Trade openness, global competitiveness, and catching up between the European Union countries

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Abstract

Purpose – This study aims to establish the position of the European Union (EU-28) countries in the dynamics of international trade openness linkages and the Global Competitiveness Index (GCI) in correlation with the gross domestic product (GDP) per capita, research and development (R&D) expenditures, innovation capability and information and communication technology (ICT) adoption.

Design/methodology/approach – In the panel data set, comparative analyses were applied to scatter diagrams, correlation and regression analyses and structural equation models using Eurostat and World Economic Forum (WEF) data for the EU-28 countries in the period 2008–2019.

Findings – The empirical results did not confirm the hypotheses that a positive correlation exists between GCI and trade openness indicators and between GDP per capita and GCI. The ICT adoption and innovation capability increase GCI, which affects GDP per capita.

Practical implications – The empirical results provide a better understanding of the importance of trade policies, particularly in terms of trade openness and trade shares of the EU-28 countries, as it could contribute to increasing the GCI of the EU-28 countries. Furthermore, the results of this study underline the importance of ICT adoption and innovation capability and the need for appropriate government policies that improve global competitiveness.

Originality/value – This study, through empirical analysis, demonstrates the existence of correlations between trade openness (exports as % of GDP, imports as % of GDP and export market shares as % of world trade), R&D expenditures, innovation capability, ICT adoption, GDP per capita and the GCI in the EU-28 countries. In addition, this study contributes managerial and policy-based implications on driving forces of global competitiveness.

Keywords Global competitiveness index, International trade indicators, Trade openness, Research and development expenditures, Innovation capability, Information and communication technology adoption, Gross domestic product per capita, European Union

Paper type Research paper

1. Introduction

This article aimed to examine the European Union (EU-28) countries' position in international trade openness measures in relation to the gross domestic product (GDP) per capita to identify links with global competitiveness. As a result, the structural equation model (SEM) was developed that measures links and relationships of trade openness indicators and GDP per capita with the Global Competitiveness Index (GCI).

The globalisation of economies has contributed to rapid structural changes with increasing trade shares of a range of emerging economies (Landesmann and Stöllinger, 2019). Liberalisation promoted trade openness and has increased the global competitiveness of individual countries. Liberalisation, EU enlargement and trade openness have contributed to GDP per capita increases for the EU-28 countries (Breuss, 2018). The new EU Member States were able to increase overall trade openness.

Technology upgrading and innovation systems were positively linked with the prevailing liberalised trade regime (Radosevic, 2018, 2022). Moreover, in efficiency-driven countries, efficient macro-economic policy dealing with economic growth, inflation rate, tax rates, foreign direct investments (FDIs), trade balance, labour productivity and costs could be included among essential drivers of competitiveness (Rusu and Roman, 2018).

Trade and investment integration can improve competitiveness through two channels: first, by increasing the size of the market available to domestic firms and, second, by driving productivity and innovation by exposing firms to international competition, expertise and technology (WEF, 2016). The latter signifies smart strategy specialisation (S3), which neglects public research within entrepreneurial ecosystems and challenges the ability of S3 to reduce wide disparities in research and innovation performance across the EU countries (Švarc *et al.*, 2020).

Increasing global and macro-regional linkages at the EU level allows exports to become more intensive and competitive globally. Global competitiveness varies widely across the EU-28 countries (Marčeta and Bojnec, 2020, 2021, 2022).

EU's traditional trade openness and investment firmly underpin its economic competitiveness and resilience (European Commission, 2015). Open strategic autonomy becomes the new horizon towards which the EU trade policy is directed. It aims to balance the benefits of trade openness and competitiveness with strengthened resilience, sustainability, a more assertive stance towards unfair trade practices and rules-based cooperation (Schaus, 2021).

Global competitiveness of countries can be defined as the set of institutions, policies and factors that determine a country's level of productivity (WEF, 2009). According to the OECD (2002), a country's competitiveness is the degree to which, under free and open market conditions, it can produce goods and services that meet international market standards while maintaining and increasing the incomes of its people in the long run. The state corporate governance and export promotion programmes' role in assisting small and medium enterprises can be crucial in developing entrepreneurial ecosystems, improving export behaviour and achieving competitiveness (Coudounaris, 2018; Lukason and Vissak, 2020). Competitiveness measures a country's advantage or disadvantage in selling its products in international markets. Taylor (1984) defines it as creating an appropriate environment that enhances global competitiveness and trade openness or reduces barriers and compares one's performance with competitors.

This article contributes to theories and practices analysing the EU-28 countries' trade openness and global competitiveness measured with the GCI and their relationships with GDP per capita as a proxy for the level of economic development, ICT adoption, innovation capability and R&D expenditures. A traditional understanding of the global competitiveness

of the EU-28 countries was captured by the competitiveness factors of trade openness (exports as % of GDP and imports as % of GDP and export market share in % of world trade) and GDP per capita. The study contributes to a better understanding of the mechanisms through which digitalisation of economies, innovation capability and R&D expenditures and trade openness as a country-specific driver affect global competitiveness. We used data collected on these indicators to analyse trends in trade openness over the period 2008–2019 and to conduct correlation, regression and SEM analyses.

The rest of the article is structured as follows. The second section presents the literature review, where trade openness and global competitiveness are defined, and the concepts are introduced. The third section deals with the data and method used, while the fourth section focuses on the analyses of patterns in trade openness defined by exports as % GDP, imports as % GDP and export market shares in % world trade. The fifth section analyses the relationships between trade openness measures, ICT adoption, innovation capability, R&D expenditure, GCI and GDP per capita using scatter plots, correlation and regression analyses and SEM. The sixth section discusses the results and provides implications. The final section derives findings and conclusions.

2. Literature review

Classical trade theories emphasise the importance of trade for productivity, competitiveness and economic growth. There are a few studies on trade openness (Nannicini and Billmeier, 2011; Fuji, 2019). Different factors can explain successful competitiveness in international trade (Porter, 1990; Monteiro et al., 2017; Wang et al., 2017).

Empirical studies have shown a positive relationship between trade and economic growth, namely, that reducing trade barriers stimulates economic growth and promotes welfare (Fagerberg and Knell, 2007). Krugman (1998) argued that economic integration at the global level potentially enhances economic agglomeration, specialisation, revitalisation of production, the sale of differentiated goods and, thus, profit maximisation. Gräbner et al. (2021) pointed out that various alternatives to the label "trade openness" have been proposed, such as trade dependency ratio, trade openness index, trade share or trade ratio. Fuji (2019) also noted that, at the international level, most of the variation in trade flows was returned to changes in GDP. Njindan (2017) defined an open economy as one that displays a relatively high share of trade in total economic activity and significant interaction and linkages with the rest of the world of international competitiveness.

Therefore, the government's task is to consider trade openness and restrictions as a management tool to ensure that export market shares are accelerated and, thus, promote global competitiveness at the level of the EU-28 countries. Export market shares in % world trade are an important indicator of international competitiveness. On the other hand, a country's policy on trade restrictions leads to market closure and, thus, hinders the development of international competitiveness.

Different empirical measures of international competitiveness have been developed in the literature. Previous studies on export competitiveness have calculated indicators such as export and import market shares, export-to-import price ratios, net export market shares, price and quality competitiveness and relative comparative export, import and trade advantages (Bojnec and Fertő, 2008, 2012b; Suwannarat, 2017). At the company level, questionnaires measuring different aspects of company and branch levels competitiveness have been developed (Appendix). Based on the regression results, Rusu and Roman (2018) concluded that among crucial drivers of competitiveness in their sample of analysed countries are GDP and its growth, inflation rate, trade developments, labour productivity and costs of business start-up procedures.

Eide and Felke (2014) argued that the economic adjustment process in Portugal was strongly driven by growth in export activity. The later improvement in price competitiveness has supported the positive export trend. Pilinkiene (2016) confirmed the empirical interdependence among the triad components, that is, trade openness, economic growth and competitiveness. It has been established that economic growth leads to the improvement of trade openness, while competitiveness leads to the improvement of economic growth.

Cavallo and Frankel (2008) found that trade openness makes countries less vulnerable to crises and that the relationship is even more vital when correcting the endogeneity of trade. A country heavily integrated into world markets is more exposed to shocks from abroad. Marčeta and Bojnec (2021) noted that an essential task for the EU-28 countries is increasing the cohesion of their economies, trade openness and pursuing higher levels of competitiveness and economic growth.

Trade intensity can be associated with imperfect competition and the degree of product differentiation. It can be caused by consumer taste for variety over differentiated products and the intensity of intra-industry trade (Bernhofen, 2001). According to Foster (2008), countries can benefit from liberalisation most in the long run, but they can suffer from short-run adverse effects of liberalisation. The effects of product differentiation and changing trade costs for trade intensity are asymmetric (Gilbert et al., 2022).

Gräbner et al. (2021) suggested that technologically superior countries are likely to benefit from trade and tend to record higher de-facto openness to trade. The trade openness index should capture two dimensions: first, the share of a country's trade in its income and, second, the interaction and connectivity of the country with the rest of the world. Measures of trade openness tend to be narrow and typically use export/GDP, import/GDP or (export + import)/GDP (Squalli and Wilson, 2011). Njindan (2017) found correlations between trade openness and trade growth. Marčeta and Bojnec (2020), in the context of the EU-28 countries, correlated the WEF sub-data set and found a negative correlation coefficient between GCI and the share of import in GDP and a modest correlation coefficient between GDP per capita and the share of export in GDP. Squalli and Wilson (2011) showed that an increase in trade openness is associated with an increase in real GDP per capita growth. Coluccia et al. (2020) found that R&D elasticity is positively related to market appreciation by stakeholder investors. R&D elasticity appears stable over time at a level of 0.05; this value indicates that a firm's revenue will increase by 5% if its R&D spending increases by 1%.

Omoke and Opuala-Charles (2021) suggested that export has a significant positive impact on economic growth, while the impact of import on economic growth is negative and significant. Rodriguez and Rodrik (2001) noted that the relationship between trade openness and GDP per capita growth is still unresolved. However, trade openness is systematically and significantly related to significant differences in per capita income levels between countries (Frankel and Rose, 2002). Technology, innovation, exports and firm performance can be considered the essential factors that help manufacturing firms become more competitive. However, Radoševic (2018) observed a decline in production capabilities for most of the EU-25 economies despite, on average, significant improvements in R&D and technology capability. The latter suggests that the EU has severe weaknesses in converting its R&D and technological knowledge into production capabilities.

To summarise the previous literature, Table 1 provides several relevant studies focusing on trade openness and measurement of competitiveness in association with R&D expenditures and innovation, technology and market value indicators.

The relationship between economic growth, R&D expenditures and innovation, trade openness, market shares and competitiveness measures has attracted attention in the literature. However, far less attention has been given to innovation capability, digital technologies with ICT adoption and GCI. Our study aimed to fulfil the literature gap on the mutual relationship between GCI, innovation capability and ICT adoption in addition to the traditional trade openness, R&D expenditures and GDP per capita variables in the case of the EU-28 countries. The rise of the digital economy with ICT adoption can be considered among the essential factors that can help to become more competitive in the open global economic environment.

The main objective of our study was to investigate the evolution of the competitive position of the EU-28 countries in the world market and particularly to define the position of the EU-28 countries based on groups of international trade openness variables and their links with global competitiveness. Trade openness takes into account imports/GDP and exports/GDP. Exports market shares in world trade are becoming a key competitiveness factor that needs strengthening. We observed export market shares in world trade and GDP per capita and their links with global competitiveness. The GDP per capita of the EU-28 countries is included in the analysis to account for heterogeneity in the level of economic development among the EU Member States (Breuss, 2018; Aiginger, 2021). International trade is vital for measuring competitiveness, especially in terms of export market shares in world trade that can influence the GCI.

Based on the literature review and derived theoretical model and for the purpose of the research, we aimed to answer the following two research questions (RQs):

RQ1. Does the change in trade openness increase the EU-28 countries' global competitiveness in relation to gross domestic product per capita growth?

RQ2. What is the impact of trade openness on global competitiveness in the EU-28 countries?

We set the following two research hypotheses:

H1. There is a correlation between the indicators of international trade openness (export as % gross domestic product and import as % gross domestic product), gross domestic product per capita and global competitiveness in the EU-28 countries over the period 2008–2019.

H2. Export market shares in % world trade, innovation capability, research and development expenditures and information and communication technology adoption positively impact Global Competitiveness Index in the EU-28 countries.

Measures, contribution and main findings	Study by
Correlations between trade openness and trade growth	Njindan (2017)
Correlation coefficient between GDP per capita and the share of export in GDP	Marčeta and Bojnec (2020)
Trade openness is associated with an increase in real GDP per capita growth	Squalli and Wilson (2011
Export has a significant positive impact on economic growth	Omoke and Opuala-Charles (2021)
Contribution of trade openness on economic growth and competitiveness	Pilinkiene (2016)
R&D effect on market (the firm revenue) of R&D to economic growth and productivity at the firm level	Coluccia et al. (2020)
Source: Compiled by authors	

Table 1.
Summary of some studies on trade openness and measures of competitiveness

3. Data sources and methodology

3.1 Data

We considered the EU-28 countries in the sample from 2008 to 2019. We aimed to establish the correlation between the GCI and the indicators of trade openness in three aspects: exports as % of GDP, imports as % of GDP and export market share in % of world trade. We calculated on the initial year constant based indices of variables: export as % of GDP, import as % GDP and export market shares in % of world trade. In addition, we included indices of WEF variables: innovation capability, ICT adoption and R&D expenditures.

GDP per capita was used as a proxy control variable for the level of economic development to consider the heterogeneity of the EU-28 countries or the differences between them.

The sources used to construct the trade openness measures (export/GDP, import/GDP and export market share in % of world trade) and real GDP per capita were Eurostat (2021) statistics. The empirical analysis of the GCI was based on data from the World Economic Forum (WEF, 2008–2019) reports for the EU-28 countries in the period 2008–2015 and 2015–2019. Data for R&D expenditures, innovation capability and ICT adoption were also obtained from WEF (2019, 2020).

3.2 Methods

The links between trade openness, GDP per capita and global competitiveness for the EU-28 countries were investigated using scatter plots, correlation analysis and linear structural equation modelling (SEM). The data were examined using constructed scatter plots, showing the dependencies between GCI and the selected indicators. The relationship between trade openness performance and global competitiveness was plotted using scatter plots, indicating a linear relationship. SPSS and AMOS software were used to analyse the data.

4. Analysis of the EU-28 countries' competitive position in the world economy

4.1 Export market shares in world trade

The EU-28 countries are major players in international trade in goods and services. In globalisation processes, export market shares are vital, as they indicate market expansion in world trade. According to Eurostat (2016), Germany has the most significant export share among the EU countries, contributing 27.1% of the EU-28 merchandise exports to non-EU countries. Additional significant export shares were contributed by the UK (13.3%), Italy (10.4%) and France (10.2%). According to Eurostat (2016), the EU-28 countries were the world's largest exporters of manufactured goods and services and the largest export market for around 80 countries.

Table 2 shows that China, the EU-28 countries and the USA were the most prominent players in world trade. In 2019, China accounted for the largest share of world exports (17.3%), followed by the EU-28 countries (15.8%), the USA (11.4%), Japan (4.9%) and Russia (3.1% in 2018).

4.2 The EU-28 countries in the context of international trade, gross domestic product per capita and the Global Competitiveness Index

Comparatively, we were interested in the relationship between GDP per capita, trade openness changes and GCI in the EU-28 countries.

4.2.1 Measures of trade openness. Different definitions are used for trade openness, such as the share of import (M) in GDP or (M/GDP), the share of exports (X) in GDP or (X/GDP)

and total trade divided by GDP: $(X + M)/GDP$. As a measure of trade openness, we used: export/GDP and import/GDP. We added an additional measure with export market share in % world trade. This was motivated by Gräbner et al. (2021).

Trade openness of the EU-28 countries has increased because of the integration policy or common market and globalisation processes. As a result, export market share growth is evident, particularly in the newly acceded EU countries. So the EU-28 countries have boosted trade openness and export market shares (Table 3).

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
European Union-28	16.1	16.8	15.5	15.5	15.1	15.8	15.5	15.6	16.0	15.8	15.6	15.8
Russia	3.9	3.3	3.4	3.7	3.7	3.6	3.4	2.7	2.5	2.8	3.1	–
The USA	10.9	11.6	11.1	10.6	10.8	10.8	11.1	11.8	12.0	11.5	11.3	11.4
Brazil	1.7	1.7	1.7	1.8	1.7	1.7	1.5	1.5	1.5	1.6	1.6	1.6
China	12.0	13.2	13.7	13.6	14.3	15.1	16.0	17.9	17.3	16.9	16.9	17.3
Japan	6.6	6.4	6.7	5.9	5.6	4.9	4.7	4.9	5.3	5.2	5.0	4.9
India	1.5	1.9	1.9	2.2	2.0	2.3	2.2	2.1	2.1	2.2	2.2	2.2

Source: Author's calculations based on Eurostat (2019)

Table 2.
Export market
shares in % of the
world market

Country	Export/GDP 2008–2015 and 2015–2019		Import/GDP 2008–2015 and 2015–2019		Export market share (%) 2008–2015 and 2015–2019	
Belgium	96	105	95	106	81	104
Bulgaria	122	100	87	97	100	120
Czechia	128	92	123	91	94	106
Denmark	102	106	96	106	81	105
Germany	107	99	104	104	89	99
Estonia	116	95	104	94	100	113
Ireland	145	105	123	133	141	121
Greece	138	125	92	126	71	110
Spain	131	104	101	104	89	104
France	109	103	106	104	87	99
Croatia	127	112	99	113	85	118
Italy	110	107	97	106	78	100
Cyprus	140	103	107	108	100	100
Latvia	153	100	119	99	114	100
Lithuania	119	113	101	103	93	131
Luxembourg	118	94	120	92	122	105
Hungary	110	94	101	100	81	106
Malta	104	91	96	86	114	100
The Netherlands	118	100	123	97	87	102
Austria	100	105	101	106	80	104
Poland	130	113	107	109	107	121
Portugal	130	107	98	108	93	110
Romania	158	98	108	106	121	117
Slovenia	116	109	101	109	84	113
Slovakia	115	100	109	103	93	103
Finland	79	112	87	110	59	113
Sweden	89	109	92	109	80	100
The UK	101	114	98	113	94	80

Source: Authors' calculations based on Eurostat (2021)

Table 3.
Indices of trade
openness (export/
gross domestic
product, import/
gross domestic
product and export
market share) by the
EU-28 countries,
2008–2019

Between 2008 and 2019, the increases in exports/GDP, import/GDP and export market share in world trade have been observed in most of the EU-28 countries. Exports/GDP has increased, particularly in Baltic and South-Eastern EU countries. Trade of the EU-28 countries has increased because of the enlargement. During the same period, import/GDP increased rapidly in most EU-28 countries.

4.2.2 Global Competitiveness Index. The GCI (WEF, 2020) is the most widely applied competitiveness index. Recently, WEF introduced a series of methodological improvements to revise and extend the basic methodology. As a result, the GCI score with the latest WEF (2018, 2019) releases ranges from 1 to 100. It used to range from 1 to 7.

The GCI shows an increasing trend in global competitiveness for most of the EU-28 countries, particularly for newer EU Member States, in the period 2008–2019 (Table 4). The best-placed countries in 2019 were The Netherlands, the UK, Sweden and Germany, followed by Denmark, Finland, France, Luxembourg and Austria.

4.2.3 Export as % of gross domestic product, import as % of gross domestic product and Global Competitiveness Index. Trade performance of the EU-28 countries was calculated as the share of exports (imports) of goods and services in GDP and represents trade openness in integration or globalisation processes. We wanted to assess the correlation between trade openness and GCI from 2008 to 2019, specifically from 2008 to 2015 and from 2015 to 2019.

4.2.3.1 Export/gross domestic product and Global Competitiveness Index. The export performance of the EU-28 Member States was illustrated by a scatter plot showing the correlation between exports/GDP and GCI. Figures 1(a) and 1(b) show the distributions between the exports as % GDP and GCI. The grouping of countries is visible, with no country standing out. The most effective economies with higher values than 120 are typical for some Eastern EU countries – Lithuania, Latvia, Poland, Czechia and Romania – and the Mediterranean countries – Greece, Spain, Portugal and Cyprus. The more open South-Eastern EU countries are less competitive than the North-Western EU countries, which have a higher GCI. On the other hand, declines in exports as % GDP are observed in some Nordic countries, for example, Sweden and Finland, but there is an increase for Ireland.

The relationship between exports as % of GDP and the GCI shows the positions of individual EU-28 countries and their high dispersion. Sweden, Finland, the UK, Netherlands and Germany are highlighted as the larger group with the highest GCI despite lower export/GDP increases. Thus, an increase in export/GDP does not necessarily increase GCI.

Between 2008 and 2015, exports/GDP grew mainly in the new Member States, for example, Romania, by more than 50%. From 2015 to 2019, the gap between the centre and the periphery has narrowed considerably, mainly because of declines in the index for some newest EU Member States, such as Czechia, Malta, Hungary and Estonia.

According to Eurostat (2021), the UK had the lowest exports as a % of GDP (31.1%), and Luxembourg had the highest one (208.8%), while the EU-28 countries' share was 49.5%. The higher shares also had The Netherlands (83.3), Slovenia (83.7%), Slovakia (92.4%), Ireland (126.1%) and Malta (143.3%).

4.2.3.2 Import/gross domestic product and Global Competitiveness Index. Figures 2(a) and 2(b) show the distribution of the import/GDP and GCI in the EU-28 countries from 2008 to 2019, specifically from 2008 to 2015 and from 2015 to 2019.

Figure 2(a) shows mixed results by the EU-28 countries for the import/GDP growth between 2008 and 2015. The Netherlands, Luxembourg, Ireland, Czechia and Latvia experienced increases. At the same time, The Netherlands experienced relatively high GCI, like Germany.

Figure 2(b) presents the relationship distribution between import/GDP and GCI in the EU-28 countries from 2015 to 2019. The increase in import/GDP is relatively high for Ireland
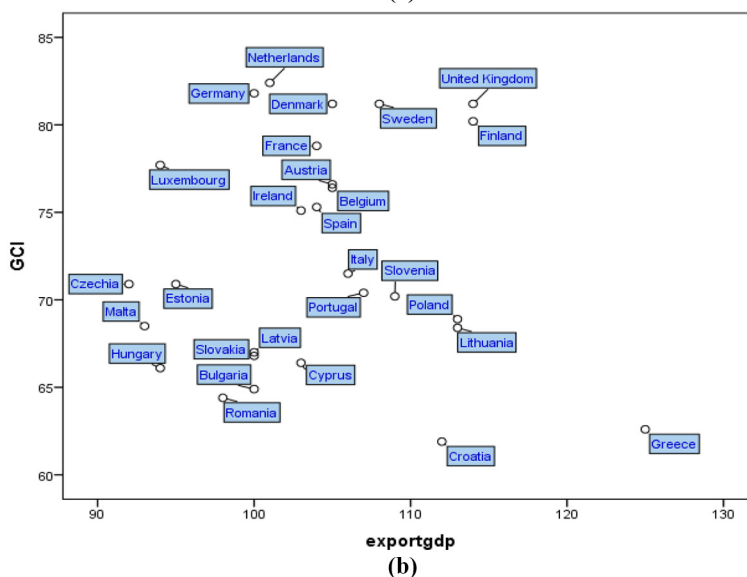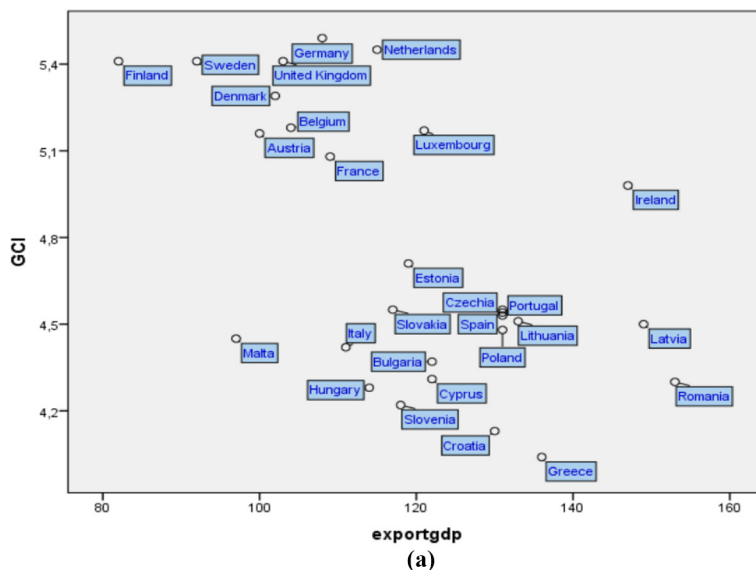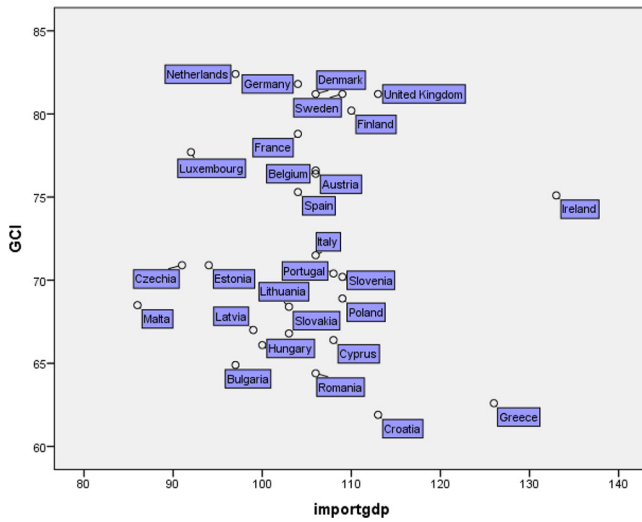
Notes: Exports of goods and services index as % of gross domestic product
shows the observed position of each country as a value between 90 and 130. If
a country's value is close to 130, then the country is more open, (a) Export/
gross domestic product and Global Competitiveness Index (2008–2015);
(b) Export/gross domestic product and Global Competitiveness Index
(2015–2019)

(a)
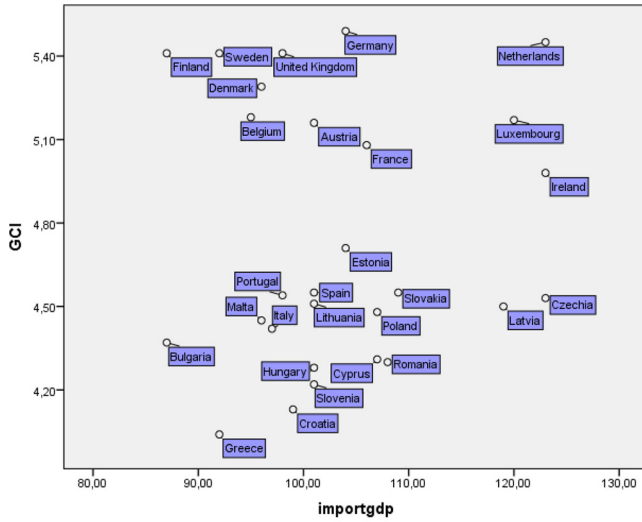
(b)

Notes: Import of goods and services index as % gross domestic
product shows the observed position of each country as a value
between 80 and 140. If a country's value is close to 140, then the
country is more open, (a) Import/gross domestic product and
Global Competitiveness Index (2008–2015); (b) Import/gross
domestic product and Global Competitiveness Index (2015–2019)

and Greece but less for the newest EU Member States. The Netherlands, Germany, Denmark, Sweden, the UK and Finland are the larger group with the highest GCI.

4.2.4 Export market shares as % of world trade and Global Competitiveness Index. Export market shares as % of world trade is an essential indicator of market expansion in world trade and measures a country's degree of importance within the world's total exports (Eurostat, 2021). Export market share was calculated by dividing the country's export by the world's total exports (expressed in %). The aim was to analyse and compare the EU-28 countries in terms of export market shares in world trade and GCI from 2008 to 2019, specifically from 2008 to 2015 and from 2015 to 2019.

Figure 3(a) depicts the scatter diagram showing the relationship between the GCI and the export market shares as % of world trade of the EU-28 countries from 2008 to 2015. We can identify two clusters of closely related export market shares for older in the upper part and predominantly newer EU Member states in the lower part of Figures 3(a) and 3(b) from 2015 to 2019. The main exception in the lower part with lower GCI is Greece from 2008 to 2015. While there are observed gaps between the oldest North-Western EU countries and the newest South-Eastern EU countries, we can see a pattern toward a convergency.

4.2.5 Gross domestic product per capita and Global Competitiveness Index. The aim was to compare the index of GDP per capita and GCI. GDP per capita approximates the level of economic development and living standards. Therefore, we calculated the index of GDP per capita using real GDP per capita (index based on constant volume in 2010 euro).

Figure 4(a) shows the scatterplot matrix for the index of GDP per capita and GCI from 2008 to 2015. We can see a correlation between the indicators with two main clusters: developed, old EU Member States and others. The lowest index of GDP per capita and GCI were recorded in some Southern EU countries such as Greece, Cyprus and Italy.

Figure 4(b) represents the relation between the index of GDP per capita and GCI from 2015 to 2019 and shows that countries with a lower or a medium change in GDP per capita have had a higher GCI: The Netherlands, Germany, Denmark, Sweden and the UK. On the other hand, countries with a medium or more significant change in GDP per capita had a lower GCI. The latter relates to a group of new EU Member States, except Greece and Portugal.

4.2.6 Innovation capability. Innovation policies aim to stimulate firms' R&D activities while overlooking that R&D is not the only source of innovation (Radoševic, 2018). Innovation is significantly associated with significant R&D investments to create new products and offer better production and distribution methods (Loo, 2018). A cross-sectoral innovation platform can create a symbiosis between university, business and local communities that manage innovation activities and technologies to increase competitiveness (Gjelsvik, 2018).

4.2.7 Information and communication technology adoption. This indicator refers to mobile-cellular telephone subscriptions per 100 population. Broadband availability and ICT adoption can be essential for competitiveness, economic growth (Bojnec and Fertő, 2012a) and international trade (Bojnec and Fertő, 2009, 2010). However, Marčeta and Bojnec (2020) found that correlation coefficients between GCI and selected ICT variables were very low with GCI in the years 2014–2017: users of mobile telephone lines 0.22 and the internet have a very low correlation (0.12).

5. Correlation and regression analyses and structural equation model
The empirical analysis was based on data from Eurostat and the WEF reports for the EU-28 countries. Correlation and regression analyses provide insights into the relationships and associations between GCI and trade openness (export market share), innovation capability, R&D expenditures, ICT adoption and GDP per capita.
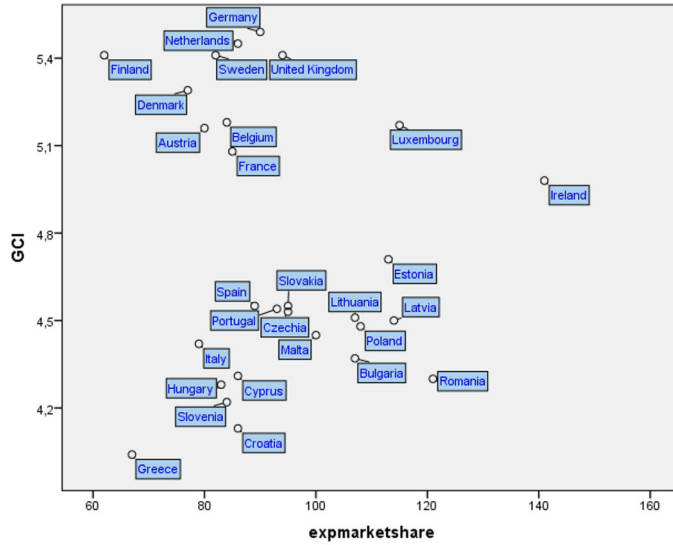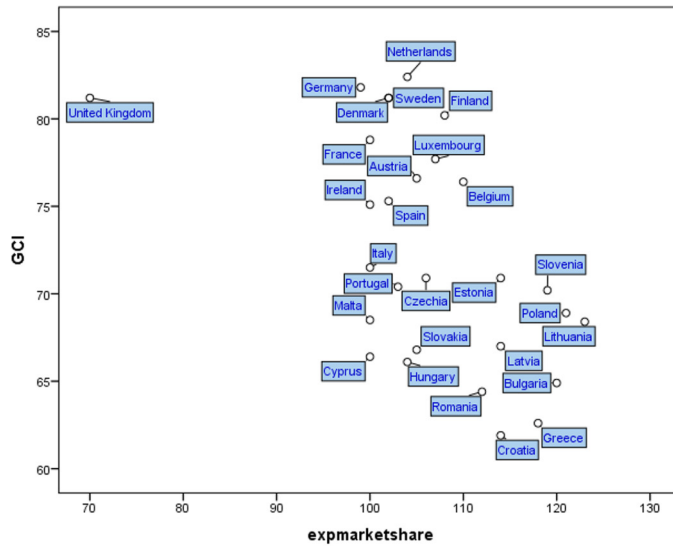
(a)

(b)

Notes: (a) Export market share and Global Competitiveness Index
(2008–2015); (b) export market share and Global
Competitiveness Index (2015–2019)
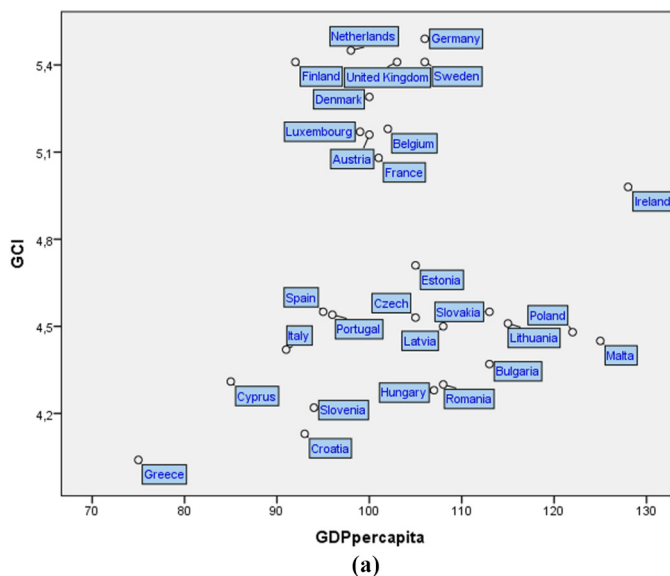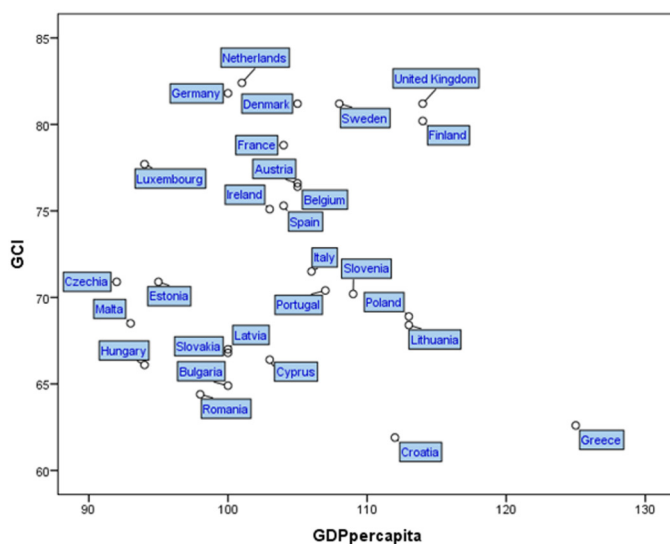
Notes: (a) Gross domestic product per capita and Global
Competitiveness Index (2008–2015); (b) gross domestic product
per capita and Global Competitiveness Index (2015–2019)

5.1 Correlation analysis

The correlation coefficients between trade openness measures, GDP per capita, innovation capability, R&D expenditures, ICT adoption and GCI show the negative correlation coefficients for GCI with export/GDP (−0.451) and GDP per capita (−0.179) (Table 5). Therefore, export as % of GDP and GDP per capita are less likely to enhance GCI, which is enhanced by positive and statistically significant correlation coefficients for innovation capability (0.976), ICT adoption (0.959) and R&D expenditures (0.831). A relatively low positive correlation was also found between GCI and import as % of GDP (0.084) and a modest correlation between GCI and export market share (0.450).

The hypothesis *H1* cannot be confirmed because there was a negative correlation of the GCI with export as % of GDP and GDP per capita in the EU-28 countries from 2008 to 2019.

5.2 Regression analysis

The adjusted $R^2 = 0.985$ shows the adequacy of the regression model, and the *p*-value of *F*-test significance = 0.000 confirms the significance of variables and the measurement model fits.

Country	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014– 2015	2015/ 2016	2017/ 2018	2018/ 2019	2019/ 2020
Austria	5.23	5.13	5.09	5.14	5.22	5.15	5.16	5.2	5.2	5.1	76.6
Belgium	5.14	5.09	5.07	5.20	5.21	5.13	5.18	5.3	5.2	5.2	70.4
Bulgaria	4.03	4.02	4.13	4.16	4.27	4.31	4.37	4.4	4.5	5.2	64.9
Croatia	4.22	4.03	4.04	4.08	4.04	4.13	4.13	4.1	4.2	5.2	61.9
Cyprus	4.53	4.57	4.50	4.36	4.32	4.30	4.31	4.0	4.3	4.4	66.4
Czechia	4.62	4.67	4.57	4.52	4.51	4.43	4.53	4.7	4.8	4.5	70.9
Denmark	5.58	5.46	5.32	5.40	5.29	5.18	5.29	5.3	5.4	4.1	81.2
Estonia	4.67	4.56	4.61	4.62	4.64	4.65	4.71	4.8	4.8	4.2	70.9
France	5.50	5.43	5.37	5.47	5.55	5.54	5.50	5.2	5.2	4.3	78.8
Finland	5.22	5.13	5.14	5.14	5.11	5.05	5.08	5.5	5.5	4.3	80.2
Germany	5.46	5.37	5.39	5.41	5.48	5.51	5.49	5.6	5.7	4.5	80.8
Greece	4.11	4.04	3.99	3.92	3.86	3.93	4.04	4.0	4.0	4.8	62.6
Hungary	4.22	4.22	4.33	4.36	4.30	4.25	4.28	4.2	4.3	5.3	66.1
Ireland	4.99	4.84	4.74	4.77	4.91	4.92	4.98	5.2	5.2	5.4	75.1
Italy	4.35	4.31	4.37	4.43	4.46	4.41	4.42	4.5	4.5	4.7	71.5
Luxembourg	4.26	4.06	4.14	4.24	4.35	4.40	4.50	5.2	5.2	4.8	77.7
Latvia	4.45	4.30	4.38	4.41	4.41	4.41	4.51	4.4	4.4	5.5	67.0
Lithuania	4.85	4.96	5.05	5.03	5.09	5.09	5.17	4.6	4.6	5.5	68.4
Malta	4.31	4.30	4.34	4.33	4.41	4.50	4.45	4.5	4.6	5.1	68.5
Netherlands	5.41	5.32	5.33	5.41	5.50	5.42	5.45	5.6	5.7	5.2	82.4
Poland	4.28	4.33	4.51	4.46	4.46	4.46	4.48	4.6	4.6	5.5	68.9
Portugal	4.47	4.40	4.38	4.40	4.40	4.40	4.54	4.5	4.6	5.7	70.4
Romania	4.10	4.11	4.16	4.08	4.07	4.13	4.30	4.3	4.3	4.0	64.4
Slovakia	4.40	4.31	4.25	4.19	4.14	4.10	4.15	4.3	4.3	4.0	66.8
Slovenia	4.50	4.55	4.42	4.30	4.34	4.25	4.22	4.4	4.5	4.3	70.2
Spain	4.72	4.59	4.49	4.54	4.60	4.57	4.55	4.6	4.7	4.3	75.3
Sweden	5.53	5.51	5.56	5.61	5.53	5.48	5.41	5.5	5.5	5.0	81.2
The UK	5.30	5.19	5.25	5.39	5.45	5.37	5.41	5.4	5.5	5.2	81.2

Table 4.
Global Competitiveness Index for the EU-28 countries

Source: WEF, 2008/2009, 2009/2010, 2010/2011, 2011/2012, 2012/2013, 2013/2014, 2014/2015, 2015/2016, 2016/2017, 2017/2018, 2018/2019 and 2019/2020

The regression coefficients show mixed results (Table 6). The regression coefficients for trade openness indicators are statistically insignificant. On the other hand, three regression coefficients are statistically significant at 1%: innovation capability, R&D expenditures (but with a negative sign of the regression coefficient) and ICT adoption. Therefore, the set *H2* is only partly confirmed. However, it can be rejected when considering only trade openness indicators.

5.3 Structural equation model

The SEM was tested by presenting a model of the GCI of the EU-28 countries grouped based on the indices of exports as a share of GDP in %, imports as a share of GDP in %, exports market shares in (%) of world trade, GDP per capita and GCI (Table 7). Indices of all variables were calculated for the two sub-periods, 2008–2015 and 2015–2019.

The SEM fits the data reasonably well for all groups combined (Normed Fit Index [NFI] = 0.809; Incremental Fit Index [IFI] = 0.830; and Comparative Fit Index [CFI] = 0.810 which is lower and, therefore, minimum acceptable). A value close to 0.95 reflects a good fit. Tucker–Lewis's coefficient is 0.050, and the Root Mean Square Error of Approximation is 0.339, which is higher than 0.05, and the model does not fit well, but it is acceptable. It is higher than 0.08. The SEM can be accepted for all structures, but the SEM differs in parameter estimates, predictions and strength of association for import/GDP (0.15), export/GDP (−0.73) and export market share (0.75). The SEM is accepted based on the results. The independence model value of less than 0.05 indicates a good fit for the model. Relation is significant, (PCLOSE), *p*-value is < 0.05.

We conclude that the measurement model fits well.

Based on this, we proceed to verify this model.

Figure 5 explains the relationship between each variable and the GCI. It can, therefore, help identify future challenges for the EU-28 countries in terms of achieving global competitiveness. Export market shares in % of world trade have the highest impact on GCI (0.75), negatively associated with export/GDP (−0.73), but the value is significant.

The set *H2* that exports as % of GDP and export market shares in % of world trade positively impact global competitiveness in the EU-28 countries can be partially confirmed. However, by using the SEM analysis, we have shown that variables of trade openness have mixed impacts on GCI.

6. Discussion and policy implications

We examined the GCI position of the EU-28 countries in the relationships with key indicators of trade openness, innovation capability, R&D expenditures, ICT adoption and GDP per capita. This research provided new insights on trade openness and global competitiveness from panel data using correlation, regression and SEM approaches within a framework of the EU-28 countries, which after Brexit or after the UK leaves the EU in 2020 consists of the EU-27 countries.

The findings can represent essential support for the profession on the existence of linear links between innovation capability, R&D expenditures, ICT adoption and level of economic development or GDP per capita and GCI, with striking findings on largely insignificant or non-linear links between trade openness and GCI. The latter can be explained by imperfect competition and intra-industry trade. Bourdon *et al.* (2018) pointed out a non-linear pattern between trade openness and GDP growth when export quality is considered: trade may negatively impact GDP growth when countries specialise in low-quality products. Higher quality of diversified export products is also needed for international competitiveness (Vissak *et al.*, 2018). Improving export quality could ensure higher economic growth and global competitiveness, a process and efforts towards improving innovation capability in an

Country	GCI	GDP per capita	Import/GDP	Export/GDP	Export share	Innovation capability	R&D expenditures	ICT adoption
Pearson correlation coefficients								
GCI	1							
GDP per capita	0.380	1						
Import/GDP	0.084	0.213	1					
Export/GDP	−0.451	−0.179	0.437	1				
Export share	0.450	0.717	0.465	0.225	1			
Innovation capability	0.976	0.290	0.097	−0.427	0.386	1		
R&D expenditures	0.831	0.149	0.102	−0.327	0.282	0.911	1	
ICT adoption	0.959	0.352	0.017	−0.551	0.396	0.922	0.771	1
Significance (1-tailed)								
GCI	.							
GDP per capita	0.002	.						
Import/GDP	0.269	0.058	.					
Export/GDP	0	0.093	0	.				
Export share	0	0	0	0.048	.			
Innovation capability	0	0.015	0.239	0.001	0.002	.		
R&D expenditures	0	0.136	0.227	0.007	0.018	0	.	
ICT adoption	0	0.004	0.450	0	0.001	0	0	.

Source: Authors' calculations based on Eurostat (2020) and WEF (2020)

Table 5.
Correlation matrix

| Country | Unstandardised coefficients | | Standardised coefficients | t | Significance | 95.0% confidence interval for B | | Collinearity statistics | |
	B	Standard error	Beta			Lower bound	Upper bound	Tolerance	VIF
Constant	−34.467	11.969		−2.88	0.006	−58.532	−10.402		
GDP per capita	0.190	0.103	0.057	1.845	0.071	−0.017	0.397	0.294	3.40
Import/GDP	−0.070	0.072	−0.020	−0.978	0.333	−0.215	0.074	0.646	1.55
Export/GDP	0.097	0.072	0.045	1.361	0.180	−0.047	0.241	0.258	3.88
Export share	0.013	0.086	0.006	0.146	0.884	−0.160	0.185	0.190	5.27
Innovation capability	1.015	0.087	0.878	11.627	0.00	0.839	1.190	0.049	20.56
R&D expenditures	−0.221	0.052	−0.197	−4.289	0.00	−0.325	−0.117	0.132	7.60
ICT adoption	0.320	0.081	0.304	5.303	0.00	0.268	0.595	0.085	11.81

Notes: Dependent variable: GCI. The number of observations = 56 based on the average change indices for the years in the two periods 2008–2015 and 2015–2019

Table 6.
Regression
coefficients

internationally open environment (Choi and Cho, 2021). Aiginger (2021) argued for setting strategic objectives with global perspectives.

Ketels and Porter (2021) found Europe's sluggish performance to be driven by a failure to adjust the EU's policy approach to fundamental changes in global competitiveness and economic challenges. However, improving export quality could ensure higher economic growth and global competitiveness with practical innovation and technology development.

The analysis carried out was limited only to some aspects of the trade openness measures, and it can be expanded on some additional measures such as the role of FDIs (Frenkel *et al.,* 2004; Vujanović *et al.,* 2021; Götz and Jankowska, 2022). The different correlations between variables of trade openness and GCI are essential for a better understanding of the economic research dimension of trade openness for policymakers, among others, to support innovation and high technology export. The latter is supported by our regression results on the importance of innovation capability and ICT adoption to increase GCI. In addition to policy relevance, these

RMSEA				
Model	*RMSEA*	*LO 90*	*HI 90*	*PCLOSE*
Default model	0.339	0.217	0.476	0.000
Independence model	0.348	0.291	0.407	0.000
Model fit	*NFI*	*RFI*	*IFI*	*TLI*	*CFI*
	Delta1	*rho1*	*Delta2*	*rho2*	
Default model	0.809	0.044	0.830	0.050	0.810
Saturated model	1.000		1.000		1.000
Independence model	0.000	0.000	0.000	0.000	0.000

Source: Authors' calculation

Table 7.
Goodness-of-fit measures for the structural equation model
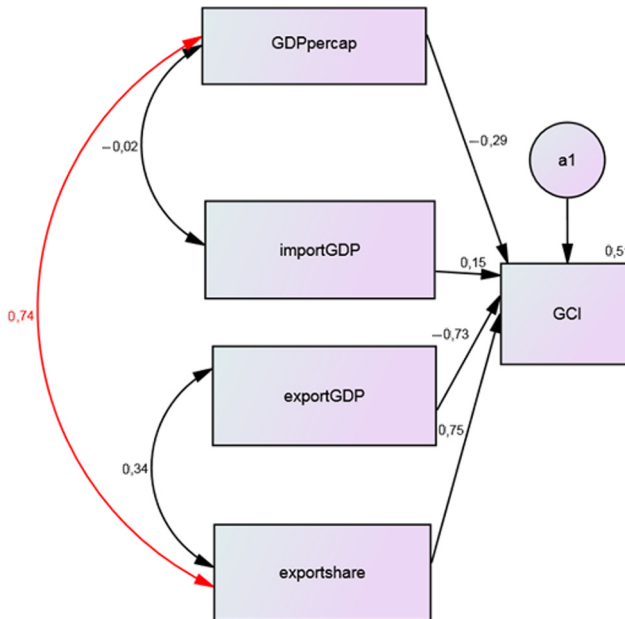
Figure 5.
Model linkages between trade openness measures, gross domestic product per capita and Global Competitiveness Index

results would be interesting for managers and practices. Managers could provide incentives to improve innovation performance through already used strategies and measures for ICT adoption and consequently to improve business activities. There is a need for appropriate government policies that improve global competitiveness as the challenging issue at micro-managerial and practical levels. The empirical results highlight the importance of innovation capabilities and ICT adoption that can benefit public and managerial practice and improve quality of life and knowledge-based lifelong learning society.

7. Conclusion

This article has analysed drivers of global competitiveness in the context of the EU-28 countries in the years 2008–2019. It contributes to a better understanding of global competitiveness assessment and comparative analysis of international trade openness measured by export/GDP, import/GDP and export market shares as % of world trade. It builds from previous research limited to exports and imports intensity and competitiveness. However, we have demonstrated a link between trade openness, innovation capability, R&D expenditures, ICT adoption, GDP per capita and global competitiveness GCI indicator. We point out a linear pattern of the GCI with innovation capability, R&D expenditures and ICT adoption. Trade openness may negatively impact GCI and can be linked to non-linear patterns in intra-industry development.

Trade openness and export market shares in world trade can be necessary for exporting firms to achieve strategic objectives. The GDP per capita of the EU-28 countries is included in the analysis to account for heterogeneity because the EU Member States vary considerably in terms of GDP per capita (Breuss, 2018; Aiginger, 2021). The EU-28 countries have progressed in export competitiveness, especially the new EU Member States. In addition to trade openness, their catching-up process with older EU Member States can play an essential role in innovation capability and ICT adoption to increase GCI as a possible driver for economic growth and economic development.

The set *H1* regarding the correlation between trade openness indicators (export as % of GDP, import as % of GDP and export market share) and global competitiveness cannot be confirmed. Instead, this could be linked to possible structural changes and more significant instabilities in international markets, which have increased in recent years.

The set *H2* that exports as % of GDP and export market shares in world trade, innovation capability, R&D expenditures and ICT adoption positively impact global competitiveness in the context of the EU-28 countries; this *H2* is partly confirmed. GCI's positive and significant association is confirmed with innovation capability and ICT adoption.

Traditional trade openness indicators only partly determine global competitiveness in the EU-28 context. Therefore, future studies should include other explanatory variables such as human capital, technology, FDI and innovation and financial system variables. Finally, an issue for further research is the impact of Brexit on the EU-27 and the UK's global competitiveness and future enlargements of the EU-27 Member States.

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Appendix

The measurement items
Technological capabilities (Knight and Cavusgil, 2004).

In a major export market, compared to your major competitors, please evaluate your firm in each of the following areas (1 = strongly disagree and 7 = strongly agree):

- Our firm is at the leading technological edge of our industry in this market.
- We invented a lot of the technology embedded in this product.

- Compared with local competitors, we're often the first to introduce product innovations or new operating approaches.
- We are recognized in our main export market for products that are technologically superior.

Marketing capabilities (McKee *et al.*, 1992; Knight and Cavusgil, 2004)

In a major export market, compared to your major competitors, please evaluate your firm in each of the following areas (1 = strongly disagree and 7 = strongly agree):

- Our firm has a wide knowledge of customers and competitors.
- Our firm's advertising is effective.
- Our firm's ability to use marketing tools (product design, pricing, advertising, etc.) to differentiate our products is competitive.
- Our firm's pricing strategies are effective.

Export performance (Cavusgil and Zou 1994; Keh *et al.*, 2007)

Please indicate the extent to which your firm has achieved in the following areas in your major export market over the past three years (1 = strongly disagree and 7 = strongly agree):

- We have achieved the goal of sales growth.
- We have achieved the goal of market share.
- We have achieved the goal of profitability.
- We have gained a foothold in the targeted foreign market.
- We have built a global leadership position in our industry.
- We have improved the awareness of our company.
- We have improved the image of our company.
- We have improved the awareness of our product.
- We have improved the image of our product.

Competitive *intensity* (Cadogan *et al.*, 2006)

Please evaluate your major export market in each of the following areas (1 = strongly disagree and 7 = strongly agree):

- Competition in our export market is cut-throat.
- There are many promotion wars in our export market.
- Anything that one competitor can offer others can match easily.
- Price competition is a hallmark of our export market.

Product type

What are your firm's main export items?

Brand ownership

Does your firm export with its own brand when exporting overseas?

- Yes
- No

Target country's economic development level

Please select one of the following three overseas markets that your firm is most focused on.

- Developed countries
- Newly developed countries
- Developing countries

714

About the authors

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