

Internationalization, research expenditures and ICT exports in the EU

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Abstract: The ICT sector belongs among the most dynamic and innovative branches of economy. This study aims to focus on the ICT sector in the internationalization process in the European Union, in line with our earlier research on this topic. Our analysis employs GERD and BERD as key indicators of high value-added exports. To capture the output indicator of internationalization, we considered the ICT share of total exports. Two hypotheses were tested: (H1) the higher share of GERD positively correlates with ICT export volumes of goods and services within the EU and (H2) the higher share of BERD positively correlates with ICT export volumes of goods and services within the EU. The overall aim of the paper is to determine whether rising R&D expenditures contribute to greater internationalization via ICT exports within the EU.

Keywords: *BERD, EU, export volumes, GERD, internationalization*

1. Introduction

The process of international expansion of enterprises and rising export volumes from developed countries has been analyzed more intensively since the 1990s, when the scope of international activities at many enterprises grew significantly. In the past two decades, the ICT sector has been part of by far the largest R&D-investing sector in advanced economies, including the EU (European Commission, 2011; OECD, 2022). Its role became even more pronounced during the COVID-19 pandemic, when various ICT technologies helped society to combat lockdowns and mitigate the impact of various restrictions (Plăcintă *et al.*, 2022). Due to the absence of physical barriers (Canarella and Miller, 2018; Baldwin and Forslid, 2020), ICT exports could be smoothly transferred across borders. These factors can further boost the internationalization trend. We identified a research gap in the study of the relationship between research expenditures and ICT exports, especially when applied to EU Member States. Despite decades of European integration, the countries still display different socioeconomic characteristics stemming from previous historical development.

The article focuses on business expenditures in R&D (BERD) on ICT, representing the micro level and R&D gross expenditures (GERD), representing the macro level. We consider the ICT share of total exports an output indicator of R&D activities to determine the high value-added production and export volumes. The analysis is carried out in the EU Member States using data extracted from the Eurostat and UNCTAD databases.

We test the following hypotheses:

H1: The higher share of GERD positively correlates with ICT export volumes of goods and services within the EU.

H2: The higher share of BERD positively correlates with ICT export volumes of goods and services within the EU.

The authors' aim is to determine whether rising R&D expenditures contribute to greater internationalization of EU Member States via ICT exports.

For comparative purposes, we divided the EU Member States into Old Member States (EU-15) and New Member States (NMS). Additionally, we applied the EU's macro-regional division based on the social models of Dølvik and Martin (2014) for a more exact description of the EU's heterogeneity.

2. Literature review

There are many approaches to internationalization in literature. According to Beamish (1990), it is “a process in which companies enhance awareness of the impact of international transactions on their future”. Welch and Loustarinen (1993) define internationalization as a process of “growing a company’s participation in international operations”.

Internationalization research has focused on its various aspects (e.g., Porter, 1998; Dunning and Lundan, 2008; Love and Ganotakis, 2013; Wadeson, 2020 or Fernandes *et al.*, 2020), ranging from the internationalization process after the bipolar division, considering the globalization influx, the growing dynamics of international trade in goods, rising international competitiveness and institutional aspects to “born globals” and impact on SMEs.

The R&D impact on further economic indicators has traditionally been analyzed within two broad groups of theories. While the first group focuses on the concept and measurement of capital, the second includes research and development models (so-called R&D models). The R&D models (see, e.g., Romer, 1990 or Grossman and Helpman, 1991; 2021) are based on microeconomic analysis and incentives for research and development.

When considering innovation and international trade, there are two main approaches in literature. The first includes models focusing on factor endowment (Porter, 1990; Davis, 1995) such as labor force and capital equipment, which in later studies transformed into human capital and knowledge. The second consists of technology-based models (starting with Posner, 1961; Vernon, 1966 or Krugman, 1979) based on competitive advantages in the form of technology gaps or the degree of maturity of the technology. Given the field of our analysis, the later models are more familiar to us.

ICT is analyzed in the literature from multiple perspectives. It ranges from GPT or general purpose technology (Guerrieri *et al.*, 2010; Plăcintă *et al.*, 2022) to a segment of international trade (Hagsten and Kotnik, 2016; Ipsmiller and Dikova, 2021) or to impacts on income distribution (Nevado-Peña *et al.*, 2019; Cioacă *et al.*, 2020). ICT is one of the outputs of R&D activities, it determines export volumes and contributes to the internationalization of businesses and economies.

According to OECD (2022), ICT products “must either be intended to fulfill the function of information processing and communication by electronic means, including transmission and display, or use electronic processing to detect, measure and/or record physical phenomena, or to control a physical process”. However, this sector interferes in both branches of international trade—trade in goods and trade in services—as described in more detail in the methodology section.

The ICT industry has introduced innovation also in non-ICT industries and services, making it an important contribution to the economic growth of advanced economies (De Prato *et al.*, 2011; EU, 2022). In 2021, the share of high-tech and medium high-tech exports was about 57% of the total EU export capacity (European Commission, 2022). The ICT sector is currently an integral part of high-tech exports (Coad and Vezzani, 2017; OECD, 2023).

The scope of research papers analyzing the link between BERD and ICT exports is relatively small and focuses only on several EU geographic hubs, mainly located in the EU-15. Nunes *et al.* (2012) and Karahan (2017) demonstrated a causal link between business enterprise R&D intensity and the share of high and medium-high manufacturing, including the ICT sector. Further research papers focus on the nexus in various EU regions. As Koski *et al.* (2002) have concluded, one cluster of ICT activities and larger BERD investment is located between London through Germany to Northern Italy (generally known as “the great central banana” in the literature). Other hubs were located in the Helsinki and Stockholm metropolitan areas.

Lindmark *et al.* (2010) found that the EU lags behind the US in BERD in ICT sector, emphasizing the weaker presence of EU companies in the sector. Furthermore, they confirmed virtually identical European BERD hubs in ICT to those identified by Koski *et al.* (2002) a decade earlier. Next to states such as the UK, Germany and France, there is another hub in Northern Europe (Sweden, Finland and the Netherlands). All the hubs are in EU-15, which confirms its position as the EU’s innovation and technology leader.

These findings are in line with an analysis by Piekkola (2018), who concludes that the majority of business R&D is concentrated mainly in the greater Helsinki area and few in other Finnish regions. The link between business R&D and export performance was confirmed Carboni and Medda (2020) for manufacturing firms in seven West-European countries. Sandu and Ciocanel (2014) found a positive correlation between R&D volumes (BERD and GERD) investment in EU states, although in the same cases, the nexus

deviated from the general outcome. Vlčková and Stuchlíková (2023) analyzed the relationship between GERD expenditures and higher technological specialization in Germany between 1988 and 2021 and concluded that GERD and technological specialization negatively affect exports.

Several studies focus on ICT in the New Member States. Plăcintă *et al.* (2021) analyzed the impact of BERD on several indicators in the Central and South-East European region but found no positive correlation between BERD and economic output. In contrast, Lengyel (2012) analyzed the ICT sector in the CEE region with an impact on Hungary and found a positive correlation.

The literature analyzing the direct impact of GERD and ICT exports aims at prevalingly high-tech exports, same as in case of BERD. Already in the 1990s, the nexus between R&D and high-level technology trade was confirmed (Grupp, 1995). The role of intellectual property (IP) rights is in general considered for the output of R&D activities (e.g., OECD, 2018; De Prato *et al.*, 2011; EU, 2022).

Kabaklarli *et al.* (2018) showed a significant positive impact of IPR on high-tech exports in 14 OECD countries, including many EU-15 Member States. Bayar *et al.* (2020) concluded the link for the transition countries for the period 2000–2016 emphasizing the role of IP rights in the process. The positive correlation between GERD and high-tech exports for the European countries was concluded by Srholec (2005), Seyoum (2010), Guravsar *et al.* (2010), Kittová and Steinhauser (2020) and Pelikánová (2023).

The literature further identifies the main European hubs of ICT activities. These hubs are clustered in the “great central banana”, historically a backbone of European manufacturing production, and in Scandinavian countries. From this perspective, the NMS still lag behind their Western counterparts. These findings about the uneven geographical distribution of ICT activities will be incorporated in the calculations presented in the following section of the paper.

3. Methodology

For our analysis, we extracted data from the databases of Eurostat (BERD and GERD indicators) and UNCTAD (for the shares of ICT exports in total exports of goods and services) from the period 2009–2020. ICT goods exports are based on the World Customs Organization Harmonized System (HS), which provides the definition of ICT products. In line with our previous articles (Potužáková and Öhm, 2018; 2020), we incorporated a two-year time lag to ensure the comparability of the results with previous studies on internationalization.

The input indicators are gross expenditures on R&D representing both the macro level, business expenditure on R&D and the micro level. The output indicators are the shares of ICT exports in the total exports of goods and services. Both also belong among the main indicators in accordance with the *Frascati Manual* (OECD, 2015) for using the R&D statistics for international comparison. GERD focuses on the overall expenditure on research and development, whereas BERD measures business expenditure. With rising requirements on high-value added production and innovations, the additional source to state has become crucial for R&D investment (WorldBank, 2023; NIFU, 2016). Both indicators consider OECD (2023) for the main science and technology indicators measuring the competitiveness of national economies.

The analysis was carried out in EU Member States, including the UK. Beyond the West (EU-15) and East (NMS) division, the EU macro-regions division based on the social models of Esping-Andersen (1990), Sapir (2006) as well as Dølvik and Martin (2014) was applied to better analyze the heterogeneity of the Member States.

The *Anglo-Saxon model* (Great Britain and Ireland) is characterized by a low level of government intervention, a decisive role of the market and the concept of a minimal state. The *Continental model* (Austria, Germany, France, Belgium, Luxembourg and the Netherlands) is based on the basic idea that preventing social problems is more effective than addressing them. The objective of such a model is a high level of social protection and employment. The *Scandinavian model* (Finland, Sweden and Denmark) is characterized by egalitarian tendencies and high redistribution of a system which can only be financed through high employment. The *Southern European* or the *Mediterranean model* (Spain, Italy, Greece, Portugal, Malta

and Cyprus) is defined by higher income inequality, and social systems do not reach the parameters prevalent in most of the original EU countries. The problem is strict legislation to protect workers' rights, creating rigidity in the labor market. The *post-communist* or the so-called *Central European model* (the Czech Republic, Slovakia, Poland, Hungary and Slovenia) and the *Baltic model* (Estonia, Lithuania and Latvia) take on the elements of the continental and liberal model with regard to its time of origin. The Central European model is closer to the continental model, while the Baltic model is predominantly liberal. The *Balkan model* (Romania, Bulgaria and Croatia) combines the liberal model regarding the mutual investments with the Mediterranean in terms of distribution.

Trade statistics divide the ICT sector into three groups: (1) information technology equipment (computers and related hardware), (2) communications equipment and (3) software (OECD, 2023). In services, international trade is divided among three sectors as well: (1) telecommunication services, (2) IT consulting and related services and (3) programming and related services (Cattaneo *et al.*, 2010; OECD, 2018).

In this article, we test the hypotheses that the higher share of BERD and the higher share of GERD positively correlate with ICT export volumes goods and services of the EU Member States. The aim is to determine if rising R&D expenditures contribute to the strengthening of internationalization of the EU Member States via exports.

The initial investigation was carried out using correlation analysis. The correlation coefficients were presented in a simple table showing the estimated Pearson's correlation coefficient. Statistically significant coefficients are shown in red. The second sequence was a regression analysis where the parameters of the linear model were estimated by the ordinary least squares (OLS) method. The fit of the model was assessed by a standard F-test, which corresponds to the decomposition of the variability of the dependent variable into model and residual variables.

The sub-parameters were tested by t-tests, with the significance of the model's guidelines also considered as a test of the significance of the correlation coefficient, which was taken as a guide in the interpretation to determine the strength and direction of any dependence. A complementary Durbin-Watson test was designed to detect possible autocorrelation of the residuals. As mentioned above, the final set of methods resulted from our previous articles. First, the Koyck's model was used to test the delay and

determine the analyzed lag, but its results did not differ significantly from the mentioned methods (mostly OLS regression); for this reason, it was omitted from further stages of research. Therefore, standard correlation matrices were applied, which enabled us to compare the delays across the study period.

4. Results and discussion

The results of the analyses are very compelling. With the lag analyzed, some of the subsets studied displayed a statistically significant dependence. This is then consistent in most cases in the context of other calculations, but there are also some non-significant and unexpected results that deserve further investigation. The level of significance for all analyses was set at 5%, but in many cases the tests were much stronger and met the 1% alpha value (the so-called Type I error).

The first round of analyses examined the linear dependence of the above data on R&D expenditures and exports in the sample of countries studied. Our primary expectation, also based on previous research, was that there is a time lag of two to three years before a significant effect in economy. From the data obtained, correlation matrices were generated that show the outputs of the dependence analysis at different points in time (this avoids the problem of autocorrelation, as it is a local comparison), allowing the detection of statistically significant effects.

With a view to explore the data in further detail, the breakdown of the data by geographic units was important for the research objective. This allowed testing the hypotheses about the different approaches of the states or units in which they are grouped due to their geopolitical or socioeconomic similarities.

The tables below summarize the results. The first factor, GERD expenditures, showed no statistically significant dependence, either during a single period or a single possible lag. Thus, there was no statistically significant correlation between the variables. The effect of spending was not demonstrated on either the goods (Table 1, column 'whole') or services (Table 2, column 'whole') shares. However, in some subsets we recognized very suspicious values which may warrant further research with larger samples.

Table 1. The GERD correlation to goods in 2020 (whole dataset, western/eastern/northern/southern subsets).

Variable	Correlations (database)				
	Marked correlations are significant at $p < .05000$ N = 22 (nw = 14; ne = 8; nn = 18; ns = 4); counts vary over years due to incomplete data				
	goods2020 (whole)	goods2020 (west)	goods2020 (east)	goods2020 (north)	goods2020 (south)
gerd2009	-0.367522	0.045003	-0.236617	-0.522591	-0.214114
gerd2010	-0.352897	0.042363	-0.260682	-0.522342	-0.262360
gerd2011	-0.296437	0.085542	-0.250492	-0.489155	-0.283576
gerd2012	-0.258788	0.111743	-0.209809	-0.455419	-0.379892
gerd2013	-0.242023	0.170538	-0.176796	-0.436039	-0.451127
gerd2014	-0.236198	0.159189	-0.120392	-0.431418	-0.466138
gerd2015	-0.220892	0.125107	-0.049062	-0.409389	-0.521988
gerd2016	-0.294299	0.125412	-0.118540	-0.454737	-0.357971
gerd2017	-0.257675	0.146785	0.006101	-0.415030	-0.141207
gerd2018	-0.240447	0.105387	0.028417	-0.399648	-0.110342
gerd2019	-0.251342	0.099030	-0.040983	-0.413388	0.107950
gerd2020	-0.258858	0.091481	-0.081164	-0.403250	0.817760

The West–East division was further deepened and the socioeconomic models applied. The Scandinavian, Anglo-Saxon, Continental and Southern models were grouped under EU-15 and the Central European, Baltic and Balkan models under NMS to better monitor the heterogeneity. To our surprise, we found no relevant results when comparing EU-15 and NMS (with the highest correlation coefficient reaching approximately 0.36 and the lowest p-value approximately 0.20).

Table 2. The GERD correlation to services in 2020 (whole dataset, western/eastern/northern/southern subsets).

Variable	Correlations (database)				
	Marked correlations are significant at $p < .05000$ N = 22 ($n_w = 14$; $n_e = 8$; $n_n = 18$; $n_s = 4$); counts vary over years due to incomplete data				
	services2020 (whole)	services2020 (west)	services2020 (east)	services2020 (north)	services2020 (south)
gerd2009	0.315025	0.362544	-0.019324	0.235701	0.862013
gerd2010	0.316856	0.355351	0.053453	0.225683	0.884298
gerd2011	0.285872	0.318717	0.118570	0.174460	0.895501
gerd2012	0.249781	0.266923	0.149704	0.122367	0.914825

Variable	Correlations (database)				
	Marked correlations are significant at $p < .05000$ N = 22 ($n_w = 14$; $n_e = 8$; $n_n = 18$; $n_s = 4$); counts vary over years due to incomplete data				
	services2020 (whole)	services2020 (west)	services2020 (east)	services2020 (north)	services2020 (south)
gerd2013	0.220839	0.231271	0.138753	0.090847	0.912916
gerd2014	0.190197	0.187129	0.233228	0.055114	0.862779
gerd2015	0.069649	0.038992	0.191081	-0.079850	0.800848
gerd2016	0.041276	0.001957	0.073926	-0.080100	0.668623
gerd2017	0.038727	0.000799	0.047358	-0.084047	0.468450
gerd2018	0.005735	-0.034260	-0.021915	-0.126954	0.351886
gerd2019	0.003324	-0.036370	-0.027485	-0.128758	0.115015
gerd2020	-0.029065	-0.077682	-0.058920	-0.148353	-0.272224

To identify more similarities and differences, we divided the EU into North (Scandinavian, Anglo-Saxon, Continental, Central European and Baltic) and South (Southern and Balkan model). Especially Southern countries potentially correlate in 2020 with goods for the same year. The potential correlation with services would be more interesting. The figures show strongly decreasing correlation coefficients with decreasing lag (from approximately 0.9 at an 11-year lag to 0.1 at a 1-year lag). This again confirms that a two- to three-year potential lag is insignificant. The general problem with this subset lies in its very low amount of data ($n = 4$) due to incomplete Balkan statistics which practically renders all figures insignificant. Statistically significant linkages can be observed for the whole Northern bloc. It is noticeable that the significance is approved only in relation to the goods sector and only in the Northern cluster of states. Thus, it is important to further analyze this dependence throughout the years and possible gaps. The following Table 3 highlights the results for the rest of the analyzed period (note that for 2009 to 2012 there is no significant correlation).

Table 3. The correlation matrix of GERD and goods share over time.

goods2012	goods2013	goods2014	goods2015	goods2016	goods2017	goods2018	goods2019
-0.429688	-0.500650	-0.534322	-0.588246	-0.567228	-0.564229	-0.529439	-0.511052
-0.428153	-0.492010	-0.520087	-0.576757	-0.558161	-0.560755	-0.528557	-0.515008
-0.396869	-0.450801	-0.466553	-0.528736	-0.509821	-0.535112	-0.501807	-0.499208
-0.370139	-0.423194	-0.444209	-0.507009	-0.496392	-0.506712	-0.466336	-0.461306
-0.357318	-0.419850	-0.452650	-0.512139	-0.506298	-0.496063	-0.447879	-0.433433
-0.368213	-0.430031	-0.463368	-0.517656	-0.519703	-0.494194	-0.441100	-0.425450
-0.319613	-0.372761	-0.404876	-0.463260	-0.480063	-0.449091	-0.400135	-0.403310
-0.376368	-0.429641	-0.463088	-0.517232	-0.529206	-0.501557	-0.452375	-0.447820

goods2012	goods2013	goods2014	goods2015	goods2016	goods2017	goods2018	goods2019
-0.337879	-0.393548	-0.430162	-0.482969	-0.494906	-0.465865	-0.415404	-0.407738
-0.325625	-0.384767	-0.421957	-0.472699	-0.494213	-0.466816	-0.408767	-0.400075
-0.342628	-0.397795	-0.430234	-0.481421	-0.501402	-0.482446	-0.426413	-0.418804
-0.329694	-0.382898	-0.414613	-0.486490	-0.488442	-0.472451	-0.418624	-0.412702

The second input indicator, BERD, shows very similar results. There is no statistically significant relationship across years (the highest correlation coefficient is 0.40 while p-value is about 0.07). For BERD, the situation is even more insignificant across the North–South and West–East divisions of the EU. However, a closer examination of the data and its significance suggests that the statistical significance is mainly influenced by the limited number of observations that has led to a higher requirement for the value of the sample correlation coefficient.

Many factors can explain the insignificance of the BERD indicator. A basic comparison of the BERD and the GERD data shows that the share of business investment (BERD) is in general lower than the share of government investment (GERD) in all EU Member States. Regionally, higher proportions of private investment (even relatively) are evident in more advanced Northern and Western countries. However, some individual countries show an increasing trend in BERD in ICT over time (Estonia or France), others show a decreasing trend (Spain or Slovenia), and we also found countries without a significant trend (UK). This can make evaluating such a small sample of data difficult. If additional data are obtained, it will be interesting to construct models that consider not only the regional but also the time-series effects.

Nevertheless, governments across the EU may mandate businesses to spend more to substitute for the government investment in R&D. Especially with the rising pressures on fiscal budgets related to future challenges such as energy transformation, population aging or defence, it will be more complicated for governments to allocate resources to R&D, despite its necessity.

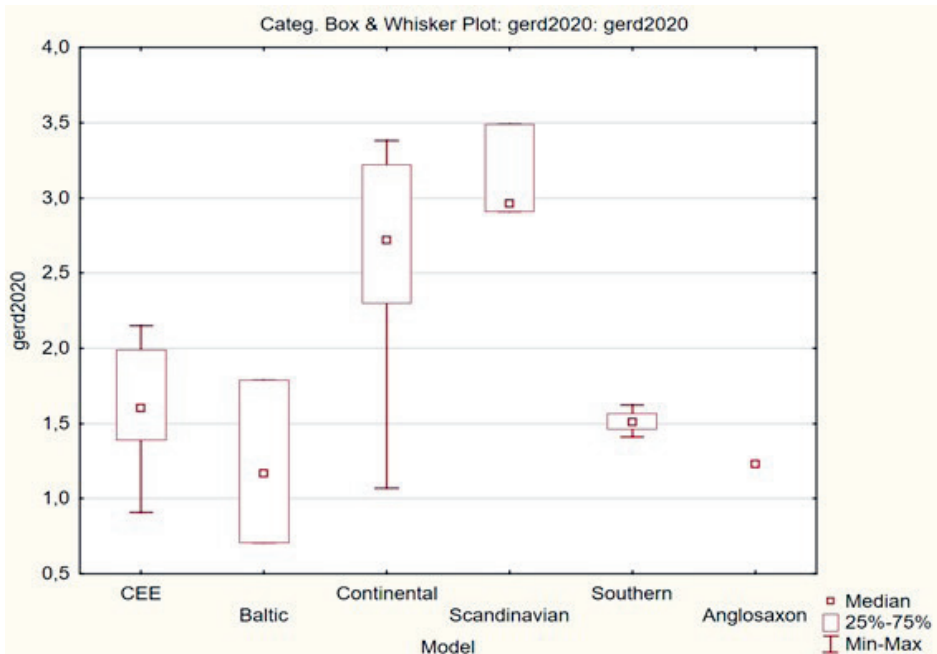
The results therefore invite a reflection on the overall interpretation. Two issues stand out for the future. First, the results of previous research, which indicated a lag of two to three years, now appear to be no longer valid and the lag seems to be lengthening. Alternatively, there may be a distortion of the relationship based on other major events (e.g., the COVID-19 pandemic) or the overall addition of other possible factors related to the degree of interconnectedness or disconnectedness between the countries. Second, is there a natural dividing line that groups together countries with similar outcomes?

The second large round of analyses addressed the diversity of the models. A box plot showing the basic descriptive statistics for each model in a graphical comparison provides a basic comparative view.

A deeper analysis is provided by variance decomposition, using the one-factor ANOVA method. Figure 1 presents the verification of the assumption of homoskedasticity using Levene's test of the agreement of variances. Its purpose is not only to confirm the appropriateness of the overall method, but also to link the results to previous findings. The nature of the matching of variances within groups of states can be inferred from the trends of divergence or convergence of the model units. For example, in 2020, the Levene's test of variance homogeneity reached the p-value only of 0.0856 which means the divergence is still very low.

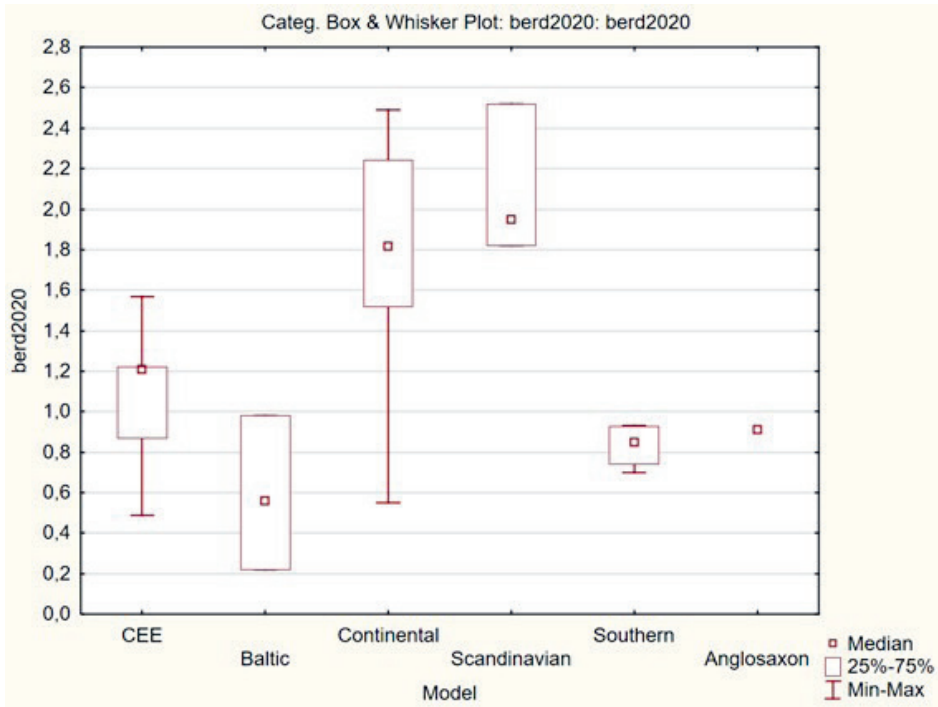
The main results of the variance analysis mainly point to trend-related issues. The findings from our previous papers are confirmed, with a slight decrease in significance for GERD expenditures. This difference is minimal and remains in the order of tenths of a percent. The heterogeneity of all models is still very significant (e.g., p-value of 0.0035 in 2020).

Figure 1. Diversity of models for GERD 2020.



For BERD, while the situation is equally significant, there is no clear trend. However, there are significant differences in investment by countries in this area. There is no temporal trend, but there are statistically significant differences. The share of BERD spending (Figure 2) shows the opposite trend to GERD. Here, the significance levels strengthen over time. While in 2012, the dependence is significant, although a 2% significance level was needed, in 2021, the test was very strong and even a tenth of a per mille significance was sufficient.

Figure 2. Diversity of models for BERD 2020.



Thus, we can see the differences and similarities in the individual indicators of R&D spending and their evolution over time, but overall, and most importantly, there are still significant differences across country models.

5. Conclusion

The ICT sector belongs among the most dynamic and innovative branches of national economies. It enables the shift to higher value-added production and supports further internationalization via exports. We assumed that R&D investments are therefore interconnected with ICT exports. The aim of the paper was to determine whether rising R&D (concretely GERD and BERD) expenditures contribute to the rising internationalization of the EU via the growth of ICT exports. To approve or disapprove these statements we tested two hypotheses: (1) the higher share of GERD positively correlates with ICT export volumes of goods and services within the EU and (2) the higher share of BERD positively correlates with ICT export volumes of goods and services within the EU.

The first hypothesis (H1) can be approved only partially. There was a significant association only in the area of GERD expenditures and only for the Northern countries for ICT exports in goods. This link is strong mainly for the years 2015–2017. In the years 2018–2020, the strength of the link declined, possibly reflecting the declining effect of globalization or deglobalization in this period, which is in line with the findings of Sullivan (2019). Those trends had emerged already before the COVID-19 pandemic in 2020–2021, which strongly influenced global trade volumes (UNCTAD, 2023).

Surprisingly, there was no significant dependence in the division of Western and Eastern cluster. However, we have approved the significant factor of GERD in the Northern area over some years (2013–2020) in the sector of goods. The potential of the Southern area is dubious as we lack some important data from the Balkan states. This leaves space for further research based on larger subsets.

Moreover, we discovered some unexpected outcomes. The geographical distinction of West–East does not reflect the current reality in our research field. Instead, the EU's North and South division appeared to be a new trend. The New Member States, especially Central European States, followed by the Baltic States, are in the situation where the GERD and BERD patterns resemble those of Northern and Continental states. Their impact is more likely to be in the more developed North. Conversely, the efficiency of R&D investments in the Southern and Balkan states is either insignificant or the vector of results is oriented in a different direction. We can observe the beginning of the new division of the EU Member States diverging from the traditional one.

To conclude, the states or social models with lower R&D expenditures can achieve relatively satisfactory ICT export performance. In other words, the same financial amount invested into the R&D can deliver various outputs. This is good news for the EU Member States with below-average economic output.

To our surprise, the GERD (overall R&D expenditure including state expenditure) still played a more dominant role than BERD, associated with the private sector, in the observed period.

This effectiveness and the dominant role of the state in research expenditure should be therefore implemented into the assessment of the R&D policies. Policymakers should monitor not only the input indicators such as BERD or GERD but also the volume of ICT and high-tech exports alongside other output indicators of intellectual property.

To summarize, we can confirm only the first hypothesis (H1) and only partially, not completely across all the EU areas and social models. We reject the second hypothesis (H2) with BERD factor even in its subset analyses.

Based on our calculations, in certain social models, the rising GERD expenditures indeed contribute to greater internationalization of the EU Member States via ICT exports. However, the other effects of the ICT exports also deepen divergences within the EU through varying export volumes across the analyzed social models.

Future research will examine the effects of national research policies and the divergence or convergence of the particular social models.

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Data Availability Statement: As mentioned in the methodology section, all data used in this article were extracted from the datasets of Eurostat (BERD and GERD indicators) and UNCTAD (shares of ICT exports on total exports of goods and services) for the years 2009–2020. No other data sources were employed.

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