical analysis | there is a significant lag compared to Western Europe |
| Fertő and Hubbard (2001) | examining the competitiveness of the Hungarian food economy vis-à-vis the EU | Hungary | revealed comparative advantages | by the end of the 1990s, the comparative advantages remained stable in Hungary |
| Fertő (2008) | examination of competitiveness in the domestic food industry based on market structure | Hungary | revealed comparative advantages and foreign trade competitiveness indicators | the contradictory effect of a concentrated market on competitiveness |
| Jámbor et al. (2018) | examining competitiveness in international cocoa trade | the world's largest cocoa producers and processors | revealed comparative advantages | cocoa production from developing countries, processed cocoa from developed countries goes into international trade |
| Madarász and Papp (2006) | competitiveness of tourism at the micro-regional level | Hungarian micro - regions | qualitative research methodology, in depth interviews | active participants and shapers of some micro-regions to improve their |

| | | | | |
|---|---|---|---|---|
| | | | | own competitiveness |
| Major (2015) | examination of the competitiveness of the domestic beer market | Hungary | descriptive statistical analysis | brewing can be a catalyst for the further development and growth of other industries |

Source: own construction, 2019

## 2.6 Lessons learned from the analysis of international and domestic literature

The focus of the literature presented above is on examining the industrial, sectoral direction of meso-level competitiveness. In this chapter, I would like to present the experiences of the literature analysis. The purpose of this is to be able to systematize my thoughts during the studies I have read and to form the theoretical framework for my research.

The high number of resources in the international literature has made it a clear difficulty to conduct the literature review. It is clear to me from the processed literature that due to the complexity of competitiveness, its definition is also complicated. In many cases, the different levels of interpretation converge, and these are difficult boundaries to draw, especially when it comes to non-economic or non-corporate competitiveness. In all other cases, such as regional (as a joint analysis of a region within a country, or even several countries) or an industry, it is often difficult for authors to classify the level of interpretation. There are a number of complex cases (e.g., including the competitiveness of firms that are essentially part of an industry but also interpreted along a geographic concentration, e.g., Albaladejo, 2010; Partiwi et al., 2014) where categorization itself is possible in several ways. This is the reason why I consider it important to use a meso-level interpretation, in which case we can basically interpret competitiveness at a regional or industry level.

It can be seen from the processed literature that there is no generally accepted system of measurement tools at any level, not even at the meso level. The most commonly used solutions, however, do exist, as evidenced by Önsel et al. (2008) in defining the competitiveness of nations as the success or the failure in international competition. Such a measurement method is, for example, a comparison of the results achieved in

international trade (Kung et al., 2016; Remeikiene et al., 2015; Obadi and Korcek, 2016; Fojtikova, 2016; Beno, 2017), which, basically using an index of revealed comparative advantages, is a kind of ranking training. Similarly, the study of a domestic industry using the method of comparative advantage (Cai et al., 2018; Cimpoies, 2013) or questionnaire research (Alam and Natsuda, 2016), with descriptive statistical analysis, case study (Albaladejo, 2010) type research also occur relatively often. In addition, several studies (Harrison and Kennedy, 1997; Aswicahyono and Pangetsu, 2000; Ahrend, 2006; Obadi and Korcek, 2016; Albaladejo, 2010) suggest that measuring competitiveness, and thus measuring industrial competitiveness, should be the use of more versatile measuring tools is the most appropriate, it is recommended to use them together, thus nuancing the image in connection with a given result.

Overall, about the Hungarian literature can be said, that the number of Hungarian-language studies attempting and analyzing industry competitiveness is rather low, and many of the studies examine the issue of competitiveness in other dimensions, such as at the corporate or national economic level. I have not come across a study that deals with the competitiveness of a given product, but no study deals with a (meta) level of competitiveness higher than the level of the national economy. The vast majority of the works in this dissertation use a quantitative methodology, only Madarász and Papp (2006) undertake to analyze their chosen industry using a qualitative research methodology. Studies using quantitative research methodology can basically be divided into 2 groups. Some of them perform descriptive statistical analyzes based on existing statistics, while a significant part of them measure, examine and evaluate the competitiveness of a given industry with the revealed comparative advantages. For this, the Balassa index and other indicators are basically used. Regarding the analyzed industry, it can be said that the majority of the studies are in the field of food economics, either in general or in a selected sector (beer industry, wine sector, cocoa sector). There is also a study in the printing industry and the tourism sector. It is worth noting that other industries are not in the authors' focus.

The authors interpret competitiveness in a different way, which seems to be related to the chosen methodology as well. While Madarász and Papp (2006) make the interpretation of competitiveness derived from competition, they do not provide an exact definition. In the interviews conducted during the research, the interviewees are asked to connect and interpret competition, the level of competition, the influencing factors and cooperation,

and then they finally interpret what was said as competitiveness, thus treating the two concepts, competition and competitiveness, as something synonymous. In this case, we can talk about the only qualitative study, here the authors focused on the statements made by the interviewees.

Coltea (2006) and Major (2015) present and analyze industry competitiveness using descriptive statistical tools, comparing selected industries at the country level in a fundamentally European environment with similar industries in other countries. Although Coltea (2006) does not provide a common definition of competitiveness in his study, the statistical data analyzed suggest that the cost structure of the industry between Eastern and Western Europe is examined to measure industrial competitiveness. According to the wording of Major (2015: p. 454), competitiveness is *"in an economic approach, the ability of an enterprise, group of enterprises or national economy to successfully sell a given product or service in a given market"*, an essential element of which is its ability to offer more and more cost-effectively. to market. This wording includes the levels of interpretation of companies, industries and the national economy, as well as the application of competitiveness on the basis of price and cost structure. Accordingly, the author also examines supply-side and demand-side competitiveness in the beer industry.

Each of the studies using the method of revealed comparative advantages (Balogh JM, 2016; Jámbor et al., 2018; Fertő and Hubbard, 2001; Fertő, 2008) returns to international trade when interpreting competitiveness and evaluates an industry, product group, or the competitiveness of a product. All of the studies state that there is no mature, uniformly accepted measurement option for measuring competitiveness, but in addition to different price and cost structures, the theory and method of revealed comparative advantages can also be applied (Balogh JM, 2016; Jámbor et al., 2018; Fertő and Hubbard, 2001; Fertő, 2008). Each of these studies can be related to agriculture, the food industry and the food economy.

## 2.7 The formulation of meso-level competitiveness used in the dissertation

Based on the Hungarian and international literature presented and analyzed above, I define and use meso-level competitiveness in my dissertation as follows:

*It is possible to define meso-level competitiveness the successes as a whole of the domestic companies operating in a given industry (sector), the extent of which can be determined in the international comparison of the given industry (sector), so in the comparison of domestic industry (sector) with foreign industry (sector) established.*

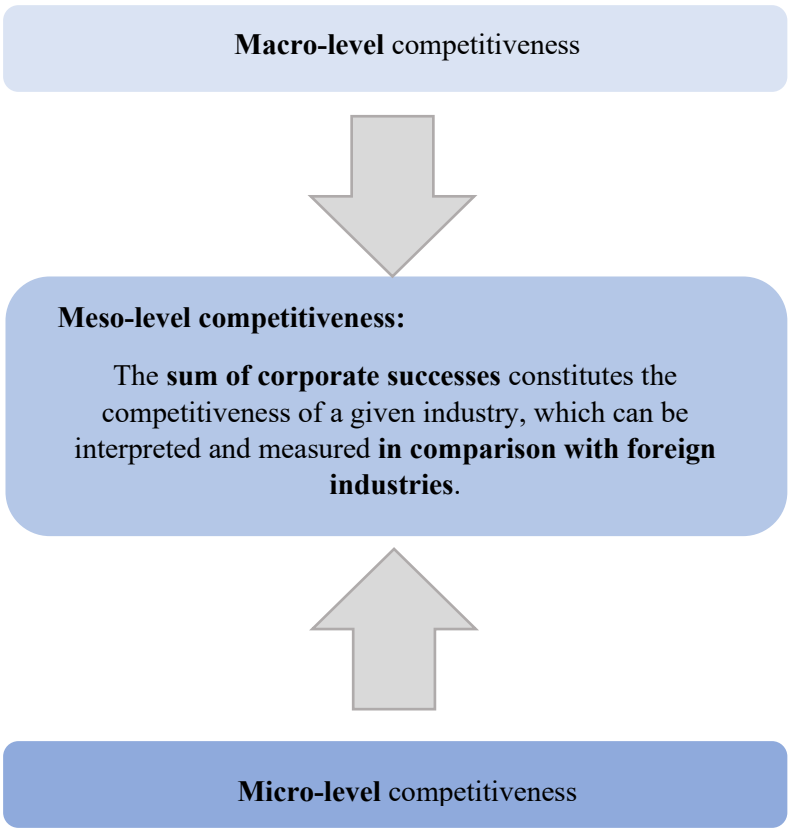
To explain this definition, I refer back to the work of Nelson (1992) and Capello (1994), so by meso-level competitiveness, I mean and examine industry (sectoral) competitiveness. For interpretation at the meso level, I consider it essential to emphasize the direct movement from the micro and macro levels. In the case of competitiveness, defined in the first half of the definition (as the sum of the successes of companies operating in a given industry), I mean the upward move from the micro level based on the wording of Czarny and Zmuda (2018). According to this, micro-level competitiveness can only be interpreted at the company level, in the case of summing up experiences, achievements, successes and failures, we are already talking about the industry level. In the case of the interpretation of micro-level competitiveness, the focus is on product-level competitiveness based on the comparison with the product (service) produced by the competitors.

Using Czakó's (2005) formulation of industry competitiveness, I interpret the downward movement from the macro level to meso-level competitiveness, since the basis of comparison is the comparison and interpretation of domestic and foreign industries. Thus, although the basis of comparison is even a comparison of a country that would refer to a macro level, it does not mean a macro level in my interpretation. This is only a comparison for a given industry, which does not measure and interpret the competitiveness of a given country as a whole. According to my interpretation, the macro level includes the interpretation and measurement of country-level competitiveness, which is not limited to a single industry (sector), but examines the country as a whole, the nation and the achievement of national economic performance (for example: GDP, employment, labour productivity), and moreover, it offers growth opportunities for the citizens of a given country (Aiginger et al., 2013).

And if we look at the industrial and/or sectoral formulation of the definition, at the meso level it is possible to compare domestically produced product groups with foreign product groups, which product groups also mean the competitiveness of a sector, sub-sector or

branch. The above line of reasoning and the derivation of the meso-level competitiveness definition are intended to be illustrated in the following figure, Figure 10.

*Figure 9. - Derivation of a meso-level competitiveness definition*




Source: own construction, 2019

# Chapter 3. The chosen industry: presentation of dairy industry as well as dairy industry competitiveness researches

After developing and presenting the theoretical framework of competitiveness, I would like to present in this chapter the reasons for my choice of the industry I have chosen, the dairy industry. This precedes the presentation of hypotheses and the methodology used, as well as the empirical research itself. The chapter is divided into three subchapters. The first thus presents the chosen industry, the dairy industry from a global, European and domestic perspective[15], covering the global context, especially the regulatory environment and changes in the European Union. Then, in the second subchapter, to the main features of changing consumer behavior (thus, the increasing impact of milk and dairy substitutes in consumer baskets). The third major unit of the chapter covers the mapping and summary of previous dairy competitiveness research based on both domestic and international literature.

For the empirical study of the industry competitiveness presented in the previous chapters of the dissertation on the basis of the theory and analyzed by the literature, I chose the dairy industry, which has several reasons for my choice. The dairy industry is an industry that produces basic food, so I think it is important for the growing population to look at the competitiveness of this basic food industry. Although it is difficult to completely delimit the industry, as the product range is very diverse (milk, yoghurts, cheeses, etc.), the original raw material used is milk itself (Szabó, 1996), so it can be used as a single industry for competitiveness analysis. One of the defining properties of milk and dairy products is their perishability. Apart from certain products (for example: milk powder, condensed milk, certain cheeses), due to this perishable nature of the products, there are physical limitations to the marketability of milk and dairy products, so it is relatively easy to draw a test when analyzing the competitiveness of the dairy industry. The scope of research in the present dissertation is limited to the Member States of the European Union.

[15] „Chapter 3. The chosen industry: presentation of dairy industry and dairy competitiveness researches" (basically subsections 3.1 and 3.2) is written based on the statement of co-authors attached to the dissertation Nagy, J., Jámbor Zs., Freund, A. (2019): Industry 4.0 Solutions Case Study, based on the case study EFOP-3.6.2-16-2017-00007 "Aspects of the Development of a Smart, Sustainable and Inclusive Society: Social, Technological, Innovation Networks in Employment and the Digital Economy 2.1 and 2.2. For the sake of maximum transparency, I have indicated the source separately as "Nagy et al. (2019)" at the end of the given paragraphs in question.

The structure of the chapter is as follows. I will present primarly the EU dairy industry in a global context, followed by an examination of the EU dairy industry (including of course the Hungarian dairy industry) at Member State level. I do this as follows: on the one hand, I present the most important regulatory environment for the dairy industry in the EU, and on the other hand, the analysis of the most important descriptive statistics. This is followed by a discussion of the key features of consumer habits in the EU. Finally, from competitiveness' point of view, I would like to substantiate the statements of the hypotheses by analyzing the range of research found in the domestic and international literature.

## 3.1 The dairy industry

The world's population has tripled since the 1950s, and by July 2018, the Earth's population had already exceeded 7.6 billion. Although this number is slowing down, it continues to grow, and it is estimated that by 2050 the world population will exceed well over 9 billion people (Central Statistic Office, KSH, 2018). For this reason, the issue of world food supply is an ongoing challenge, was also one of the central topics of discussion at the 2018 World Forum in Davos, and a global initiative was taken at the World Economic Forum to address the nearly 70% increase in food demand (WEF, 2018b). Another important aspect is that with the development of countries and the increase in the living standards of the population, the range of foods to be consumed changes significantly, the energy needs of the population are much higher, and animal protein intake in daily consumption increases (Horn, 2013). Meeting the growing and changing needs and reducing and mitigating the environmental impacts and burdens is a serious challenge for the economy, including for some actors in the food industry. According to the list of Food Engineering published in 2017, Nestlé (1st), Pepsi Co. (2nd) and AB Inbev (3rd) are among the largest food companies in the world in terms of sales revenue, but the list includes dairy processing companies. Lactalis (18th), Dairy Farmers of America (24th) and Parmalat (51st). Nagy et al. (2019).

U.S. (91.3 billion kg / year), India (60.6 billion kg / year) and China (35.7 billion kg / year) are the world leaders in world milk production, with Brazil, Germany at the top of the list. and Russia (Worldatlas, 2018), EU production as a whole is significant, accounting for almost 25% of world production. According to a FAO (2008) report, the

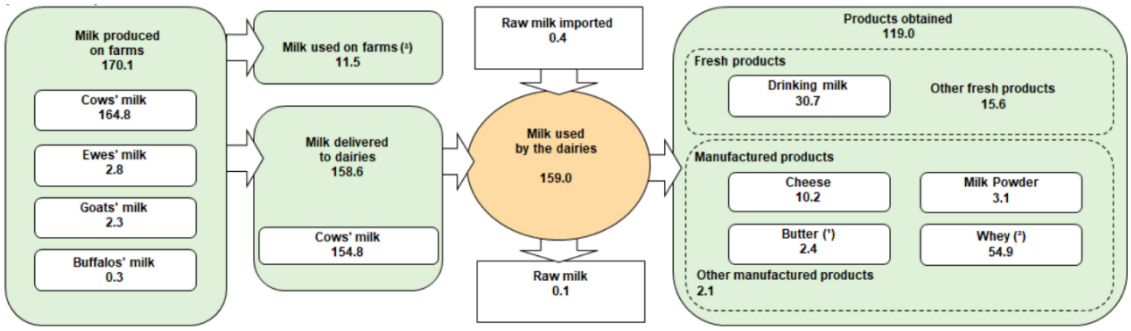
most important milk-producing regions are the South Asian region (including India, of course) and the EU25, which account for almost half of world milk production. The EU accounts for 30% of world trade growth, mainly with higher processed products (cheese, milk powder, butter). This is due to the fact that its main competitors have been able to increase their milk production to a greater extent, which is why European countries are entering the market with highly processed products. Nearly half of the cheeses produced in the world are made in Europe, the demand for consuming these dairy products has increased sharply in recent years and further demand is expected to increase in the future (Tacken et al., 2009; Lemoine, 2016; Jansik et al., 2014). Nagy et al. (2019).

In Europe, approx. 170 million tonnes of milk are produced and approx. 45 million tonnes of fresh dairy products will be consumed. According to Eurostat data, in 2016, one-fifth of the milk produced came from Germany, with a further 16% from France, 10% -10% from the UK and the Netherlands (Lemoine, 2016, Eurostat, 2017). European milk production is growing, but livestock size is declining, suggesting efficiency gains and an increase in milk production per animal, with some figures showing an increase of almost 10% per cow in the UK between 2006 and 2016. rain yield (AHDB, 2018). Domestic milk production in the European Union is approx. It gives 1% (WITS, 2019). Nagy et al. (2019).

According to a Eurostat (2018c) report, raw milk produced in the European Union (EU28) is approx. It was 170.1 million tonnes, which is 1.9 million tonnes more than in 2016, more than 11% higher[16]. 96.8% of this raw milk comes from cow's milk. 93.2% (158.6 million tons) of the produced milk goes to milk processors, the remaining less than 7% is processed by milk producers, resold as raw milk or for own use and consumption. For European milk processing, it can be said to work almost exclusively from EU raw materials, as raw milk imports did not reach 1% (0.4 million tonnes). The volume of milk and milk products obtained from processed raw milk was 119 million tonnes in 2017, more than a third of which is available on the market as milk and other fresh dairy products known to households, as well as cheeses, butter, milk powder and other sour milk products (for example: yoghurts). These 2017 results are shown in Figure 11.

[16] This increase in milk production has been observed since the end of the milk quota on 31 March 2015. The milk quota was in force between 1984 and 2015, in the European Union to address surplus production, and in the years following the abolition of the milk quota is characterized by a structural renewal of milk production (eg switching to higher milk yields) and a modernization process (Salou 2017, Eurostat, 2019).

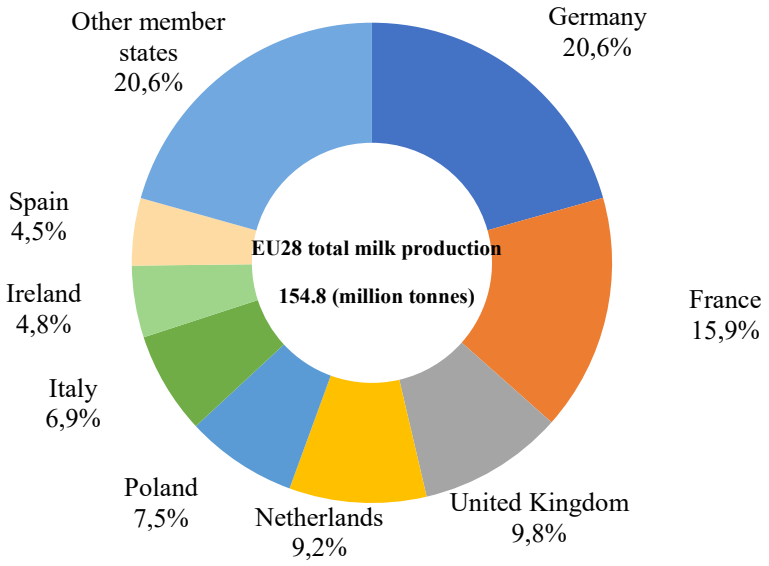
*Figure 10. - EU milk production and processing in 2017 (values in million tonnes)*




Source: Eurostat (2018c)

Regarding the production of cow's milk in the EU Member States, in 2017 Germany, France, the United Kingdom, the Netherlands, Poland, Italy, Ireland and Spain accounted for almost 80% of cow's milk production, while the other 20 Member States accounted for only 20.6% of cow's milk production (Figure 12).

*Figure 11. - The largest producers of cow's milk in EU (in 2017)*




Source: based on Eurostat (2018b), own construction, 2019

Examining the last nearly 2 decades, it can be said that the ranking given by the 2017 report on the distribution of EU milk production by country is unchanged, with a few

exceptions. Germany has been the largest milk-producing country in the EU for decades, followed by France, the United Kingdom and the Netherlands. The 8 largest milk-producing countries account for 80% of total EU milk production, while Hungary is in the middle of the ranking with milk production of around 1%. Following the abolition of the milk quota in 2015, there is a minimal rearrangement between the 8 largest milk producers, but the basic order is still unchanged (Table 9).

*Table 9. - Milk production in EU Member States between 2001 and 2018 (values in thousands of tonnes)*

| Country / period | 2001-2003 | 2004-2006 | 2007-2009 | 2010-2012 | 2013-2015 | 2016-2018 |
|---|---|---|---|---|---|---|
| **German** | 26 941,24 | 27 081,81 | 27 678,15 | 29 233,40 | 31 185,27 | 32 133,57 |
| **France** | 23 316,03 | 23 047,10 | 23 213,89 | 24 180,74 | 24 890,79 | 24 542,06 |
| **United Kingdom** | 14 356,45 | 14 024,28 | 13 410,07 | 13 659,53 | 14 569,17 | 14 958,27 |
| **Netherlands** | 10 617,94 | 10 521,61 | 11 047,26 | 11 647,80 | 12 672,17 | 14 166,47 |
| **Poland** | N/A | 8 817,09 | 8 994,04 | 9 376,36 | 10 457,29 | 11 574,22 |
| **Italy** | 9 994,12 | 10 096,26 | 10 438,30 | 10 223,64 | 10 687,52 | 11 539,95 |
| **Ireland** | 5 276,57 | 5 184,50 | 5 080,72 | 5 414,47 | 5 995,02 | 7 377,05 |
| **Spain** | 5 886,48 | 5 886,10 | 5 772,05 | 5 926,24 | 6 590,82 | 6 999,47 |
| **Denmark** | 4 470,77 | 4 458,30 | 4 613,60 | 4 839,97 | 5 138,53 | 5 490,00 |
| **Belgium** | 2 937,21 | 2 850,00 | 2 894,06 | 3 308,34 | 3 717,44 | 4 028,60 |
| **Austria** | 2 648,67 | 2 636,33 | 2 691,61 | 2 883,18 | 3 034,40 | 3 157,98 |
| **Czech Republic** | N/A | 2 501,31 | 2 410,54 | 2 376,40 | 2 432,22 | 2 935,19 |
| **Sweden** | 3 240,97 | 3 174,09 | 2 957,16 | 2 857,08 | 2 910,65 | 2 812,96 |
| **Finland** | 2 435,03 | 2 360,67 | 2 276,07 | 2 265,97 | 2 346,09 | 2 369,71 |
| **Portugal** | 1 856,61 | 1 879,14 | 1 865,18 | 1 838,77 | 1 856,02 | 1 852,67 |
| **Hungary** | 1 682,72 | 1 518,77 | 1 426,71 | 1 342,67 | 1 456,83 | 1 542,63 |
| **Litvania** | 992,73 | 1 212,33 | 1 335,67 | 1 318,52 | 1 404,34 | 1 395,32 |
| **Romania** | N/A | 1 048,90 | 1 058,17 | 892,04 | 930,13 | 1 030,35 |
| **Slovakia** | 990,15 | 955,56 | 920,81 | 820,90 | 845,02 | 822,28 |
| **Latvia** | 435,59 | 519,20 | 620,28 | 668,52 | 782,61 | 802,70 |
| **Estonia** | 469,37 | 571,00 | 597,10 | 636,30 | 713,07 | 729,87 |
| **Greece** | 607,60 | 691,41 | 692,34 | 663,18 | 627,80 | 617,83 |
| **Bulgaria** | N/A | 789,09 | 672,47 | 512,00 | 503,23 | 590,46 |
| **Slovenia** | 486,39 | 507,57 | 523,83 | 526,73 | 534,11 | 576,78 |
| **Croatia** | 501,45 | 607,75 | 668,82 | 617,50 | 513,32 | 473,31 |
| **Luxembourg** | 259,57 | 256,92 | 264,96 | 280,05 | 308,32 | 377,04 |
| **Cyprus** | 142,40 | 140,67 | 147,53 | 152,34 | 160,87 | 214,05 |
| **Malta** | 40,04 | 41,32 | N/A | N/A | 42,17 | 41,52 |

Note: For N / A, no data were available in the Eurostat Database, the data are averaged over a 3-year period. The order of the countries in the table shows the result of the descending order of the last 3-year average (2016-2018).

Source: based on Eurostat database (2019), own calculation, 2019

The price of raw cow's milk varies greatly in the European Union. While typically Eastern European countries are able to realize lower selling prices for raw cow's milk, Western and Southern European countries are able to sell milk at higher prices, up to 50% higher. This huge difference e.g. For Greece and Lithuania, the average price for the period 2016-2018. Although no sales price information is available for Malta for this period, it appears that the highest sales prices were reached in the previous 3 periods. In contrast, Lithuania and Latvia were able to calculate the lowest prices. In all EU Member States, sales prices have fallen since the abolition of the milk quota. Hungary has low sales prices in European comparison. This is shown in Table 10.

*Table 10. - Sales price of raw cow's milk in the European Union (in EUR)*

| Country / period | 2007-2009 | 2010-2012 | 2013-2015 | 2016-2018 |
|---|---|---|---|---|
| **Greece** | 39,85 | 41,86 | **43,14** | **39,01** |
| **Italy** | 38,32 | 41,03 | 41,55 | **38,94** |
| **Finland** | **40,11** | **42,32** | 42,58 | 37,60 |
| **Sweden** | 32,75 | 38,26 | 39,08 | 36,38 |
| **Austria** | 33,88 | 33,65 | 36,91 | 36,34 |
| **Netherlands** | 32,55 | 35,93 | 38,84 | 35,03 |
| **Denmark** | 33,18 | 34,69 | 37,32 | 34,22 |
| **Germany** | 31,66 | 32,94 | 35,16 | 32,53 |
| **Ireland** | 27,97 | 30,84 | 34,27 | 32,48 |
| **Croatia** | N/A | 32,84 | 34,13 | 32,14 |
| **Luxembourg** | 33,28 | 31,35 | 34,69 | 32,12 |
| **Belgium** | 29,82 | 31,19 | 33,72 | 31,20 |
| **France** | N/A | 32,85 | 35,70 | 31,10 |
| **Slovakia** | 29,63 | 30,01 | 32,47 | 30,88 |
| **United Kingdom** | 28,91 | 30,72 | 35,63 | 30,17 |
| **Poland** | 25,77 | 28,24 | 30,73 | 29,78 |
| **Spain** | 34,16 | 30,28 | 33,53 | 29,12 |
| **Portugal** | 32,66 | 29,48 | 32,16 | 28,79 |
| **Hungary** | 27,86 | 29,28 | 31,37 | 28,56 |
| **Slovenia** | 28,87 | 29,50 | 31,96 | 28,36 |
| **Estonia** | 25,84 | 29,83 | 28,72 | 27,97 |
| **Romania** | **22,62** | **24,23** | **27,13** | 26,81 |
| **Latvia** | **23,87** | 27,24 | 27,14 | **26,79** |
| **Litvania** | 24,09 | **26,51** | **27,05** | **26,41** |
| **Bulgaria** | N/A | N/A | N/A | N/A |
| **Cyprus** | N/A | N/A | N/A | N/A |
| **Czech Republic** | N/A | N/A | N/A | N/A |
| **Malta** | **43,29** | **45,84** | **48,56** | N/A |

Note: For N / A, no available data were available in the Eurostat Database, the highest values are marked in green and the lowest values in purple.

Source: based on Eurostat database (2019), own calculation, 2019

Tables 11 and 12 show the export and import trade of dairy products in the Member States of the European Union. The data clearly show that Germany is not only the largest milk-producing country in the European Union, but also the largest export and import activity. It is interesting to note, however, that each of the largest milk-producing countries is also one of the largest exporting countries, albeit with some realignment. The Dutch export activity is more than 30% higher than the French export activity for the period 2016-2018, despite the fact that French milk production was 70% higher than the Dutch milk production in the period under review. The UK, as the 3rd largest dairy country in 2016-2018, had more modest export activity and only ranked 9th in that period. It can also be observed that the distribution of export activities by country, with a few exceptions (individual and some location differences in each period examined), has remained almost unchanged over the last 12 years, ie similar production structure and export activity in the EU Member States. Germany, the Netherlands, France, Belgium, Italy, Denmark, Ireland, Poland and the United Kingdom are therefore traditionally large milk producers, processors and exporters.

*Table 11. - Dairy exports of EU Member States to the world (values in thousands of USD)*

| Country / period | 2007-2009 | 2010-2012 | 2013-2015 | 2016-2018 |
|---|---|---|---|---|
| **Germany** | 9 046 519 | 10 138 617 | 11 036 798 | 9 660 045 |
| **Netherlands** | 6 953 604 | 8 558 963 | 9 530 856 | 9 328 125 |
| **France** | 6 968 199 | 7 689 688 | 8 043 267 | 6 977 108 |
| **Belgium** | 3 285 143 | 3 770 645 | 4 055 371 | 3 872 844 |
| **Italy** | 2 267 896 | 2 871 803 | 3 181 350 | 3 471 500 |
| **Denmark** | 2 385 033 | 2 565 736 | 2 557 086 | 2 677 412 |
| **Ireland** | 1 885 801 | 2 145 455 | 2 291 426 | 2 543 388 |
| **Poland** | 1 682 356 | 1 959 471 | 2 435 445 | 2 449 884 |
| **United Kingdom** | 1 452 418 | 1 706 782 | 2 068 155 | 2 091 274 |
| **Spain** | 1 218 839 | 1 271 880 | 1 445 922 | 1 545 112 |
| **Austria** | 1 282 609 | 1 333 597 | 1 484 238 | 1 373 375 |
| **Czech Republic** | 758 284 | 818 555 | 927 976 | 836 809 |
| **Greece** | 380 193 | 442 148 | 596 316 | 699 890 |
| **Lithuania** | 531 071 | 639 017 | 684 242 | 572 777 |
| **Hungary** | 299 755 | 368 565 | 469 381 | 480 875 |

| | | | | |
|---|---|---|---|---|
| **Luxembourg** | 343 206 | 396 513 | 552 204 | 441 094 |
| **Finland** | 508 351 | 617 570 | 590 692 | 432 092 |
| **Portugalia** | 379 259 | 415 534 | 425 911 | 381 753 |
| **Sweden** | 406 197 | 405 584 | 498 145 | 345 484 |
| **Slovakia** | 362 857 | 351 803 | 385 487 | 314 689 |
| **Latvia** | 174 552 | 243 941 | 289 788 | 270 019 |
| **Bulgaria** | 131 764 | 165 435 | 221 440 | 208 084 |
| **Romania** | 62 628 | 119 645 | 183 778 | 197 695 |
| **Cyprus** | 53 875 | 77 940 | 118 351 | 194 548 |
| **Estonia** | 164 584 | 207 124 | 228 222 | 191 729 |
| **Slovenia** | 153 119 | 172 861 | 176 860 | 186 647 |
| **Croatia** | 65 535 | 67 522 | 52 818 | 74 837 |
| **Malta** | 178 | 350 | 390 | 2 001 |

Note: The amounts are given as an average over a 3-year period, with the data series sorted in descending order for the period 2016-2018.

Source: based on World Integrated Trade Solution (WITS) database, own calculation, 2019

There has been a stronger rearrangement in import activity (Ireland and Denmark are in the top 10 and Sweden and Austria are in the EU). The largest import activity was carried out by Germany, the Netherlands and France in the period 2016-2018, Germany's import activity significantly exceeds the import activity of all other Member States, the following countries (the Netherlands, France, Italy and Belgium) have a similar intensity of import activity. A more significant and continuous decrease over the last 12 years has been seen in Greece alone, with its import activity declining in each period under review. In contrast, Poland's import activity has been growing steadily since 2007, but the same trend can be observed for Austria, the Netherlands, Denmark, Hungary, Croatia, Bulgaria and Romania. Hungary is also typically found at the end of the second third of the rankings in terms of production, exports and imports.

*Table 12. - Dairy imports of EU Member States with the world (values in thousands of USD)*

| Country / period | 2007-2009 | 2010-2012 | 2013-2015 | 2016-2018 |
|---|---|---|---|---|
| **Germany** | 7 353 853 | 8 061 305 | 8 339 355 | 8 187 067 |
| **Netherlands** | 3 222 946 | 3 822 410 | 4 410 741 | 4 420 223 |
| **France** | 3 417 246 | 3 776 150 | 4 132 132 | 4 201 120 |
| **Italy** | 4 444 375 | 4 838 386 | 4 855 385 | 4 090 730 |
| **Belgium** | 3 351 213 | 3 712 951 | 4 049 621 | 4 000 868 |
| **United Kingdom** | 3 789 476 | 3 873 557 | 4 240 943 | 3 853 617 |
| **Spain** | 2 483 378 | 2 341 620 | 2 283 105 | 2 015 932 |

| | | | | |
|---|---|---|---|---|
| **Sweden** | 750 537 | 982 450 | 1 146 042 | 1 075 750 |
| **Poland** | 425 273 | 661 650 | 965 512 | 1 051 394 |
| **Austria** | 823 363 | 879 885 | 986 640 | 986 983 |
| **Greece** | 1 072 719 | 1 045 855 | 996 535 | 891 731 |
| **Ireland** | 566 522 | 591 164 | 842 649 | 793 338 |
| **Denmark** | 664 232 | 704 735 | 729 869 | 733 771 |
| **Czech Republic** | 549 354 | 655 268 | 703 184 | 684 322 |
| **Portugalia** | 729 526 | 694 012 | 656 828 | 604 534 |
| **Romania** | 264 987 | 317 659 | 371 934 | 521 745 |
| **Hungary** | 364 584 | 399 594 | 402 368 | 455 887 |
| **Slovakia** | 300 940 | 375 704 | 416 940 | 409 270 |
| **Finland** | 316 923 | 408 285 | 464 038 | 397 603 |
| **Luxembourg** | 367 910 | 424 414 | 466 542 | 378 569 |
| **Lithuania** | 128 627 | 226 712 | 311 993 | 285 035 |
| **Croatia** | 120 615 | 148 479 | 213 096 | 256 808 |
| **Bulgaria** | 117 746 | 199 043 | 246 891 | 252 533 |
| **Slovenia** | 139 227 | 173 083 | 189 942 | 191 939 |
| **Latvia** | 98 653 | 141 321 | 168 795 | 159 197 |
| **Cyprus** | 77 936 | 85 125 | 87 887 | 92 174 |
| **Estonia** | 54 136 | 68 706 | 84 782 | 84 299 |
| **Malta** | 51 711 | 54 213 | 56 518 | 57 148 |

Note: The amounts are given as an average over a 3-year period, with the data series sorted in descending order for the period 2016-2018.

Source: based on World Integrated Trade Solution (WITS) database, own calculation, 2019

The domestic dairy industry has faced a number of challenges in recent years, including the accession to the European Union, as a result of which large quantities of dairy products produced in other EU member states, which remained in surplus and were therefore dumped, arrived in Hungary. The number of dairy cows has decreased significantly since EU accession, but this decline stopped later, and there has been a slight increase since then. Regarding the change in the producer price of milk, it can be said that the fall in the price of milk has stopped compared to the previous decrease, and in 2017 it increased by about 20% compared to 2016 (KSH, 2017). There are many dairy farms in Hungary, but its composition is dominated by a large number of smaller farms, and only a few larger dairy farms can be found, so overall a rather fragmented dairy production structure can be observed. Our dairy industry can be said to be quite concentrated, with only some manufactories and some medium-sized dairies in addition to some larger dairies. In a European comparison, we can find a dairy farm in milk

production that is the largest and even the largest in Central Europe, not only in terms of number of individuals, but also in terms of milk yield. Nagy et al. (2019)

Regarding the sector, it can be said that Hungary has been a net exporter of dairy products and eggs for the past almost 10 years. A surplus of HUF 4.8 billion was generated in 2017 (KSH, 2017). If we look at the trade data of Hungary, it is clear that our exports of fresh milk are significant (WITS, 2018 database), but the trade of higher processed dairy products does not provide such a positive picture. Nagy et al. (2019)

As can be seen from Tables 38 and 39 in the Appendix, the domestic dairy industry produced significant exports from certain product groups between 1999 and 2018, while other product groups are characterized by clear import dominance. Based on the data of the WITS database (2019), the tables show the results of export and import activities of 18 types of dairy products between 1999 and 2018, expressed in USD, expressed as 5-year averages. In general, it can be said about trade activity (even with the slightly distorting effect of the average calculation) that the trade activity of the dairy industry has multiplied for the domestic dairy industry in the last 20 years, on average four times in terms of exports and ten times in terms of imports. The largest export product group is milk and cream with a fat content of between 1% and 6% (without condensation), other cheeses, products made from natural milk ingredients and, in recent years, bulk cheeses. In addition, it can be seen that Hungary has a significant import activity from milk and cream (with a fat content of more than 6%, without concentrating), yoghurt, butter, fresh and powdered cheeses.

The domestic dairy sector had to face further difficulties. One of these is the abolition of the milk quota system, because it favors more efficient, more competitive farming. As Salou (2017) points out, this marked the end of one of the iconic pillars of the Common Agricultural Policy on 1 April 2015. The measure is expected to increase competitiveness and market orientation of the industry. In addition to the increase in supply associated with the end of the quota system, the introduction of the Russian embargo and the emergence of cheap imported dairy products also had a negative impact on the domestic sector, as prices fell significantly (Balogh P., 2016). Nagy et al. (2019) The milk quota system has been in place in the EU for 3 decades, between 1984 and 2015, to reduce the previous significant overproduction, which has also had a significant impact on world market prices. Prior to the quota system, dairy farms could sell their milk at guaranteed

purchase prices (which were higher than world market prices), but the quota system reduced overproduction and imposed a levy on surplus production (Eurostat, 2018d). With the introduction of the quota system, the number of dairy farms (about one-fifth) and the number of dairy cows decreased significantly, while the share of farms specializing in dairy farming increased among all dairy farms (Eurostat, 2018d).

As can be seen from previous milk production data, in the case of Hungary, the goal would have been to maintain the quota system. However, it has been in the interest of traditionally large milk producers, milk processing Member States, to abolish this system. Thus e.g. Germany, Denmark, Ireland, Italy and the United Kingdom have also argued for phasing out, having previously pushed and exceeded their quota limits (Tarpataki, 2014).

## 3.2 Consumer habits of milk and milk products

The vast majority of the world's population, more than 6 billion people (ie almost four-fifths), consume milk and dairy products (FAO, 2020), according to some sources this is more than 7 billion people (IFCN, 2018). So milk is indeed a global basic foodstuff, as we can conclude. Consumption patterns of milk and dairy products in general can be said to vary considerably from country to country and continent to continent. According to the FAO (2008) study, the milk equivalent per capita milk consumption is approx. It means 100 kg per year, but its approximately three times the average in western Europe (but average milk consumption is generally high in European countries, ie over 150 kg / capita per year) and only a third or even less for some African and Asian countries.

Data on per capita consumption of milk and milk products in the Member States of the European Union, including butter, cheese, cream, whole milk, milk (excluding butter) and acidified products, are shown in Tables 16 to 21 of the Appendix. It is clear from the tables that there are significant differences between EU citizens in the consumption of milk and milk products, depending on the country, and that milk and milk consumption patterns changed significantly between 2002 and 2013[17]. These are, of course, different due to cultural differences and traditions between countries and even regions (it wirth to think of the French cheese consumption tradition).

[17] In the FAO database, this is the latest data currently available on milk and dairy product consumption.

In general, butter consumption has increased in many Member States since the turn of the millennium (Austria, Bulgaria, the Czech Republic, Finland, Slovenia, Sweden), while in other Member States with otherwise high average butter consumption (eg France, Germany) or stagnating. Butter consumption varies considerably from one Member State to another, with France averaging around 8 kg / capita per year in recent years, while Bulgaria, Romania or even Hungary not even reaching 1 kg / capita per year.

The level of cheese consumption in the EU does not differ much (with the exception of Cyprus and Romania, where the least cheese is consumed, with an average consumption of around 4-5 kg), while in Greece, France, Germany and Austria consumers seek the most cheese in the EU. on the shelves of shops, in these countries the annual consumption of cheese exceeds 20 kg / person. Cheese consumption in Belgium, Finland, Croatia, Latvia, Poland, Lithuania, Luxembourg, Germany, Slovenia, Sweden, Spain, the United Kingdom increased gradually over the 12 years under review, while cheese consumption in the Netherlands, France and Greece showed a slight downward trend.

The Member States of the Union show very different levels of cream consumption. While in some Member States the consumption of cream is almost imperceptible and the annual consumption of 0.5 kg / capita is not reached (eg Bulgaria, Croatia, Cyprus, Malta, the Netherlands, Romania, United Kingdom), in other Member States it is significant, around 10 kg or less. annual cream consumption per capita (Belgium, Denmark, Latvia, Sweden). The average consumption is around 6-7 kg per year as a consumer (this includes Germany, Finland, Slovenia, Hungary, Poland, Austria), in these countries there has been no significant change in consumption in the last 12 years.

Milk consumption (excluding butter) in the European Union is typically highest in the northern Member States (Finland, the Netherlands and Sweden), with a per capita consumption of between 340 and 410 kg per year. The lowest milk consumption is in Cyprus, Slovakia and Bulgaria, where it is much lower, at around Between 125 and 150 kg of milk, Hungary is among the last member states in the ranking with a milk consumption of around 160 kg / capita per year, with a similar consumption rate as Spain. While milk consumption in Lithuania, Poland, Denmark, Croatia and Germany gradually increased over the period under review, Hungary, Portugal, Slovenia and the United Kingdom showed stagnant consumption, while Italy, Bulgaria, Ireland and Latvia clearly showed declining milk consumption.

Total EU milk consumption shows interesting results compared to the milk consumption discussed briefly above. Romania has the highest total milk consumption (204.4 kg / capita / year) despite the fact that its milk consumption is not among the countries with the highest milk consumption. On the other hand, fatty milk accounts for a large share of its consumption, compared to Finland, which has the highest milk consumption (413.7 kg / capita / year), much less whole milk (118.9 kg / capita / year). Whole milk consumption is also high in Croatia, Estonia, Finland and the Netherlands. Italy, Latvia and Poland, on the other hand, have the lowest consumption of different milk types.

Whey is produced as by-product of cheese and curd, cottage cheese production. Whey consumption in the EU is very low, negligible (this is also affected by the short-term shelf life of whey), and significant consumption in the Member States can only be measured in Denmark (12 kg / capita / year).

Based on the research of Kürthy et al. (2016), it can be said about the consumption habits of fresh milk and dairy products in Hungary that the continuous growth stopped until 2013, and since then there has been a slight decrease. In its structure, in addition to the decrease in the consumption of fresh milk, the consumption of other dairy products (yoghurts, cottage cheese, cheese, butter) began to increase, but this is still far from the ideal level. The Milk Interprofessional Organization and Product Council has launched the Milk Heart campaign, which aims to draw attention to domestic milk consumption: the promotion of high-quality domestic products and thus the support of domestic producers, and the development of a health-conscious lifestyle (NAK, 2018). Nagy et al. (2019)

Emerging consumer demand for milk and milk products is largely determined by the growing demand for plant-based products to replace and replace milk and milk products, which have been growing in recent years. Due to different eating habits, diets, allergies and fashions, the interest of consumers in dairy-free, milk substitute products seems to be strengthening, especially in the case of more solvent consumers in developed countries. It can be observed, for example, that the vast majority of the population in Europe (around 90%) is tolerant to lactose in milk, yet their sensitivity to certain components of dairy products is a major health concern (Pólya és Kovács, 2013).

However, in addition to milk and milk products, it is important to mention a growing importance of a substitute product group, which is creating a serious competitive situation

both in Europe and in the world. This product range is the product range of soy, almond, rice, oat-based milk and dairy substitutes among plant-based foods (Jeske et al., 2018). The production of these substitute products is a matter of quality (eg achieving the right level of protein content), the development of sustainable farming, but it is definitely a rapidly changing, evolving group of substitute products.

## 3.3 Previous researches on dairy competitiveness

In this subchapter of the dissertation, I have collected previous research results in the dairy industry, relying on sources found in both the domestic and international literature. Due to the focus of the dissertation on the EU Member States, I considered it important to collect the scope of these previous researches specifically for this EU research area.

An early workshop study in 1996 (Szabó, 1996) was carried out within the framework of the research program entitled "*In global competition?*"[18], which aimed to examine the competitiveness of the Hungarian dairy industry. To investigate the competitiveness of the Hungarian dairy industry, the author used the Porter diamond model and prepared a case study. Although his research started at the company level (basically he proposes measures for corporate competitiveness), he draws from the company level, taking into account the analysis of the available statistical data for the industry as a whole. The significance of the study is that it gives an extremely comprehensive picture of the 90s, the domestic relations, such a comprehensive study on the dairy industry and the dairy market was not really born in the future either. The aim of Szabó's (1996) research was to determine the most important factors that determine the competitiveness of a given industry. These main factors are economies of scale, customer side strength (bargaining power of retail chains, adaptability and final consumer needs, their price sensitivity), innovation skills, and various subsidies. In his study, Szabó (1996) found that the competitiveness of the Hungarian dairy industry lags behind that of the then EU member states.

Drescher and Maurer (1999) examined the competitiveness of the European dairy industry in their study, which focused on comparing the German dairy industry with that

[18] Competitiveness Research Center has been conducting research since 1995, which in 2018 arrived in phase. Source: https://www.uni-corvinus.hu/fooldal/kutatas/kutatokozpontok/versenykepesseg-kutatokozpont/, download time: August 19, 2020

of other EU Member States. The study was carried out for the period 1986 to 1997 for certain groups of dairy products. In the first year of the period under review, it was still EU12, and later it was expanded to EU15, and the competitiveness analysis was carried out to EU15, with the exception of Finland. The meso-level study was carried out using the method of revealed comparative advantages and concluded that the German dairy industry is more competitive with its European counterparts for certain dairy products. Certain product groups were also at the forefront of competitiveness during the period considered. Such a group of products is the range of yoghurts, whereas in the group of cheeses, Danish, Dutch and Italian milk processing are more competitive.

In their study, Gorton et al. (2006) examine the situation of Hungarian agriculture by calculating the ratio of resource costs to the post-accession period by analyzing 3 different scenarios. These are non-accession, accession old productivity rates, and accession with dynamic productivity developments opportunities, by analyzing baseline data from 2000 to 2002. Based on their general equilibrium model, they concluded that in the case of all three options, domestic agriculture struggles with serious competitive constraints, and they do not see an opportunity for the international competitiveness of the dairy industry.

The competitiveness of the food economy was also examined by Majkovic et al. (2006), who compared the competitiveness of 9 other member states that joined Slovenia at the same time for the period 1999–2003. For their research, they used an index of revealed comparative advantages, the results were not divided into separate product groups, only for each industry. It has been found that the Slovenian dairy industry has a comparative advantage over other countries in terms of meat and beverages.

Dillon and co-authors (2008) examined Ireland's competitiveness (and compared it with some major dairy-producing Member States, including, for example, Belgium, Denmark, the Netherlands, Italy, Germany) in the early 2000s. Basically, the definition of competitiveness in the narrow sense, so cost-based competitiveness, was their starting point and traditional factors of production were taken into account. It was concluded that, in Ireland, from the production factors, land and labor factors are inefficient in Irish milk production, so increasing them would lead to higher competitiveness for Irish milk production.

In a larger study, Tacken et al. (2009) examined the competitiveness of the European dairy industry, based on the theory of international economics. The report is based on

their work commissioned by the European Commission, DG Enterprise and Industry and carried out as part of a general project on the competitiveness of the European food industry. Their study examined several levels of competitiveness, including corporate (the largest dairy in Europe), industry (dairy industry in some EU Member States) and globally, the latter considering the EU25 as a unit and comparing the results achieved by the EU, for example with the dairy industry in the USA, New Zealand, Canada. A number of indicators were chosen to determine industry competitiveness, such as the value added of the dairy industry within the food industry, the change in the index of revealed comparative advantages (showing the change in export specialization for a given product group), the change in world market share, and labor productivity. The authors concluded that the competitiveness of the EU25 dairy industry (although considered to be an innovative and global player) has deteriorated compared to its largest competitors in the world market.

Bojnec and Fertő (2008b, 2014) examined the competitiveness of the dairy industry in some European countries using indices of revealed comparative advantages. Their previous study in 2008 compared the competitiveness of Croatia, Hungary and Slovenia with those of the EU15. It has been found that apart from a few product groups and a successful year, it has to cope with increasing difficulties in maintaining and improving its competitiveness in the dairy industry. In a subsequent study in 2014, it analyzed the export competitiveness of the then 27 Member States of the European Union between 2000 and 2011 in EU and non-EU markets. Not only the index of revealed comparative advantages was used for the analysis, but the stability and durability of the calculated competitiveness were also examined. Their research concluded that a fundamental difference exist for each dairy product groups between the degree of competitiveness of the 15 Member States that joined earlier and the 12 Member States that joined later. Different results were obtained for intra- and extra-EU competitiveness and for different groups of dairy products with different levels of processing.

Jansik and co-authors (2014) conducted a complex competitiveness analysis examining the competitiveness of dairy industries in northern European countries. The main factors determining the competitiveness of the dairy industry are economic performance (profitability, dairy concentration, milk prices, etc.), productivity (labor productivity, total factor productivity, unit milk production), international trade performance, growth (dairy exports, dairy production, dairy sales growth) and innovation (R&D costs per sale).

The factor of international trade performance was measured by the method of revealed comparative advantages and the export share of sales. Based on the quantitative results, a semi-structured questionnaire survey was also conducted in the 8 Northern European countries examined, and nearly 100 interviews were conducted with various actors in the dairy supply chain. The authors came to an interesting finding. The 5 main factors influencing competitiveness, and the indicators derived from them, were not finally included in a single index, which would give the final ranking among the examined countries. Due to the sensitivity of the weighting (i.e., a very different order emerges depending on the weights) and the differences between countries in each factor, the authors remained presenting and explaining the results achieved by the factor group. In their study, Jansik and Irz (2015) identified the relationship of some actors in the dairy chain with other industries and sectors, the role and weight of the dairy industry in the national economy, and the economic decisions of each (also affecting the industry) as factors determining the competitiveness of the industry. the availability of services to support the dairy industry and the public perception of the sector (and its impact). The authors suggest that these difficult-to-quantify and highly related factors should be taken into account in addition to the traditionally accepted factors when determining the competitiveness of the industry, as they consider that the emphasis on efficiency is cost, cost management and sales (also internationally).

Vőneki and co-authors (2015) examined the competitiveness of the European dairy industry prior to the abolition of the milk quota, essentially taking into account the first decade of the 2000s. Their study for the period 2016-2020 concludes that, based on their profitability-based model, domestic dairy herds and milk production will start to grow slightly during that period, generally predicting intensifying European competition, with milk processing remaining a weak point in the domestic dairy industry.

The entire EU dairy industry was also studied by Simo et al. (2016). The competitiveness of certain aggregate groups of dairy products in Slovakia has been given special attention and examined for the period 2007-2013. The revealed comparative advantage index and its alternatives were used for their study. It has been concluded that Slovakia has a clear competitive advantage in certain groups of aggregated milk products, which is the product with different fat content of milk at the lowest level of processing.

The below Table 13. shows, in alphabetical order, the main studies examining the competitiveness of the dairy industry in the European region presented in Section 3.3, based on their method and main results.

*Table 13. - Summary table of dairy competitiveness studies in the European Union*

| **Authors** | **Period and focus** | **Method** | **Main results** |
|---|---|---|---|
| Bojnec and Fertő (2008b, 2014) | 2000 – 2011, Hungary and EU members | revealed comparative advantages | EU15 országainak és később csatlakozottak között versenyképessége termékcsoportonként alapvető különbséggel rendelkezik |
| Dillon et al. (2008) | beginning of the 2000's, Ireland and largest milk producers in EU | competitiveness assessed on the basis of factors of production | Irish dairy industry has low land and labour productivity |
| Drescher and Maurer (1999) | 1986 – 1997, Germany and EU12/EU15 | revealed comparative advantages | for the yoghurt product group, the competitiveness of the German dairy industry |
| Gorton et al. (2006) | based on 2000 – 2002 results a forcast for Hungary | use of a general equilibrium model | within Hungarian agriculture, the dairy industry has competitive disadvantage |
| Jansik et al. (2014), Jansik and Irz (2015) | examining the competitivenes s of the dairy industry in northern European countries | revealed comparative advantages (in case of international trade performance) | economic performance, productivity, international trade performance, growth, innovation |
| Majkovic et al. (2006) | 1999 – 2003, Slovenia and member states joined in 2004 | revealed comparative advantages | Slovenian meat, dairy and beverages have a comparative advantage within the food sectors |
| Simo et al. (2016) | 2007 – 2013, Slovakia and EU members | revealed comparative advantages | competitive advantage for the lowest processed milk (its various varieties) |
| Szabó (1996) | 1990-96, Hungary | case study, Porterian diamond model | Determinants of competitiveness: economies of scale, customer-side strength, innovation skills, subsidies. Competitiveness of the domestic dairy industry lagging behind the western part of Europe. |

| | | | |
|---|---|---|---|
| Tacken et al. (2009) | 1995-2005, EU in global comparision | revealed comparative advantages | examination of all three levels of competitiveness, deteriorating competitiveness compared to world market competitors |
| Vőneki et al. (2015) | first decade of the 2000's | profitability based model | After the abolition of the milk quota, domestic milk processing will remain a weak point of the dairy industry compared to European competitors. |

Source: own construction, 2020

In the present chapter of the dissertation I presented the dairy industry, which is the field of empirical research. I started from the trends that can be observed in the global, world economy, presented the characteristic features of the European dairy industry, and then, focusing on the European Union, including the European Union, collected the competitiveness studies of the dairy industry. In the next part of the dissertation, building on the theoretical framework created in the previous chapters, I present the research questions of the dissertation and my hypotheses and sub-hypotheses for their analysis with the related methodological solutions.

# Chapter 4. Research questions, hypotheses

In this chapter, based on the previous chapters of the dissertation, I have collected the following findings, from which my research questions follow, and they will be answered by testing the established hypotheses:

- limited in the literature on industrial competitiveness in the field of agricultural economics (e.g. Albaladejo, 2010; Beno, 2017; Cimpoies, 2013; Ignjatijevic et al., 2013; Savic et al., 2012) and within this to the dairy industry (e.g. Bojnec and Fertő , 2008a, 2014; Drescher and Maurer, 1999; Dillon et al., 2008; Tacken et al., 2009; Jansik et al., 2014), this issue is more typical of other industries, sectors or industries of industrial production. competitiveness of the service sector (e.g. mining Lyshenko et al., 2018; wood processing Sujová et al., 2015; manufacturing Olczyk and Kordalska, 2018; pharmaceutical industry Cai et al., 2018; textile industry Bilalis et al., 2006);

- the number of recent (so published in the last few years analsying the past few years also) and long-term (15-20 years) industry competitiveness analyzes is rare (e.g. Balogh, JM 2016, Jámbor et al., 2018), typical of some year (3-10 years) analyzes (e.g. Lyashenko et al., 2018; Beno 2017). Regarding the competitiveness of the dairy industry, I did not find an analysis of the competitiveness of the dairy industry examined within the EU within the last 5 years, the latest data examine the competitiveness of the European dairy industry up to and including 2011 (Bojnec and Fertő, 2014);
- the number of studies in a larger, economically, socially related area (e.g. ASEAN Member States, Loo, 2018; Bojnec and Fertő for the European Union, 2014) is rare. It is more common to perform analyzes focusing on the specific industry of a country or industry in a smaller region (e.g. Visegrad countries, Beno, 2017); and
- the number of analyzes examining the relationship between the degree of factor supply and competitiveness in the dairy industry is low (Dillon et al., 2008).

## 4.1 Research questions

The subject of my own research is therefore, in line with the above, the examination of industry-level competitiveness, more precisely the examination of the competitiveness of the European dairy industry. I formulate my research questions as follows:

**1. How competitive are the Member States of the European Union regarding their dairy industries?**

**2. What factors do affect the competitiveness of the dairy industry in the Member States of the European Union?**

To answer the research questions, I am looking for the answer with the hypotheses set up in the following subsection, by testing them.

## 4.2 Hypotheses

I am looking for the answer to the research questions about the competitiveness of the dairy industry with the 4 hypotheses and 6 sub-hypotheses explained below.

***H1: The competitiveness of the domestic dairy industry lags behind that of the EU Member States.***
***H1a: The competitiveness of the domestic dairy industry lags behind that of the EU15 Member States.***
***H1b: The competitiveness of the domestic dairy industry lags behind the competitiveness of the dairy industry of the Central and Eastern European Member States.***

The meso-level competitiveness defined in subchapter 2.7 of the dissertation was defined as follows:

*It is possible to define meso-level competitiveness the successes as a whole of the domestic companies operating in a given industry (sector), the extent of which can be determined in the international comparison of the given industry (sector), so in the comparison of domestic industry (sector) with foreign industry (sector) established.*

Based on these, the competitiveness of the domestic dairy industry means the totality of the successes of the companies operating in the domestic dairy industry, which includes both milk production and milk processing. In my dissertation I interpret the competitiveness of the Hungarian dairy industry compared to the EU dairy industry.

Based on the definition, the hypothesis and its two sub-hypotheses seek to answer the question of whether the competitiveness of a domestic dairy industry lags behind that of a foreign dairy industry in an international comparison. For this purpose (fixing or narrowing the scope of the foreign dairy industry to be examined) I compare the dairy industry competitiveness of the European Union member states with the domestic dairy industry competitiveness. I make an international comparison based on the results obtained in international trade, which can be inferred from the given definition and accepted in the literature. Accepting the method published in the literature, I perform the analysis by calculating the indexes of the *Revealed Comparative Advantages (RCA index*, Balassa, 1965) and the indices presented in subchapter 1.3.2 of the dissertation for industry, including the dairy industry. Due to the criticisms concerning the original index presented in the mentioned subsection (such as the issue of asymmetry, the issue of taking

imports into account in addition to exports), I also perform the calculation of the created alternative indices, in summary the following:

- Revealed Comparative Advantages (RCA index, Balassa, 1965)
- Revealed Trade Advantage (RTA index, Vollrath, 1991)
- Logarithm of Revealed Comparative Advantages (LnRCA, Vollrath, 1991)
- Revealed Competitiveness Index (RC index, Vollrath, 1991)
- Revealed Symmetric Comparative Advantage (RSCA index, Dalum et al. 1998)

The Revealed Comparative Advantage Index formulated by Balassa (1965) is structured as follows (Fertő, 2003; Jámbor 2008):

$$RCAij = \left(\frac{X_{ij}}{X_{it}}\right) \Big/ \left(\frac{X_{nj}}{X_{nt}}\right), \text{ where}$$

$X$ means export,

$i$ is the examined country,

$j$ is the examined product,

$t$ is the group of products,

$n$ means the group of countries.

As a result, when calculating the index, the ratio of a given country's exports of a given product to total exports is compared to the exports of a group of reference countries. If the *RCA* index is higher than one, the country in question has a comparative advantage over the reference countries for the product under investigation, if it is less than one, it is at a competitive disadvantage.

The original index has been the subject of a number of criticisms, for a number of reasons, but most notably its asymmetry to 0 and its failure to take into account various economic policies. The problem of asymmetry stems from the fact that in the case of a competitive disadvantage the RCA index takes a value between 0 and 1, while in the case of a competitive advantage it takes any value greater than 1, thus overestimating the relative weight of the given sector. Vollrath (1991) proposes three steps to solve the above problems, these were the introduction of the *Revealed Trade Advantage Index (RTA)*, the

*Logarithm of Revealed Comparative Advantage (LnRCA)*, and *Revealed Competitiveness (RC)* indices.

To construct the *Revealed Trade Advantage index (RTA)*, it first introduces the *Revealed Import Advantage (RMA)* index, replacing the import data in the *RCA* index already presented above. Compared to the *RCA* index, *RMA* presents an average comparative advantage, thus solving the problem of asymmetry. Thus, the revealed import benefit index is as follows:

$RMA_{ij} = (M_{ij}/M_{it}) / (M_{nj}/M_{nt})$

Subsequently, as a second step, Vollrath (1991) develops the *Revealed Trade Advantage (RTA)* index, which takes into account both export and import data, so positive values represent competitive advantage and negative values represent competitive disadvantage. Based on the above, the revealed commercial advantage index is as follows:

$RTA_{ij} = RCA_{ij} - RMA_{ij}$

Vollrath's (1991) second index proposes a *Logarithm of Revealed Comparative Advantages (LnRCA)*, which has the advantage that, like the *Revealed Comparative Advantages* index *(RCA)*, it contains only export data, making it less exposed to possible distortions generated by economic policy (Fertő, 2003).

The third index to be mentioned is the *Revealed Competitiveness* index. Vollrath (1991) created his own *Revealed Competitiveness* index (RC), taking the natural logarithm of the *RCA* and *RMA* indices. The *RC* index is symmetric to 0, and positive values represent the comparative advantage, which can be described as follows:

$RC_{ij} = ln\ RCA_{ij} – ln\ RMA_{ij}$

As a further solution, we consider important the solution of Dalum et al. (1998) to the problems of the initial *Revelaed Comparative Advantage* index *(RCA)*. The authors created the *Revealed Symmetric Comparative Advantage (RSCA)*:

$RSCA_{ij} = (RCA_{ij} – 1) / (RCA_{ij} + 1)$

RSCA takes values between -1 and 1, positive values represent the comparative export advantage, while values between 0 and -1 take the comparative export advantage.

To test the hypothesis, I use the World Bank's World Integrated Trade Solution (WITS) database, focusing on the achievements of the EU-28 international trade in determining the competitiveness of the dairy industry. I carry out the analysis for the period 1999-2018 on the one hand for the dairy industry as a whole (this determines the competitiveness of the industry in relation to the competitiveness of the foreign industry) and on the other hand for the groups of dairy products created by each dairy industry. In addition to calculating indices for the dairy industry as a whole, which brings more general results, I consider it important to calculate the competitiveness results of each group of dairy products in order to create a more nuanced overall picture. In the WITS database, the number of defined main groups of dairy products, broken down by HS04, is currently 6 and the number of main groups of dairy products is 18 (see Tables 36 and 37 in the Appendix for more information).

***H2: The competitive position gained by Member States in the EU dairy industry was stable during the period under review, so between 1999 and 2018.***
***H2a: The acquired competitive positions of the domestic dairy industry were more stable compared to the acquired competitive positions of the dairy industry in the EU15 Member States between 1999 and 2018.***
***H2b: The acquired competitive positions of the domestic dairy industry were more stable compared to the acquired competitive positions of the dairy industry in the Central and Eastern European Member States between 1999 and 2018.***

In connection with the first research question, another important question is to what extent and how a given acquired competitive position changes during the study period, ie the issue of stability is examined (Hinloopen and van Marrewijk, 2001; Fertő, 2003; Utkulu and Seymen, 2004; Seyoum, 2007). Hypothesis H2, as well as the related 2 sub-hypotheses, examine whether the competitive positions acquired by the domestic dairy industry, compared to the competitive positions acquired by the foreign dairy industry, were durable and constant in the examined period. The acquired competitive positions are basically worth examining here for product groups during a given period, in order to be able to monitor the change or even the stability of the competitive positions formed in a given sector during the examined period. My preliminary assumption is that these positions were stable at the product group level. Accepting this hypothesis would send an important message and challenge to sectors without a competitive product group.

To test the hypothesis, ie to examine the changes in the competitive positions acquired in the domestic dairy industry, I apply different stability methods for the whole period, the examined domestic and foreign dairy industries, their individual sectors (18 product groups).

For the study of stability, basically 2 types of stability can be distinguished. One type shows the stability of the distribution of the revealed comparative advantage indices from one base period to the other period, and the other type shows the stability of the value of the revealed comparative advantage indices between the beginning and the end point of the studied period (Fertő, 2003). The stability test for the first type is based on the work of Hoekman and Djankov (1997), according to which the correlation coefficient of the index types of the revealed comparative advantages must be calculated compared to a base year. In the case of a high correlation coefficient, it can be concluded that the structure of the revealed comparative advantages did not change much in the examined period, so it can be said to be stable (Fertő, 2003). And in the case of a low correlation coefficient, of course, the opposite can be deduced, that is, a changed structure means a lack of stability.

He also uses the method of Hoekman and Djankov (1997) to examine the other type of stability. Here, we measure the relative weight of products that had a revealed comparative advantage in a given period (typically a year) but had a revealed comparative disadvantage in a subsequent period, or vice versa. It had a revealed comparative disadvantage in a given period, and this became a comparative advantage in the following year (Fertő, 2003). Another method is to use transition probability matrices (based on Hinloopen and van Marrewijk, 2001; Fertő, 2003), which categorizes the values of the calculated revealed comparative advantage indices into 4 groups as follows (Table 14).

*Table 14. – Grouping of revealed comparative advantage index values*

| **Group** | **Value** | **Meaning** |
|---|---|---|
| *Group a* | $0 < RCA \leq 1$ | means revealed comparative disadvantage |
| *Group b* | $1 < RCA \leq 2$ | means weak/modest revealed comparative advantage |
| *Group c* | $2 < RCA \leq 4$ | means medium revealed comparative advantage |
| *Group d* | $4 < RCA$ | means very high revealed comparative advantage |

Source: based on Hinloopen és van Marrewijk (2001), own construction, 2019

The basis of the transition probability matrix mentioned above measures and compares the frequency of transitions between the beginning (1999) and ending (2018) years of the

study period (in this case between 1999 and 2018), e.g. the distribution of the revealed comparative advantage indices belonging to the group for the closing year, and so on (Table 15).

*Table 15. – The transition probability matrix*

<table>
<tr><th rowspan="2">First year</th><th colspan="4">Final year</th></tr>
<tr><td>Group a</td><td>Group b</td><td>Group c</td><td>Group d</td></tr>
<tr><td>Group a</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Group b</td><td></td><td colspan="2" rowspan="2">the distribution of the indices of each group in the final year compared to the beginner</td><td></td></tr>
<tr><td>Group c</td><td></td><td></td></tr>
<tr><td>Group d</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Distribution of 1st year</td><td colspan="4">distribution of first year RCA results</td></tr>
<tr><td>Distribution of final year</td><td colspan="4">distribution of last year RCA results</td></tr>
</table>

Source: based on Hinloopen és van Marrewijk (2001), Fertő (2003), own construction, 2019

***H3: Higher milk yields result in higher dairy competitiveness in EU Member States.***

In connection with the second research question, with Hypothesis H3, I assume that milk production with higher milk yields also results in a dairy industry with more competitive dairy products. Testing the hypothesis may provide an answer to the question of whether the dairy industry with a high milk yield is indeed also a dairy industry with a higher competitiveness in the European Union. If the hypothesis is accepted, it could be stated that the increase of milk yield during milk production clearly contributes to the development of competitiveness, which is a useful statement from the point of view of economic policy.

Examining the competitiveness of the dairy industry, Drescher and Maurer (1999) found a lower competitive position with lower German milk yields compared to the Danish and Dutch dairy industries. In previous Hungarian research, Tímár (2004) established the relationship between milk yield and competitiveness, Bojnec (2008) examined the relationship between milk quality factors (including milk yield) and the competitiveness of the dairy industry for the Slovenian dairy industry. In his analysis, he characterized the increase in milk yield and the improvement of milk quality factors in the increase of

competitiveness as a determining source. Pogány et al. (2011) performed cost-based calculations on a small sample (8 dairy farms in western Hungary) and concluded that although there is a correlation, even farms with higher specific milk yields can only become profitable with subsidies and become competitive. Based on all this, it can be said that although the relationship between milk yield and the competitiveness of the dairy industry has been studied, it is relatively long ago and in a narrow circle, so it is worth examining and analyzing the relationship and testing the hypothesis on a more recent database.

To test the hypothesis, I compare the milk yield data of the Eurostat database for the EU Member States with the indices of the comparative advantage of each dairy product group. The study covers 18 dairy product groups and 28 Member States over a period of 20 years (1999-2018). I plan to use correlation calculation to determine the strength of the relationship between milk yield and competitiveness. I expect a positive relationship between milk yield and competitiveness in advance. The sources of the data are the Eurostat, FAO and World Bank (WITS) databases already mentioned.

***H4: EU Member States with higher factor supply conducts to higher competitiveness in the dairy industry.***

***H4a: Higher supply of land, labour and capital results in higher competitiveness of the dairy industry.***

***H4b: The level of agricultural support increases the competitiveness of the dairy industry.***

Related to my second research question, my fourth hypothesis and related sub-hypotheses examine the extent to which the supply of classical factors of production (land, labor, capital) influences the development of competitiveness in the dairy industry of the European Union. The hypothesis is based on the assumption that the competitiveness of industry in countries with better factors of production is also higher in milk production and for different groups of dairy products. As Couillard and Turkina (2015) found in their research, agriculture in general is highly dependent on factor supply, so it can be concluded that higher factor supply increases the competitiveness of agriculture. In their study, Bojnec and Fertő (2014) stated that there are groups of dairy products with a higher level of processing, for which the role of innovation (due to complex knowledge-intensive

processes) and international marketing is significant to increase the competitiveness of product groups.

To test the hypothesis, I interpret the indicators of land, labor and capital supply in agriculture (unfortunately, such detailed data are not available for the dairy industry). I interpret the land supply of a given country as the ratio of utilized agricultural land to the total population and measure it in 1000 ha / person. In addition, I interpret it as the ratio of the number of dairy cattle to the total population in units of units, which can be interpreted as an alternative to the supply of land. I interpret the supply of the labor force as the ratio of the agricultural labor force / total active workers and give it in percentage form (or as an econometric natural logarithm). To examine the supply of capital, I take into account the contribution of agriculture to GDP (MGRESZ) on the one hand, and the contribution of agriculture to GDP multiplied by the per capita GDP of a given country (TOKE, thousand USD / capita). In addition, I interpret the level of milk subsidies (TEJTAM) as a factor influencing the model. I assume in advance a positive relationship between each factor and competitiveness. The data sources are the World Bank WDI, FAO and Eurostat databases.

So the aim of the research is not only to examine how competitive the dairy industries of each EU Member State are in the international dairy market, but also to examine what determines the competitiveness of each dairy industry. Previous research is available from Tacken et al. (2009), Wijnands et al. (2008), but while the former focuses on the dairy industry, the latter usually examines the food industry. Furthermore, Wijnands et al. (2008) do not conduct an EU-wide study, but focus on a country-specific industry, Dillon et al. (2008) and Simo et al. (2016). What makes one more competitive than the other in the EU, and what factors can be used to improve competitiveness? Using the aforementioned literature, the fourth hypothesis seeks to answer these questions, for which I use the gravity model to identify the factors determining the comparative advantages of the dairy industry in the European Union, estimating the following regression model:

$$\ln RCA_{it} = \alpha_0 + \alpha_1 \ln TEJHOZ_{it} + \alpha_2 \ln FOLD_{it} + \alpha_3 \ln TEHLET_{it} + \alpha_4 \ln MUNKA_{it} + \alpha_5 \ln MGRESZ_{it} + \alpha_6 \ln TOKE_{it} + \alpha_7 \ln TEJTAM_{it} + \alpha_8 REGIO_{it} + v_i + \varepsilon_{it}$$

where

$i$ is the unit of analysis (country),

$t$ means the observed time interval (year),

$V_i$ an error term that shows a constant country effect over time,

$\varepsilon_{it}$ and an error term that varies from country to country and over time.

Table 16 provides a brief description and summary of the model variables involved in the testing.

*Table 16. – Main variables and its characteristics involved into testing*

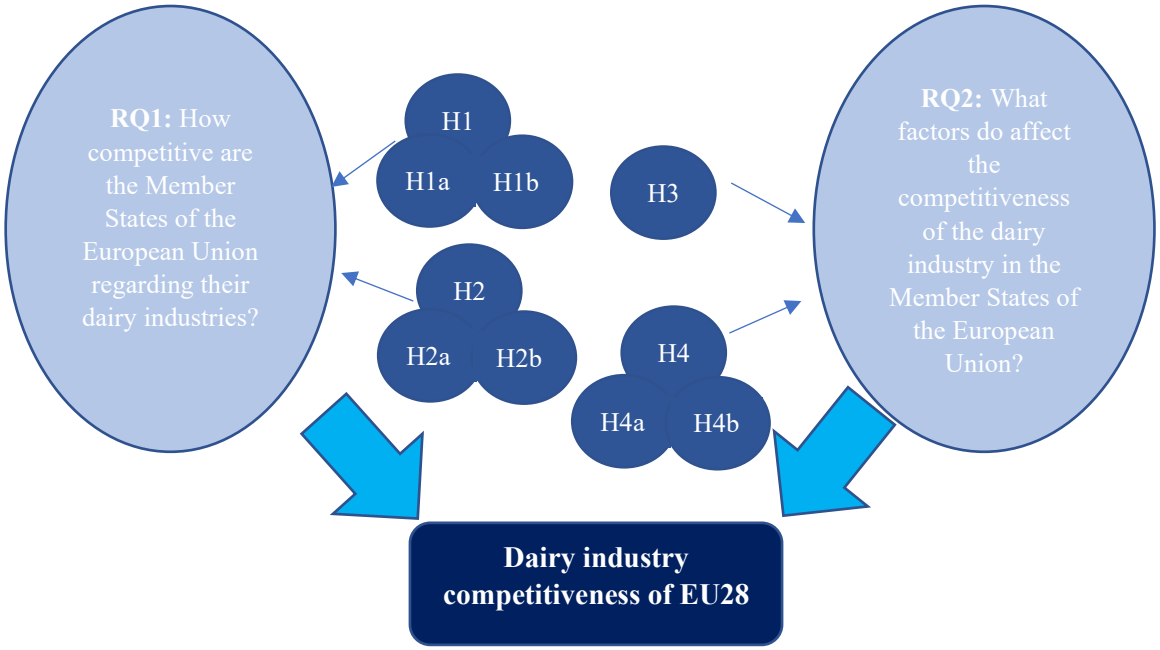
| **Variables** | **Description of variable** | **Source of data** |
|---|---|---|
| RCA | Revealed comparative advantages index and alternatives (RCA, RMA, RTA, RC, RSCA) | World Bank, WITS |
| TEJHOZ | Milk yield: the amount of milk given by a cow per year (tonnes / cow) | FAO |
| FOLD | Land supply: utilized agricultural land / total population (1000 ha / person) | World Bank, FAO |
| TEHLET | Dairy cattle supply: total dairy cattle / total population (cows / person) | FAO |
| MUNKA | Labor supply: agricultural labor / total active workers (Ratio) | World Bank, FAO |
| MGRESZ | Share of agriculture in GDP (%) | FAO |
| TOKE | Contribution of agriculture to GDP * GDP / capita (thousand USD / person) | World Bank, FAO |
| TEJTAM | Milk production subsidies (thousand euros) | European Committee |
| REGIO | Binary variable for EU28 Member States: value for EU15 Member States 1, otherwise 0 | own grouping |

Source: own construction, 2019

There are several panel data analysis procedures to test the determinant of competitiveness in global agricultural trade (Jámbor, 2017). These include OLS estimation, fixed and random effect models, predictable overall least squares estimation (FGLS), and in addition, panel-corrected standard errors (PCSE) methods. In addition to using the static methods listed above (PCSE model), I also run dynamic panel models that are suitable for handling autocorrelation, heteroskedasticity, and endogeneity between explanatory variables according to literature recommendations (Arellano and Bover 1995; Blundell and Bond, 1998).

In summary, the logical relationship between the research questions and hypotheses of the dissertation is shown in Figure 13.

*Figure 12. - The logical line between the research questions and hypotheses of the dissertation*




Source: own construction, 2020

## 4.3 Methodological limitations of empirical research

To test the hypotheses presented in the previous subsection, I use the method of revealed comparative advantages described in more detail in subsection 1.3.2 of the dissertation. The data are from the World Bank's World Integrated Trade Solution (WITS, 2019a) database. The WITS database contains exports and imports of trade in goods at a value in USD based on data from commodity and partner countries. The number of reporting countries in the database exceeds 170 countries, and the database has contained statistics since 1962 (WITS, 2019b). The examined data cover the product group HS04, divided into six levels, resulting in 18 product groups (the product-level names can be found in Tables 36 and 37 in the Appendix). As I calculate the Balassa indices of 18 product groups of 28 EU member states between 1999-2018, the total sample size is 10,080 items.

However, I am also aware of the limitations of the research presented above, which can be broadly divided into the following main areas: the EU borderline involved in the study, the WITS database as the source of the data used, and the method itself (comparative advantage method).

When examining the competitiveness of the dairy industry, I will confine myself to examining the dairy industries in the current Member States of the European Union. There are mainly lengthy reasons for this, which I have to consider due to the requirements of the dissertation. In an extended case, the literature search would have exceeded compliance with this size requirement. Furthermore, due to the essential food nature of milk and dairy products, it seems a logical decision to limit ourselves to a relatively well-defined environment, which in this dissertation is the border of the European Union.

The World Bank WITS website has the following problems with trade data:

- the sums of the values given in the lower level breakdown do not necessarily correspond to the higher level values, ie the sums of the HS6 level data may not give the exact HS4 and HS2 level data (aggregation problem);
- data may in many cases be incomplete at country and year level;
- data may vary from classification system (HS system is not fully compatible with BEC and SITC systems);
- the exports of one country do not necessarily correspond to the imports of another country, in the same relation (matching problem).

Furthermore, in addition to the research limitations listed above, the following problems are most often raised in the literature in relation to the Balassa indices (Halpern, 1994; Fertő, 2003):

- its values are sensitive to zero (this is especially problematic when running mathematical-statistical models). This problem is mostly handled using the natural-based logarithm, which I will follow in the dissertation;
- the results are sensitive to missing values (this is especially problematic when running mathematical-statistical models). This problem is most often handled by giving the missing values a value of zero;

- asymmetric results (the Balassa index shows a comparative advantage from 1 to infinity, but does not distinguish between low and high values). This is usually solved by grouping.

Of course, these results are also influenced by the design of the product groups themselves. As I mentioned in Chapter 3 of the dissertation, the range of dairy products gives a very diverse picture, the element that best describes the range of dairy products is the raw material used, milk (Szabó, 1996). Certainly, these product group boundaries could be modified (an excellent example of this is the question of classifying Hungarian lump curd into the appropriate dairy product group), supplemented. Still, I think that, taking into account these frameworks and constraints, it generally provides a good picture of the situation and competitiveness of the dairy industry in each country during the period under review.

It is important to note here when reflecting on the research limitations, that in case of hypotheses H3 and H4, in the case of explanatory variables, I did not include macroeconomic effects such as e.g. the exchange rate changes, but I am aware of its limitations. I need to interpret the results in the light of this.

Taking into account the above limitations and dealing with the problems, I perform the calculations and interpret the results in the next chapter of the dissertation.

# Chapter 5. Application of meso-level competitiveness, presentation and analysis of the results of empirical research

In the present chapter of the dissertation, the empirical research for testing the hypotheses formulated on the basis of the research questions (subsection 4.1 of the dissertation) (subsection 4.2 of the dissertation) is presented and analyzed. Thus, the present analysis is its application to competitiveness testing at the meso level, which is also accepted in the literature. Based on the previously presented, I present the analysis by hypothesis.

## 5.1 Competitiveness of the Hungarian dairy industry in relation to the EU Member States (Hypothesis H1)

Based on the above, the following competitiveness indices have been calculated for the period 1999-2018 for the EU Member States:

- Revealed Comparative Advantages (RCA index, Balassa, 1965),
- Revealed Trade Advantages (RTA index, Vollrath, 1991),
- Revealed Competitiveness Index (RC index, Vollrath, 1991),
- Revealed Symmetric Comparative Advantage (RSCA index, Dalum et al. 1998), and
- Logarithm of Revealed Comparative Advantages (LnRCA, Vollrath, 1991).

After calculating the indices, I performed a correlation analysis between the indices, the results of which are shown in Table (17) below. I determined the strength of the correlation based on Guilford (1950). As is clear from Table 17, the correlation between each index is at least moderate but rather strong, suggesting a high or strong relationship. Thus, in the following, I will confine myself to a more detailed analysis of the Index of Comparative Advantages (RCA). The results for the calculations of the additional index (RTA, RC, RSCA, and LnRCA) can be found in Appendix, tables 40-43.

*Table 17. – Correlation between revealed comparative advantage indices*

| Correlation | RCA | RTA | RC | RSCA | LnRCA |
|---|---|---|---|---|---|
| **RCA** | 1 | | | | |
| **RTA** | 0.88 | 1 | | | |
| **RC** | 0.40 | 0.49 | 1 | | |
| **RSCA** | 0.57 | 0.47 | 0.75 | 1 | |
| **LnRCA** | 0.52 | 0.41 | 0.81 | 0.92 | 1 |

| **Note:** | |
|---|---|
| <0.4 | low level of correlation |
| 0.4≤ <0.7 | medium level of correlation |
| 0.7≤ <0.9 | high level of correlation |
| 0.9≤ | very high level of correlation |

Source: own construction based on WITS database data, 2020, determination of correlation strength based on Guilford (1950)

Table 18 below shows the results of the Revealed Comparative Advantage Index (RCA) by country for the period under review. I divided the period into four equal parts, each of the periods spanning 5-5 years. During the division, I was able to enforce the separation of the countries that joined after May 1, 2004, as well as the periods following the 2008 World Economic Crisis. The five-year cycles show the arithmetic mean of the RCA values achieved.

*Table 18. – RCA values between 1999 and 2018 in the EU Member States*

| EU countries | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|
| **Austria** | 1.88 | 1.70 | 1.64 | 1.57 |
| **Belgium** | 1.72 | 1.51 | 1.67 | 1.66 |
| **Denmark** | 5.03 | 4.32 | 4.31 | 4.53 |
| **United Kingdom** | 0.58 | 0.62 | 0.63 | 0.80 |
| **Finland** | 0.71 | 0.87 | 1.40 | 1.20 |
| **France** | 2.19 | 2.14 | 2.47 | 2.47 |
| **Greece** | 1.00 | 1.36 | 1.37 | 2.25 |
| **Netherlands** | 2.26 | 1.95 | 2.22 | 2.78 |
| **Ireland** | 1.49 | 1.84 | 2.02 | 2.02 |
| **Luxembourg** | 2.87 | 3.02 | 4.67 | 5.93 |
| **Germany** | 1.33 | 1.29 | 1.27 | 1.18 |
| **Italy** | 0.68 | 0.80 | 0.96 | 1.09 |
| **Portugal** | 0.90 | 1.37 | 1.22 | 0.98 |
| **Spain** | 0.95 | 0.90 | 0.85 | 0.82 |
| **Sweden** | 0.21 | 0.29 | 0.43 | 0.39 |

| | | | | |
|---|---|---|---|---|
| **EU15 mean** | **1.59** | **1.60** | **1.81** | **1.98** |
| **Bulgaria** | 0.20 | 0.32 | 0.48 | 0.43 |
| **Cyprus** | 2.53 | 2.75 | 4.12 | 5.08 |
| **Czech Republic** | 0.77 | 1.00 | 0.92 | 0.80 |
| **Estonia** | 1.64 | 1.82 | 1.78 | 1.82 |
| **Croatia** | 1.17 | 1.01 | 1.12 | 0.82 |
| **Poland** | 1.20 | 1.79 | 1.65 | 1.57 |
| **Latvia** | 1.69 | 2.19 | 2.76 | 2.67 |
| **Lithuania** | 3.30 | 4.38 | 3.99 | 3.32 |
| **Hungary** | 0.49 | 0.48 | 0.60 | 0.56 |
| **Malta** | 0.01 | 0.01 | 0.01 | 0.03 |
| **Romania** | 0.08 | 0.16 | 0.27 | 0.37 |
| **Slovakia** | 0.70 | 1.11 | 0.80 | 0.63 |
| **Slovenia** | 0.78 | 0.79 | 0.87 | 0.82 |
| **EU13 mean** | **1.12** | **1.37** | **1.49** | **1.46** |
| **EU28 mean** | **1.37** | **1.49** | **1.66** | **1.74** |

Source: own calculation based on WITS database data, 2020

Using the table by Hinloopen and van Marrewijk (2001) to categorize the revealed comparative advantage indices (in Section 4.2 of the dissertation), it can be said that the comparative advantage of the dairy industry in each country provides a rather varied picture. Luxembourg, Denmark and Cyprus have a large advantage, France, Greece, the Netherlands, Ireland, Latvia, Lithuania have a medium advantage and Austria, Belgium, Finland, Germany, Italy, Estonia, Poland have a weak comparative advantage. All other Member States have a comparative disadvantage in the dairy industry. It can be observed that for the EU15 the comparative advantage of the Member States was above the EU28 average in all four examined periods, while for the EU13 it was all at a competitive disadvantage on average. This is also clear from the fact that there are hardly any Member States with a comparative disadvantage in the EU15, while in the EU13 the number of people with an advantage and a disadvantage is divided.

In the period 2014-2018, Luxembourg (5.93), Cyprus (5.08), Denmark (4.53) and Lithuania (3.32) had the highest comparative advantage. Among the EU Member States, Malta (0.03), Romania (0.37) and Sweden (0.39) had the largest comparative disadvantages. These results are consistent with those presented in Chapter 4 of the dissertation.

It can be observed that the countries that had a comparative disadvantage in the first period under review (UK, Spain, Sweden, Bulgaria, the Czech Republic, Hungary, Malta, Romania, Slovakia and Slovenia) maintained this disadvantage in the last period under review. Similarly, the dairy industry in countries with a comparative advantage has generally maintained this advantage throughout the period under review, with a few exceptions only in the form of a deteriorating or just improving comparative advantage index. Thus, Croatia deteriorated compared to the period under review (from 1.17 to 0.82), while Finland, Italy and Portugal slightly improved their comparative advantage index. Examining the results of the EU15 and EU13 on their own, it can be seen that the results of Denmark clearly show a strong comparative advantage over the whole period under review, while for the EU13 Lithuania, in addition to Cyprus, performed in a balanced way. Although a moderately strong comparative advantage, France and the Netherlands achieved a clearly balanced advantage.

Since the 2004 accession, the EU15 has generally improved its performance, thanks to an enlarged common market, but also the newly acceded countries (with a few exceptions, such as a largely stagnant Hungary or a deteriorating Croatia). their comparative index. Looking at the impact of the economic crisis that erupted in 2008, the dairy industry in the Member States is characterized by either stagnation or some improvement after 2008. Looking at 2008, Lithuania, Cyprus and Finland have also improved their comparative advantage to a greater extent.

Regarding Hungary, it can be said that the dairy industry has a revealed comparative disadvantage in the whole examined period, at the industry level the RCA indicator does not even approach the value of 1, which represents a comparative advantage. Thus, it is clearly at a disadvantage in terms of the EU-15 average, and is also in the last third of the line in terms of EU13. However, in addition to the values of the comparative advantage index of the dairy industry in each country, the analysis at the level of dairy product groups is also an important aspect of analysis. This is also a legitimate demand due to the diverse product range of the dairy industry itself.

The RCA index values for each dairy product group are shown in Tables 19 and 20 below. This shows the values of the Group 6 product groups for milk and milk products in the main product group HS04 by country. A more detailed explanation of the relevant product group can be found in Table 36 in the Appendix.

*Table 19. - RCA values for dairy product groups by EU Member States I.*

| EU országok | 040110 <1% fat, milk | 040120 1%-6% fat, milk | 040130 6 % < fat, milk | 040210 max. 1,5 % fat, milk, cream | 040221 min. 1.5% fat, milk, cream, not sweet. | 040229 min. 1.5% fat, milk, cream, sweet. | 040291 cond milk, cream, not sweet. | 040299 cond milk, cream, sweet. | 040310 yoghurt |
|---|---|---|---|---|---|---|---|---|---|
| **Austria** | 8.37 | 4.14 | 1.44 | 0.28 | 0.39 | 0.20 | 0.08 | 0.11 | 5.40 |
| **Belgium** | 2.46 | 2.15 | 2.48 | 1.85 | 1.32 | 0.33 | 1.21 | 3.31 | 1.27 |
| **Denmark** | 0.67 | 1.97 | 2.85 | 1.18 | 5.24 | 1.13 | 0.46 | 0.17 | 1.03 |
| **United Kingdom** | 0.25 | 1.01 | 1.67 | 0.50 | 0.79 | 1.41 | 0.37 | 0.27 | 0.56 |
| **Finland** | 0.07 | 0.11 | 0.96 | 1.56 | 0.14 | 0.00 | 0.00 | 0.00 | 2.18 |
| **France** | 2.19 | 1.89 | 2.46 | 1.70 | 1.40 | 1.96 | 1.29 | 0.44 | 3.52 |
| **Greece** | 0.37 | 0.12 | 0.15 | 0.10 | 0.03 | 0.14 | 0.83 | 0.38 | 15.09 |
| **Netherlands** | 1.69 | 1.20 | 2.65 | 1.30 | 2.78 | 1.21 | 6.10 | 4.80 | 0.24 |
| **Ireland** | 1.60 | 0.91 | 0.52 | 2.84 | 2.45 | 0.44 | 0.02 | 0.16 | 0.84 |
| **Luxembourg** | 2.95 | 11.49 | 5.48 | 0.04 | 0.02 | 0.95 | 12.88 | 0.12 | 5.68 |
| **Germany** | 1.62 | 2.11 | 1.37 | 1.34 | 0.33 | 0.21 | 2.45 | 0.53 | 2.11 |
| **Italy** | 0.14 | 0.08 | 0.17 | 0.09 | 0.02 | 0.06 | 0.05 | 0.06 | 0.08 |
| **Portugal** | 4.89 | 4.27 | 1.60 | 0.62 | 1.06 | 1.23 | 0.41 | 0.29 | 1.46 |
| **Spain** | 1.40 | 0.72 | 2.38 | 0.31 | 0.20 | 0.20 | 0.74 | 2.27 | 2.15 |
| **Sweden** | 0.56 | 0.14 | 0.41 | 0.85 | 0.97 | 0.05 | 0.27 | 0.03 | 0.30 |
| **EU15 mean** | **1.95** | **2.15** | **1.77** | **0.97** | **1.14** | **0.64** | **1.81** | **0.86** | **2.79** |
| **Bulgaria** | 0.28 | 0.18 | 0.09 | 0.21 | 0.10 | 0.03 | 0.05 | 0.06 | 1.14 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Cyprus** | 0.16 | 0.03 | 7.26 | 0.04 | 0.00 | 0.01 | 0.04 | 0.09 | 0.51 |
| **Czech Republic** | 0.86 | 3.31 | 0.98 | 1.41 | 0.80 | 0.57 | 0.42 | 0.89 | 1.90 |
| **Estonia** | 0.50 | 5.16 | 2.34 | 4.26 | 2.61 | 0.04 | 1.20 | 1.18 | 2.72 |
| **Croatia** | 2.04 | 2.56 | 0.34 | 0.02 | 0.03 | 0.07 | 0.00 | 0.68 | 3.52 |
| **Poland** | 0.82 | 1.16 | 2.70 | 4.57 | 0.70 | 0.63 | 0.50 | 0.29 | 1.52 |
| **Latvia** | 2.60 | 12.01 | 1.88 | 2.36 | 1.40 | 0.47 | 0.27 | 5.23 | 1.42 |
| **Lithuania** | 0.86 | 1.67 | 15.21 | 6.43 | 0.86 | 0.13 | 2.61 | 9.57 | 0.52 |
| **Hungary** | 2.34 | 2.13 | 0.27 | 0.14 | 0.06 | 0.02 | 0.01 | 0.01 | 0.27 |
| **Malta** | 0.00 | 0.08 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| **Romania** | 0.16 | 0.25 | 0.13 | 0.08 | 0.02 | 0.18 | 1.42 | 0.11 | 0.61 |
| **Slovakia** | 1.78 | 2.47 | 1.45 | 0.70 | 0.36 | 0.04 | 0.01 | 0.92 | 1.43 |
| **Slovenia** | 0.75 | 8.09 | 0.43 | 0.20 | 0.06 | 0.05 | 0.02 | 0.07 | 1.34 |
| **EU13 mean** | **1.01** | **3.01** | **2.55** | **1.57** | **0.54** | **0.17** | **0.50** | **1.47** | **1.30** |
| **EU28 mean** | **1.51** | **2.55** | **2.13** | **1.25** | **0.86** | **0.42** | **1.20** | **1.14** | **2.10** |

Source: own calculation based on WITS database, 2020

*Table 20. - RCA values for dairy product groups by EU Member States II.*

| EU countries | 040390 skim milk | 040410 whey | 040490 natural milk part. | 040500 butter | 040610 fresh cheese | 040620 grated cheese | 040630 proc. cheese | 040640 blue cheese | 040690 other cheese |
|---|---|---|---|---|---|---|---|---|---|
| **Austria** | 0.78 | 1.74 | 0.49 | 0.21 | 1.22 | 0.40 | 3.71 | 0.26 | 1.35 |
| **Belgium** | 3.92 | 0.54 | 0.53 | 2.67 | 0.66 | 1.19 | 2.81 | 0.22 | 0.61 |
| **Denmark** | 0.66 | 2.80 | 6.16 | 4.87 | 12.04 | 8.71 | 2.34 | 24.93 | 4.64 |
| **United Kingdom** | 0.33 | 0.55 | 0.30 | 0.70 | 0.87 | 0.21 | 0.83 | 0.64 | 0.38 |
| **Finland** | 1.24 | 2.78 | 2.90 | 3.13 | 0.15 | 0.03 | 2.38 | 0.08 | 1.05 |
| **France** | 2.88 | 3.48 | 2.41 | 1.29 | 2.63 | 2.37 | 3.50 | 3.55 | 2.76 |
| **Greece** | 0.98 | 0.58 | 0.38 | 0.04 | 0.35 | 0.30 | 0.18 | 0.10 | 6.82 |
| **Netherlands** | 1.06 | 2.38 | 2.73 | 3.56 | 0.34 | 4.40 | 0.49 | 0.30 | 4.18 |
| **Ireland** | 1.82 | 3.62 | 1.23 | 8.81 | 0.86 | 1.30 | 2.77 | 0.11 | 2.92 |
| **Luxembourg** | 3.96 | 0.04 | 0.03 | 1.37 | 4.13 | 3.92 | 3.18 | 11.18 | 6.74 |
| **Germany** | 1.70 | 1.39 | 1.12 | 0.64 | 1.83 | 0.38 | 1.20 | 1.28 | 1.18 |
| **Italy** | 0.12 | 0.76 | 0.33 | 0.21 | 2.66 | 4.22 | 0.24 | 4.86 | 1.75 |
| **Portugal** | 0.69 | 0.78 | 0.30 | 1.99 | 0.06 | 0.04 | 0.08 | 0.00 | 0.37 |
| **Spain** | 1.75 | 0.44 | 0.27 | 0.73 | 0.68 | 0.49 | 0.39 | 0.19 | 0.52 |
| **Sweden** | 0.31 | 0.21 | 0.50 | 0.57 | 0.17 | 0.05 | 0.18 | 0.11 | 0.28 |
| **EU15 mean** | **1.48** | **1.47** | **1.31** | **2.05** | **1.91** | **1.87** | **1.62** | **3.19** | **2.37** |
| **Bulgaria** | 0.33 | 0.05 | 0.06 | 0.22 | 1.19 | 0.02 | 0.42 | 0.01 | 2.00 |
| **Cyprus** | 0.49 | 0.00 | 0.00 | 0.92 | 1.83 | 4.61 | 0.02 | 0.00 | 48.80 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Czech Republic** | 0.58 | 1.03 | 0.26 | 0.73 | 0.85 | 0.05 | 0.32 | 0.33 | 0.46 |
| **Estonia** | 1.75 | 1.66 | 0.56 | 2.81 | 1.99 | 0.39 | 0.34 | 0.12 | 2.15 |
| **Croatia** | 3.86 | 0.68 | 0.11 | 0.86 | 0.41 | 0.41 | 1.84 | 0.65 | 0.35 |
| **Poland** | 2.48 | 2.89 | 1.30 | 1.30 | 1.78 | 0.29 | 3.45 | 0.26 | 1.18 |
| **Latvia** | 3.16 | 1.35 | 1.07 | 2.42 | 2.02 | 0.09 | 0.79 | 0.38 | 2.96 |
| **Lithuania** | 1.66 | 5.09 | 3.49 | 3.08 | 8.71 | 0.24 | 0.58 | 0.43 | 5.95 |
| **Hungary** | 0.38 | 0.38 | 1.98 | 0.10 | 0.30 | 0.04 | 0.74 | 0.00 | 0.43 |
| **Malta** | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.02 | 0.01 | 0.01 | 0.05 |
| **Romania** | 0.10 | 0.04 | 0.04 | 0.03 | 0.50 | 0.00 | 0.11 | 0.00 | 0.21 |
| **Slovakia** | 0.59 | 0.36 | 0.17 | 0.34 | 1.27 | 0.04 | 1.42 | 0.55 | 0.66 |
| **Slovenia** | 2.16 | 0.39 | 0.07 | 0.24 | 0.15 | 0.05 | 0.16 | 0.01 | 0.43 |
| **EU13 mean** | **1.35** | **1.07** | **0.70** | **1.01** | **1.62** | **0.48** | **0.78** | **0.21** | **5.05** |
| **EU28 mean** | **1.42** | **1.29** | **1.03** | **1.57** | **1.77** | **1.22** | **1.23** | **1.81** | **3.61** |

Source: own calculation based on WITS database, 2020

Examining the revealed comparative advantage of each country, basically a few groups with different characteristics seem to emerge. In one of these groups, the dairy industry in the Member States has a very high comparative advantage (above value 10) for certain product groups. An example of this is Cyprus' outstandingly high comparative advantage in the other cheeses product group. Denmark achieved results above 10 in the blue cheese' product group, Greece in the yoghurt product groups, Luxembourg, Latvia and Lithuania in the higher fat milk and cream groups, with outstandingly high comparative advantage values.

The outcome of the RCA achieved by Cyprus is interesting. It has a strong comparative advantage in the case of grated cheeses and a weak comparative advantage in the categories of fresh cheeses. In addition, behind the outstanding performance of the Cypriot dairy industry in other cheeses, the so-called halloumi[19] cheeses are available. These are traditionally made Cypriot cheeses, popular not only in Cyprus but also in many other countries. However, in all other product groups, the Cypriot dairy industry has a comparative disadvantage. Thus, the specialization in different types of cheese and its successful implementation can be well observed in the case of Cyprus.

The dairy industry in another observable group of Member States is balanced in that they have a comparative advantage in the majority of the 18 dairy product groups. This may not be a particularly high advantage, but it certainly points to a well-performing dairy industry. These include Denmark, France, the Netherlands and Germany. For these countries, only a few product groups can be identified where there are product groups with a clear comparative disadvantage. These product groups are typically found among dairy products with a lower level of processing. This suggests that the Member States in the group have made a conscious effort to develop a favorable product mix and to achieve a high level of production of higher value-added products.

The results also show that there are countries with a high comparative advantage in almost all product groups, which have a distinctly high advantage over the dairy industry in other Member States in the study period. Thus e.g. Denmark (blue cheeses, RCA = 24.93),

[19] Cypriot halloumi cheeses with a millennial production tradition have been a popular and growing export product of the country for decades (Papademas and Robinson, 1998). Source: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1471-0307.1998.tb02646.x?casa_token=TIPewlyophgAAAAA:9JNYEIAbyN_jhoS2zCzvn3B4JO39OY9bdhqVxbbKCO, download time: July 1, 2020

Cyprus (other cheeses, RCA = 48.8), Greece (yoghurts, RCA = 15.09), Latvia (milk and cream with a fat content of between 1% and 6%, not concentrated, RCA = 12.01), or Lithuania (milk and cream, of a fat content, by weight, exceeding 6%, not concentrated, RCA = 15.21). However, there are also product groups where even the best performer in the studied countries has only a weak comparative advantage. This indicates the presence of very strong competition and the existence of similar production technology and knowledge. An example is France (milk and cream in solid form, with a fat content of at least 1.5%, sweetened product group, RCA = 1.96). This product group is one of the product groups (in addition to blue cheeses) where all EU13 have a comparative disadvantage.

Comparing the averages of the EU15 and EU13 product groups and the processing needs of dairy products, it can be observed that the EU15 RCA values exceed the EU13 results for almost all higher processed product groups. That is, the new Member States are more at a disadvantage than the EU15 in producing dairy products that require more sophisticated processing technology. Similarly, for product groups with lower processing requirements (typically the processing of raw milk into liquid milk with different fat contents), it can be observed that although less sharply, the EU13 has on average a higher apparent comparative advantage compared to the EU15. For the EU13 and thus, of course, for Hungary as well, this kind of unfavorable product structure can be detected during the whole period under review, which is a serious challenge for the majority of the newly acceded Member States.

Regarding Hungary, it can be said that out of the 18 dairy product groups, it achieved a comparative advantage in three product groups during the period, namely 4110 (milk and cream with a fat content not exceeding 1%, without condensation), 4120 (milk with a fat content of between 1% and 6% and cream, not concentrated) and 40490 (products made from natural milk ingredients). The latter group includes pasteurized milk protein concentrates prepared from *"skimmed milk by ultrafiltration"*, which are important raw materials for the pharmaceutical, meat and canning industries (Ódor and Molnár, 2011: p. 38).

Thus, between 1999 and 2018, the Hungarian dairy industry was in the last quarter of the ranking between the EU28, far behind the EU15 and EU13 averages (only ahead of Bulgaria, Malta, Romania and Sweden).

***Based on these described above, I accept both sub-hypotheses H1a and H1b and hypothesis H1, that the competitiveness of the Hungarian dairy industry lags behind that of the EU Member States.***

## 5.2 Analysis of competitive positions in the dairy industry (Hypothesis H2)

In the previous subsection (5.1), I examined and analyzed the competitiveness of the EU Member States in the dairy industry for the period between 1999 and 2018, for product groups by calculating the various comparative advantage indices (RCA, RTA, RC, RSCA, LnRCA). However, it is not enough to know what the dairy industries in each Member State have achieved. It is also important to know how much the acquired competitive position (whether the advantage or disadvantage) has changed during the 20 years under study, and to what extent and in what direction the structure of the acquired comparative advantage has changed. Related to this is my hypothesis and sub-hypothesis H2, which is presented in detail in subchapter 4.2 of the dissertation. The results of the presented stability tests are included in this subsection.

The stability tests for testing Hypothesis H2 are as follows:

1. Change from a base period to another period using the correlation coefficient of the revealed comparative advantage based on the work of Hoekman and Djankov (1997);
2. Application of transition probability matrices based on the work of Hinloopen and van Marrewijk (2001) and Fertő (2003).

The results of the first type of stability test for the entire test cycle and study period are shown in Table 44 in the Appendix. In the following (for reasons of length), the results of the years selected from this complete table are collected and presented in more detail. These years are: the first two years of the period under review (1999, 2000), the year of accession of the EU10 (2004), the year of accession of Bulgaria and Romania (2007), the economic crisis and beyond (2008, 2009), the year of accession of Croatia (2013), the year of the abolition of the milk quota and the following year (2015, 2016), and the last year examined (2018). The results of this are shown in Table 21 below. To determine the strength of the correlation in this case as well (similarly when testing the H1 hypothesis,

i.e. determining the correlation between each revealed comparative index), I considered the work of Guilford (1950).

*Table 21. – Examination of correlation coefficients between RCA indices for the distinguished years of the study period for EU28*

| EU15: | 2000 | 2004 | 2007 | 2008 | 2009 | 2013 | 2015 | 2016 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| Austria | 1.00 | 0.87 | 0.69 | 0.64 | 0.59 | 0.65 | 0.64 | 0.31 | 0.31 |
| Belgium | 0.92 | 0.42 | 0.43 | 0.41 | 0.40 | 0.35 | 0.42 | 0.39 | 0.39 |
| Denmark | 0.98 | 0.98 | 0.97 | 0.96 | 0.96 | 0.94 | 0.95 | 0.94 | 0.90 |
| United Kingdom | 0.94 | 0.68 | 0.60 | 0.66 | 0.66 | 0.42 | 0.03 | -0.05 | 0.08 |
| Finland | 0.87 | 0.87 | 0.88 | 0.91 | 0.98 | 0.87 | 0.85 | 0.82 | 0.78 |
| France | 0.97 | 0.75 | 0.65 | 0.51 | 0.47 | 0.40 | 0.38 | 0.36 | 0.30 |
| Greece | 1.00 | 1.00 | 0.99 | 1.00 | 0.98 | 0.99 | 0.99 | 0.99 | 0.99 |
| Netherlands | 0.99 | 0.93 | 0.88 | 0.85 | 0.89 | 0.88 | 0.87 | 0.69 | 0.59 |
| Ireland | 0.99 | 0.93 | 0.97 | 0.93 | 0.91 | 0.87 | 0.88 | 0.90 | 0.94 |
| Luxembourg | 0.97 | 0.91 | 0.78 | 0.48 | 0.32 | 0.33 | 0.38 | 0.62 | 0.73 |
| Germany | 0.98 | 0.79 | 0.82 | 0.81 | 0.81 | 0.84 | 0.84 | 0.88 | 0.79 |
| Italy | 1.00 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| Portugal | 0.93 | 0.82 | 0.51 | 0.50 | 0.72 | 0.71 | 0.70 | 0.76 | 0.66 |
| Spain | 0.93 | 0.69 | 0.63 | 0.70 | 0.74 | 0.70 | 0.74 | 0.76 | 0.69 |
| Sweden | 0.85 | 0.61 | 0.42 | 0.37 | 0.12 | -0.11 | -0.10 | 0.00 | 0.03 |
| **EU13:** | **2000** | **2004** | **2007** | **2008** | **2009** | **2013** | **2015** | **2016** | **2018** |
| Bulgaria | 0.96 | 0.70 | 0.66 | 0.63 | 0.58 | 0.37 | 0.68 | 0.54 | 0.45 |
| Cyprus | 0.99 | 0.92 | 0.78 | 0.77 | 0.75 | 0.75 | 0.76 | 0.77 | 0.78 |
| Czech Republic | 0.92 | 0.36 | -0.07 | -0.12 | -0.08 | -0.13 | -0.15 | -0.12 | -0.13 |
| Estonia | 0.91 | 0.85 | 0.61 | 0.42 | 0.44 | -0.12 | -0.16 | -0.14 | -0.11 |
| Croatia | 0.98 | 0.89 | 0.66 | 0.76 | 0.79 | 0.82 | 0.67 | 0.75 | 0.83 |
| Poland | 0.96 | 0.80 | 0.41 | 0.40 | 0.42 | 0.18 | 0.33 | 0.18 | 0.23 |
| Latvia | 0.99 | 0.06 | -0.02 | 0.08 | -0.16 | -0.14 | -0.09 | -0.08 | -0.09 |
| Lithuania | 0.61 | 0.22 | 0.20 | 0.36 | 0.35 | 0.11 | 0.01 | -0.04 | -0.06 |
| Hungary | 0.94 | 0.86 | 0.12 | -0.01 | 0.17 | 0.14 | 0.16 | 0.21 | 0.31 |
| Malta | 1.00 | 0.09 | 0.17 | -0.13 | -0.07 | -0.07 | -0.10 | -0.09 | -0.07 |
| Romania | 0.99 | 0.89 | -0.09 | -0.08 | -0.08 | -0.04 | -0.08 | -0.10 | -0.12 |
| Slovakia | 0.71 | 0.48 | 0.39 | 0.45 | 0.42 | 0.04 | -0.01 | 0.04 | 0.05 |
| Slovenia | 0.96 | 0.96 | 0.76 | 0.76 | 0.76 | 0.72 | 0.70 | 0.71 | 0.73 |

| Note (in absolute terms): | |
|---|---|
| <0.4 | low level of relation |
| 0.4≤ <0.7 | medium level of relation |
| 0.7≤ <0.9 | high level of relation |
| 0.9≤ | very high level of relation |

Source: Own calculation based on WITS database data, 2020, grouping based on Guilford (1950)

In general, the results obtained by the EU15 have remained more stable than those of the other 13 new Member States. Behind the dairy industry in the Member States with the most stable positions among the EU15, two major groups can be identified. One group includes the dairy industry of countries that had a clear comparative advantage, competitive positions, and these were maintained during the period. These include Denmark, Germany, the Netherlands, Ireland and even Greece (in practice, Greece has had an advantage throughout). These are all Member States with very good dairy industries. The other group includes countries that have maintained their revealed comparative disadvantage over the years. Thus for example Italy, which has not been able to move away from its position of comparative disadvantage for years, did not become a weak advantage until after 2010. Italy is also interesting in terms of its competitiveness and competitive position because it is one of the largest dairy countries in Europe (it is in the top 10, as it appears in Chapter 3 of the dissertation), yet it does not have a clear comparative advantage in general, it has maintained this position the Member State over the years. Like Italy, this group also includes countries like Portugal, Spain and Sweden.

In the EU15, two further directions are worth noting. One such trend is the development of the competitiveness of Member States that have lost their stability over the years. These include Austria, Belgium, the United Kingdom and France. Strong stability has disappeared in all of these Member States, but all but the United Kingdom have maintained or even slightly improved their competitiveness in the dairy sector. The United Kingdom, on the other hand, also has a clear comparative disadvantage at the end of the period. The other interesting direction is related to Luxembourg. In this case, after the initial positions, which can be said to be stable, the period between 2008 and 2015 shows unstable positions, and then again strongly stable results were obtained. Their competitiveness results also show that Luxembourg had a comparative competitive advantage throughout the period under review. This apparent comparative advantage increased further from 2009 onwards, strengthened significantly and the Member State maintained this position until the end of the period. Luxembourg retained the position of this newly acquired higher comparative advantage, which was also reflected in the results of the stability test.

In the case of the Member States that joined after 2004, in general, the positions they have acquired over the years have been less stable during the period under review. This kind of instability is clearly visible after the 2004 accession, thanks to the new framework that

has emerged. This persisted until the end of the period for almost all states. Exceptions to this are Bulgaria and Slovenia, which maintained a competitive competitive position stable until 2018, Croatia, which maintained its position around weak comparative advantage and disadvantage, and Cyprus, which maintained its comparative advantage position during the period. Estonia and Lithuania were able to maintain their results with a comparative advantage but declining stability, as were Poland and Latvia. Czech Republic, Hungary, Malta, Romania and Slovakia have had a comparative disadvantage with unstable positions throughout, so there is no strong improvement in their competitiveness based on the results.

The results show that in the previously selected years, neither the 2008 crisis nor the 2015 quota was abolished, and the stability results did not really change. The reason for this can be explained, among other things, by the industry itself, which is the focus of the research (the range of milk and dairy products that are considered basic foodstuffs). In addition, larger changes have a slow effect, e.g. the impact of the abolition of quotas on the dairy industry may have a longer duration. The special nature of foods (especially staple foods) is also an important consideration compared to other products. In times of crisis, consumer demand for food, including basic foodstuffs, does not decrease, nor does it postpone the purchase of food, for example by buying a luxury item. As a result of the boom, it is no longer consuming more basic food, but increasing demand for other, higher-quality, more processed foods. A good example of this is China, India, where consumer demand for butter and cheese has grown significantly over the years.

The results of the second type of stability test for the entire test cycle and study period are given in Tables 45 in the Appendix. Below (Table 22) only the results of a few selected Member States (Hungary, Denmark, France and Ireland) are presented.

*Table 22. - Transition probability matrices to show stability results between 1999 and 2018 (Hungary, Denmark, France and Ireland)*

**Hungary**

| **Starting year (1999)** | **Final year (2018)** | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 82.35% | 11.76% | 5.88% | 0.00% |
| *Group b* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 100.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 94.4% | 0.0% | 5.6% | 0.0% |
| Distribution of final year (2018) | 77.8% | 16.7% | 5.6% | 0.0% |

**Denmark**

| **Starting year (1999)** | **Final year (2018)** | | | |
|---|---|---|---|---|
| | *Group a* | *b* csoport | *Group a* | *d* csoport |
| *Group a* | 50.00% | 33.33% | 16.67% | 0.00% |
| *Group b* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 33.33% | 33.33% | 33.33% |
| *Group d* | 0.00% | 0.00% | 14.29% | 85.71% |
| Distribution of starting year (1999) | 33.3% | 11.1% | 16.7% | 38.9% |
| Distribution of final year (2018) | 22.2% | 22.2% | 16.7% | 38.9% |

**France**

| **Starting year (1999)** | **Final year (2018)** | | | |
|---|---|---|---|---|
| | *Group a* | *b* csoport | *Group a* | *d* csoport |
| *Group a* | 25.00% | 50.00% | 25.00% | 0.00% |
| *Group b* | 33.33% | 33.33% | 33.33% | 0.00% |
| *Group c* | 9.09% | 27.27% | 54.55% | 9.09% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 22.2% | 16.7% | 61.1% | 0.0% |
| Distribution of final year (2018) | 16.7% | 33.3% | 44.4% | 5.6% |

**Ireland**

| **Starting year (1999)** | **Final year (2018)** | | | |
|---|---|---|---|---|
| | *Group a* | *b* csoport | *Group a* | *d* csoport |
| *Group a* | 62.50% | 25.00% | 12.50% | 0.00% |
| *Group b* | 20.00% | 20.00% | 60.00% | 0.00% |
| *Group c* | 0.00% | 33.33% | 66.67% | 0.00% |
| *Group d* | 0.00% | 0.00% | 50.00% | 50.00% |
| Distribution of starting year (1999) | 44.4% | 27.8% | 16.7% | 11.1% |
| Distribution of final year (2018) | 33.3% | 22.2% | 38.9% | 5.6% |

Source: own calculation based on WITS database, 2020

Based on the results of the transition probability matrices, some different directions seem to emerge: deteriorating, stagnant, slightly improving, and strongly improving directions between each dairy product group.

A deteriorating distribution can be observed (i.e., the distribution between the starting (1999) and the final year (2018) for each dairy product group based on the calculated RCA indicators) for Slovenia and Bulgaria. No improvement can be seen for any of their product groups, and their products, which previously faced a competitive disadvantage, still have this disadvantage. A deteriorating trend can also be detected in the case of the Czech Republic. In the case of the country, the number of product groups with a comparative disadvantage increased significantly by the end of the year.

There is a wide range of stagnants in the Member States (stagnant in a weak starting position or stagnant in a strong starting position). Thus e.g. for the United Kingdom, Portugal and Slovakia, where the results are almost the same at the end of the period. The Netherlands is stagnant in a strong position, meaning that many of its product groups have a competitive advantage, and this will be maintained at the end of the period. The same is true for Cyprus, where the Member State maintains some very high RCA results.

Slightly improving results in Spain (several product groups were placed in categories “b”, “c” or “d” in the final year), Romania (two product groups also gained a comparative advantage in category “b” or “c”), Hungary, Italy (slightly upwards). the range of product groups with a comparative advantage has expanded), Ireland, Lithuania, Latvia, Greece, Estonia, Finland, Austria. It also includes Germany and France (both with a strong previous position).

In addition, Luxembourg achieved strong improvements (the largest improvement, with strong RCAs for a further 6 product groups by the end of the period, in addition to the previous 4 strong RCAs). Poland also belongs to this group, which has carved out its previous disadvantage and turned into a competitive advantage in 6 product groups during the 20 years under review. In the case of Denmark, we can also see a significant improvement, which has led to a further improvement in its previous strong positions. This latter result is in line with Denmark's traditionally very good role as a milk producer and milk processor. The case of Poland can serve as an example, when a newly acceded member state is able to break out of the previous disadvantage and compete with the

EU15 member states with the appropriate product structure, expertise and application of technology.

In the case of Hungary, some improvement can be observed in the initial and final years. According to this, compared to the beginning of the year, when 17 (94.4%) of the 18 dairy product groups had a comparative disadvantage, this ratio slightly improved in the last year and is weak for 3 dairy product groups (16.7%), one dairy product group (5.6%), the Hungarian dairy industry gained a high comparative advantage. The probability that a variety of dairy products belonging to group "a" will remain in group "a" in a starting year (i.e. has a comparative disadvantage) is high, 82.35% based on the results. On the other hand, the chances of a product group with a comparative disadvantage belonging to groups "b" or possibly "c" (i.e. having a weak or high comparative advantage) are 11.76% and 5.88%, i.e. a slow but sure improvement trend can be felt.

***Based on the above described test results, I reject sub-hypotheses H2a and H2b. The acquired competitive positions of the domestic dairy industry were not more stable either compared to the EU15 or compared to the Central and Eastern European Member States between 1999 and 2018. Thus, I reject Hypothesis H2 itself, as it is only partially true that the competitive position of the Member States was stable during the period under review.***

## 5.3 Examination of the factors influencing the competitiveness of the dairy industry (hypotheses H3 and H4)

In subchapters 5.1 and 5.2 of the dissertation, the competitiveness of the dairy industry of the EU28 member states was examined, separately analyzing the competitiveness situation of the former EU15 member states and the 13 new member states between 1999 and 2018 (subchapter 5.1). In addition, I examined not only the competitiveness results, but also the stability of the acquired competitive positions (subsection 5.2), also separating the Member States that joined after 2004 from the previous ones. Within this analysis, I placed special emphasis on the competitiveness of Hungary in the dairy industry and the acquired competitive position. In this subsection (5.3) I present the analysis of the testing of my two hypotheses (H3 and H4) belonging to my second

research question, ie I aim to examine the factors determining the competitiveness of the dairy industry for the given countries and period.

The division of the subsection is as follows. First, a descriptive statistical analysis of the database of the regression model presented in Chapter 3, followed by the results of the correlation calculation between the individual variables. Next, I evaluate and compare the results of the chosen regression models (method of corrected errors of panel estimation and dynamic panel model). Argument for the use of the Panel Estimation Corrected Error Method (PCSE) Balogh, J.M. (2015) and Beck and Katz (1995) also state that *"the model is able to handle heteroskedasticity, AR1-type autocorrelation, and the problem of correlation between panels"* (Balogh, J.M., 2015: p. 480). The application of the dynamic panel model (GMM) is based on Arellano and Bover (1995), Blundell and Bond (1998), Leitão (2011). During the development of the method, the problems related to endogenicity, heteroskedasticity and series correlation that can otherwise occur in the static method can be successfully remedied (Leitão 2011), and the same model is also used by Fogarasi and Zubor-Nemes (2017).

I took the natural logarithm of the explanatory variables in the model (the content and source of which I presented in Chapter 3).

Table 23 below provides descriptive statistics for each variable. It can be seen from the table that the number of observations for each variable differs, the lowest being for milk subsidies. The variance values show that relatively large changes in the manifest comparative advantages can be observed during the study period.

*Table 23. - Descriptive statistics of regression model variables during the observation period*

| Variables | Nr. of observations | Mean | St. deviation | Min. value | Max. value |
|---|---|---|---|---|---|
| **lnRCA** | 560 | 0.1977 | 1.2249 | -7.1515 | 1.9749 |
| **lnTEJHOZ** | 559 | 1.7636 | 0.2929 | 0.8414 | 2.2925 |
| **lnFOLD** | 558 | -1.0496 | 0.7759 | -3.7899 | 0.1689 |
| **lnTEHLET** | 559 | 5.0710 | 0.7059 | 3.4706 | 7.5299 |
| **lnMUNKA** | 526 | 0.6387 | 0.6640 | -1.3093 | 2.1199 |
| **lnMGRESZ** | 560 | 0.7200 | 0.6848 | -1.5606 | 2.5764 |
| **lnTOKE** | 560 | 6.2584 | 0.4268 | 5.1210 | 7.1834 |
| **lnTEJTAM** | 416 | 8.1625 | 0.2838 | 6.6516 | 9.3831 |
| **REGIO** | 560 | 0.5357 | 0.4992 | 0 | 1 |

Source: own edition based on database, 2020

To examine the relationship between the variables chosen for the model, I performed a correlation calculation, the results of which are shown in Table 24 below. Using Guilford's (1950) grouping, the variables can be said to have a high (0.7 <) correlation only between MGRESZ (share of agriculture) and LABOR (labor supply). So there is a strong relationship (but it is not strong either), there is only a medium or rather weak relationship between the other variables, so the chosen variables can be the explanatory variables of the model.

*Table 24. - Correlation coefficients between explanatory variables*

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| **lnTEJHOZ (1)** | 1 | | | | | | | |
| **lnFOLD (2)** | -0.31 | 1 | | | | | | |
| **lnTEHLET (3)** | 0.11 | 0.35 | 1 | | | | | |
| **lnMUNKA (4)** | -0.35 | 0.60 | -0.19 | 1 | | | | |
| **lnMGRESZ (5)** | -0.51 | 0.43 | -0.42 | 0.79 | 1 | | | |
| **lnTOKE (6)** | 0.24 | 0.13 | 0.09 | 0.04 | 0.22 | 1 | | |
| **lnTEJTAM (7)** | 0.21 | 0.05 | -0.08 | 0.10 | 0.11 | 0.23 | 1 | |
| **REGIO (8)** | 0.41 | -0.09 | 0.38 | -0.56 | -0.61 | 0.39 | -0.03 | 1 |

Source: own calculation, 2020

Unit root test was performed by Campbell and Peron (1991) and Levin et al. (2002), Im et al. (1997), as a result of which it can be said that the chosen variables do not have a unit root, ie they can be interpreted as stationary, they can be considered as well modeled. The result of this is shown in Table 25.

*Table 25. - The result of unit root test of variables*

| Variables | Corr. t-value | Probability |
|---|---|---|
| **lnRCA** | -4.7826 | 0.0000 |
| **lnTEJHOZ** | -6.7639 | 0.0000 |
| **lnFOLD** | -2.4408 | 0.0073 |
| **lnTEHLET** | -2.9660 | 0.0015 |
| **lnMUNKA** | -3.2938 | 0.0000 |
| **lnMGRESZ** | -4.3641 | 0.0000 |
| **lnTOKE** | -4.9532 | 0.0000 |
| **lnTEJTAM** | -6.1016 | 0.0000 |

Source: own calculation, 2020

The following are the results of the regression models, i.e. the interpretation of the determinants that determine the competitiveness of the dairy industry.

*Table 26. - Determinants of dairy competitiveness (PCSE model)*

| Variables | Coef. | Std. Err. | z | P>z | Min.* | Max.* |
|---|---|---|---|---|---|---|
| **lnTEJHOZ** | 0.5385 | 0.1335 | 4.0300 | 0.0000 | 0.2768 | 0.8001 |
| **lnFOLD** | 0.6238 | 0.1421 | 4.3900 | 0.0000 | 0.3453 | 0.9023 |
| **lnTEHLET** | 0.2516 | 0.0597 | 4.2100 | 0.0000 | 0.1346 | 0.3687 |
| **lnMUNKA** | 0.2959 | 0.0809 | 3.6600 | 0.0000 | 0.1372 | 0.4545 |
| **lnMGRESZ** | -0.8478 | 0.1544 | -5.4900 | 0.0000 | -1.1504 | -0.5452 |
| **lnTOKE** | 1.0492 | 0.1180 | 8.8900 | 0.0000 | 0.8179 | 1.2805 |
| **lnTEJTAM** | -0.7524 | 0.1150 | -6.5400 | 0.0000 | -0.9779 | -0.5270 |
| **REGIO** | -0.4433 | 0.0681 | -6.5100 | 0.0000 | -0.5767 | -0.3099 |
| **Constant** | -1.2660 | 1.1759 | -1.0800 | 0.2820 | -3.5707 | 1.0387 |
| **Nr. of observations** | 398.000 | | | | | |
| **$R^2$** | 0.3831 | | | | | |

*95% confidence interval

Source: own calculation, 2020

Regarding Hypothesis H3 (i.e., the relationship between milk yield and competitiveness), it can be seen from the table above that, as previously expected, there is a positive relationship between milk yield and the competitiveness of the dairy industry. That is, if milk yield increases by 1%, dairy competitiveness increases by 0.5358% based on the PCSE model. The goal set during milk production, ie the increase of milk yield, the results of husbandry technology achieved in dairy farms, animal husbandry technology, feeding

(feed quality, composition), modern technologies and knowledge appear in animal husbandry, thus increasing the competitiveness of the sector.

In connection with hypothesis H4, the triple traditional factors of production of land, labor, and capital are explained by additional explanatory variables in the model. Two variables were included for land supply (as I have already indicated in Chapter 3 of the dissertation): land supply (lnFOLD) and dairy cattle supply (lnTEHLET). The table above also shows the positive impact of both on the competitiveness of the dairy industry. This represents, on the one hand, the advantage of an intensive production structure and, on the other hand, the economical operation of dairy farms with a large number of individuals. With regard to labor supply, the sector is a labor-intensive sector. Where agricultural employment is higher, the manifest comparative advantage indices are also higher based on the model. There seems to be a negative effect between competitiveness and the share of agriculture. Member States with a lower share of agriculture have higher competitiveness performance in the dairy sector. This is in line with international trends, as the most competitive economies worldwide have a low agricultural share / weight (see USA, Australia, etc.). The fragmented production structure and the large number of small farms can also be considered a feature of Central and Eastern Europe, which does not improve competitiveness. In addition, however, it can be seen that this is a capital-intensive sector. It is clear from the results that modern dairy industry requires capital and knowledge, the application of modern technologies is essential. Perhaps a somewhat surprising result is the negative impact of dairy subsidies (lnTEJTAM) on competitiveness outcomes. The explanation behind this is that, although milk-related subsidies can support and provide a solution in the short term, in the long run, these milk-related subsidies do not have the effect of increasing competitiveness.

The result obtained for the dynamic panel model is shown in Table 27 below. It can be seen from the table that the results are less reliable (see p-values in the table), so their evaluation should be treated with caution, but basically supports what has been described above.

*Table 27. - Determinants of dairy competitiveness (dynamic panel model)*

| Variables | Coef. | Std. Err. | z | P>z | Min.* | Max.* |
|---|---|---|---|---|---|---|
| **L1.** | 0.1808 | 0.0414 | 4.3700 | 0.0000 | 0.0997 | 0.2618 |
| **lnTEJHOZ** | 0.1118 | 0.1518 | 0.7400 | 0.4620 | -0.1858 | 0.4094 |
| **lnFOLD** | 0.9602 | 0.0938 | 10.2400 | 0.0000 | 0.7764 | 1.1440 |
| **lnTEHLET** | 0.3521 | 0.1201 | 2.9300 | 0.0030 | 0.1166 | 0.5875 |
| **lnMUNKA** | 0.2220 | 0.1048 | 2.1200 | 0.0340 | 0.0166 | 0.4275 |
| **lnMGRESZ** | -0.5238 | 0.1696 | -3.0900 | 0.0020 | -0.8562 | -0.1915 |
| **lnTOKE** | 0.2376 | 0.1728 | 1.3800 | 0.1690 | -0.1010 | 0.5763 |
| **lnTEJTAM** | 0.0551 | 0.0908 | 0.6100 | 0.5440 | -0.1229 | 0.2331 |
| **REGIO** | 1.3313 | 0.1868 | 7.1300 | 0.0000 | 0.9652 | 1.6975 |
| **Constant** | -3.3152 | 0.9667 | -3.4300 | 0.0010 | -5.2098 | -1.4206 |

*95% confidence interval

Source: own calculation, 2020

I considered it important to run the same models separately according to whether they are EU15 Member States or Member States that joined after 2004 (EU13). The purpose of this, of course, is to be able to identify any differences that may be discovered between these two large groups. Placing these results side by side, Tables 28 and 29 show them first based on the PCSE and then the dynamic panel model.

In both models, the p-values of certain variables are quite high, so conclusions, over-generalizations, should be treated with caution (specifically in relation to the results of the dynamic panel model).

Perhaps the most striking result (Table 28) from the PCSE model is that the effect of all explanatory variables is stronger in the EU13 than in the EU15, suggesting that the explanatory power of the model is higher (for example, ln MGRESZ, lnTOKE and lnTEJTAM have a stronger effect). In other words, the competitiveness of the EU13 dairy industry is determined by the examined factors rather than in the case of the EU15 - this is also indicated by the high value of R2 in the case of the EU13.

*Table 28. - Determinants of dairy competitiveness by region (PCSE model)*

| Variables | EU15 | | | | EU13 | | | |
|---|---|---|---|---|---|---|---|---|
| | Coef. | Std. Err. | z | P>z | Coef. | Std. Err. | z | P>z |
| **lnTEJHOZ** | -0.3454 | 0.0628 | -5.5000 | 0.0000 | -0.6882 | 0.2178 | -3.1600 | 0.0020 |
| **lnFOLD** | -0.1763 | 0.0320 | -5.5100 | 0.0000 | 1.4893 | 0.3246 | 4.5900 | 0.0000 |
| **lnTEHLET** | 0.3551 | 0.0294 | 12.0900 | 0.0000 | -0.1306 | 0.2436 | -0.5400 | 0.5920 |
| **lnMUNKA** | 0.1269 | 0.0503 | 2.5200 | 0.0120 | 0.4912 | 0.2574 | 1.9100 | 0.0560 |
| **lnMGRESZ** | -0.0774 | 0.1142 | -0.6800 | 0.4980 | -3.0681 | 0.4659 | -6.5900 | 0.0000 |
| **lnTOKE** | 0.3664 | 0.0995 | 3.6800 | 0.0000 | 3.2703 | 0.3492 | 9.3600 | 0.0000 |
| **lnTEJTAM** | -0.4226 | 0.0978 | -4.3200 | 0.0000 | -1.1090 | 0.1737 | -6.3900 | 0.0000 |
| **Constant** | -0.0038 | 1.0835 | 0.0000 | 0.9970 | -4.9897 | 2.3779 | -2.1000 | 0.0360 |
| **Nr. of observations** | 211.000 | | | | 187.000 | | | |
| **R2** | 0.2481 | | | | 0.6231 | | | |

Source: own calculation, 2020

However, it can also be seen, specifically in the case of the dynamic panel model, that each explanatory variable is less significant when applying a regional breakdown. In addition to the above, this may be due to a decrease in the number of observations.

*Table 29. - Determinants of dairy competitiveness by EU15 and EU13 (dynamic panel model)*

| Változók | EU15 | | | | EU13 | | | |
|---|---|---|---|---|---|---|---|---|
| | Coef. | Std. Err. | z | P>z | Coef. | Std. Err. | z | P>z |
| **L1.** | 0.7827 | 0.0364 | 21.5000 | 0.0000 | 0.2796 | 0.0598 | 4.6700 | 0.0000 |
| **lnTEJHOZ** | 0.0125 | 0.0816 | 0.1500 | 0.8780 | -0.2685 | 0.2829 | -0.9500 | 0.3430 |
| **lnFOLD** | -0.2234 | 0.0695 | -3.2100 | 0.0010 | 1.1426 | 0.1457 | 7.8400 | 0.0000 |
| **lnTEHLET** | 0.0429 | 0.0432 | 0.9900 | 0.3200 | 0.1980 | 0.2217 | 0.8900 | 0.3720 |
| **lnMUNKA** | 0.1679 | 0.0607 | 2.7700 | 0.0060 | -0.0303 | 0.1798 | -0.1700 | 0.8660 |
| **lnMGRESZ** | -0.0680 | 0.1036 | -0.6600 | 0.5110 | -0.4628 | 0.2881 | -1.6100 | 0.1080 |
| **lnTOKE** | 0.1295 | 0.0883 | 1.4700 | 0.1430 | 0.0812 | 0.3084 | 0.2600 | 0.7920 |
| **lnTEJTAM** | -0.0981 | 0.0417 | -2.3500 | 0.0190 | 0.0092 | 0.1731 | 0.0500 | 0.9580 |
| **Konstans** | -0.4619 | 0.5059 | -0.9100 | 0.3610 | 0.4582 | 1.7559 | 0.2600 | 0.7940 |

Source: own calculation, 2020

***Based on the above described test results, I accept Hypothesis H3, according to which higher milk yields result in higher competitiveness of the dairy industry in the EU Member States.***

***H4a, so higher supply of land, labor and capital, all results in higher competitiveness of the dairy industry, I partially accept its sub-hypothesis. I reject the sub-hypothesis of H4b, so that the level of agricultural support increases the competitiveness of the dairy industry. Thus, overall, I partially accept Hypothesis H4.***

# Chapter 6. Summary, further research directions

The focus of my doctoral dissertation was the theory of meso-level competitiveness and its application. In the theoretical unit of the dissertation, I went into detail about the available literature on meso-level competitiveness. The starting point was the concepts of micro- and macro-level competitiveness. In addition to the theoretical framework, I gathered the possibilities of measurement methods. A significant part of the theoretical part of the dissertation is a systematic literature analysis, which aimed to examine the available literature on meso-level competitiveness. In the dissertation, I then applied the measurement method accepted in the literature to determine meso-level competitiveness, using the index and its variants of the manifest comparative advantage. For this, I took the example of a chosen industry, the dairy industry.

Following this logic of the dissertation, I have collected the following new and novel results, which I would like to list as a contribution of the dissertation to the available scientific knowledge. New and novel results include both theoretical and empirical results:

- Systematic literature analysis of meso-level competitiveness.
- Application of meso-level competitiveness theory to the dairy industry.
- A trade-based study of the long-term competitiveness of some EU Member States in the dairy industry.
- Priority study of industry competitiveness for Hungary.
- Examining the stability of the competitiveness of the EU Member States in the dairy industry.
- Identification of the factors behind the different performances of the dairy industry.

Although the literature on competitiveness research is very rich, it basically focuses on two major levels, micro-level (i.e., corporate) and macro-level (i.e., country) competitiveness research. The conceptual definition of meso-level competitiveness is also difficult, it is difficult to draw boundaries in the study circle. Yet, based on the available literature, two major directions seem to emerge, regional and industry competitiveness as meso-level competitiveness directions. However, it is important to note that although these are two directions and interpretations, the phenomenon of industry, sector and regional competitiveness cannot be separated in many cases.

For my meso-level literature analysis, I performed a systematic analysis according to the PRISMA protocol. As a result, I identified the main directions of meso-level competitiveness, the main research areas, sectors and applied methods. As a result of the analysis of the literature (which also included the analysis of the international and domestic literature), I chose the method used for empirical research, the method of comparative advantages. To the best of my knowledge, the systematic literature analysis method used in the dissertation according to the PRISMA protocol has not been dealt with in the Hungarian language literature before. I did not find this type of systematic analysis for the analysis of the meso-level competitiveness literature or the competitiveness literature in general in the Hungarian literature.

After defining meso-level competitiveness, I attempted to apply it. For this, I chose the dairy industry in its field of application. I considered a long period of 20 years, between 1999 and 2018, as the research boundary of the research, and the 28 EU Member States that still existed in 2018 as the geographical boundary. When examining the competitiveness of the industry, I gave priority to the situation of the domestic dairy industry, so in the hypotheses I also examined the competitiveness of the 15 previously associated member states and the 13 associated member states after 2004 separately. I compared the development of Hungary's dairy industry competitiveness to these.

Overall, the competitiveness of the domestic dairy industry has faced a competitive disadvantage for the sector as a whole throughout the 20 years under review, none of the emerging comparative indices and their variants have reached the lower limit of competitiveness, so it is in the last third of the ranking for the EU as a whole. away from the Hungarian dairy industry. However, I considered it important to examine this period at the product group level as well, as we get a slightly more nuanced picture based on the results at the product group level. It is quite difficult to delimit the range of dairy products, yet a logical grouping is offered by the World Bank's classification of HS04 product group 6, on the basis of which different dairy products can be classified into 18 product groups. Some of these product groups require lower processing (eg different fat processing of milk), while other product groups require higher processing (eg cheeses, products made from natural milk ingredients).

Based on the above (ie examined at the level of dairy product groups), it can be said about the Hungarian dairy industry that 3 product groups were identified that proved to be

competitive during the period under review. Two of these represent the lower processing product range (processing of raw milk with different fat contents, ie milk and cream with a fat content not exceeding 40110, not exceeding 1%, without concentration, and milk and cream with a fat content of between 40120, 1% and 6%, without compression). Another product group represents a product range with a higher level of processing, the range of products made from natural milk ingredients (40490) (eg. milk protein concentrate). The latter product range means a wide range of uses in the pharmaceutical industry, it is further processed in the meat industry, and it means a product that requires complex technology. From the point of view of Hungary, specialization in the product range with a higher level of processing can be a goal and an opportunity to break out.

Comparing the averages of the EU15 and the 13 new Member States product groups and the processing needs of dairy products, it can be observed that the EU15 comparative advantage index values (and other versions of the index) exceed the EU13 results for almost all higher processed product groups. That is, the newly acceded Member States are more at a disadvantage than the EU15 in producing dairy products that require more sophisticated processing technology. For the EU13 and thus, of course, for Hungary as well, this kind of unfavourable product structure can be detected during the whole period under review, which is a serious challenge for the majority of the newly acceded Member States.

In addition to the competitiveness study carried out for Hungary and other EU member states, I also considered it important to examine the stability of the acquired competitive positions for the indicated period. The question was how much the positions acquired (whether positive or negative) changed over the period. Whether the dairy industry in a given Member State has held a stable position while retaining the comparative advantage it has acquired or may have lost that advantage over the years. It may have kept the former competitive disadvantage stable in a given Member State's dairy industry, meaning it could not break out in 20 years. Is there a change in the direction of certain Member States? A series of questions came up.

The two methods used in the study are to examine the change from the base period to another period using a correlation coefficient of the manifest comparative advantages and by using transition probability matrices. In this case, too, I split the study into the 15 Member States that joined earlier and the 13 other Member States in order to make any

discrepancies more visible. Based on the results, it can be said that the EU15 Member States retained their previously acquired positions better during the period under review. The competitive position of the Hungarian dairy industry resulted in lower stability compared to other Member States.

In connection with my second research question, I examined the most important explanatory factors behind the competitiveness of the dairy industry, using the method of corrected errors in panel estimation and dynamic panel models. In the case of regression models, I also performed the separation of the EU15 and the newly acceded Member States.

The results confirm that, as expected, there is a positive relationship between milk yield and dairy competitiveness based on the model regarding the relationship between milk yield and competitiveness. In other words, the goal set during milk production, ie the increase of milk yield, the results of husbandry technology in dairy farms, animal husbandry technology, feeding (feed quality, its composition), modern technologies and knowledge appear in animal husbandry, thus increasing the sector's competitiveness.

Based on a further result of the model, in those Member States with a lower share of agriculture, the dairy competitiveness score is higher. This is in line with international trends, as the most competitive economies worldwide have a low agricultural share / weight (see USA, Australia, etc.). The fragmented production structure and the large number of small farms can also be considered a feature of Central and Eastern Europe, which does not improve competitiveness. In addition, however, it can be seen that this is a capital-intensive sector. It is clear from the results that modern dairy industry requires capital and knowledge, the application of modern technologies is essential.

Perhaps the most interesting result of the regression models is the negative impact of milk subsidies on competitiveness. It can be concluded that subsidies should be treated with caution. Based on the results of the model, it can be said that the competitiveness of the dairy industry cannot be improved or developed with the existing subsidies linked to milk. It is much more important to create a capital-intensive sector that enables the application of modern technologies in line with Industry 4.0, outstanding achievements with modern expertise, support for large-scale farming in both milk production and processing, and specialization in more processed dairy products. Although the scope of these subsidies

provides some assistance in the short term, support to the actors of the sector, of course, the competitiveness of a sector cannot be based on this model.

There are several limitations to my research, and thus to the dissertation itself, and I consider it essential for the dissertation to describe them and take them into account in this part of the dissertation. Research constraints belong on the one hand to the research methodological group and on the other hand to the constraints of research boundaries. The limitations belonging to the methodological group of the research are basically related to the index and variants of the applied comparative advantages and the stability study, as well as the limitations caused by the source of the data, the available or not attainable data. I discussed these methodological limitations in more detail in subsection 4.3 of the dissertation. The size limit defined in the dissertation was limited in time to the period between 1999 and 2018, and in terms of its geographical boundaries to the Member States of the European Union. It was appropriate to draw this geographical boundary, yet the presence of this research constraint must be reckoned with. As trade in dairy products is not limited to the Member States of the European Union, major milk-producing and milk-processing countries can be ranked in the world (USA, New Zealand, India) (FAO, 2020). An additional limitation is the independent use of the applied method, as opposed to the use of the complex competitiveness method.

Based on my research results and research limitations, future research directions can also be outlined. On the one hand, as a complement to meso-level competitiveness research, I consider it important to complement research at the enterprise level. By finding and presenting best practices in Hungary, they can help and set an example for other actors in the sector. Thus, returning to the definition of industry competitiveness formulated in the dissertation, the totality of corporate successes would increase industry competitiveness.

On the other hand, referring to the methodological research limitations defined in Chapter 4 of the dissertation, it would be worthwhile to expand the research presented in the dissertation by including macroeconomic indicators, thus shading the results obtained in the dissertation.

Thirdly, I would find it interesting to repeat the research presented in the dissertation after a few years, supplementing the period under study with later years. This is due to the exit of Great Britain on 31 January 2020 from the EU. Great Britain, a Member State that played significant role in several industries, including the dairy industry, on both the

import and export side, being a large milk-producing and milk-processing country. I suppose that the effects of Britain's exit would also become visible in terms of industrial competitiveness. A further argument in favour of extending the investigation period is that unfortunately we are living in a period of a pandemic. The effect of the coronavirus on the competitiveness of the dairy industry can yield interesting results, even though it is a staple food. In addition, we can get surprising results from comparisons with other food industries. Finally, an additional research direction is the extension of the studied region to other regions or even to the whole world, and the comparison of new research results with the results obtained in the dissertation.

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# Appendix

*Table 30. - Butter consumption in EU Member States between 2002 and 2013 (data in kg / capita / year)*

| Country | 2002-2004 | 2005-2007 | 2008-2010 | 2011-2013 |
|---|---|---|---|---|
| **Austria** | 5,08 | 5,28 | 5,38 | 5,51 |
| **Belgium** | 5,50 | **6,20** | 5,49 | **7,04** |
| **Bulgaria** | **0,36** | **0,25** | **0,26** | **0,68** |
| **Croatia** | **0,52** | **0,48** | 1,04 | 1,23 |
| **Cyprus** | **0,92** | **0,68** | **0,96** | 1,05 |
| **Czech Republic** | 3,98 | 4,32 | 4,48 | 5,02 |
| **Denmark** | 1,72 | 1,83 | 1,89 | 1,93 |
| **Estonia** | 4,92 | 2,98 | 2,35 | 2,20 |
| **Finland** | 4,25 | 3,98 | 4,27 | 5,39 |
| **France** | **8,13** | **8,09** | **7,85** | **7,43** |
| **Germany** | 6,07 | 6,18 | 5,47 | 5,40 |
| **Greece** | 1,05 | 1,14 | 1,07 | 1,02 |
| **Hungary** | 1,02 | **0,99** | **0,75** | **0,78** |
| **Ireland** | 2,99 | 2,73 | 3,14 | 3,14 |
| **Italy** | 2,95 | 2,82 | 2,47 | 2,66 |
| **Latvia** | 2,30 | 1,59 | 2,05 | 2,15 |
| **Lithuania** | 3,01 | 1,27 | 1,89 | 2,33 |
| **Luxembourg** | **0,16** | **0,43** | 2,07 | 1,96 |
| **Malta** | **0,90** | **0,75** | **0,93** | 1,06 |
| **Netherlands** | 2,31 | 2,22 | 1,28 | 1,45 |
| **Poland** | 4,46 | 4,24 | 4,32 | 3,95 |
| **Portugalia** | 2,23 | 2,17 | 1,88 | 2,09 |
| **Romania** | **0,41** | **0,54** | **0,66** | **0,59** |
| **Slovakia** | 2,74 | 1,93 | 2,29 | 2,59 |
| **Slovenia** | 1,38 | 2,38 | 2,86 | 2,71 |
| **Spain** | **0,79** | **0,84** | **0,79** | **0,77** |
| **Sweden** | 3,48 | 2,81 | 3,21 | 4,51 |
| **United Kingdom** | 3,24 | 3,44 | 2,97 | 3,31 |

Note: the tables show average consumption values for 3-year periods from 2002 to 2013, the highest values are marked in green and the lowest values in purple.

Source: own calculation based on FAO database (2019)

*Table 31. table - Cheese consumption in EU Member States between 2002 and 2013 (data in kg / capita / year)*

| Country | 2002-2004 | 2005-2007 | 2008-2010 | 2011-2013 |
|---|---|---|---|---|
| **Austria** | **21,37** | **20,80** | **21,76** | **22,80** |
| **Belgium** | 16,15 | 17,12 | 19,62 | 19,25 |
| **Bulgaria** | 8,57 | 9,34 | 8,61 | 9,16 |
| **Croatia** | 7,24 | 7,73 | 9,02 | 9,88 |
| **Cyprus** | **5,14** | **4,95** | **5,30** | **3,78** |
| **Czech Republic** | 13,83 | 15,63 | 16,24 | 16,24 |
| **Denmark** | 19,46 | **23,93** | **21,79** | 18,71 |
| **Estonia** | 13,26 | 7,67 | 7,02 | **7,92** |
| **Finland** | 15,21 | 15,11 | 17,73 | 21,97 |
| **France** | **24,12** | **23,94** | **24,42** | **23,89** |
| **Germany** | 19,72 | 20,00 | 20,57 | 21,63 |
| **Greece** | **26,53** | **28,45** | **26,15** | **25,56** |
| **Hungary** | 9,65 | 10,61 | 11,15 | 10,83 |
| **Ireland** | 10,83 | 10,22 | 12,34 | 13,58 |
| **Italy** | **21,38** | **22,11** | **22,77** | **23,71** |
| **Latvia** | **5,95** | 7,27 | 12,72 | 15,83 |
| **Lithuania** | 6,97 | 13,19 | 13,09 | 14,19 |
| **Luxembourg** | 10,26 | 13,38 | 12,50 | 15,47 |
| **Malta** | 12,20 | 11,39 | 12,16 | 13,18 |
| **Netherlands** | 20,77 | 19,54 | 18,05 | 17,34 |
| **Poland** | 13,14 | 12,89 | 13,26 | 15,56 |
| **Portugalia** | 9,02 | 9,46 | 9,14 | 9,23 |
| **Romania** | **2,10** | **3,49** | **5,13** | **5,12** |
| **Slovakia** | 8,83 | 11,82 | 11,17 | 9,94 |
| **Slovenia** | 11,01 | 12,72 | 14,36 | 13,99 |
| **Spain** | 7,41 | 8,10 | 8,82 | 8,93 |
| **Sweden** | 18,13 | 17,89 | 19,04 | 19,37 |
| **United Kingdom** | 9,68 | 10,82 | 10,94 | 11,08 |

Note: the tables show average consumption values for 3-year periods from 2002 to 2013, the highest values are marked in green and the lowest values in purple.

Source: own calculation based on FAO database (2019)

*Table 32. - Cream consumption in EU Member States between 2002 and 2013 (data in kg / capita / year)*

| Country | 2002-2004 | 2005-2007 | 2008-2010 | 2011-2013 |
|---|---|---|---|---|
| **Austria** | 2,88 | 4,37 | 6,31 | 7,62 |
| **Belgium** | 7,54 | **10,29** | **9,99** | **9,55** |
| **Bulgaria** | **0,00** | **0,01** | **0,11** | **0,08** |
| **Croatia** | **0,23** | **0,05** | **0,19** | **0,17** |
| **Cyprus** | **0,30** | **0,69** | **0,06** | **0,00** |
| **Czech Republic** | 1,52 | 4,06 | 4,48 | 3,77 |
| **Denmark** | **11,32** | **9,47** | **10,49** | **9,68** |
| **Estonia** | 1,47 | 0,87 | 3,93 | 3,16 |
| **Finland** | 6,60 | 6,68 | 6,69 | 6,11 |
| **France** | 4,84 | 5,52 | 5,84 | 3,75 |
| **Germany** | 6,79 | 6,40 | 6,22 | 6,41 |
| **Greece** | 1,97 | 2,27 | 2,70 | 2,88 |
| **Hungary** | 6,83 | 7,10 | 6,47 | 6,78 |
| **Ireland** | 5,23 | 6,01 | 5,77 | 5,47 |
| **Italy** | 3,33 | 3,45 | 3,89 | 3,27 |
| **Latvia** | 7,92 | **11,32** | **12,93** | **17,02** |
| **Lithuania** | 3,25 | 3,35 | 5,74 | 8,12 |
| **Luxembourg** | 2,09 | 3,38 | 3,17 | 2,61 |
| **Malta** | **0,21** | **0,47** | **0,35** | **0,46** |
| **Netherlands** | **0,45** | **0,14** | **0,13** | **0,12** |
| **Poland** | 5,77 | 5,93 | 6,49 | 6,78 |
| **Portugalia** | 1,76 | 1,65 | 1,78 | 1,69 |
| **Romania** | **0,04** | **0,06** | **0,19** | **0,14** |
| **Slovakia** | 4,12 | 1,79 | 1,40 | 1,45 |
| **Slovenia** | 7,69 | 7,34 | 7,47 | 7,73 |
| **Spain** | 2,06 | 1,87 | 2,65 | 2,39 |
| **Sweden** | **9,44** | **10,18** | **12,33** | **13,35** |
| **United Kingdom** | **0,03** | **0,03** | **0,51** | **0,31** |

Note: the tables show average consumption values for 3-year periods from 2002 to 2013, the highest values are marked in green and the lowest values in purple.

Source: own calculation based on FAO database (2019)

*Table 33. - Milk consumption in EU Member States (milk consumption without butter) between 2002 and 2013 (data in kg / capita / year)*

| Country | 2002-2004 | 2005-2007 | 2008-2010 | 2011-2013 |
|---|---|---|---|---|
| **Austria** | 255,47 | 228,21 | 234,72 | 249,33 |
| **Belgium** | 241,22 | 232,57 | 241,81 | 231,02 |
| **Bulgaria** | 160,89 | 157,69 | 137,10 | 149,38 |
| **Croatia** | 186,52 | 214,30 | 213,00 | 226,39 |
| **Cyprus** | **146,72** | **128,72** | **130,77** | **124,29** |
| **Czech Republic** | 198,84 | 204,57 | 186,63 | 189,47 |
| **Denmark** | 207,05 | 272,20 | 268,79 | 267,83 |
| **Estonia** | 253,36 | 249,74 | 250,23 | 263,88 |
| **Finland** | **347,43** | **349,26** | **380,81** | **413,75** |
| **France** | 272,03 | 258,99 | 239,81 | 240,36 |
| **Germany** | 246,45 | 254,28 | 258,83 | 256,59 |
| **Greece** | 273,29 | 291,25 | 287,66 | 265,09 |
| **Hungary** | 162,49 | 169,65 | 164,02 | 161,47 |
| **Ireland** | 322,62 | 278,37 | 277,15 | 282,43 |
| **Italy** | 264,26 | 266,15 | 261,31 | 254,37 |
| **Latvia** | 212,25 | 204,89 | 228,03 | 191,83 |
| **Lithuania** | 216,25 | 285,34 | 296,23 | 287,29 |
| **Luxembourg** | 281,22 | 283,13 | 236,88 | 263,90 |
| **Malta** | 191,14 | 177,62 | 173,80 | 185,60 |
| **Netherlands** | **350,08** | **355,39** | **348,79** | **339,62** |
| **Poland** | 192,30 | 167,51 | 174,31 | 201,30 |
| **Portugalia** | 206,94 | 217,46 | 212,91 | 209,97 |
| **Romania** | 228,75 | 257,30 | 255,47 | 239,52 |
| **Slovakia** | **108,73** | **129,57** | **136,09** | **128,58** |
| **Slovenia** | 244,03 | 242,07 | 254,20 | 239,13 |
| **Spain** | 163,93 | 162,03 | 167,82 | 168,67 |
| **Sweden** | **376,06** | **365,68** | **356,83** | **341,12** |
| **United Kingdom** | 236,30 | 242,41 | 240,75 | 235,71 |

Note: the tables show average consumption values for 3-year periods from 2002 to 2013, the highest values are marked in green and the lowest values in purple.

Source: own calculation based on FAO database (2019)

*Table 34. - Whole milk consumption of EU Member States between 2002 and 2013 (data in kg / capita / year)*

| Country | 2002-2004 | 2005-2007 | 2008-2010 | 2011-2013 |
|---|---|---|---|---|
| **Austria** | 40,21 | 17,84 | 16,51 | 15,27 |
| **Belgium** | 61,45 | 60,58 | 62,19 | 58,12 |
| **Bulgaria** | 95,33 | 89,22 | 72,90 | 79,06 |
| **Croatia** | **109,87** | **135,27** | **111,23** | **113,34** |
| **Cyprus** | 107,94 | 95,44 | 91,54 | 93,71 |
| **Czech Republic** | 30,19 | 42,51 | 31,56 | 28,12 |
| **Denmark** | 27,08 | 33,09 | 39,15 | 51,70 |
| **Estonia** | **112,98** | **120,55** | **152,75** | **133,76** |
| **Finland** | **127,44** | **128,53** | **128,18** | **118,91** |
| **France** | 63,76 | 51,00 | 35,56 | 39,96 |
| **Germany** | 71,73 | 68,23 | 72,38 | 72,27 |
| **Greece** | 81,17 | 84,06 | 96,46 | 83,30 |
| **Hungary** | 70,22 | 72,33 | 65,78 | 63,39 |
| **Ireland** | 199,10 | 153,98 | 117,42 | 87,92 |
| **Italy** | 40,54 | 38,14 | 36,03 | **32,12** |
| **Latvia** | 125,53 | 87,64 | 66,76 | **30,05** |
| **Lithuania** | 107,96 | 109,49 | 105,28 | 73,76 |
| **Luxembourg** | 197,60 | 173,20 | 113,70 | 75,26 |
| **Malta** | 82,21 | 82,30 | 82,22 | 86,66 |
| **Netherlands** | **116,75** | **133,76** | **145,78** | **137,75** |
| **Poland** | 44,08 | 23,62 | 25,27 | **32,65** |
| **Portugalia** | 59,81 | 62,06 | 51,13 | 42,27 |
| **Romania** | **213,54** | **233,58** | **221,81** | **204,46** |
| **Slovakia** | 20,16 | 25,49 | 38,30 | 38,31 |
| **Slovenia** | 82,17 | 53,63 | 45,67 | 34,18 |
| **Spain** | 96,49 | 88,77 | 91,36 | 89,24 |
| **Sweden** | 79,26 | 72,98 | 68,11 | 56,75 |
| **United Kingdom** | **122,80** | **119,55** | **114,00** | **113,88** |

Note: the tables show average consumption values for 3-year periods from 2002 to 2013, the highest values are marked in green and the lowest values in purple.

Source: own calculation based on FAO database (2019)

*Table 35. - Whey consumption in EU Member States* between 2002 and 2013 (data in kg / capita / year)*

| Country | 2002-2004 | 2005-2007 | 2008-2010 | 2011-2013 |
|---|---|---|---|---|
| **Bulgaria** | 0,00 | 0,02 | 0,02 | 0,00 |
| **Denmark** | **6,39** | **10,14** | **6,84** | **12,19** |
| **France** | 0,02 | 0,02 | 0,03 | 0,05 |
| **Latvia** | 0,66 | 0,56 | 0,67 | 0,91 |
| **Netherlands** | 0,62 | 0,09 | 0,03 | 0,00 |
| **Poland** | 0,00 | 0,02 | 0,05 | 0,03 |
| **Sweden** | 0,06 | 0,06 | 0,06 | 0,16 |

(*) data for many EU Member States are not available in the FAO database

Note: the tables show average consumption values for 3-year periods from 2002 to 2013, the highest values are marked in green.

Source: own calculation based on FAO database (2019)

*Table 36. - The main product groups in product group HS04 (group of dairy products, eggs, honey and other foodstuffs of animal origin)*

| Code | Description | Included in the research? |
|---|---|---|
| 0401 | Milk and cream; not concentrated, not containing added sugar or other sweetening matter. | **yes** |
| 0402 | Milk and cream; concentrated or containing added sugar or other sweetening matter | **yes** |
| 0403 | Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream, whether or not concentrated, containing added sugar, sweetening matter, flavoured or added fruit or cocoa. | **yes** |
| 0404 | Whey and products consisting of natural milk constituents; whether or not containing added sugar or other sweetening matter, not elsewhere specified or included. | **yes** |
| 0405 | Butter and other fats and oils derived from milk; dairy spreads. | **yes** |
| 0406 | Cheese and curd. | **yes** |
| 0407 | Birds' eggs, in shell; fresh, preserved or cooked. | ***no*** |
| 0408 | Birds' eggs, not in shell; egg yolks, fresh, dried, cooked by steaming or boiling in water, moulded, frozen or otherwise preserved, whether or not containing added sugar or other sweetening matter. | ***no*** |
| 0409 | Honey; natural. | ***no*** |
| 0410 | Edible products of animal origin; not elsewhere specified or included. | ***no*** |

Source: own construction based on https://www.foreign-trade.com/reference/hscode.htm?cat=1, 2019

*Table 37. – List of milk and milk products (at level 6) in the main product group HS04*

| Code | Description |
|---|---|
| 040110 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content not exceeding 1% (by weight) |
| 040120 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content exceeding 1% but not exceeding 6% (by weight) |
| 040130 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content exceeding 6% (by weight) |
| 040210 | Dairy produce; milk and cream, concentrated or containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content not exceeding 1.5% (by weight) |
| 040221 | Dairy produce; milk and cream, concentrated, not containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content exceeding 1.5% (by weight) |
| 040229 | Dairy produce; milk and cream, containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content exceeding 1.5% (by weight) |
| 040291 | Dairy produce; milk and cream, concentrated, not containing added sugar or other sweetening matter, other than in powder, granules or other solid forms |
| 040299 | Dairy produce; milk and cream, containing added sugar or other sweetening matter, other than in powder, granules or other solid forms |
| 040310 | Dairy produce; yoghurt, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit or cocoa |
| 040390 | Dairy produce; buttermilk, curdled milk or cream, kephir, fermented or acidified milk or cream, whether or not concentrated or containing added sweetening, flavouring, fruit or cocoa (excluding yoghurt) |
| 040410 | Dairy produce; whey, whether or not concentrated or containing added sugar or other sweetening matter |
| 040490 | Dairy produce; natural milk constituents (excluding whey), whether or not containing added sugar or other sweetening matter, n.e.s. |
| 040500 | Dairy produce; butter and other fats and oils derived from milk |
| 040610 | Dairy produce; fresh cheese (including whey cheese), not fermented, and curd |
| 040620 | Dairy produce; cheese of all kinds, grated or powdered |
| 040630 | Dairy produce; cheese, processed (not grated or powdered) |
| 040640 | Dairy produce; cheese, blue-veined (not grated, powdered or processed) |
| 040690 | Dairy produce; cheese (not grated, powdered or processed), n.e.s. |

Note: this table no longer includes the products of product groups 0407, 0408, 0409, 0410 as they are not milk and milk products

Source: own construction based on WITS database, 2019

*Table 38. - Hungarian export activity by product group between 1999 and 2018 (average of the period, values in USD 1000)*

| Product code | Product description | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|---|
| 040110 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content not exceeding 1% (by weight) | 425 | 19703 | 23316 | 8318 |
| 040120 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content exceeding 1% but not exceeding 6% (by weight) | 14288 | 51602 | 131933 | 127098 |
| 040130 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content exceeding 6% (by weight) | 818 | 3330 | 3666 | 15744 |
| 040210 | Dairy produce; milk and cream, concentrated or containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content not exceeding 1.5% (by weight) | 7771 | 1949 | 654 | 704 |
| 040221 | Dairy produce; milk and cream, concentrated, not containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content exceeding 1.5% (by weight) | 3815 | 1400 | 241 | 209 |
| 040229 | Dairy produce; milk and cream, containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content exceeding 1.5% (by weight) | 25 | 3 | 126 | 103 |
| 040291 | Dairy produce; milk and cream, concentrated, not containing added sugar or other sweetening matter, other than in powder, granules or other solid forms | 1016 | 0 | 135 | 3 |
| 040299 | Dairy produce; milk and cream, containing added sugar or other sweetening matter, other than in powder, granules or other solid forms | 8 | 57 | 55 | 25 |

| | | | | | |
|---|---|---|---|---|---|
| 040310 | Dairy produce; yoghurt, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit or cocoa | 1115 | 7533 | 7045 | 2098 |
| 040390 | Dairy produce; buttermilk, curdled milk or cream, kephir, fermented or acidified milk or cream, whether or not concentrated or containing added sweetening, flavouring, fruit or cocoa (excluding yoghurt) | 2714 | 956 | 6380 | 7853 |
| 040410 | Dairy produce; whey, whether or not concentrated or containing added sugar or other sweetening matter | 1030 | 4072 | 5640 | 23160 |
| 040490 | Dairy produce; natural milk constituents (excluding whey), whether or not containing added sugar or other sweetening matter, n.e.s. | 5691 | 9745 | 9425 | 10619 |
| 040500 | Dairy produce; butter and other fats and oils derived from milk | 3053 | 4237 | 4616 | 2744 |
| 040610 | Dairy produce; fresh cheese (including whey cheese), not fermented, and curd | 4048 | 5363 | 4473 | 24660 |
| 040620 | Dairy produce; cheese of all kinds, grated or powdered | 192 | 27 | 212 | 1703 |
| 040630 | Dairy produce; cheese, processed (not grated or powdered) | 1394 | 4405 | 17246 | 35837 |
| 040640 | Dairy produce; cheese, blue-veined (not grated, powdered or processed) | 7 | 2 | 29 | 13 |
| 040690 | Dairy produce; cheese (not grated, powdered or processed), n.e.s. | 35992 | 37792 | 48418 | 59572 |

Source: own construction based on WITS database, 2020

*Table 39. - Hungarian import activity by product group between 1999 and 2018 (average of the period, values in USD 1000)*

| Product code | Product description | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|---|
| 040110 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content not exceeding 1% (by weight) | 31 | 915 | 2283 | 1986 |
| 040120 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content exceeding 1% but not exceeding 6% (by weight) | 439 | 39853 | 70145 | 36532 |
| 040130 | Dairy produce; milk and cream, not concentrated, not containing added sugar or other sweetening matter, of a fat content exceeding 6% (by weight) | 1129 | 13172 | 25470 | 23437 |
| 040210 | Dairy produce; milk and cream, concentrated or containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content not exceeding 1.5% (by weight) | 2691 | 9682 | 14129 | 9757 |
| 040221 | Dairy produce; milk and cream, concentrated, not containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content exceeding 1.5% (by weight) | 1895 | 2858 | 3101 | 3808 |
| 040229 | Dairy produce; milk and cream, containing added sugar or other sweetening matter, in powder, granules or other solid forms, of a fat content exceeding 1.5% (by weight) | 7 | 65 | 33 | 115 |
| 040291 | Dairy produce; milk and cream, concentrated, not containing added sugar or other sweetening matter, other than in powder, granules or other solid forms | 153 | 797 | 4820 | 2031 |
| 040299 | Dairy produce; milk and cream, containing added sugar or other sweetening matter, other than in powder, granules or other solid forms | 1557 | 1641 | 3272 | 4561 |
| 040310 | Dairy produce; yoghurt, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit or cocoa | 4891 | 14219 | 17410 | 32994 |
| 040390 | Dairy produce; buttermilk, curdled milk or cream, kephir, fermented or acidified milk or cream, whether or not concentrated or containing added sweetening, flavouring, fruit or cocoa (excluding yoghurt) | 1645 | 20255 | 24991 | 25344 |

| | | | | | |
|---|---|---|---|---|---|
| 040410 | Dairy produce; whey, whether or not concentrated or containing added sugar or other sweetening matter | 1842 | 5431 | 5802 | 8063 |
| 040490 | Dairy produce; natural milk constituents (excluding whey), whether or not containing added sugar or other sweetening matter, n.e.s. | 166 | 1012 | 886 | 4204 |
| 040500 | Dairy produce; butter and other fats and oils derived from milk | 1702 | 16605 | 25373 | 32128 |
| 040610 | Dairy produce; fresh cheese (including whey cheese), not fermented, and curd | 8621 | 14327 | 21318 | 33816 |
| 040620 | Dairy produce; cheese of all kinds, grated or powdered | 1389 | 3382 | 6552 | 11425 |
| 040630 | Dairy produce; cheese, processed (not grated or powdered) | 4426 | 15801 | 15390 | 14406 |
| 040640 | Dairy produce; cheese, blue-veined (not grated, powdered or processed) | 512 | 1713 | 2683 | 2964 |
| 040690 | Dairy produce; cheese (not grated, powdered or processed), n.e.s. | 10311 | 81426 | 108203 | 129836 |

Source: own construction based on WITS database, 2020

*Table 40. - Revealed Trade Advantage Index (RTA) values for EU Member States between 1999 and 2018*

| EU members | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|
| **Austria** | 1.03 | 0.86 | 0.79 | 0.58 |
| **Belgium** | -0.19 | -0.07 | 0.13 | -0.09 |
| **Denmark** | 4.14 | 3.11 | 3.03 | 3.24 |
| **United Kingdom** | -0.32 | -0.48 | -0.54 | -0.40 |
| **Finland** | 0.22 | 0.28 | 0.41 | 0.22 |
| **France** | 0.86 | 0.97 | 1.22 | 1.12 |
| **Greece** | -2.30 | -1.55 | -2.39 | -1.30 |
| **Netherlands** | 0.15 | 0.10 | 0.44 | 0.73 |
| **Ireland** | 0.47 | 0.42 | 0.29 | 0.25 |
| **Luxembourg** | 1.09 | 0.79 | 1.38 | 2.72 |
| **Germany** | 0.37 | 0.33 | 0.36 | 0.28 |
| **Italy** | -1.06 | -0.93 | -0.91 | -0.67 |
| **Portugal** | -0.74 | -0.43 | -1.12 | -1.03 |
| **Spain** | -0.67 | -0.61 | -0.82 | -0.46 |
| **Sweden** | -0.45 | -0.64 | -0.93 | -0.99 |
| **EU15 mean** | **0.17** | **0.14** | **0.09** | **0.28** |
| **Bulgaria** | -0.36 | -0.32 | -1.00 | -0.94 |
| **Cyprus** | 1.26 | 1.35 | 2.20 | 3.39 |
| **Czech Republic** | 0.14 | 0.25 | 0.13 | 0.13 |
| **Estonia** | 0.76 | 1.25 | 0.92 | 0.95 |
| **Croatia** | 0.01 | 0.28 | -0.04 | -0.58 |
| **Poland** | 0.83 | 1.41 | 0.89 | 0.35 |
| **Latvia** | 0.70 | 0.94 | 0.73 | 0.85 |
| **Lithuania** | 2.47 | 3.53 | 2.46 | 1.59 |
| **Hungary** | 0.17 | -0.10 | -0.15 | -0.18 |
| **Malta** | -1.36 | -1.83 | -1.93 | -1.71 |
| **Romania** | -0.67 | -0.28 | -0.62 | -0.65 |
| **Slovakia** | 0.14 | 0.16 | -0.29 | -0.31 |
| **Slovenia** | 0.46 | 0.03 | -0.28 | -0.27 |
| **EU13 mean** | **0.35** | **0.51** | **0.23** | **0.20** |
| **EU28 mean** | **0.26** | **0.31** | **0.16** | **0.24** |

Source: own calculation based on WITS database, 2020

*Table 41. - Revealed Competitiveness Index (RC) values for EU Member States between 1999 and 2018*

| EU members | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|
| **Austria** | 0.02 | -0.02 | -0.15 | -0.09 |
| **Belgium** | -0.26 | -0.20 | -0.11 | -0.16 |
| **Denmark** | 1.07 | 0.74 | 0.91 | 0.77 |
| **United Kingdom** | -0.44 | -0.55 | -0.62 | -0.30 |
| **Finland** | 0.30 | 0.40 | 0.04 | -0.39 |
| **France** | 0.55 | 0.71 | 0.78 | 0.66 |
| **Greece** | -2.50 | -2.32 | -1.94 | -1.62 |
| **Netherlands** | -0.08 | -0.20 | -0.08 | 0.12 |
| **Ireland** | -0.11 | 0.10 | -0.06 | -0.21 |
| **Luxembourg** | -0.85 | -0.78 | -0.52 | -0.02 |
| **Germany** | 0.32 | 0.41 | 0.43 | 0.36 |
| **Italy** | -2.25 | -2.03 | -1.66 | -1.40 |
| **Portugal** | -1.99 | -1.25 | -1.24 | -1.02 |
| **Spain** | -0.80 | -0.85 | -0.95 | -0.59 |
| **Sweden** | -1.50 | -1.54 | -1.29 | -1.22 |
| **EU15 mean** | **-0.57** | **-0.49** | **-0.43** | **-0.34** |
| **Bulgaria** | -1.89 | -1.85 | -2.09 | -1.95 |
| **Cyprus** | 0.51 | -0.10 | -1.37 | -1.44 |
| **Czech Republic** | 0.77 | 0.15 | 0.16 | 0.14 |
| **Estonia** | -0.11 | 0.86 | 0.54 | -0.17 |
| **Croatia** | -0.19 | -0.26 | -0.71 | -0.91 |
| **Poland** | 1.19 | 1.30 | 0.63 | 0.26 |
| **Latvia** | 0.02 | -0.06 | 0.07 | 0.13 |
| **Lithuania** | 1.57 | 1.30 | 0.77 | 0.49 |
| **Hungary** | -0.02 | -1.52 | -1.67 | -1.86 |
| **Malta** | -1.68 | -4.58 | -4.88 | -4.54 |
| **Romania** | -2.63 | -2.08 | -2.27 | -1.98 |
| **Slovakia** | 0.00 | -0.08 | -0.89 | -1.03 |
| **Slovenia** | 0.76 | -0.80 | -1.73 | -1.89 |
| **EU13 mean** | **-0.13** | **-0.59** | **-1.03** | **-1.14** |
| **EU28 mean** | **-0.36** | **-0.54** | **-0.71** | **-0.71** |

Source: own calculation based on WITS database, 2020

*Table 42. - Revealed Symmetric Comparative Advantage Index (RSCA) values for EU Member States between 1999 and 2018*

| EU members | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|
| **Austria** | -0.17 | -0.14 | -0.16 | -0.11 |
| **Belgium** | 0.10 | 0.03 | 0.09 | 0.09 |
| **Denmark** | 0.23 | 0.23 | 0.30 | 0.28 |
| **United Kingdom** | -0.37 | -0.33 | -0.31 | -0.19 |
| **Finland** | -0.46 | -0.37 | -0.21 | -0.32 |
| **France** | 0.28 | 0.28 | 0.35 | 0.34 |
| **Greece** | -0.55 | -0.48 | -0.43 | -0.36 |
| **Netherlands** | 0.15 | 0.06 | 0.14 | 0.28 |
| **Ireland** | -0.09 | 0.00 | 0.05 | 0.02 |
| **Luxembourg** | -0.09 | 0.00 | 0.11 | 0.21 |
| **Germany** | 0.01 | 0.04 | 0.03 | 0.01 |
| **Italy** | -0.55 | -0.51 | -0.45 | -0.39 |
| **Portugal** | -0.44 | -0.32 | -0.18 | -0.20 |
| **Spain** | -0.20 | -0.23 | -0.25 | -0.25 |
| **Sweden** | -0.72 | -0.63 | -0.51 | -0.53 |
| **EU15 mean** | **-0.19** | **-0.16** | **-0.10** | **-0.07** |
| **Bulgaria** | -0.81 | -0.71 | -0.56 | -0.58 |
| **Cyprus** | -0.48 | -0.54 | -0.61 | -0.69 |
| **Czech Republic** | -0.33 | -0.21 | -0.22 | -0.27 |
| **Estonia** | -0.26 | -0.06 | -0.05 | -0.12 |
| **Croatia** | -0.25 | -0.36 | -0.32 | -0.32 |
| **Poland** | -0.27 | 0.04 | 0.07 | 0.06 |
| **Latvia** | -0.33 | -0.04 | 0.13 | 0.10 |
| **Lithuania** | -0.05 | 0.09 | 0.18 | 0.15 |
| **Hungary** | -0.58 | -0.63 | -0.57 | -0.51 |
| **Malta** | -0.98 | -0.98 | -0.99 | -0.96 |
| **Romania** | -0.91 | -0.83 | -0.73 | -0.62 |
| **Slovakia** | -0.38 | -0.19 | -0.31 | -0.39 |
| **Slovenia** | -0.48 | -0.53 | -0.56 | -0.60 |
| **EU13 mean** | **-0.47** | **-0.38** | **-0.35** | **-0.37** |
| **EU28 mean** | **-0.32** | **-0.26** | **-0.21** | **-0.21** |

Source: own calculation based on WITS database, 2020

*Table 43. - Logarithm of Revealed Comparative Advantage Index (LnRCA) values for EU Member States 1999-2018*

| EU members | 1999-2003 | 2004-2008 | 2009-2013 | 2014-2018 |
|---|---|---|---|---|
| **Austria** | -0.57 | -0.45 | -0.50 | -0.29 |
| **Belgium** | 0.20 | 0.05 | 0.18 | 0.20 |
| **Denmark** | 0.40 | 0.46 | 0.75 | 0.74 |
| **United Kingdom** | -0.93 | -0.82 | -0.75 | -0.41 |
| **Finland** | -1.49 | -1.05 | -0.57 | -1.32 |
| **France** | 0.62 | 0.61 | 0.75 | 0.74 |
| **Greece** | -1.95 | -1.67 | -1.22 | -0.98 |
| **Netherlands** | 0.32 | 0.09 | 0.31 | 0.66 |
| **Ireland** | -0.61 | -0.23 | -0.01 | -0.11 |
| **Luxembourg** | -0.95 | -0.67 | -0.11 | 0.42 |
| **Germany** | -0.05 | 0.05 | 0.02 | 0.02 |
| **Italy** | -2.22 | -1.94 | -1.49 | -1.13 |
| **Portugal** | -2.09 | -1.14 | -0.86 | -0.77 |
| **Spain** | -0.51 | -0.61 | -0.65 | -0.61 |
| **Sweden** | -2.98 | -2.12 | -1.52 | -1.43 |
| **EU15 mean** | **-0.85** | **-0.63** | **-0.38** | **-0.28** |
| **Bulgaria** | -3.25 | -3.18 | -2.09 | -1.95 |
| **Cyprus** | 0.23 | 0.14 | -0.76 | -1.01 |
| **Czech Republic** | -1.05 | -0.68 | -0.54 | -0.64 |
| **Estonia** | -1.09 | -0.33 | 0.00 | -0.56 |
| **Croatia** | -0.88 | -1.09 | -1.01 | -0.97 |
| **Poland** | -0.61 | -0.03 | 0.15 | 0.11 |
| **Latvia** | -0.55 | -0.53 | 0.16 | 0.17 |
| **Lithuania** | 0.11 | 0.13 | 0.47 | 0.33 |
| **Hungary** | -1.53 | -2.29 | -2.46 | -2.57 |
| **Malta** | -1.97 | -4.28 | -4.87 | -4.32 |
| **Romania** | -4.34 | -3.51 | -2.63 | -2.25 |
| **Slovakia** | -1.18 | -0.40 | -1.18 | -1.36 |
| **Slovenia** | -1.19 | -1.72 | -2.02 | -2.16 |
| **EU13 mean** | **-1.33** | **-1.37** | **-1.29** | **-1.32** |
| **EU28 mean** | **-1.08** | **-0.97** | **-0.80** | **-0.77** |

Source: own calculation based on WITS database, 2020

*Table 44. - Correlation coefficients between RCA indices for the study period for EU28*

| **EU15:** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Austria** | 1.00 | 0.96 | 0.94 | 0.89 | 0.87 | 0.83 | 0.77 | 0.69 | 0.64 | 0.59 | 0.50 | 0.56 | 0.69 | 0.65 | 0.63 | 0.64 | 0.31 | 0.39 | 0.31 |
| **Belgium** | 0.92 | 0.66 | 0.57 | 0.53 | 0.42 | 0.40 | 0.41 | 0.43 | 0.41 | 0.40 | 0.42 | 0.40 | 0.38 | 0.35 | 0.40 | 0.42 | 0.39 | 0.39 | 0.39 |
| **Denmark** | 0.98 | 0.97 | 0.94 | 0.95 | 0.98 | 0.98 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.94 | 0.95 | 0.95 | 0.94 | 0.91 | 0.90 |
| **United Kingdom** | 0.94 | 0.93 | 0.94 | 0.92 | 0.68 | 0.70 | 0.73 | 0.60 | 0.66 | 0.66 | 0.58 | 0.47 | 0.63 | 0.42 | 0.14 | 0.03 | -0.05 | 0.24 | 0.08 |
| **Finland** | 0.87 | 0.87 | 0.85 | 0.89 | 0.87 | 0.91 | 0.89 | 0.88 | 0.91 | 0.98 | 0.92 | 0.90 | 0.89 | 0.87 | 0.88 | 0.85 | 0.82 | 0.79 | 0.78 |
| **France** | 0.97 | 0.92 | 0.90 | 0.89 | 0.75 | 0.71 | 0.69 | 0.65 | 0.51 | 0.47 | 0.44 | 0.29 | 0.37 | 0.40 | 0.35 | 0.38 | 0.36 | 0.19 | 0.30 |
| **Greece** | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.99 | 1.00 | 0.99 | 1.00 | 0.98 | 0.99 | 0.99 | 1.00 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 |
| **Netherlands** | 0.99 | 0.95 | 0.94 | 0.91 | 0.93 | 0.89 | 0.84 | 0.88 | 0.85 | 0.89 | 0.88 | 0.88 | 0.81 | 0.88 | 0.88 | 0.87 | 0.69 | 0.54 | 0.59 |
| **Ireland** | 0.99 | 0.96 | 0.95 | 0.94 | 0.93 | 0.92 | 0.95 | 0.97 | 0.93 | 0.91 | 0.92 | 0.93 | 0.90 | 0.87 | 0.87 | 0.88 | 0.90 | 0.92 | 0.94 |
| **Luxembourg** | 0.97 | 0.94 | 0.92 | 0.91 | 0.91 | 0.88 | 0.78 | 0.78 | 0.48 | 0.32 | 0.34 | 0.44 | 0.37 | 0.33 | 0.23 | 0.38 | 0.62 | 0.60 | 0.73 |
| **Germany** | 0.98 | 0.94 | 0.92 | 0.86 | 0.79 | 0.86 | 0.83 | 0.82 | 0.81 | 0.81 | 0.81 | 0.81 | 0.79 | 0.84 | 0.84 | 0.84 | 0.88 | 0.87 | 0.79 |
| **Italy** | 1.00 | 1.00 | 1.00 | 1.00 | 0.98 | 0.98 | 0.97 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| **Portugal** | 0.93 | 0.84 | 0.79 | 0.80 | 0.82 | 0.53 | 0.53 | 0.51 | 0.50 | 0.72 | 0.85 | 0.87 | 0.77 | 0.71 | 0.69 | 0.70 | 0.76 | 0.69 | 0.66 |
| **Spain** | 0.93 | 0.79 | 0.80 | 0.68 | 0.69 | 0.58 | 0.60 | 0.63 | 0.70 | 0.74 | 0.62 | 0.67 | 0.70 | 0.70 | 0.70 | 0.74 | 0.76 | 0.78 | 0.69 |
| **Sweden** | 0.85 | 0.87 | 0.86 | 0.78 | 0.61 | 0.31 | 0.41 | 0.42 | 0.37 | 0.12 | -0.17 | -0.22 | -0.24 | -0.11 | -0.10 | -0.10 | 0.00 | 0.01 | 0.03 |
| **EU13:** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** |
| **Bulgaria** | 0.96 | 0.99 | 0.97 | 0.84 | 0.70 | 0.80 | 0.85 | 0.66 | 0.63 | 0.58 | 0.51 | 0.61 | 0.57 | 0.37 | 0.63 | 0.68 | 0.54 | 0.52 | 0.45 |
| **Cyprus** | 0.99 | 0.93 | 0.99 | 0.98 | 0.92 | 0.84 | 0.80 | 0.78 | 0.77 | 0.75 | 0.72 | 0.74 | 0.72 | 0.75 | 0.75 | 0.76 | 0.77 | 0.78 | 0.78 |
| **Czech Republic** | 0.92 | 0.80 | 0.85 | 0.72 | 0.36 | -0.02 | -0.11 | -0.07 | -0.12 | -0.08 | -0.17 | -0.14 | -0.11 | -0.13 | -0.11 | -0.15 | -0.12 | -0.10 | -0.13 |
| **Estonia** | 0.91 | 0.56 | 0.74 | 0.90 | 0.85 | 0.61 | 0.37 | 0.61 | 0.42 | 0.44 | 0.14 | 0.12 | -0.10 | -0.12 | -0.10 | -0.16 | -0.14 | -0.13 | -0.11 |
| **Croatia** | 0.98 | 0.93 | 0.95 | 0.95 | 0.89 | 0.81 | 0.74 | 0.66 | 0.76 | 0.79 | 0.79 | 0.75 | 0.81 | 0.82 | 0.70 | 0.67 | 0.75 | 0.79 | 0.83 |
| **Poland** | 0.96 | 0.86 | 0.79 | 0.88 | 0.80 | 0.61 | 0.44 | 0.41 | 0.40 | 0.42 | 0.34 | 0.32 | 0.26 | 0.18 | 0.36 | 0.33 | 0.18 | 0.13 | 0.23 |
| **Latvia** | 0.99 | 0.95 | 0.43 | 0.24 | 0.06 | -0.01 | -0.05 | -0.02 | 0.08 | -0.16 | -0.10 | -0.09 | -0.12 | -0.14 | -0.16 | -0.09 | -0.08 | -0.12 | -0.09 |
| **Lithuania** | 0.61 | 0.61 | 0.81 | 0.78 | 0.22 | 0.33 | 0.34 | 0.20 | 0.36 | 0.35 | 0.25 | 0.19 | 0.21 | 0.11 | 0.09 | 0.01 | -0.04 | -0.15 | -0.06 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hungary** | 0.94 | 0.91 | 0.92 | 0.84 | 0.86 | 0.67 | 0.34 | 0.12 | -0.01 | 0.17 | 0.10 | 0.13 | 0.12 | 0.14 | 0.16 | 0.16 | 0.21 | 0.22 | 0.31 |
| **Malta** | 1.00 | 1.00 | 1.00 | 1.00 | 0.09 | 1.00 | 0.99 | 0.17 | -0.13 | -0.07 | -0.11 | -0.09 | 0.53 | -0.07 | -0.08 | -0.10 | -0.09 | -0.06 | -0.07 |
| **Romania** | 0.99 | 0.98 | 0.99 | 0.99 | 0.89 | 0.64 | 0.86 | -0.09 | -0.08 | -0.08 | -0.09 | -0.09 | 0.16 | -0.04 | -0.10 | -0.08 | -0.10 | -0.10 | -0.12 |
| **Slovakia** | 0.71 | 0.74 | 0.61 | 0.51 | 0.48 | 0.66 | 0.45 | 0.39 | 0.45 | 0.42 | 0.25 | 0.16 | 0.14 | 0.04 | -0.01 | -0.01 | 0.04 | 0.07 | 0.05 |
| **Slovenia** | 0.96 | 0.96 | 0.96 | 0.91 | 0.96 | 0.89 | 0.79 | 0.76 | 0.76 | 0.76 | 0.73 | 0.73 | 0.73 | 0.72 | 0.71 | 0.70 | 0.71 | 0.71 | 0.73 |

Source: own calculation based on WITS database, 2020

*Table 45. - Transition probability matrices to show stability between 1999 and 2018[20] by country*

**Austria**

| **Starting year (1999)** | **Final year (2018)** | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 72.73% | 18.18% | 9.09% | 0.00% |
| *Group b* | 0.00% | 50.00% | 50.00% | 0.00% |
| *Group c* | 33.33% | 0.00% | 0.00% | 66.67% |
| *Group d* | 0.00% | 0.00% | 100.00% | 0.00% |
| Distribution of starting year (1999) | 66.7% | 11.1% | 16.7% | 5.6% |
| Distribution of final year (2018) | 55.6% | 16.7% | 16.7% | 11.1% |

**Belgium**

| **Starting year (1999)** | **Final year (2018)** | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 71.43% | 28.57% | 0.00% | 0.00% |
| *Group b* | 20.00% | 20.00% | 60.00% | 0.00% |
| *Group c* | 0.00% | 20.00% | 60.00% | 20.00% |
| *Group d* | 100.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 38.9% | 27.8% | 27.8% | 5.6% |
| Distribution of final year (2018) | 38.9% | 22.2% | 33.3% | 5.6% |

[20] The results of the transition probability matrix for Malta, Sweden are missing from the inserted tables. This is because the indices of manifest comparative advantage all belong to group "a", so the illustrative table does not provide meaningful information.

## Bulgaria

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 94.12% | 0.00% | 5.88% | 0.00% |
| *Group b* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 100.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 94.4% | 0.0% | 5.6% | 0.0% |
| Distribution of final year (2018) | 88.9% | 5.6% | 5.6% | 0.0% |

## Croatia

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 91.67% | 8.33% | 0.00% | 0.00% |
| *Group b* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 25.00% | 25.00% | 50.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 100.00% | 0.00% |
| Distribution of starting year (1999) | 66.7% | 5.6% | 22.2% | 5.6% |
| Distribution of final year (2018) | 72.2% | 11.1% | 16.7% | 0.0% |

## Cyprus

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 92.86% | 0.00% | 0.00% | 7.14% |
| *Group b* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 100.00% | 0.00% | 0.00% |
| *Group d* | 50.00% | 0.00% | 0.00% | 50.00% |
| Distribution of starting year (1999) | 77.8% | 5.6% | 5.6% | 11.1% |
| Distribution of final year (2018) | 83.3% | 5.6% | 0.0% | 11.1% |

## Czech Republic

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 90.91% | 0.00% | 0.00% | 9.09% |
| *Group b* | 60.00% | 40.00% | 0.00% | 0.00% |
| *Group c* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 61.1% | 27.8% | 11.1% | 0.0% |
| Distribution of final year (2018) | 83.3% | 11.1% | 0.0% | 5.6% |

**Estonia**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 53.85% | 23.08% | 7.69% | 15.38% |
| *Group b* | 50.00% | 0.00% | 50.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 66.67% | 33.33% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 72.2% | 11.1% | 0.0% | 16.7% |
| Distribution of final year (2018) | 55.6% | 22.2% | 11.1% | 11.1% |

**Finland**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 76.92% | 15.38% | 7.69% | 0.00% |
| *Group b* | 33.33% | 0.00% | 33.33% | 33.33% |
| *Group c* | 0.00% | 50.00% | 50.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 72.2% | 16.7% | 11.1% | 0.0% |
| Distribution of final year (2018) | 61.1% | 16.7% | 16.7% | 5.6% |

**Greece**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 68.75% | 25.00% | 6.25% | 0.00% |
| *Group b* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 100.00% |
| Distribution of starting year (1999) | 88.9% | 0.0% | 0.0% | 11.1% |
| Distribution of final year (2018) | 61.1% | 22.2% | 5.6% | 11.1% |

**Italy**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 92.86% | 7.14% | 0.00% | 0.00% |
| *Group b* | 0.00% | 0.00% | 100.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 100.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 77.8% | 11.1% | 11.1% | 0.0% |
| Distribution of final year (2018) | 72.2% | 5.6% | 11.1% | 11.1% |

**Latvia**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 36.36% | 18.18% | 36.36% | 9.09% |
| *Group b* | 50.00% | 0.00% | 50.00% | 0.00% |
| *Group c* | 50.00% | 50.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 100.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 61.1% | 11.1% | 22.2% | 5.6% |
| Distribution of final year (2018) | 38.9% | 27.8% | 27.8% | 5.6% |

**Lithuania**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 37.50% | 25.00% | 12.50% | 25.00% |
| *Group b* | 50.00% | 0.00% | 0.00% | 50.00% |
| *Group c* | 50.00% | 0.00% | 25.00% | 25.00% |
| *Group d* | 0.00% | 50.00% | 25.00% | 25.00% |
| Distribution of starting year (1999) | 44.4% | 11.1% | 22.2% | 22.2% |
| Distribution of final year (2018) | 33.3% | 22.2% | 16.7% | 27.8% |

**Luxembourg**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 45.45% | 9.09% | 0.00% | 45.45% |
| *Group b* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 100.00% |
| *Group d* | 0.00% | 0.00% | 25.00% | 75.00% |
| Distribution of starting year (1999) | 61.1% | 5.6% | 11.1% | 22.2% |
| Distribution of final year (2018) | 33.3% | 5.6% | 5.6% | 55.6% |

**Netherlands**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 66.67% | 16.67% | 16.67% | 0.00% |
| *Group b* | 33.33% | 33.33% | 0.00% | 33.33% |
| *Group c* | 0.00% | 0.00% | 60.00% | 40.00% |
| *Group d* | 0.00% | 0.00% | 25.00% | 75.00% |
| Distribution of starting year (1999) | 33.3% | 16.7% | 27.8% | 22.2% |
| Distribution of final year (2018) | 27.8% | 11.1% | 27.8% | 33.3% |

**Poland**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 41.67% | 33.33% | 25.00% | 0.00% |
| *Group b* | 20.00% | 40.00% | 40.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 100.00% | 0.00% |
| Distribution of starting year (1999) | 66.7% | 27.8% | 0.0% | 5.6% |
| Distribution of final year (2018) | 33.3% | 33.3% | 33.3% | 0.0% |

**Portugalia**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 83.33% | 8.33% | 8.33% | 0.00% |
| *Group b* | 50.00% | 50.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 100.00% | 0.00% |
| *Group d* | 0.00% | 100.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 66.7% | 22.2% | 5.6% | 5.6% |
| Distribution of final year (2018) | 66.7% | 22.2% | 11.1% | 0.0% |

**Romania**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 88.89% | 5.56% | 5.56% | 0.00% |
| *Group b* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 100.0% | 0.0% | 0.0% | 0.0% |
| Distribution of final year (2018) | 88.9% | 5.6% | 5.6% | 0.0% |

**Slovakia**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 80.00% | 13.33% | 6.67% | 0.00% |
| *Group b* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 0.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 83.3% | 16.7% | 0.0% | 0.0% |
| Distribution of final year (2018) | 83.3% | 11.1% | 5.6% | 0.0% |

**Slovenia**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group b* | 50.00% | 0.00% | 50.00% | 0.00% |
| *Group c* | 50.00% | 0.00% | 0.00% | 50.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 77.8% | 11.1% | 11.1% | 0.0% |
| Distribution of final year (2018) | 88.9% | 0.0% | 5.6% | 5.6% |

**Spain**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 92.86% | 7.14% | 0.00% | 0.00% |
| *Group b* | 33.33% | 33.33% | 33.33% | 0.00% |
| *Group c* | 0.00% | 0.00% | 100.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 77.8% | 16.7% | 5.6% | 0.0% |
| Distribution of final year (2018) | 66.7% | 22.2% | 11.1% | 0.0% |

**United Kingdom**

| Starting year (1999) | Final year (2018) | | | |
|---|---|---|---|---|
| | *Group a* | *Group b* | *Group c* | *Group d* |
| *Group a* | 87.50% | 6.25% | 6.25% | 0.00% |
| *Group b* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group c* | 100.00% | 0.00% | 0.00% | 0.00% |
| *Group d* | 0.00% | 0.00% | 0.00% | 0.00% |
| Distribution of starting year (1999) | 88.9% | 5.6% | 5.6% | 0.0% |
| Distribution of final year (2018) | 88.9% | 5.6% | 5.6% | 0.0% |

Source: own calculation based on WITS database, 2020