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EVALUATION OF THE IMPLEMENTATION OF SMART SPECIALISATION STRATEGY IN LITHUANIAN INDUSTRY

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Abstract. This article provides data-driven analyses of Lithuanian foreign trade activities. We combine Herfindahl-Hirschman Index (HHI) and Lauraéus-Kaivo-oja Index (LKI) measures to identify key changes and trends in export and import structures of the Lithuanian economy. The findings suggest that the export and import portfolios of the Lithuanian economy have been successfully diversified and the Lithuanian Smart Specialisation Strategy (S3) successful implemented in years 2015 through 2020. Presented in the form of HHI and LKI time series, our findings and the corresponding conclusions will be relevant to both the Lithuanian export and import industry and to industrial and economic policymakers in Lithuania and in international export and import agencies.

Keywords: industrial structure, smart specialisation, Herfindahl-Hirschman Index, Lauraéus-Kaivo-oja Index, export portfolios, import portfolios.

JEL Classification: C44, O14, O47.

Introduction

The term "smart specialisation" (SS) was first formally introduced in the context of European cohesion policy as part of a broader reform (Barca, 2009). Literature sources suggest its meaning as a process aimed at transforming the economic structure of a country, region or other geographical unit and developing new activities (Foray, 2018). It also provides for the inclusion of local policies in the improvement of further development guidelines (Barca, 2009). Smart specialization differs from usual industrial development in two essential complementary aspects (Gianelle et al., 2020). First, the states must follow the principle of selection in the enlargement process, i.e., focus on targeted economic activities. In this re-

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spect, horizontal or sectorial policies should play an important role, which should improve the conditions for economic exchange and entrepreneurship while complementing the policies of the HS. Second, that selection must be based on interactive solutions between policy makers and the private sector. This allows us to uncover new opportunities in the context of potential benefits, risks, and policy needs (Foray & Goenaga, 2013).

All of this shows that smart specialization reflects a process of diversification of the country's industries, which is aimed at concentrating available resources and competencies in a limited number of areas and ensures the purposeful transformation of industry. It can be accelerated if the country's government is involved in the process and supports new promising industries (Foray, 2014).

Internationalisation plays an important role in national industrial development. In the context of smart specialisation, it combines aspects such as joint scientific research, strategic alliances, mergers, and acquisitions, etc. (Foray et al., 2012).

The main result of the SS is the structural changes in the country's economic development. It is inseparable from diversification. Its scale depends to a large extent on existing capacities and knowledge, as they ensure the further development of R&D innovation activities (Foray & Goenaga, 2013).

The European Commission has presented six steps for a strategy to implement the theoretical concept of the HS:

1) analysis of the regional context and identification of innovation potential;
2) establishing a sound and inclusive governance structure;
3) developing a common vision for the future of the region;
4) selection of a limited number of regional development priorities;
5) developing the right mix of policies;
6) development of integrated monitoring and evaluation mechanisms (European Commission, 2012).

The process of implementing all these practical steps and measures presupposes the development of the necessary policies and appropriate industrial diversification strategies. The concept of the SS stipulates that the planned changes must largely be built on the existing industrial structure of the country or region, while involving as many business entities and stakeholders as possible in the process of developing and implementing the new policy (Roth, 2021; Valentinov et al., 2019).

It is important that policies focus on promoting entrepreneurship and innovation, and that small and medium-sized enterprises are given the highest priority in creating the full potential for business links between them and with larger companies. These connections provide for the necessary platform and networking opportunities for local business initiatives and international participation (McCann & Ortega-Argilés, 2016).

In the context of the SS, the diversity of industries is very important. It depends on the number of different social groups and institutions and how these institutions differ from each other (Ginevičius et al., 2015). The source of institutional diversity can be both industries and a variety of companies, research institutes, educational institutions, public administrations and other institutions in a country or region. All the actors that make up this diversity are subordinate to different formal and informal institutions, and this leads to a greater diversity

of individual behaviors, a willingness to engage and collaborate beyond their social group (Gianelle et al., 2020). This shows the importance of diversification of economic sectors for the development of smart specialization.

Internationalisation is the basis on which regions can identify competitive industrial "niches" or specific areas of competitive advantage, both for the present and for the future, as well as to form necessary links and human flows. It is always outward-oriented, making it an integral part of the SS (Radosevic & Ciampi Stancova, 2018).

In this article, we describe trends of key economic sectors in relation to export and import. We first review pertinent literature on smart specialisation before we analyse the export and import portfolios of *over 90 sectors* of the Lithuanian economy between 2015 and 2020 focussing strongly on data-driven indicators. We then proceed to combine analyses based on both the Herfindahl-Hirschman Index and the Lauréaus-Kaivo-oja Index (Lauraéus & Kaivo-oja, 2017) of export and import portfolios in a bid to provide vital smart specialisation information for policy makers. We furthermore analyse instabilities of export and import flows, which are linked to resilience analysis of Lithuanian economy and trade. We conclude with a brief data-based discussion of issues pertaining to desirable targets and visions of the Lithuanian society based on national and regional S3 targets as defined and discussed in Lithuanian governmental policy documents.

1. Literature review

Increasing the competitiveness of industry is a response to increasing competition in markets, enabling them to increase their share. They can only remain competitive at a rate no lower than the overall growth of the market. In this situation, concentration becomes an essential strategy for their growth. Today, it is associated with the ability to adapt effectively to ever-changing external conditions. Research shows that enterprise development strategies are applied six times more often than operational stability, such as penetration (Ginevičius et al., 2015), and seven times more often than production cost reduction strategies. On the other hand, they are meaningful in cases where the activities become less attractive and the competitive positions are strong or at least moderate (Wheelen & Hunger, 1988a, 1988b; Vasiliauskas, 2006).

Concentration as a phenomenon is defined in various ways. First, it is the choice of one product, i.e. specialization, and related efforts to improve and develop its production; second, it is the desire of companies belonging to a certain industrial activity to sell more and more products (The New York Times Company, 2010; Gilligan, 2006); third, the company's desire to occupy a larger share of one or more smaller markets rather than a small share in large markets (The American Marketing Association, 2005). The following explanation of the concentration process is more acceptable: it is the concentration of means of production, labour resources and output in ever larger companies. It unites the essential forms of the company's growth – specialization, production scale and range (Ginevičius & Andriuškevičius, 2000).

All and other approaches to the concentration process are focused on the same goal – concentration, which is an essential condition for the country's economic development today. Concentration and specialization are two sides of the same coin, and it is increasingly

emphasized that specialization, through the development of knowledge, technology, innovation, etc., has the greatest impact on countries' economic development today (Lopes et al., 2019).

Economic growth is the ultimate goal of a country's specialization, and to achieve this, it is necessary to purposefully create and develop knowledge. Modern knowledge-based development of a country is primarily based on targeted specialization and the creation of certain unique advantages that are not easy and sometimes even impossible for competitors to replicate (Kaivo-oja et al., 2018; Roth et al., 2018; Tiits et al., 2015). It is worth noting that the importance of specialization is relevant in models of innovation cycles that explain the interaction between specialization and development. According to the models of innovation cycles, the development of individual technologies and products, as well as industries, begins with the emergence of (radically) new technologies and products. As time goes on and the market grows, competition intensifies, causing lower prices and thus profit margins, thus leading to industry consolidation. Eventually, as products mature and primary markets become increasingly saturated, the cost advantage (economies of scale) will become the main competitive advantage and production will be relocated to low-cost areas that are logistically close to the main mass consumer markets (Perez, 2006). Thus, innovation and technology clusters are important centres of consolidation that ensure the creation and dissemination of new knowledge. In the context of smart specialization, knowledge, technology, and innovation competencies are becoming a key factor in ensuring economic development. It is worth mentioning that neither technological nor industrial development is completely coincidental. Targeted policy planning tools and technological advances allow for the emergence of entire clusters of mutually reinforcing technological innovations and related new industries and infrastructures. Finally, this leads to structural changes in the industry, replacing traditional resource- or labour-intensive industries with modern science- and technology-intensive industries, leading to an overall increase in the knowledge and technology intensity of the economy (Tiits et al., 2015).

The concept of smart specialization does not have a very clear scientific basis, but links with theories of development cycles can be seen. However, the concept of smart specialization emphasizes the role of knowledge, technology and innovation for economic development and social well-being. The concept of smart specialization defines and values smart growth, considering the role of the evolution of human capital and knowledge for economic growth and regional cohesion. This economic growth strategy is largely focused on innovation, knowledge, and technology (Naldi et al., 2015). It can be argued that, in essence, the idea of specialization existed as much as economic theory. However, it has recently been taken on a targeted and political dimension and has become an institutional tool for targeted development. Moreover, the quality of government is an important factor influencing innovation capacity, and efficient and transparent public institutions are a necessary factor in direct support measures for innovation (Rodríguez-Pose & Di Cataldo, 2015).

The analysis of theories of smart specialization reveals that various directions and topics are analysed. Smart specialization is examined in the contexts of different business sectors. The authors (Romão, 2020; Benner, 2017) examine the challenges of the tourism sector in terms of smart specialization, the development and application of smart city solutions to

strengthen regional competitiveness (Caragliu & Del Bo, 2015) and highlight its impact in less developed regions (Asheim, 2019). Research on smart specialization emphasizes the themes of increasing competitiveness and regional cohesion.

Methodological, intelligent specialization research is also singled out, the aim of which is to form guidelines for the successful application of this concept. Research on smart specialization also examines the shortcomings of this methodology in relation to the region-dominant barriers that are specific to the region and therefore the application of the strategic concept in practice varies across regions (Ghinoi et al., 2021). Knowledge transfer networks dominating in some certain industrial sectors are important in examining the resources needed to implement a smart specialization strategy and their availability (Broekel & Mueller, 2018). The formation of these networks is directly linked to the activities and scale of the industrial sectors. There are also opportunities to diversify knowledge across different industries. An effective knowledge transfer network requires organizational resources and business collaboration. Research reveals that public support institutions and higher education institutions play an important role in promoting the growth of the network.

Examining the dynamics of a country's innovation, the authors (Frenken et al., 2007) point out that not only the diversity of sectors in different regions is important, but also the strength of the links between the elements of that diversity. Organizations compete by expanding their areas of knowledge and their ability to use more components of the knowledge space. This means that diversification promotes the diversity of innovative activities and the creation of new radical innovations through cooperation between different sectors of the economy.

The ongoing global digitalisation opens up new opportunities to identify the strengths and priorities of economic and scientific-technological development in countries and regions (Ionescu et al., 2022; Kaivo-oja et al., 2017; Roth et al., 2013, 2019). This is done through the research on smart specialization. One such direction is the determination of the level of specialization of the country's economic sector, i.e., industry (Brunner & Calì, 2006; Capasso et al., 2015; Chen & Li, 2011; Hallack, 2004; Szirmai et al., 2005). In essence, they are inseparable from the analysis of the structure of the industry. These methodologies have always been given great attention in scientific literature (Misra, 2006; Jenissen et al., 1998; Tikhomirova, 1997; Brunner & Cali, 2006; Schott, 2004; Hallack, 2004; Szirmai et al., 2005; Carlton & Perloff, 1994). This fact was caused by the changing situation – changes in the degree of concentration of economic operators and states, the conditions of entering global markets; growth in the range of production, change in the degree of integration and diversification of enterprises, etc. (Carlton & Perloff, 1994; Jenissen et al., 1998; Sabonienė, 2010).

Changes in the structure of the industry were analysed and assessed in various respects. One of the previous assessments was aimed at the determination of the level of specialization in the context of trade between the country and the region, i.e., in the context of exports of output (Drysdale, 1988; Garnant, 1989; Anderson, 1995; Sheehan, 2000; Misra, 2006; Čiučkovič et al., 2013; Anderson, 1995; Sabonienė, 2009; Snieška & Bruneckienė, 2009). It was based on the Balassa index (Balassa, 1965). This index makes it possible to assess the degree of specialization of a country's industry on the basis of the volume of exports of certain branches (or groups thereof). On the other hand, the use of this index is complicated if it is

intended to assess the structure of the industry throughout the country. In particular, it is necessary to determine the level of specialization of each industry (Sheehan & Tikhomirova, 1996):

$$CI_i = \frac{\sum_{j=1}^{n} X_j^i I_j}{\sum_{j=1}^{n} X_j^i CI_0}, \quad (1)$$

index CI_i of Knowledge Composition of Exports; X_j^i – export volumes of industry j of country I; I_j – indicator of science and research intensity for industry J; $CI_0 = \left(\sum n_j I_j\right) / n$, N – the total number of manufacturing industries.

If the output of that industry was equal in volume, the CI_i index value would be equal to one; if exports were concentrated in branches with a high R&D intensity, the index value would be greater than one, if there was a small one, smaller than one.

Subsequent proposals for determining the level of specialization of the sectors were also based on the R&D intensity index (Kotnik & Petrin, 2017). It assesses the volume of exports of industries, their growth and, as a result, distinguishes growing industries. Other authors associated further development of the country's industry with participation in Global Value Chains (Brennan & Rakhmatullin, 2015). It determines the extent to which it will be involved in job creation, revenue growth, technology diffusion and sustainable development. This participation opens up a wide range of opportunities for integration into global trade, which today is the basis for further economic development. It is no coincidence that a country's competitiveness is measured not by its ability to develop an integrated industry, but by its position in global value chains. Basically, it is proposed to assess it at three levels: first, the ability to connect to Global Value Chains; second, the ability to be a part of them; third, the ability to rise.

In the context of industry's smart specialization today, it is no longer sufficient to rely solely on R&D's contribution to its modernization, since the implementation of its strategy also involves the qualifications of employees. This means strengthening higher education, the ability of graduates to work with high technology, the creation of new R&D jobs, etc. (Tiits et al., 2015).

The HS strategy is also inextricably linked to horizontal interregional links and to industrial development policy (Brennan & Rakhmatullin, 2015; Radosevic & Ciampi Stancova, 2018). The development of new export-oriented products and the emergence of new export routes depend on trade links between regions. On the other hand, there are studies assessing the importance of non-regional links for the development of new export routes (Boschma, 2017). Regions have been found to be more likely to develop export-enhancing branches that differ from neighbouring regions. It has been noted that the export structure of the region is nevertheless advantageous if it is related to a similar industrial structure of other regions. These opportunities are further enhanced by interregional networks. This is caused by the fact that the network's knowledge and sources of innovation are brought together as a whole. At the same time, opportunities are created to increase the diversity of regional industrial development (Whittle et al., 2020).

There are other approaches to quantifying the industrial structure of the country's region (Ginevičius et al., 2015). First, it distinguishes between two sides: quantitative and qualitative.

They are then merged into one complex indicator. The quantitative one reflects the number of economic entities in the region per thousand of its population and the turnover of these entities per thousand inhabitants. The qualitative structure of the industry in the region is represented by four indicators which reflect the size of the economic operators in the region, expressed in terms of number of employees; the size of the turnover by economic operator; the number of economic activities developed by economic operators, as well as the turnover of these economic activities.

After quantifying the industrial structure of the Lithuanian regions, its impact on their economic and social development indicators was determined. It was found to be the largest for foreign direct investment and exports of goods (Godlewska-Majkowska & Komor, 2021; Kozlova & Collan, 2020; Rodionov et al., 2021; Dorozynski & Kuna-Marszalek, 2016; Blumer, 2018).

The industrial structure of countries and regions is largely reflected in its concentration indicators (Hannan, 1997; Lijesen et al., 2002; Naldi, 2003; Liston-Heyes & Pilkington, 2004). Analysis of their changes allows us to see and evaluate structural changes and their trends, and at the same time to determine how individual industries and countries' industries integrate into the global value chains, i.e., how sales volumes in international markets change.

The analysis of the methods used to assess the structure of the industry has showed that the direction of its changes, in line with the global challenges of the market, is reflected in the volume and nature of trade in international markets, i.e., export and import. In their analysis, two aspects can be distinguished: quantitative and qualitative. Quantitative changes in exports and imports show an increase / decrease in their volume, qualitative changes in their diversity. From here arises a scientific and practical problem – to assess what changes in exports and imports took place over a certain period and to establish conditions for improvement of exports and imports of Lithuanian industrial products.

2. Research methodology

To quantify the changes in the export-import structure of Lithuanian and their tends, it is first necessary to identify the current situation. It is reflected in the indicators of industrial concentration. The concept of industrial concentration, which includes an understanding of this process and the resulting opportunities for quantification of its level, has always been the subject of scientific debate. Despite the diversity of approaches, there is general agreement that the essential elements for measuring it are the number of activities and the distribution of their size. It is these that are common to all the proposed methods for measuring concentration (Table 1). (Bikker & Groenveld, 2000; Wolf, 1995; Herfindahl, 1950; Hirschman, 1945; Adams, 2017; Ginevičius, 1998).

Of all the industrial concentration indices in Table 1, the Herfindahl-Hirschman index is the most widely used because of its simplicity. Its initial expression was as follows (Wolf, 1995):

$$\tilde{K} = \sum_{i=1}^{k} \omega_i S_i, \tag{2}$$

where $\tilde{K}$ is the concentration indicator; ω_i – the materiality factor for industrial activity *I*; S_i – the relative turnover of industrial activity *I*; *K* – the number of industrial activities / sectors, $i = \overline{1,k}$.

Table 1. Production concentration indicators (source: compiled by the authors based on Bikker & Groenveld, 2000; Rinkevičiūtė & Martinkutė-Kaulienė, 2014)

Indicator (index)	Limits of change	Expression of indicator
The Herfindahl-Hirschman Index	$\frac{1}{n} = HHI = 1$	$HHI = C_H = \sum_{i=1}^{n} S_i^2$
The Hall-Tideman Index	$0 < HTI = 1$	$HTI = \frac{1}{\left(2\sum_{i=1}^{n} i \times S_i - 1\right)}$
The Rosenbluth	$0 < RI = 1$	$RI = \frac{1}{2C}$
The Comprehensive Industrial Concentration Index	$0 < CCI = 1$	$CCI = S_i + \sum_{i=2}^{n} S_i^2 \times \left[1 + \left(1 - S_i\right)\right]$
The Hannah and Kay Index	$\frac{1}{S_1} = HKI = n$	$HKI = \left(\sum_{i=1}^{n} S_i^a\right)^{\frac{1}{1-a}}$, $a > 0$, $a \neq 1$
The U Index	$\frac{1}{n} = U = \gamma$	$U = \left[\sum_{i=1}^{n} S_i \times \left(S_i \times \eta^{\frac{a-1}{a}}\right)\right]^a$
The House Index	$0 < H_m = 1$	$H_m\left(a, \{S_i\}\right) = \sum_{i=1}^{n} S_i^{2-\left[S_i \times \left(HHI - S_i^2\right)\right]^a}$
Entropy Measure	$0 = E = \log n$	$E = -\sum_{i=1}^{n} S_i \times \log 2 S_i$

The application of the $\tilde{K}$ indicator revealed its weak side – the dependence on the ω_i value of the coefficient. In its improvement, the assessment of the significance of individual activities was abandoned, and the relative size of these activities has S_i "converted with itself". As a result, the Herfindahl-Hirschman concentration index *HHI* (Herfindahl, 1950; Hirschman, 1945; Adams, 2017; Ginevičius, 1998):

$$HHI = S_1^2 + S_2^2 + S_3^2 + \ldots + S_i^2 + \ldots + S_k^2 = \sum_{i=1}^{n} S_i^2, \quad (3)$$

where HHI is the Herfindahl-Hirschman concentration index.

The concentration index K based on formulas (2)–(3) can be expressed as follows:

$$HHI = \sum_{i=1}^{k} \left(\frac{n_i}{N}\right)^2; \quad (4)$$

or

$$HHI = \frac{1}{N^2}\sum_{i=1}^{k} n_i^2. \tag{5}$$

Here N is the total number of industrial sectors; n_i – the number of enterprises in industrial sector *I*.

The total number of sectors can also be expressed as follows:

$$N = k \times \overline{n}, \tag{6}$$

where $\overline{n}$ is the average number of enterprises in the sectors.

In this case, formula (4) will look as follows:

$$HHI = \frac{1}{\left(k\overline{n}\right)^2}\sum_{i=1}^{k}\left(n_i\right)^2. \tag{7}$$

Another indicator reflecting changes in concentration was proposed (Lauraéus & Kaivooja, 2017):

$$LKI = \frac{\sigma^2}{k\overline{n}^2}, \tag{8}$$

where σ^2 is the standard deviation.

Considering that the value of the standard deviation is equal to $\left(k-1\right)\overline{n}^2$, the final formula for estimating the variations in concentration was obtained:

$$LKI = \frac{\sigma^2}{\left(k-1\right)\overline{n}^2}. \tag{9}$$

In accordance with the methodology set out, Lithuania's industrial structure as well as trends in export and import developments for the years 2015–2020 were determined.

3. Results

Based on the methodology set out above, an analysis of changes and trends in the structure of Lithuanian exports and imports was carried out. The original data were extracted from the United Nations and Statzon databases. 96 Lithuanian industrial sectors were analysed. Structural changes and trends in 2015–2020 were determined on the basis of formulas (7) and (9), i.e., the Herfindahl-Hirschman index HHI as well as the LPI index. The results of the calculations are shown graphically in Figure 1.

Figure 1 shows that the value of the HHI index decreased over the reference period. This means that the structure of both exports and imports has been diversified, which suggests that the trend of change has been advanced. This can be seen as a result of the successful implementation of the strategy for the development of national markets and smart specialization.

Based on the Herfindahl-Hirschman index, the annual changes in the Lithuanian export and import concentration were also analysed (Figure 2).

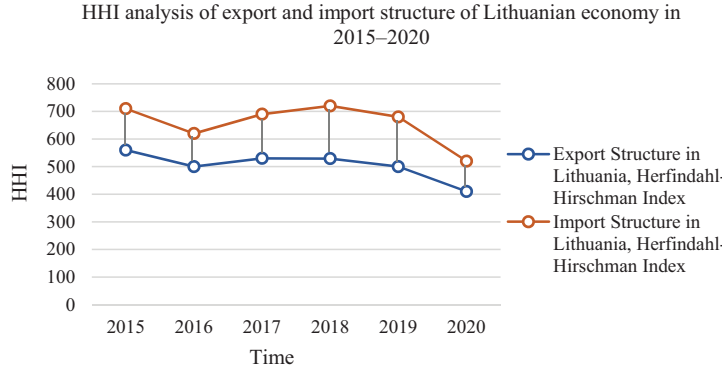

Figure 1. Changes in the Lithuanian export and import concentration for the period 2015–2020 (source: United Nations 2021//UN Comtrade Database 2021 and Statzon, 2021)

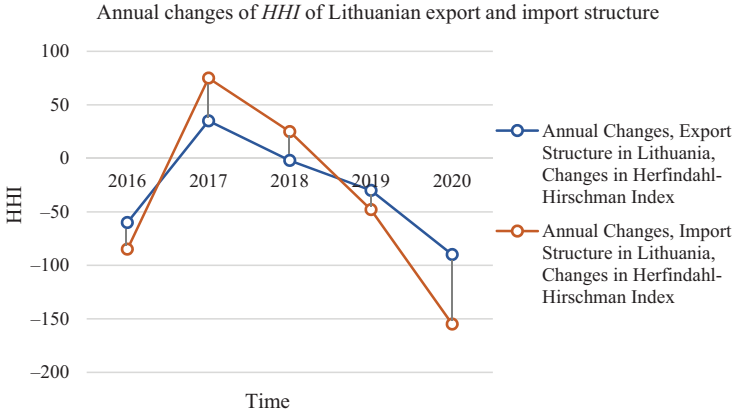

Figure 2. Annual changes in the Lithuanian export and import concentration for the period 2016–2020 (source: United Nations 2021/UN Comtrade Database 2021 and Statzon, 2021)

Figure 2 shows that the changes in Lithuania's export and import concentration, starting from 2016, have become positive, i.e., they have shifted towards a growing diversification of the industrial structure. This reflects the growing diversity of both exports and imports, i.e., positive trends.

Changes in Lithuania's export and import portfolio took place in the period 2015–2020 and were also analysed based on the *LPI* index (Figures 3 and 4).

Figures 3 and 4 show that both exports and imports have a low level of concentration. The growth of market diversity is common to all industrial sectors. When comparing the export and import markets, the former are more diversified than the latter. Figure 3 also shows that the value of the *LPI* index for exports decreased from 0.047 in 2015 to 0.03 in 2020. This means that Lithuania's exports have become increasingly diversified in the period 2015–2020, which proves the increased economic resilience of these markets.

Figure 4 also shows that the value of the *LPI* index for imports decreased from 0.06 in 2015 to 0.032 in 2020. This again means that Lithuanian imports during the period 2015–2020

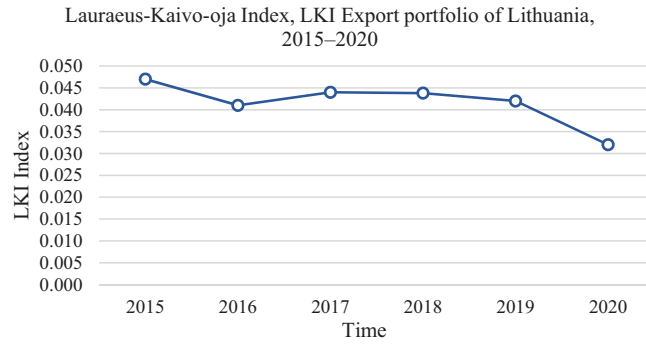

Figure 3. Changes in Lithuanian export concentration during the period 2015–2020 (source: Statzon 2021/United Nations 2021/UN Comtrade Database 2021)

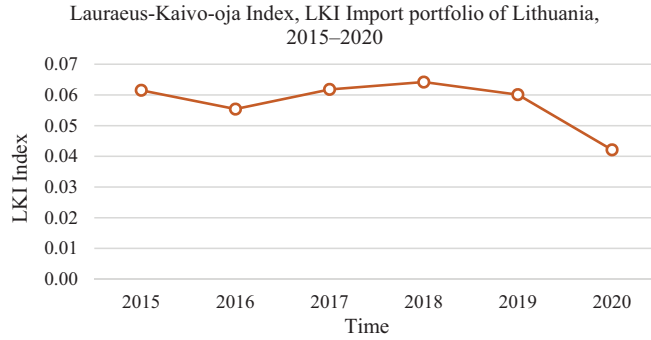

Figure 4. Changes in import volumes in Lithuania for the period 2015–2020 (source: Statzon 2021/United Nations 2021/UN Comtrade Database 2021, https://comtrade.un.org)

have also became increasingly diversified, which is evidenced by the qualitative development of Lithuania's internal markets.

Conclusions

Exports are an important part of the country's international trade. In Lithuania, it reaches over 1 billion Euros a month. Its development remains important because it improves the trade and the current account balance – as exports grow, money "flows" from abroad to the country, not vice versa. The main feature of exports is that it increases the competitiveness of the country. In a market economy, it is an important condition for economic development. This development is also influenced by the state of imports; thus, it is important to analyse and evaluate the factors contributing to the country's competitiveness exports and imports.

The state of the country's exports and imports is reflected in the degree of competition between the markets. It can be determined based on the Herfindahl-Hirschman and *LKI* indices. They consider not only the number of production sectors in question, but also their relative weighting their structure.

To adequately reflect the evolution of export and import concentrations of domestic industries, changes that have occurred over a certain period, i.e., trends in changes, need to be reflected. The values calculated for the Herfindahl-Hirschman and LCI indices showed that the situation improved over the period 2015–2020, as the level of both export and import concentration decreased. A particularly significant break occurred in 2017. This means that the structure of export and import markets has diversified, i.e., their diversity has increased, and this has increased the economic resilience of the country's national markets. It can be stated that this is the result of the successful implementation of the HS strategy.

Limitations and future lines of research

The processes of diversification of the export and import structure of a country's industries cannot take place automatically. Their scale will also depend to a large extent on the evolution of competence structure of those implementing diversification strategies. Appropriate changes must take place in science, technology, engineering, mathematics, (STEM) educational institutions. If this is not the case, the lack of competence could become crucial for the further development of industrial sectors.

Consequently, an agenda for future research focused on the development of new dynamic capabilities in the STEM education institutions of Lithuania is critically required. In general, more attention is needed to export and import structure analysis in relation to S3 strategy. Our new and novel finding was that both Lithuanian export and import portfolios have diversified in 2015–2020. This is a positive signal about new developments of the Smart Specialisation Strategy (SW3) in the Lithuanian economy, with its six key smart specialisation themes being: (1) Agricultural innovation and food technologies, (2) Energy and sustainable environment, (3) New production processes, materials and technologies, (4) Health technologies and biotechnologies, (5) Transport, logistics and ICT and (6) Inclusive and creative society. There is need to analyse these S3 priority areas in detail, but this requires new independent empirical study of export and import sectors.

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Author contributions

Arūnas Augustinaitis, Jari Kaivo-oja, and Theresa Laureus: Conceptualization (lead); writing – original draft (lead); writing (lead); review and editing (equal). Austė Kiškienė and Levan Bzhalava: Conceptualization (supporting); writing – original draft (supporting); writing (supporting); review and editing (equal). Steffen Roth: writing (supporting); review and editing (equal).

Disclosure statement

The authors declare that they have no competing financial, professional, or personal interests from other parties.

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