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Digital Coalition

The ICT sector in the Three Seas Initiative countries as a regional driver of growth

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2 Three Seas Initiative countries

Austria and Estonia – have favourable conditions for employing IT specialists and are ahead of the EU average in this respect

3

number of DESI categories in which Three Seas Initiative countries are narrowing the gap with the leading country in the EU (out of 4)

17,4 STEM graduates

per 1000 inhabitants in the Three Seas Initiative countries (the EU average is 21.9)

4.7% of GDP

in the TSI countries — share of value added created in the ICT sector in 2020

1.64 million

people employed in the ICT sector in the TSI countries in 2020

USD 73 billion

value added of the ICT sector in the Three Seas region

USD 154 billion

total value of exports of ICT goods and services by the TSI countries in 2021

EUR 160 billion

estimated value of necessary investments in digital infrastructure in the countries of the region by 2030

5.5%

share of exports of ICT services from TSI countries in global trade in IT services

11.4%

share of the total value generated by the ICT sector in the Czech Republic in 2020, including direct, indirect and induced impact

Key findings

- **The twelve countries in the Three Seas Initiative (TSI) region have the ambition and opportunities to develop economically by strengthening the IT sector.** However, they are a very diverse group and the scope of cooperation in the region (when it comes to implementing digital projects) is limited. While there is shortage of digital leaders, the region's potential manifests itself in how it is attracting a growing number of investments in the area of software and IT services, for instance. Both the Three Seas Initiative region and the IT sector are also very resilient and stable, with growth despite the pandemic and the war in Ukraine.

- **Apart from Estonia, the TSI countries are not leaders when it comes to digital development, measured using the DESI, but the distance from the leader has been narrowing over the years.** This convergence is taking place the most rapidly in the case of digital public services. In the case of connectivity infrastructure, the distance is growing, unfortunately.

- **The TSI countries have not developed a specialisation in ICT, measured in terms of the percentage of employees.** The relatively low percentage of ICT specialists among employees and of STEM graduates among all graduates points to potential difficulties when it comes to changing this situation. A positive signal is the growing scale of investments in intangible assets (at least in some countries in the region) and the constant FDI inflows, including in key areas (inclusion in the global semiconductor production chain through the investment in Poland announced by Intel).

- **The ICT sector in the TSI countries is characterised by a rapid pace of development. This is visible in the permanent increase in the share of value added in GDP, new jobs, and the dynamics of international trade.** The main specialisation in the production of ICT goods are electronic components (59%) and telecommunications equipment (20%), while services are dominated by programming, consultancy and related services (54%) and telecommunications (28%). Exports of ICT goods are based on computers and peripheral equipment (33%), telecommunications (31%) and consumer electronics (24%), while foreign sales of ICT services are dominated by computer services (81%). The ICT sector is also characterised by strong internal ties in the TSI countries. **In the Czech Republic, over 11% of domestic production is linked to demand in the ICT sector; in Poland, this is 8.5%.**

- **The increase in trade in the ICT sector, both in gross and value added terms, means that the TSI countries' economies have been effectively integrated into the mechanisms of international division of labour and the functioning of global value chains.** This is the result of FDI inflows. At the same time, their economies face the challenge of increasing the share of domestic value added in exports, moving downwards in the structure of global value chains, and improving mutual cooperation to upgrade ICT goods with advanced technology and unique competences, and thereby boost their competitiveness.

- **The implementation of tasks within global value chains characteristic of sub-supplier economies makes the cooperation between the TSI economies in the ICT sector relatively weak.** In 2018, the TSI region's share in foreign demand of domestic value added generated in the ICT goods and services sector amounted to 10.3% and 15.7%, respectively, while Germany remained its main recipient (17.3% and 16.2%).

- The countries in the region have established formal cooperation and supported the regional investment fund's activities with around USD 1 billion, but the total investment needs in the digital area alone amount to around USD 160 billion. The strengthening of cooperation and taking advantage of the difficult circumstances linked to the war in Ukraine is an opportunity for the region. Cybersecurity is an area where solid foundations have been laid.

Introduction

With a combined population of around 110 million, the twelve countries in the Three Seas Initiative (TSI) account for 14.4% of the European Union's GDP. Like the rate of economic growth, which is above the EU average, this value is constantly growing and almost corresponds to the size of the French economy. In the coming years, this region could become even more important, with development driven by closer regional cooperation, digitisation and the development of the ICT sector.

The ICT sector is playing an increasingly important role in economic, social and civilisational development, generating both economic value and becoming a catalyst for the development of other industries, innovation and attracting foreign investments. Currently, the TSI countries vary greatly in terms of digital development, but the region is characterised by convergence: the gap between them and the digital leaders is narrowing. Solutions developed in the region are becoming a model for others (for example, e-government in Estonia) and the growing number of unicorns (start-ups valued at over USD 1 billion) is translating into more and more regionally and globally recognisable brands.

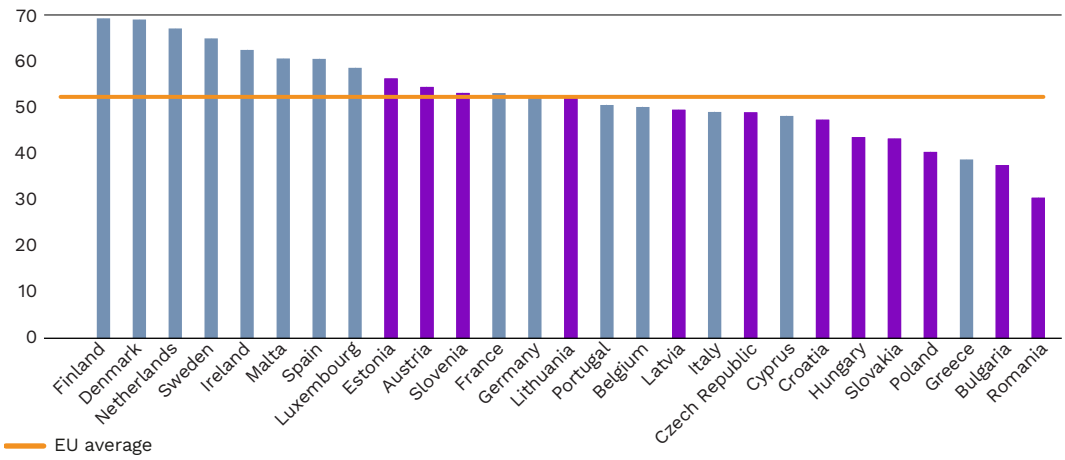
In this report, we present the state of the TSI economies' digital development and the ICT sector's role and importance in the region. The TSI region is becoming an increasingly important part of global value chains and recent events have strengthened this position. On the one hand, discussions on the nearshoring of industrial production are continuing (Ambroziak et al., 2023). On the other hand, the war in Ukraine is changing the region's perspective, directing more attention towards the situation beyond the EU's eastern border and closer cooperation with non-EU countries — Ukraine and Moldova. The report also contains examples of innovative companies from the region and support mechanisms for moving business activity there. With this comprehensive approach, it can contribute to strengthening the region's brand, global recognition, and global economic and political role.

1. Development of the ICT sector in the TSI compared to the rest of the EU

The Digital Economy and Society Index

The Threes Seas Initiative (TSI) countries vary in terms of their level of digitisation. The DESI (*Digital Economy and Society Index*, 2022), which contains data on digitisation in four categories and covers 33 indicators, shows that of the 12 TSI countries, only four (Estonia, Austria, Slovenia and Lithuania) are above the EU average. Most are in the second half of the ranking. Just one TSI country is among the EU leaders when it comes to digitisation: Estonia, which has the best-quality digital services in the public administration.

Chart 1. Countries' scores in the DESI 2022 ranking



Note: countries belonging to the Three Seas Initiative are marked in purple.

Source: prepared by PEI based on European Commission data.

The TSI countries perform best when it comes to the accessibility and quality of digital public services. Estonia has been the EU leader and role model for years, with four other countries scoring above the EU average. It is worth noting the progress of Latvia, which ranked fifth in the EU in terms of the quality of digital public services for citizens. Poland ranks first among the TSI countries and fourth in the EU in terms of data openness.

Similarly, five TSI countries (Slovenia, Austria, Lithuania, Croatia, Estonia) score above the EU average in the integration of digital technology category, which includes indicators on companies' use of digital technologies. Austria has the highest score in the TSI region in as many as four subcategories and is the EU leader when it comes to cross-border online sales. This may result from sales to neighbouring Germany, which is responsible for 29.9% of all Austrian exports; the countries share a language, which reduces service costs. Slovenia ranks second in terms of the use of ICT for environmental sustainability and is a leader in the TSI region in three subcategories.

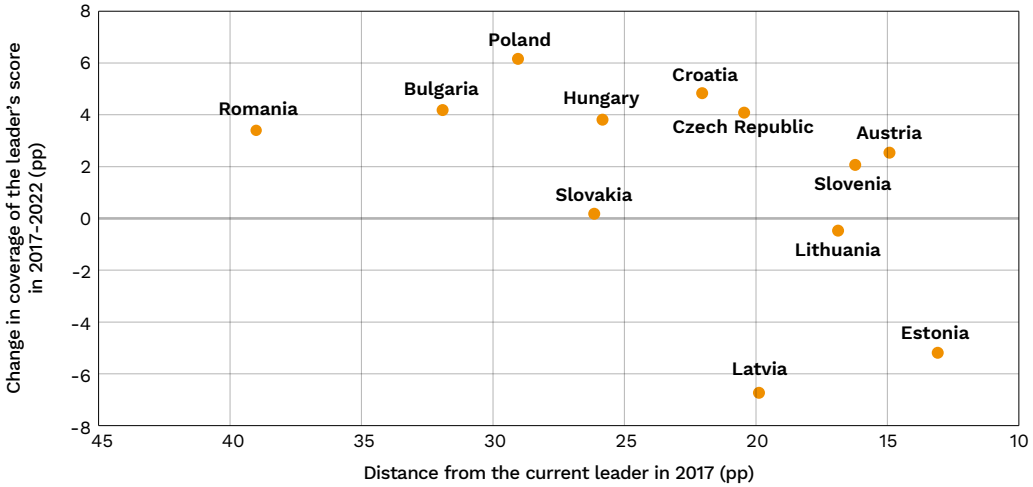
The TSI countries perform worse in the two categories measuring the foundations of digitisation: human capital and connectivity. In the former, Estonia, Croatia and Austria are above the EU average. Croatian, Latvian and Austrian society are at the forefront of the TSI region when it comes to at least basic and above-basic digital skills and at least basic IT skills. Whereas, Romania and Bulgaria have a very high proportion of female IT professionals, with Romania also leading in this category in the EU. As many as 10 TSI countries (with the exception of Poland and Hungary) are above the EU average in terms of the percentage of graduates with degrees related to ICT.

None of the TSI countries scored above average in the Connectivity category. They only scored highly in the case of specific indicators: Latvia is the EU leader in fibre to the premises (FTTP) coverage, Croatia is fully 5G-ready in terms of allocated radio frequency bands, and Romania has the best broadband price score.

TSI countries often occupy the last place in individual categories in the DESI ranking, but it is worth looking at the changes over time, especially since countries' position in the ranking is largely historically and structurally conditioned (Święcicki, 2022). In our analysis, we take into account countries' distance from the leader, rather than their place in the index. We measure this distance using DESI point values since 2017.[1] In Charts 2-6 we present the relationship between the distance (from the EU leader in a given category in 2022, in pp) and the change in the coverage of the leader's result by the country's result in 2017-2022. This enables us to see the changes over time and TSI countries' progress, which is not reflected in their position in the ranking.

[1] Changes in the DESI over time can be measured in two ways. The index's composition changes from year to year, so the first way is to adopt the methodology used in a given year and the points obtained in this way. The second is to adopt the most recent methodology (in this case, the one used in 2022) and use it to present changes over time. In this report, we use the latter approach.

Chart 2. DESI Total index – TSI countries' convergence in the overall DESI ranking

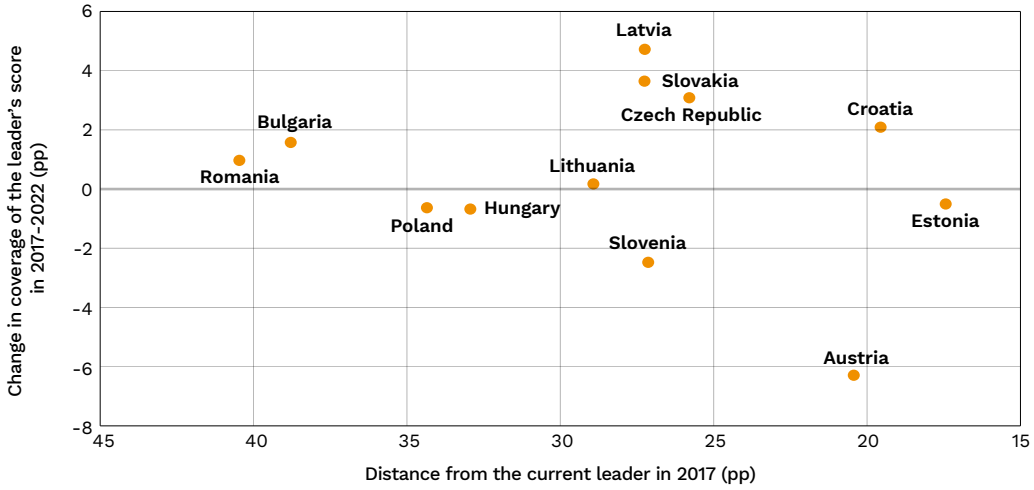


Source: prepared by PEI based on European Commission data.

Chart 2 shows that the TSI countries have mostly been reducing the distance from the leader. Those whose distance was greater in 2017 increased their overall DESI score more rapidly. The fact that, in general, convergence in individual countries' performance is observed in the EU can be missed if we only look at countries' order and position. In our analysis, we used the score of Finland, the leader in the ranking in 2022, as the reference point. The results can be interpreted as proof of convergence and the levelling of digitisation in the TSI countries.

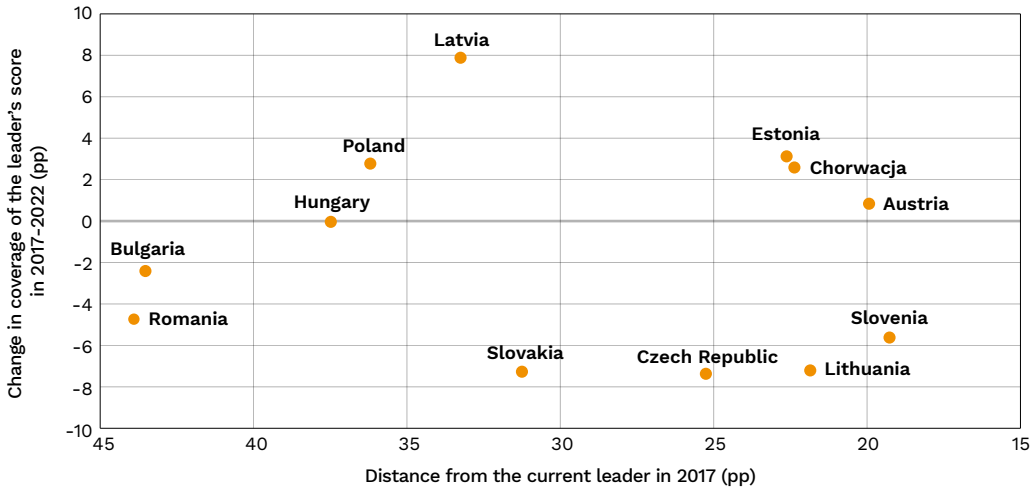
A similar phenomenon can be observed in the Human capital (albeit very weak in this category), Integration of digital technologies and Digital public services categories (Charts 3-5).

Chart 3. Human capital in the DESI – relationship between the distance from the leader and the percentage change in the leader's score



Source: prepared by PEI based on European Commission data.

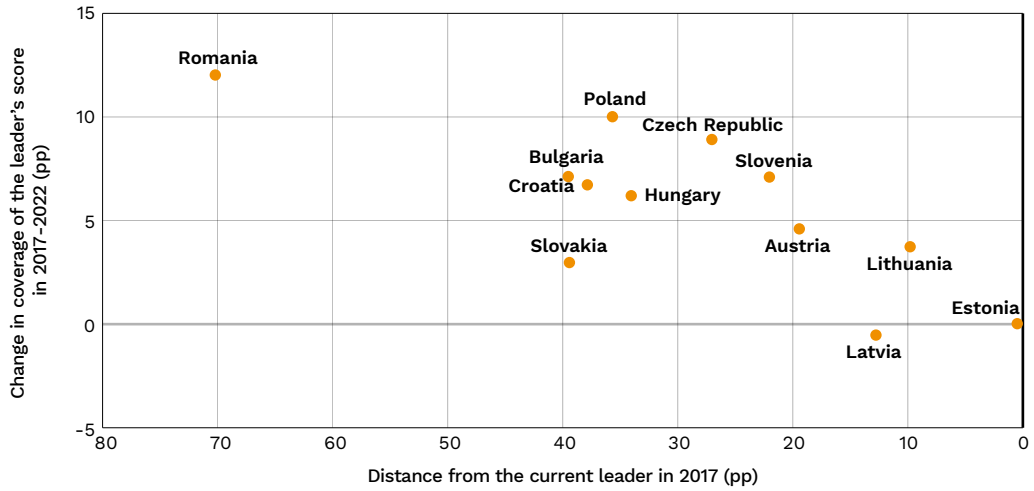
Chart 4. Integration of digital technologies category – relationship between the distance from the leader and the percentage change in the leader's score



Source: prepared by PEI based on European Commission data.

In the case of the use of digital technologies, the relationship is negative, but it seems to be the weakest. The distance between as many as six TSI countries and the leader increased during the period analysed. At the same time, public policies have only an indirect impact on indicators describing the use of technology at companies, making them more difficult to influence. Encouraging companies to use modern tools (such as AI, automation or cloud computing) often requires a change in managers' mentality, as well as training both the management and other staff. Increasing the value of these indicators not only requires the involvement of decision-makers, but also the establishment of a partnership with the private actors — modelled on the projects described as the "mission economy" by Mariana Mazzucato (Święcicki, 2022).

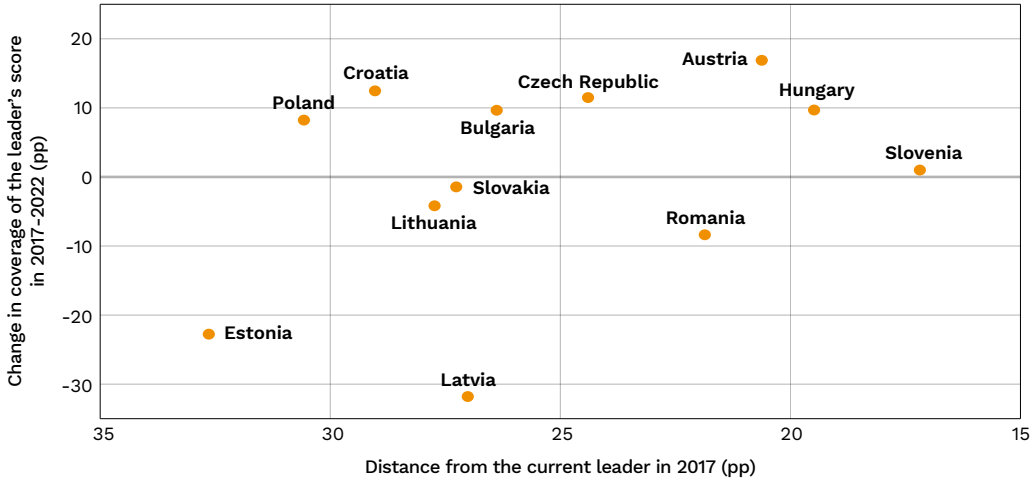
Chart 5. Digital public services category – relationship between the distance from the leader and the percentage change in the leader's score



Source: prepared by PEI based on European Commission data.

Convergence is the most pronounced in the area of digital public administration. Here, all the countries, apart from Latvia, have been catching up with the leader (Estonia). It is worth noting that the indicators in this area are the most affected by the administration's actions and decisions. The clear convergence and improvement in the rating of almost all the TSI countries may therefore suggest that the administration is effectively implementing digital solutions that affect its functioning, thereby improving the quality of services for citizens.

Chart 6. Connectivity category – relationship between the distance from the leader and the percentage change in the leader's score



Source: prepared by PEI based on European Commission data.

In the Connectivity category, 7 out of the 12 countries narrowed the gap between them and the leader. Three countries (Slovakia, Lithuania and Romania) lost slightly and in two cases there was clear divergence (Estonia, Latvia).

The European Innovation Scoreboard

The European Innovation Scoreboard (EIS, 2023) is an index similar to the DESI, but it contains data on innovation in individual EU countries and regions. The EIS divides EU countries into four groups based on their score in the ranking: emerging, moderate and strong innovators and leaders. In the latest edition of the EIS, published in 2023, the lowest category is made up exclusively of TSI countries: Croatia, Slovakia, Poland, Latvia, Bulgaria and Romania. Moderate innovators include: Estonia, Slovenia, the Czech Republic, Lithuania and Hungary. Austria is in the group of strong innovators. No TSI country made it into the group of leaders in terms of overall innovativeness.

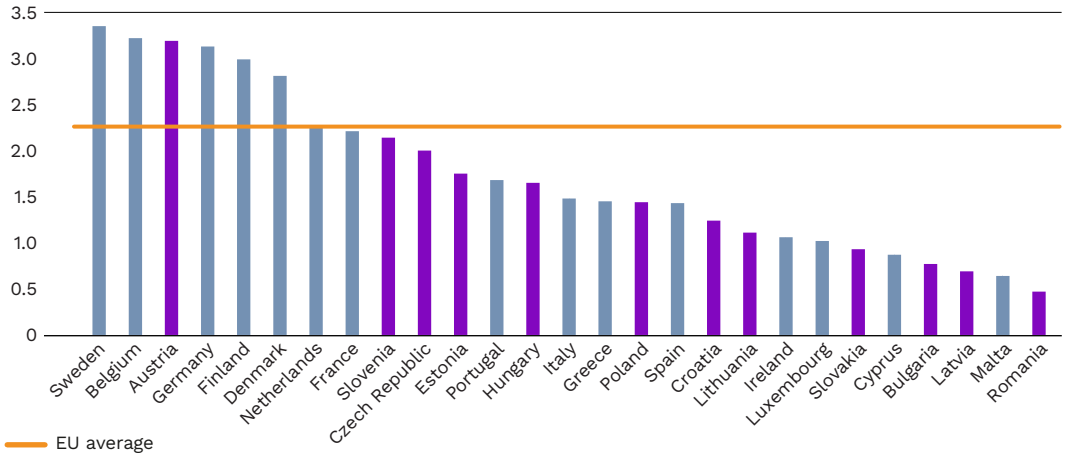
The TSI countries only did well or very well in the case of selected indicators, such as spending on innovation other than spending on R&D, where Lithuania, the Czech Republic and Estonia are the leading countries in the EU. At the regional level, there is considerable variation between the TSI countries. While two regions (Vienna in Austria and Prague in the Czech Republic) made

it into the group of leaders, 17 of the 20 regions with the lowest number of points are in the TSI countries.

Expenditure on R&D

In terms of expenditure on R&D as a percentage of GDP, Austria ranks third in the EU (3.19%) and is the only TSI country that spends more than the EU average (Chart 7). The average itself is clearly inflated by the top five countries.

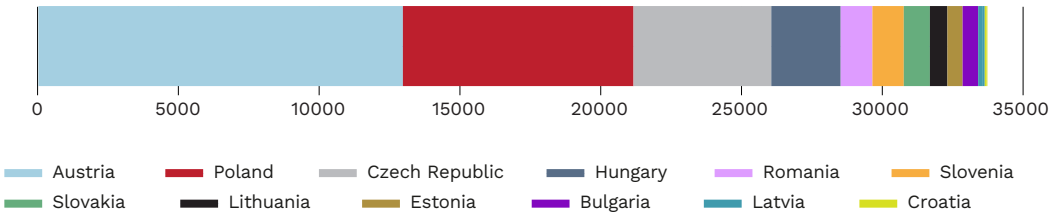
Chart 7. Gross domestic expenditure on R&D (GERD) as a percentage of GDP (2021)



Source: prepared by PEI based on Eurostat data.

Austria spends the most in the region on R&D, both as a percentage of GDP and in terms of value. Austrian spending on R&D accounts for 38% of all spending for this purpose in the entire TSI region (Chart 8). Poland spends the second-highest amount and contributes 25% of the total (1.44% of GDP).

Chart 8. Spending on R&D in the TSI countries in 2021 (millions of EUR)



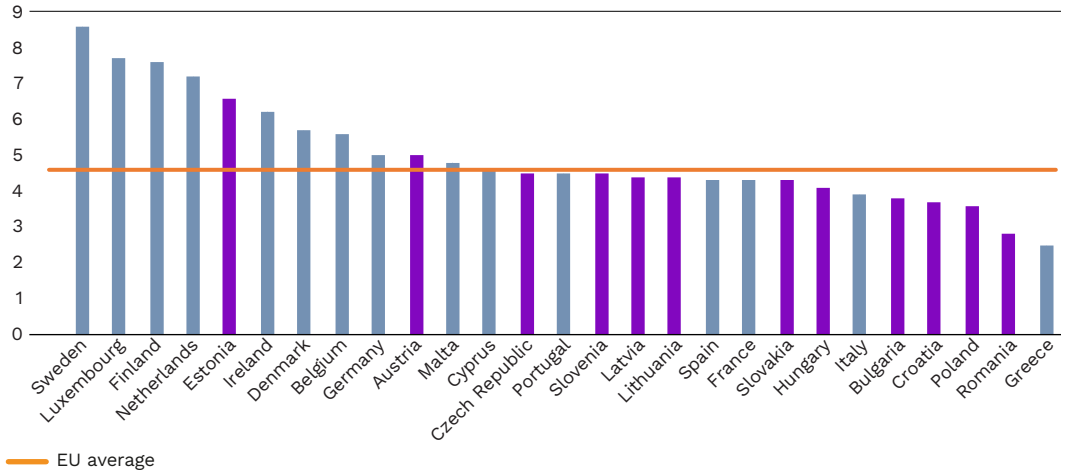
Source: prepared by PEI based on Eurostat data.

The Czech Republic is third, with 14.5% of the total (2% of Czech GDP). In most TSI countries, spending on this purpose as a percentage of GDP has increased in recent years.

ICT specialists

One of the EU's strategic goals is to increase the number of ICT specialists among employees. This is part of its strategy of digital development and maintaining its position amid global technological competition. There are currently 9.37 million ICT professionals in the EU (4.6% of total employment); by 2030, this is expected to reach 20 million (European Commission, 2021). Achieving this target will require considerable effort from the TSI countries, where — apart from Estonia and Austria (6.6% and 5% respectively) — the percentage of people employed as ICT specialists is below the EU average (Chart 10). Although the distance from the EU average is not significant in six TSI countries, a significant increase in the share of ICT specialists in the total workforce is a challenge that requires coordinating actions at many levels: higher education and lifelong learning, the labour market, and cooperation with the private sector.[2]

Chart 9. Percentage of ICT specialists in the total workforce in 2022

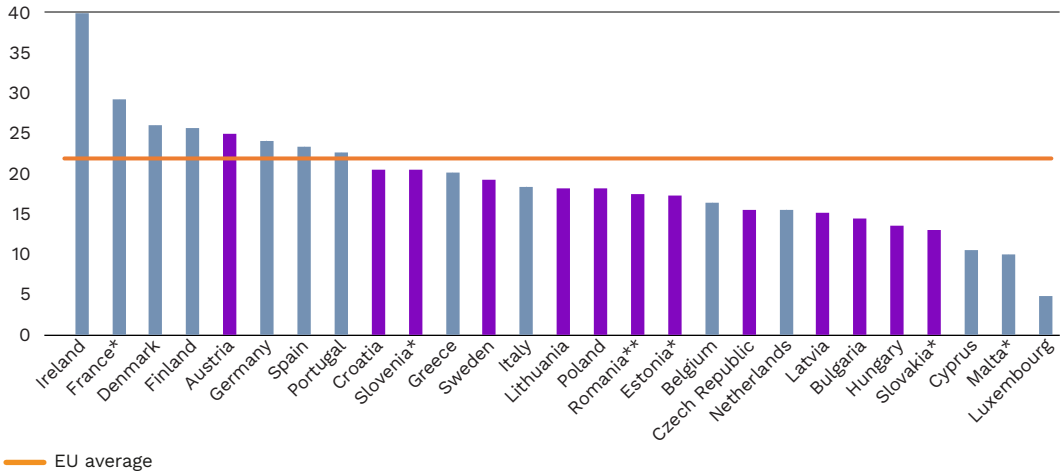


Source: prepared by PEI based on Eurostat data.

[2] In analysis on the possibility of improving countries' position in the DESI, this indicator is in the "mission economy" category (Święcicki, 2023).

Catching up in terms of the number of ICT specialists could also be difficult due to the relatively small number of graduates of the relevant fields of study. In the TSI countries, the number of STEM students as a percentage of the population is also below the EU average. In the countries analysed, 17 people per 1000 people aged 20 to 29 years have degrees in these subjects, on average. This is below the EU average; only Austria is above it. Of course, STEM graduates are not only future IT specialists; many strategies for developing the skills needed for the development of a competitive economy in the near future emphasise the need for education in these fields.

Chart 10. STEM graduates per 1000 people aged 20 to 29 years in 2020



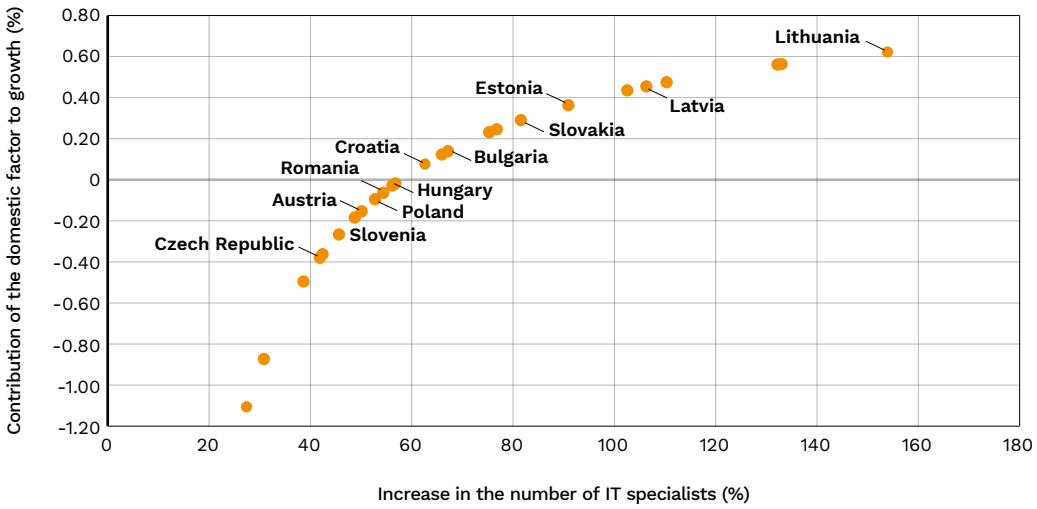
Source: prepared by PEI based on Eurostat. * data for 2020 ** data for 2019.

Do the TSI countries specialise in IT?

Regardless of the percentage of specialists, it is worth looking at how the number of them has changed over time and the emerging national specialisations in this field. For this purpose, estimates from shift-share analysis were used, which enabled us to separate the domestic factor from European or structural trends. This shows how much of the increase in the number of IT specialists in a given country results from general economic changes (such as the greater role of IT in every developed economy) and how much of it results from the development of national specialisations (Łukasik et al., 2022).

In four of the TSI countries, the country factor turned out to be significant: Lithuania, Latvia, Slovakia and Estonia. This can be interpreted as confirmation of local specialisation; these countries are creating more jobs for IT specialists than would result from EU trends or general economic changes. It may be that they offer particularly good conditions or have a well-developed system for educating these kinds of specialists. However, these are small countries, which may distort the results.[3] In contrast, in the Czech Republic, Slovenia and Austria, the country factor had a significant negative value, which means that the number of IT specialists in the country has been growing more slowly than it would have as a result of broader economic trends. In the other countries, the country factor is close to zero, so it seems that they are not creating specific national advantages in this regard.

Chart 11. Relationship between the percentage increase in the number of IT specialists in 2012-2022 and the importance of the country factor in this increase in the TSI countries, compared to other EU countries



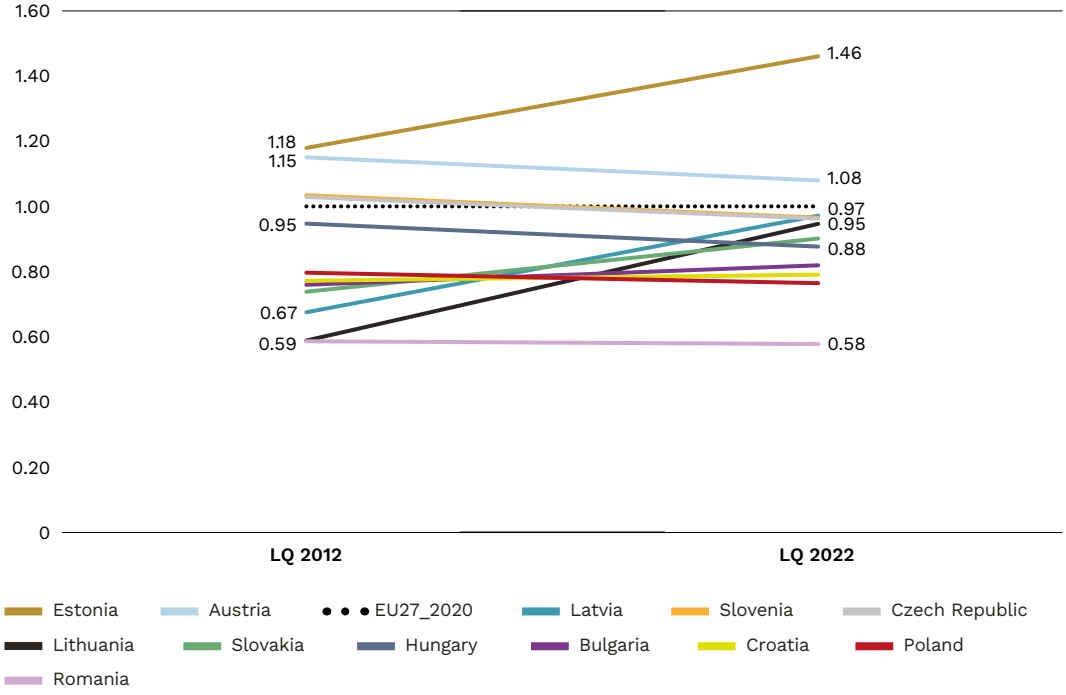
Source: prepared by PEI based on Eurostat data.

Similar conclusions on the lack of strong local specialisations can be seen if we consider the share of employment in the IT sector in total employment in the TSI countries, compared to the share in the EU as a whole. The location quotient amounts to 1 if the share in a given country is equal to that in the EU. With the exception of Estonia and Austria, it is below 1 (in 2012, it was above 1 in the Czech Republic and Slovenia), and has increased in six countries over the past decade. Like the shift-share analysis, this indicates that there

[3] At small nominal values, small changes caused by single factors, rather than structural change, may contribute to significant changes in the indicator.

is no strong specialisation in IT in the TSI region, and that employment in this sector has not grown more rapidly than the EU average.

Chart 12. Change in location quotient for IT specialists in the TSI countries in 2012-2022



Source: prepared by PEI based on Eurostat data.

2. The ICT sector's significance for the TSI countries' economies

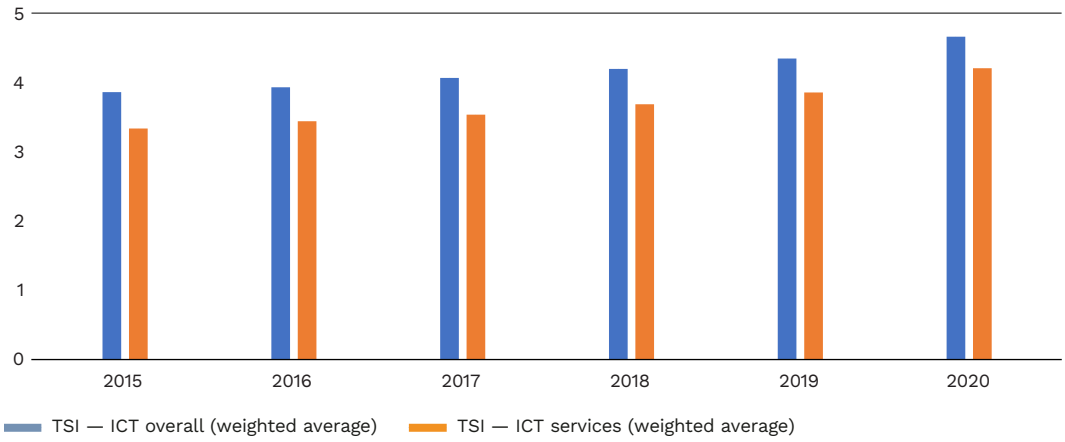
This part of the report aims to identify the characteristics and transformations taking place in the ICT sector in the TSI countries. The analysis covers the share of the ICT sector's value added in GDP, indirect and induced impact, the number of employees, and international ICT trade in goods and services in gross and trade in value added (TiVA) terms. The latter approach results from the high fragmentation of production networks due to the growing importance of vertical specialisation and the development of global value chains (GVCs) (Gereffi, 2014; Timmer et al., 2014; Cigna, Gunnella, Quaglietti, 2022). This process accelerated in 2000, when international companies' first factories in special economic zones started operating, and in 2003-2004, in connection with the Central European countries' EU accession (Ambroziak, Marczewski, 2014; Hagemejer, Ghodsi, 2017).

Employment and value added

The value added in the total ICT sector (industry and services), measured in the prices of production factors in all the TSI countries amounted to USD 73 billion in 2020. More than half of it was generated by the ICT sector in the Visegrad Group (V4) countries.[4] In 2015-2020, its average annual growth amounted to 10%. As a percentage of GDP, the weighted average[5] for the TSI countries also grew steadily, reaching 4.7% (Chart 13), 0.5 pp less than the EU-27 average (Eurostat, 2023b). The observed increase mainly resulted from the value added generated in the ICT services sector, which suggests that services lead to a gradual reduction of the existing gap.

[4] Calculated by the PEI based on Eurostat (2023a).
[5] The value added of the ICT sector in a given country as a percentage of the value added of the ICT sector of all the TSI countries.

Chart 13. Share of the ICT sector's value added in GDP in the TSI countries in 2015-2020 (%)



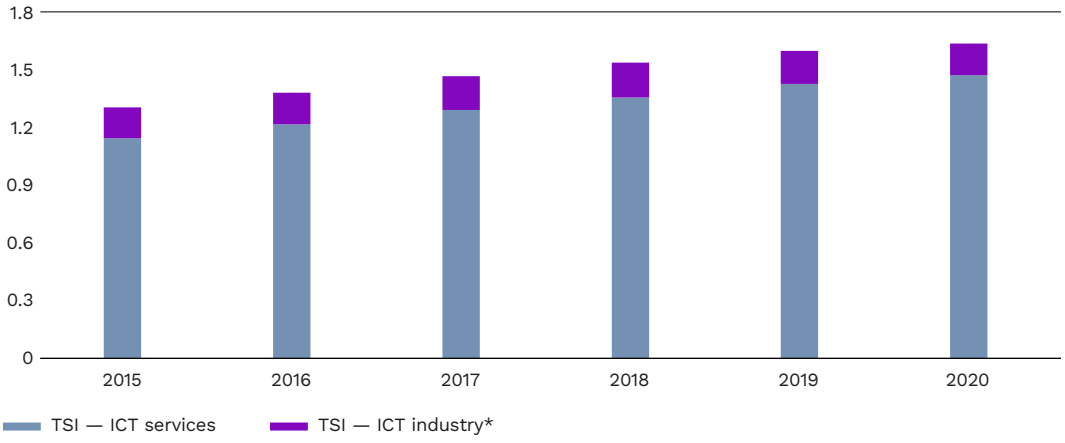
Source: prepared by PEI based on Eurostat data (2023a).

To a large extent, the TSI countries carry out tasks typical of sub-supplier economies within GVCs. Broken down by individual types of activity in the ICT industry[6] in the TSI countries, the production of electronic components (59%), telecommunications equipment (20%) and computers and peripherals (14%) played the biggest role in creating value added in 2020. In the case of ICT services, computer programming, consultancy and related services (54%) and telecommunications services (28%) played the biggest role in creating value added.[7]

The increase in the number of employees (Chart 14) also testifies to the rapid development of the ICT sector in the TSI countries. While it was stable in the ICT industry (at 160,000-180,000, over 50% of it in the production of electronic components, although the Eurostat data contains some gaps), it reached almost 1.4 million in 2020 in the case of ICT services (including over 850,000 in computer programming, consultancy and related services), growing at an average annual rate of almost 6% in 2015-2020. ICT employees in the TSI countries accounted for around 24% of all EU employees in the sector in 2020, compared to around 18% ten years earlier.

[6] According to the OECD (2011) classification, the ICT category includes computers and peripherals, communication equipment, consumer electronics, electronic parts and accessories, and other ICT goods.
[7] In line with Eurostat's approach (2023b), sections J582, J61, J62, J63 and S951 are taken into account here.

Chart 14. Number of employees in the ICT sector in the TSI countries in 2015-2020 (millions)



* incomplete data/estimates.

Source: prepared by PEI based on Eurostat data (2023a).

The ICT sector also had a significant impact on other sectors of the economy through internal cross-sector links. Using input-output tables and the Leontief model (Kutwa, 2022; d'Hernoncourt, Cordier, Hadley, 2011), it is possible to calculate a given sector's direct, indirect and induced impact on total production. This approach is based on the observation that producing a single unit of a good in a given sector generates the purchase of intermediate goods in other sectors of the economy, thereby increasing production in those sectors.

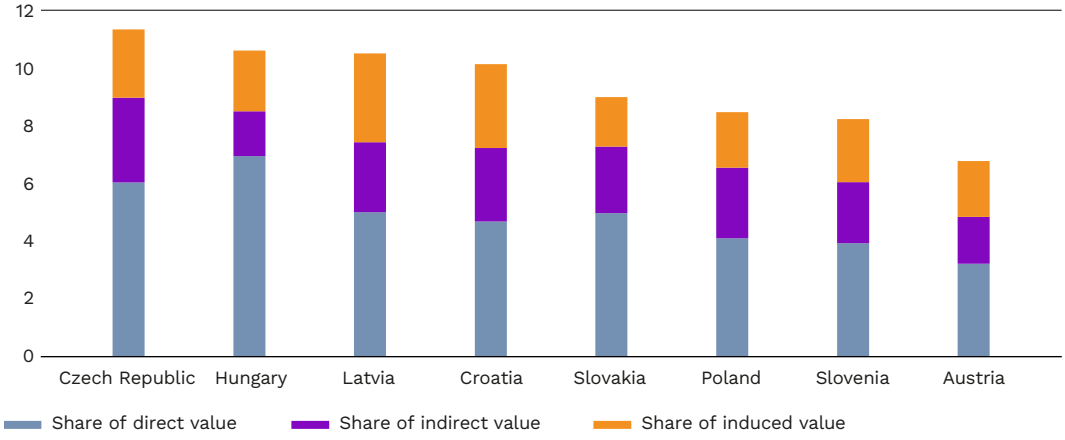
The total value of sales in a given sector is called the direct impact, while the value of the resulting production in related sectors is the indirect impact. Subsequently, each production activity leads to the payment of wages to employees, who purchase goods and services with the money they earn. Unless these products and services are imported, they increase the demand for production in the domestic economy. This effect is referred to as the induced impact.

Using the methodology adopted and the data available, we were not able to analyse all the TSI countries' economies. Input-output tables specifying the structure of the economy are available for only eight of them.[8]

[8] Austria, Czech Republic, Croatia, Slovenia, Slovakia, Hungary, Latvia and Poland.

According to this methodology, the ICT sector directly accounted for 3.2-7% of production in the TSI countries, while the total impact (direct, indirect and induced) range from 6.8% of production in Austria to 11.4% in the Czech Republic.[9]

Chart 15. Direct, indirect and induced value of the ICT sector in selected TSI countries in 2020 (% of total production)



Source: prepared by PEI based on Eurostat data.

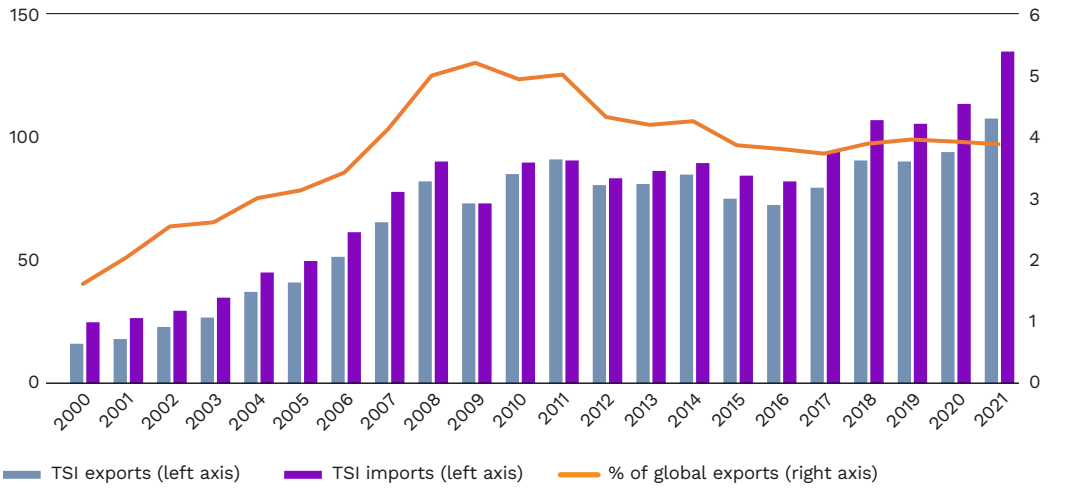
The induced value multiplier for the TSI countries ranged from 1.53 in Hungary to 2.1 in Latvia and Austria. This means that every extra euro spent on ICT products or services resulted in an additional output of between EUR 0.53 and EUR 1.1 in other sectors of the economy.

Exports of ICT goods

In 2000-2021, TSI countries' exports of ICT goods increased more than 6.5-fold in nominal terms (Chart 16). However, the greatest growth occurred in the 2000s, when the TSI countries' total share in global exports increased from 1.6% to 5.2%, before stabilising at slightly below 4%. The negative trade balance in 2021 reached USD 27 billion (including USD 9.8 billion in Poland, USD 5.7 billion in Romania and USD 5 billion in Austria).

[9] These values should not be compared to GDP. The methodology is based on calculations for production value, including value added and intermediate consumption.

Chart 16. TSI countries' exports and imports of ICT goods and share in global exports in 2000-2021 (billions of USD and %)

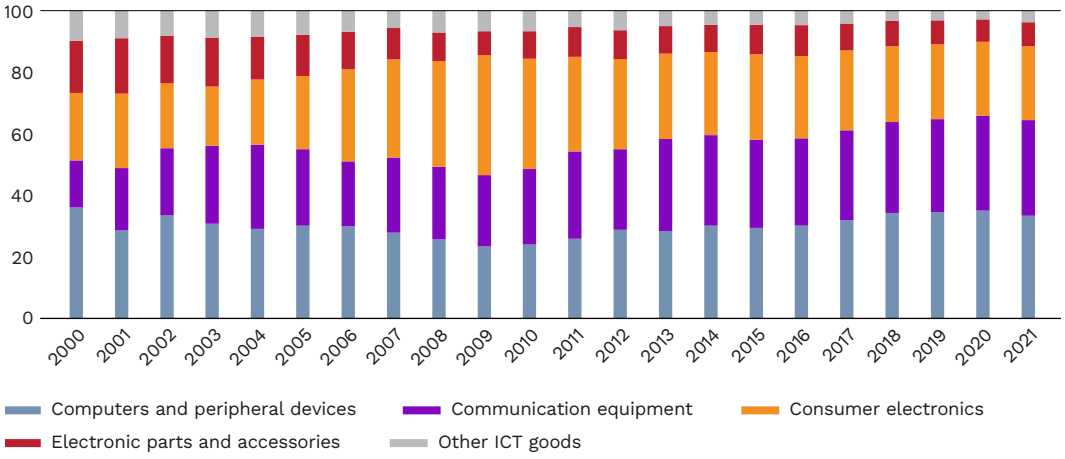


Source: prepared by PEI based on UNCTAD Data Center (2023).

In 2021, the Czech Republic (33%), Poland (20%), Hungary (16%), Slovakia (12%) and Austria (9%) accounted for the largest share of TSI countries' ICT exports. There has also been a significant change in the case of countries with lower potential. **Exports of ICT goods from Croatia, Romania and Slovenia increased more than fivefold in 2000-2021, those from Lithuania almost eightfold, those from Bulgaria more than 36-fold and those from Latvia as much as 133-fold.** Germany remained most of the TSI countries' main trading partner (Trade Map, 2023), the result of deepening integration in Europe, FDI inflows, and Central and Eastern European countries' inclusion in comprehensive ICT production networks (Meng et al., 2019).

If we turn to the subcategories of ICT goods (Chart 17), during the period studied, after a temporary decline, exports of computers and peripheral devices maintained their share in the ICT group at around 33% (the greatest significance in the exports of the Czech Republic and Poland). In the case of communication equipment, the share increased from 15 to 31% (the greatest significance in the exports of Austria, Estonia, Latvia, Romania, Lithuania, Slovakia and the Czech Republic). In the case of consumer electronics, it rose from 22 to 24% (temporarily, as much as 39%; the greatest significance in the exports of Bulgaria, Hungary, Poland and Slovakia).

Chart 17. TSI countries' exports of ICT goods divided into subcategories in 2000-2021 (% share)

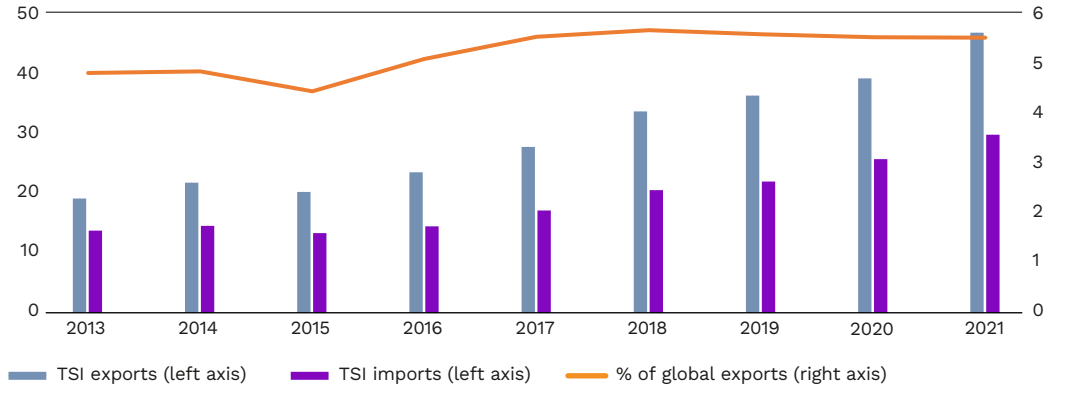


Source: prepared by PEI based on UNCTAD Data Center data (2023).

Trade in ICT services

Equally significant structural changes can be identified in trade in ICT services[10] (Chart 18).

Chart 18. TSI countries' exports and imports of ICT services and share in global exports in 2013-2021 (billions of USD and %)



* due to the lack of consistency in international statistics and the lack of complete data for all the TSI countries, the analysis only covers the years 2013-2021.

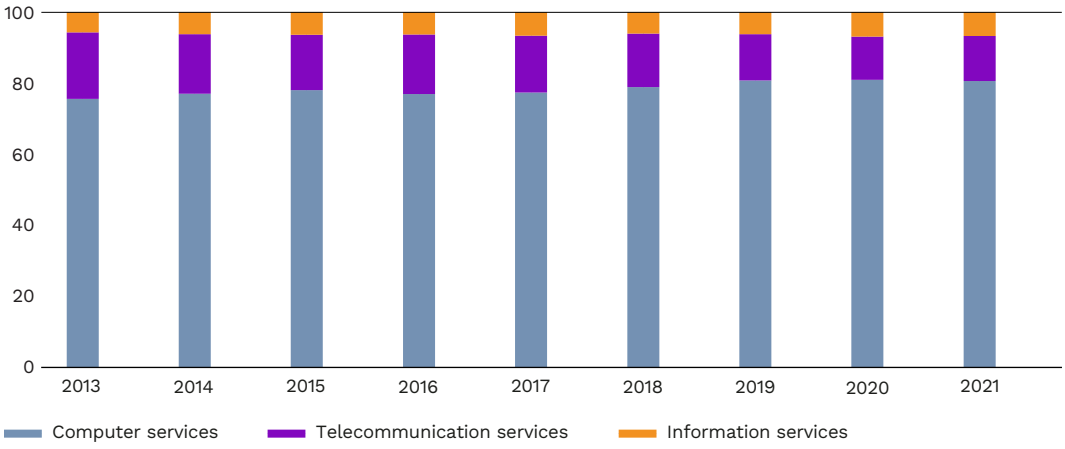
Source: prepared by PEI based on UNCTAD Data Center data (2023).

[10] Classification of services according to BMP6.

Exports of ICT services grew by over 44% over the period analysed, increasing the share in global trade from 4.8% to 5.5%. This share has stabilised since 2017. Austria, the Czech Republic, Poland and Romania remain the largest exporters, accounting for 72% of exports of ICT services from the TSI in 2021.[11] The trade balance in ICT services in all the TSI countries was positive and grew steadily (from USD 5.4 billion to USD 17 billion in 2021, including USD 4.5 in Poland, USD 4 in Romania, and USD 2.9 billion in the Czech Republic). **The growing trade in ICT services also increased their share in total trade in services**, especially in the case of Bulgaria, the Czech Republic, Estonia, Latvia and Romania (the weighted average for the TSI countries is almost 16%).[12] As in the case of trade in goods, the main factor behind these structural changes were FDI inflows seeking strategic benefits from access to cheaper and, at the same time, very well qualified human capital.

If we look at subcategories of ICT services (Chart 19), exports of computer services (75-80%) were the largest subcategory during the period analysed, dominated by Austria, the Czech Republic, Hungary, Lithuania and Poland. The share of telecommunications services declined (from 18.7% to 12.6%) and the share of information services remained at a low but stable level (5.7-7%). Bulgaria, Croatia, Estonia, Latvia, Slovakia and Slovenia recorded above-average results in the case of exports of communication services, and Bulgaria, Romania and Slovenia in the case of exports of information services.

Chart 19. Structure of the TSI countries' exports of ICT services in 2013-2021 (% share)



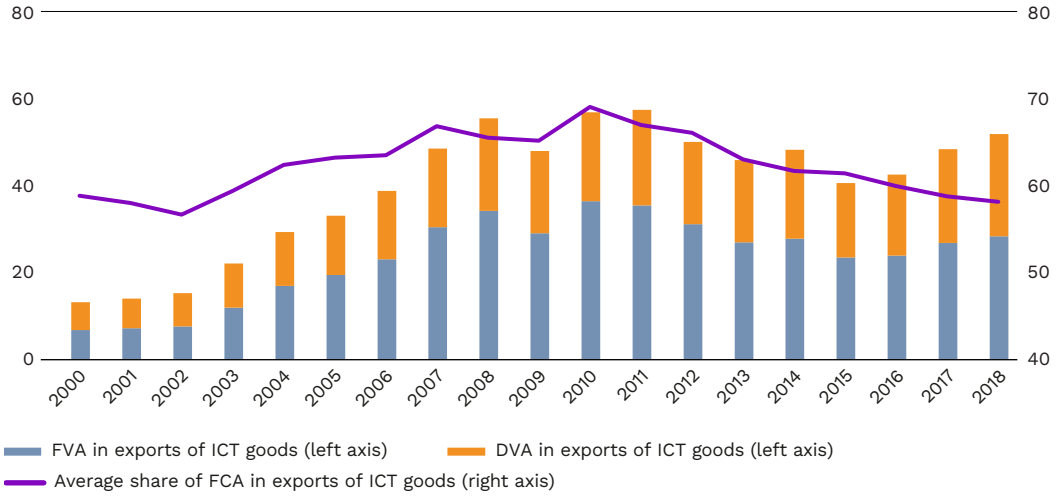
Source: prepared by PEI based on Trade Map data (2023).

[11] 20, 13, 23.5 and 15.5% respectively.
[12] A given country's exports of ICT services as a percentage of the exports of ICT services of all the TSI countries.

Analysis of added value in trade in ICT goods and services

In 2000-2018,[13] the TSI countries' ICT sector shifted gradually within GVCs towards tasks characteristic of sub-supplier economies.[14] This is visible in the growing share of intermediate products in total exports of ICT goods. For all the TSI countries, the weighted average[15] increased from 43 to 48%. This fact also corresponds to the predominance of the foreign value added content of gross exports (FVA; Chart 20),[16] which results from the nature of supply imports. **However, since 2010, the gradual increase in the share of domestic value added (DVA) in exports can be observed.** This share has increased by around 10 pp. It is worth noting that intermediate goods accounted for over 60% (according to the weighted average[17] for the TSI countries) of imports of ICT goods.

Chart 20. Domestic (DVA) and foreign value added (FVA) in the TSI countries' exports of goods in 2000-2018 (billions of USD, % share)

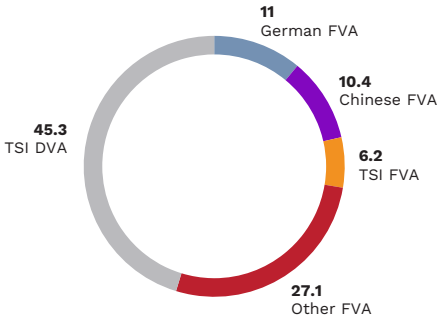


Source: prepared by PEI based on OECD data (2023).

[13] Data is only available until 2018, so it does not include changes linked to the COVID-19 pandemic and the reconfiguration of GVCs.
[14] It should be noted that, due to the nature and method of data aggregation (OECD, 2023), the best possible approximation for the ICT group of goods remains category D26 (computer, electronic and optical products).
[15] A given country's exports of ICT intermediary products as a percentage of TSI countries' exports of ICT intermediary products.
[16] This also means a low share of domestic value added content of gross exports (DVA) in exports of ICT goods, as the value of gross exports = DVA + FVA.
[17] A given country's imports of ICT intermediary products as a percentage of TSI countries' imports of ICT intermediary products.

According to data for 2018, German and Chinese value added had the highest share in TSI countries' ICT exports (Chart 21). The strength of cooperation between TSI countries was quite varied. The share of FVA from the TSI countries was the lowest in Poland (6%) and the highest in Lithuania, Latvia and Croatia (20-25%).

Chart 21. Structure of TSI countries' exports of ICT goods in terms of foreign and domestic value added in 2018 (% share)



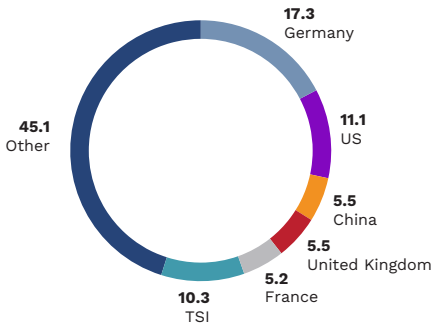
Source: prepared by PEI based on OECD data (2023).

Within domestic added value, it is also worth looking at internal links and the share of value added from other industries: the indirect domestic value added content of gross exports (IDC) (OECD, 2023; OECD, 2021; Fujii-Gambero, Cervantes-Martínez, 2015). There is also considerable differentiation in the TSI countries' economies. Taking into account only the largest exporters — Austria and the Visegrad Group countries — around 33% of Austrian value added in ICT exports came from outside this sector. In the case of Hungary, after a temporary increase to 41-46 % in the 2000s, the share of value added from other sectors in DVA fell to just 25% in 2018. In the case of the Czech Republic, Poland and Slovakia, the share of IDC fluctuated in the 40-50% range, which means the greater backward involvement of domestic suppliers from other industries. **This indicates that the ICT sector's development results in the development of many other sectors of the economy** — as we showed earlier in this report, in our analysis of indirect and induced impact. At the same time, this situation means that potential disturbances on foreign markets where final goods are sold can be have an impact on a larger number of domestic companies cooperating with producers and exporters of ICT goods.

A rather optimistic trend is the growing importance of domestic business services in creating DVA in most of the TSI countries (the weighted average[18] for all the TSI countries in 2018 was 29%). This means the growing servitisation and knowledge-intensity of exports of goods, which in turn means improving the production potential of increasingly technologically-advanced goods. At the same time, the share of domestic service companies strictly from the ICT sector in domestic value added in the TSI countries' exports of ICT goods remained relatively low (2-3% during the period analysed).[19]

The inclusion of the TSI countries' ICT goods sector in global value chains also means that it has become increasingly dependent on final demand from foreign recipients. In the case of the largest exporters (the V4 countries), the share of final foreign demand in DVA[20] grew systematically in 2000-2018, to over 80%. Chart 22 presents the geographical structure of the foreign final demand of the TSI countries' DVA. This shows to which markets exports of ICT goods from the TSI countries were connected in 2018, both directly (through finished goods) and indirectly (through intermediate goods processed in other countries and then exported to the final recipient).

Chart 22. Geographical structure of foreign final consumption of TSI countries' domestic value added in exports of ICT goods in 2018 (% share)



Source: prepared by PEI based on OECD data (2023).

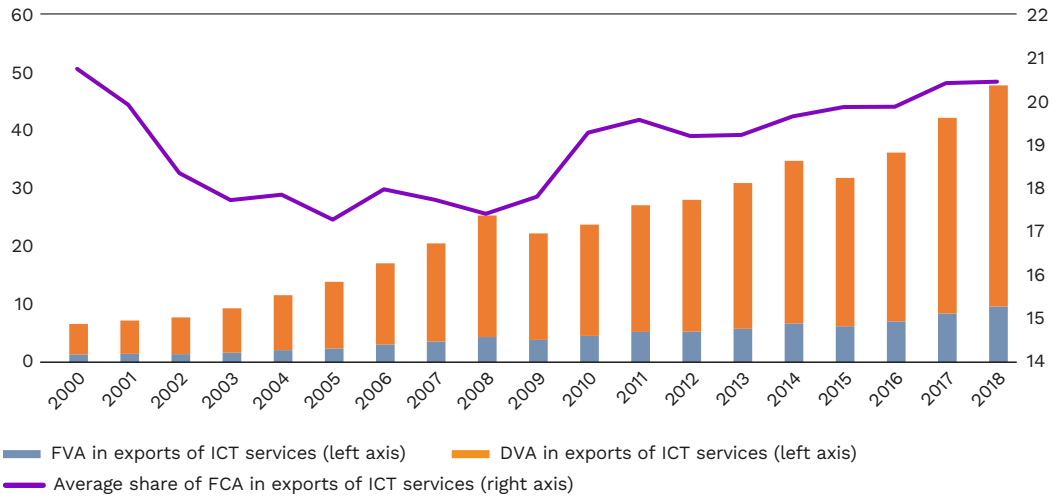
TSI countries' DVA generated in the ICT goods sector was finally consumed abroad by Germany (USD 2.5 billion; 17.3%), the US (USD 1.6 billion; 11.1%),

[18] The domestic value added of a given country's business services as a percentage of the domestic value added of business services in all the TSI countries.
[19] The domestic value added of a given country's ICT services as a percentage of the domestic value added of ICT services in all the TSI countries.
[20] See indicator VALU_FFDDVA (OECD, 2023; OECD, 2021).

other TSI countries (USD 1.5 billion;[21] 10.3%), China and the UK (USD 0.8 billion and 5.5% each) and France (USD 0.76 billion; 5.2%)

Unlike ICT exports of goods, TSI countries' exports of ICT services relied more on domestic value added, which confirms the highly localised nature of advanced knowledge (Antonelli, Feder, 2020). The ICT services sector's rapid development can also be seen in how — in all TSI countries, except the Czech Republic — the DVA in exports of ICT services exceeded the DVA in exports of ICT goods. Meanwhile, the share of FVA (Chart 23) for the TSI countries remained fairly low and stable (17-21%).[22]

Chart 23. Domestic (DVA) and foreign value added (FVA) in TSI countries' exports of ICT services in 2000-2018 (billions of USD, % share)



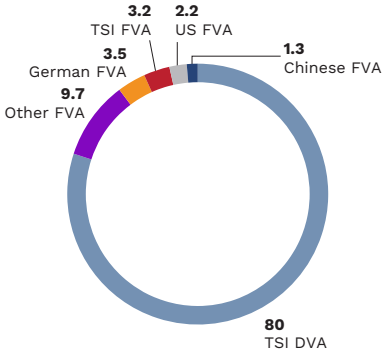
Source: prepared by PEI based on OECD data (2023).

According to data for 2018, FVA from Germany, the TSI countries and the US accounted for the highest percentage of exports of ICT services from the TSI countries (Chart 24). In the case of Austria, Germany was the most important in the geographical structure of FVA. For the Visegrad Group countries and Romania, it was Germany and the US, with China's share growing rapidly. For the Baltic States, their mutual linkages were significant, as well as the Russian content, too. The strength of cooperation between

[21] The sum of each TSI country's value added consumed in the other TSI countries. According to the value provided, Romania consumed the most in 2018 (USD 282 million), followed by Austria (USD 247 million) and Poland (USD 203 million).
[22] Weighted average; a given country's FVA as a percentage of all the TSI countries' FVA.

TSI countries was quite varied. The share of FVA from TSI countries was the lowest in Poland (8%) and the highest in Lithuania, Slovakia, Slovenia, Latvia and Croatia (over 20%).

Chart 24. Structure of TSI countries' exports of ICT services, in terms of foreign and domestic value added in 2018 (% share)



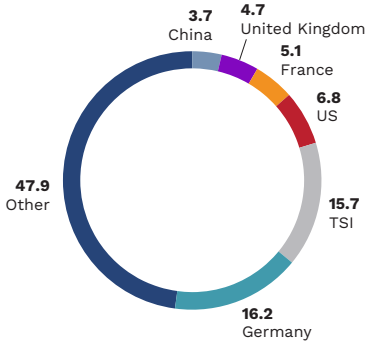
Source: prepared by PEI based on OECD data (2023).

If we look at the share of domestic supplying industries in the DVA of ICT services (the IDC indicator), every TSI country except Austria and Lithuania recorded a decline during the period studied (the weighted average[23] for the TSI countries fell from 33% to 25%). This means that the domestic ICT services sector strengthened its capacity to create value added. This may point to gradual improvement in its competence foundations, in terms of the quality of human capital and the uniqueness of knowledge.

The DVA created in ICT services sector of the TSI countries became increasingly dependent on the final foreign demand (the weighted average increased from 32% in 2000 to 46% in 2018),[24] while the geographical structure of this demand[25] was highly diversified (Chart 25).

[23] A given country's DVA of ICT services as a percentage of all the TSI countries' DVA of ICT services.
[24] See indicator VALU_FFDDVA (OECD, 2023; OECD, 2021).
[25] See indicator FFD_DVA (OECD, 2023; OECD, 2021).

Chart 25. Geographical structure of foreign final consumption of TSI countries' DVA in exports of ICT services in 2018 (% share)



Source: prepared by PEI based on OECD data (2023).

According to data for 2018, Germany had the highest share (USD 6.6 billion, 16.2% share), followed by the TSI countries (USD 6.4 billion, 15.7%), the US (USD 2.8 billion, 6.8%), France (USD 2.1 billion, 5.1%), United Kingdom (USD 1.9 billion, 4.7%) and China (USD 1.5 billion, 3.7%).

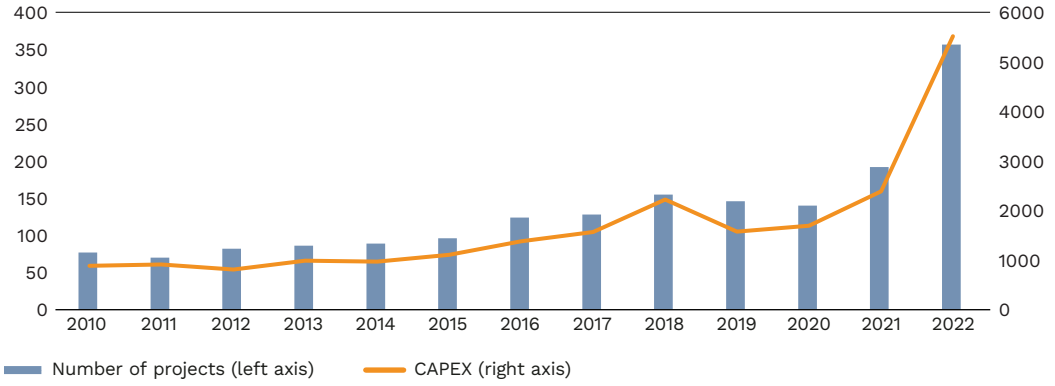
The investment environment

The TSI countries have attracted a growing number of FDI projects and, until 2008, their share in global FDI was increasing. As in the case of the increase in the value of trade in ICT goods and services, the main influx of investments took place in the 2000s. In 2008, the TSI countries accounted for a record 4.9% of total global FDI. Since then, its share in both global and EU FDI has declined.

However, a slightly different picture emerges from the data on announced investments in IT services in the TSI region (Chart 26). These accelerated last year, on top of the long-lasting upward trend. The total value of announced foreign investments amounted to approximately USD 5.5 billion in 2022, almost seven times more than a decade earlier.

The number of projects grew too; in 2022, it exceeded the sum of the projects in the two previous years. This acceleration is probably linked to the situation after the pandemic, but it is also worth noting that, according to these statistics, **the TSI region already accounts for around 8% of the global value of investments and the number of projects announced in this sector, compared to 3.5% and 4.3% respectively a decade ago** (fDI markets, 2023).

Chart 26. Number of investment projects and declared value of investments in software and IT services in the TSI countries (millions of USD)



Source: prepared by PEI based on fDI Markets data.

Investments in intangible assets

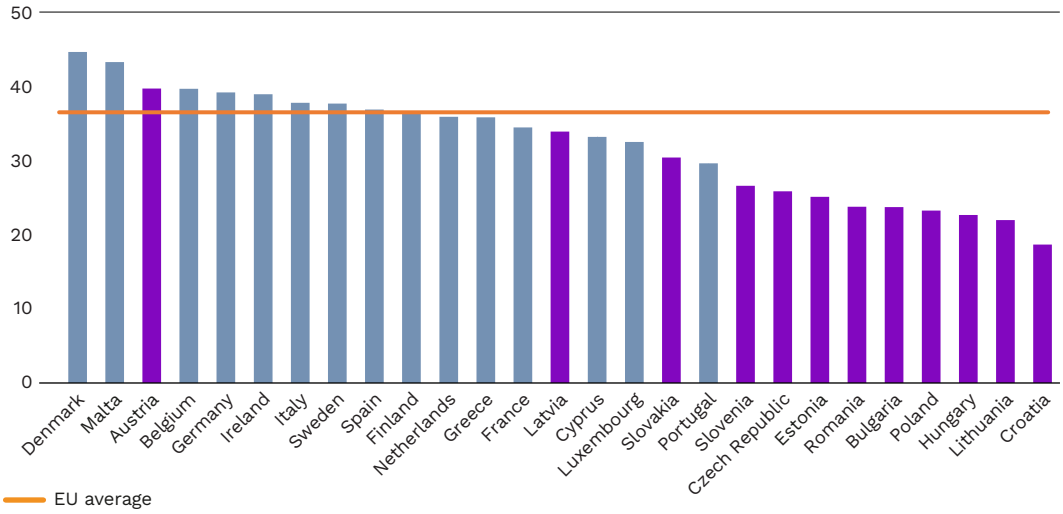
Intangible assets are often considered companies' key assets in the modern digital economy. Intellectual property, design, brand value and data, and the ability to analyse them, determine market success and development opportunities, allowing operations to be scaled much more rapidly than in the case of traditional production or services. As in the case of other indicators measuring innovation and the advancement of the economy, the TSI countries vary when it comes to investments in intangible assets.

The three Baltic States (Lithuania, Latvia and Estonia), Slovenia and Austria are at the forefront of increasing investments in intangible assets. In Poland, the value of these investments was lower in 2019 than in 2015, with stagnation in Slovakia and Bulgaria (Bontadini et al., 2023).

European Investment Bank data developed on the basis of an annual survey among European companies provides a similar picture. **The average share of intangible investments in TSI countries' total investments amounted to 26.4% in 2022, more than 10 pp below the EU average.** In the case of both the TSI countries and the EU, this value has not changed significantly over seven years of measurements. It is worth noting that intangible assets include not only expenditure on R&D or software, which are also included in the national accounts, but also investments in employees' skills or organisational processes.

Austria is currently the only TSI country where the share of intangible investments exceeds the EU average (Chart 27). Austrian companies rank third in this respect, with a share of 39.8% of all investments. The country has improved its position significantly, moving from 16th place in 2016 and increasing the share of this type of investment by 5.37 pp. The other TSI countries were in the bottom half of the ranking throughout the seven years that we have data for.

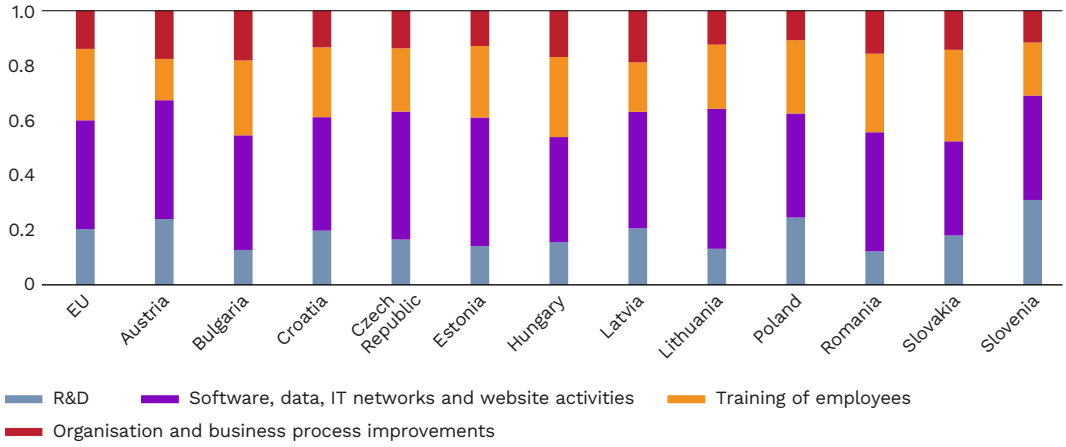
Chart 27. Investments in intangible assets (R&D; software, data, IT networks, website activities; training of employees; organisation and business process improvements) as a percentage of total investments in fiscal year 2022, on average



Source: prepared by PEI based on European Investment Bank data.

The most important component of these investments is software, data, IT networks and website activities, the largest element in investments in as many as 25 EU member states. The average structure of investments in intangible assets in the TSI countries is similar to the EU average, with individual components deviating by no more than 2.5 pp (Chart 28).

Chart 28. Structure of intangible investments declared by companies in fiscal year 2022 (as a share of total investments in intangible assets)

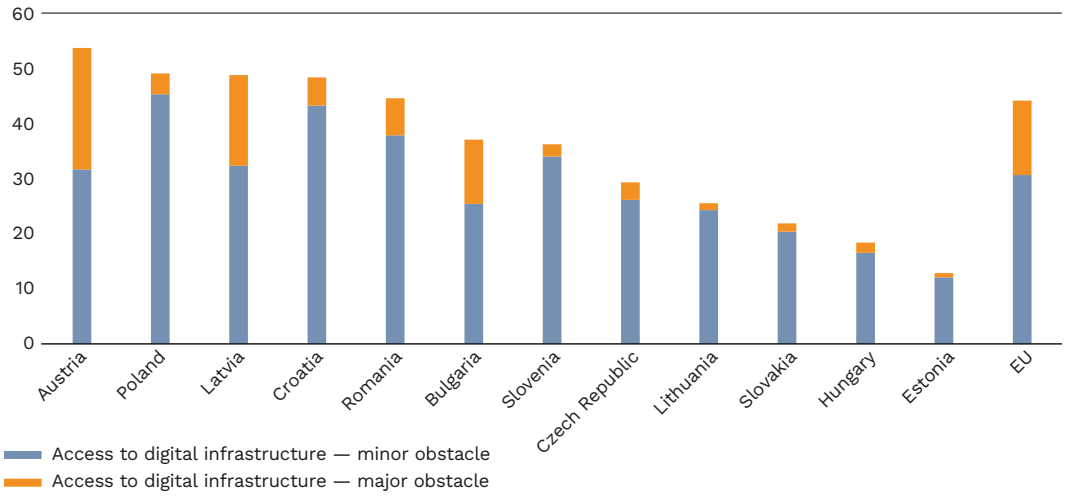


Source: prepared by PEI based on European Investment Bank data.

Investment constraints

Over the years, companies have increasingly reported that access to the right digital infrastructure is a barrier to long-term investment. In the EIB's surveys of companies, the frequency in the EU increased by 8.5 pp in 2016-2022. **In the TSI countries, this increase was smaller (5.2 pp).** Austria, Latvia and Bulgaria were the only TSI countries where over 10% of respondents cited access to digital infrastructure as a significant barrier (Chart 29). At the same time, in Austria — one of the most digitally-mature countries in the region — deficiencies in access to digital infrastructure as described as a serious obstacle to investment most often than anywhere else in the EU. At the same time, the TSI countries diverge from the EU trend whereby, with the widespread introduction of digital technologies at companies, deficiencies in digital infrastructure are less frequently seen as the main obstacle to investing. **In the TSI region, the situation differs and, in countries that are introducing digital solutions in business, companies have turned out to be more willing to report insufficient infrastructure capacity.**

Chart 29. Percentage of companies reporting access to digital infrastructure as an obstacle to long-term investment, broken down by the severity of the obstacle in 2022



Source: prepared by PEI based on European Investment Bank data.

The complexity of the situation when assessing digital infrastructure may result from several factors. **Above all, in the TSI countries, the development of the telecommunications infrastructure has been progressing in recent years, supported by EU funds, among other things.** The improvement in the quality of the networks could therefore be a factor limiting the perception of connectivity as a barrier to investment. At the same time, there were probably other barriers — financial or regulatory — in the TSI countries that may have been perceived as more important. **The TSI countries and local companies use digital technologies to a lesser extent. The delay in the technological transformation may translate into less of a sense of barriers in this area.** However, this may change and, paradoxically, more frequent reports of barriers concerning access to telecommunications infrastructure could be a positive signal of changes taking place.

3. Regulatory aspects

The TSI countries use a whole range of fiscal and regulatory tools to attract foreign investment, especially in the field of R&D. The most popular instruments are tax credits (8 countries), tax deductions (7) and financial grants (7). Hungary has introduced the largest number of instruments (as many as 12). In contrast, Bulgaria and Estonia do not offer any incentives that directly target innovative investments. In these countries, the authorities focus on the entire tax system's simplicity and transparency. In Bulgaria, the CIT rate is 10%. In Estonia, the obligation to pay CIT is deferred, as long as the company reinvests profits (the so-called "Estonian CIT").

Poland is an interesting example. Here, the scope of the available relief and support instruments for R&D is constantly being developed. As a result, in 2022, the level of tax relief in Poland was the highest in the region and the second-highest in the OECD (OECD Innotax, 2023). In recent years, Poland has also introduced special relief for robotisation or prototyping.

The support instruments offered by the TSI countries are presented in Table 1.

The scope and number of instruments supporting investments and R&D mean that, to some extent, the countries in the region are competing with each other for investments. However, as the results show, whether we look at the development of start-ups or spending on R&D as a percentage of GDP, the system of relief or other mechanisms does not simply translate into results. The variety of support mechanisms offers the prospect of regional cooperation, sharing best practices to build a more integrated market.

Table 1. Investment incentives and support instruments for R&D in the TSI countries

Incentive	Austria	Bulgaria	Croatia	Czech Republic	Estonia	Lithuania	Latvia	Poland	Romania	Slovakia	Slovenia	Hungary
R&D as % of GDP	3.19	0.77	1.24	2	1.75	1.11	0.69	1.44	0.47	0.93	2.14	1.65
Number of incentives	3	0	3	4	0	4	0	8	5	5	6	12
Tax relief	x		x				*	x	x	x	x	x
Grants	x		x	x				x		x	x	x
Loans	x		x					x			x	
Preferential tax rates						X		x				x
Lower social security contributions												x
Faster amortisation						X			x			x
Tax-free amounts								x				x
Preferential land /infrastructure rates										x	x	
Tax deductions				x		X		x	x	x	x	x
Tax exemptions				x				x	x			x
Patent-related incentives						X		x		x		x
Tax holidays				x					x			x
Financial support											x	x
Faster government approval process												x

Source: prepared by PEI based on ey.com, pwc.com, Deloitte.com data.

4. Case studies — cooperation on projects and business successes

Innovative cooperation

Cooperation potential — TSI digital projects

The Three Seas Initiative countries have created a joint list of 91 priority investment projects, worth around EUR 168.4 billion in total (www1). Most of the projects concern transport (48%) and energy (38%). Just 14% are digital projects. They seek to increase the region's security and digital integrity and raise standards in this area to the EU level. The potential for cooperation on digital projects is huge, as the demand for digital infrastructure investments in the TSI region is estimated at around EUR 160 billion by 2030 (www2).

Most of the projects currently being implemented are financed using EU funds (around 49% of them from the Connecting Europe Facility (CEF), the EIB, and others). 24% of the projects are financed using national funds, and 9% using the Three Seas Initiative Investment Fund, the commercial investment fund established in 2019 on Bank Gospodarstwa Krajowego's initiative, which currently has EUR 928 million in funds collected from contributions from institutions in the TSI countries. In addition, at the Three Seas Initiative Summit in Riga 2022, the U.S. International Development Finance Corporation and the Fund agreed on the preliminary conditions for the transfer of up to USD 300 million.

So far, one digital project has been implemented using money from the Three Seas Initiative Investment Fund: Greenergy Data Centers in Estonia, which opened in February 2022. The cost amounted to around EUR 40 million. It is the largest data centre in the Baltic region, with plans to expand it; for now, the first building out of three has been built. The centre's task is to provide computing power, storage and connectivity for enterprises and other clients from the entire TSI region. Greenergy has highly advanced security against data theft and is powered by renewable energy sources. It is also the second completed project financed entirely from the Three Seas Initiative Investment Fund.

One of the ongoing TSI projects is the Central European Drone Demonstrator (CEDD). This project, in place since 2018, was financed from national funds by the Polish Ministry of Infrastructure as part of the "Żwirko i Wigura" programme. The CEDD's aim is to develop system and legal solutions for the safe use of drones to provide commercial and public services in public space. The project's implementation within the TSI framework is meant to consist in establishing cooperation with other countries in the group and disseminating the solutions in the region.

Other projects are still in the planning phase. These include both domestic projects that – similarly to the CEDD – have the potential to be expanded to the entire TSI region and ones being created for a larger number of TSI countries from the start. The first group includes the expansion of broadband connections in Croatia. The second includes the implementation of 5G connectivity and connected and automated mobility (CAM) in the North Sea — Baltic Sea transport corridor, the construction of a digital platform for monitoring hydrographic bases in the TSI region, and construction of the Three Seas Digital Highway. The TSI countries therefore have proposals for developing the digital sector. The next step is to ensure adequate funding for the proposed projects.

Regional success stories

The Three Seas Initiative region has seen the development of many innovative companies and success stories. According to the list prepared by DigitalPoland (2022), there are 19 tech companies valued at over USD 1 billion (so-called "digital phoenixes") in the region, 38 between USD 250 million and USD 1 billion ("digital dragons") and 38 between 100 million USD and USD 250 million ("digital wolves"). These smaller companies are still developing rapidly. The global slowdown in tech has affected digital phoenixes, but digital dragons gained over 70% in value last year, and digital wolves around 25%. This section provides brief descriptions of the leading tech companies from the region.

Bolt

Bolt was founded in Tallinn in 2013 under the name Taxify. The mobile app was meant to offer users a convenient way to order a taxi. By the end of 2014, the company had raised just over EUR 1.4 million in funds from investors (www5). It continued to grow and, from 2017, started raising funds in investment rounds, reaching EUR 148 million in revenue in 2019. Despite significant losses caused by the COVID-19 pandemic and the need to cut wages, the company did not decide to lay off staff.

Further successful rounds of institutional investments have been accompanied by expansion to new markets and services. They now include food delivery, its own online supermarket, scooter and electric bike rental services, and even private car sharing. With the completion of round F, in which

the company raised EUR 628 million, its valuation reached EUR 7.4 billion (www6).

The Estonian unicorn currently employs over 3000 office workers globally and has over 100 million users on five continents (www7). According to CEO Markus Villig, Bolt could generate a profit over the next year and will be ready to go public in 2025 (www8).

UI Path

Founded in Bucharest in 2005, UI Path is a robotic process automation company. After 2015, the company's revenue appeared to grow exponentially. Its revenue rose rapidly from USD 1.2 million in revenue in 2015 to USD 5 million in 2016, USD 50 million in 2017 and nearly USD 200 million in 2018 (www9). Since 2015, the company has also been raising funds in successive rounds of institutional financing.

In March 2018, UI Path's valuation exceeded USD 1 billion, making it the first Romanian tech unicorn. All the institutional funding rounds, including USD 750 million from the F round in 2021, have contributed nearly USD 2 billion in funding. In 2021, the company announced a public offering on the New York Stock Exchange, with a valuation of USD 35 billion at the time (www10).

Vinted

Vinted is the first Lithuanian tech company that has managed to achieve unicorn status, with a market valuation of over USD 1 billion. Founded in 2008, the platform is an online marketplace for users looking to sell used clothes and fashion accessories. After changes in strategy in 2016, which abolished fees for listing products, the platform’s popularity increased significantly. Vinted decided to pass the fees on to the buyers, charging a commission of a few percent, while offering users Buyer Protection as part of the fee. In 2018, the company had already raised EUR 50 million, with 25 million users in 11 markets (www11).

The capital round in 2019 enabled the platform to raise EUR 128 million and increase its valuation to over EUR 1 billion, thereby achieving unicorn status. The next round of funding, in 2021, resulted in EUR 250 million raised and a valuation of EUR 3.5 billion. That year, the company had 45 million registered users and was present in 12 European markets and the US (www12).

By the end of 2022, Vinted had 80 million registered users in 19 countries. It had also launched a new service, Vinted Go (www13), parcel machines designed to make it easier to use the platform's services, which are currently being introduced in French agglomerations.

In Europe, the home of the world's largest fast fashion brands, such as H&M or chains owned by the Inditex group (Zara, Bershka, Pull&Bear and others), Vinted has helped change people’s approach to second-hand clothes and had a positive impact on the development of the circular economy.

InPost

Established in 2006, the Polish courier company is now one of Europe's largest last-mile delivery operators. This means that it delivers parcels to collection points, both parcel machines and Pick Up Drop Off (PUDO) points. Since 2009, InPost has been developing a network of its own Paczkomat® parcel machines.

In 2019, InPost withdrew from the Warsaw Stock Exchange after being listed for less than two years. In 2021, it debuted on the Amsterdam Stock Exchange with a valuation of EUR 9.5 billion (www14). The company used the knowledge — as well as the logistics systems and mobile apps — it had developed in Poland when expanding to other European markets.

InPost is now the fourth-largest last-mile delivery operator in Europe in terms of the number of points; it has over 52,000 in Poland, France, Spain, Britain, Italy, Portugal and the Benelux countries. At the end of 2022, it was also the largest operator of parcel machines in Europe (27,900 points), ahead of global companies such as DHL and DPD (www15).

PayHawk

Founded in 2018, PayHawk is a Bulgarian fintech start-up that deals with managing expenses in an organisation. It offers an interface centralising the payment system, including the ability to track expenses and connect employees' business payment cards to it, among other services (www16). Some PayHawk solutions can be integrated with selected accounting and ERP systems.

In 2022, the start-up added USD 100 million to its Series B funding round, increasing its valuation to USD 1 billion and making it the first Bulgarian unicorn (www17). It currently operates in 29 countries, focusing on providing services to small and medium-sized enterprises (SMEs).

Eurowag

Eurowag is a Czech fintech platform offering fuel card and innovation services for shipping companies. It also offers fleet management, road toll settlement and the handling of tax refunds from foreign payments.

The company debuted on the London Stock Exchange in 2021 with a valuation of EUR 1.98 billion (www18). It currently operates in 30 countries, serving over 300,000 vehicles and enabling them to use over 15,000 petrol stations (www19). According to the company, 90% of its customers are SMEs that only use technology to a limited extent (www20).

5. Prospects for the development of the sector in the region in times of uncertainty

The events of the past few years have strongly influenced the Three Seas Initiative countries' prospects. The COVID-19 pandemic, Russia's invasion of Ukraine and the uncertain economic situation have tested individual countries' resilience. In this context, **the ICT sector has turned out to be the region's strong point. Employment has continued to grow, especially in IT services, and new unicorns — IT companies valued at over USD 1 billion — have emerged in the region in recent years.** Nineteen have emerged since 2020, according to some sources; this list does not include UI Path, a Romanian company based in the US, which is valued at over USD 30 billion. Estonian companies are the leaders in Europe in terms of the value of VC investments per capita (www21). It is also worth emphasising the resilience of the region, which is attracting a growing number of investments in IT services, the size of which keeps growing.

Changes in global trade and growing tensions are resulting in nearshoring; that is, moving production to countries located closer to end markets. While this trend had not been clearly visible in the data until 2021 (Ambroziak et al., 2023), it could accelerate in the coming years due to the disruption of supply chains in the Pacific region and growing technological competition with China. The TSI countries could be the beneficiaries of these changes. One example are Intel's plans to invest in plants in Poland, incorporating the country into the production chain of one of the key technologies in the modern economy.

The TSI region's weakness is undoubtedly the lack of a developed brand and limited regional cooperation. The ideas collected in this report show the potential for cooperation and regional development, but the scale of the region's needs and the pace at which projects are being implemented do not guarantee a breakthrough in the coming years. Meanwhile, the war in Ukraine — as well as Ukraine and Moldova's rapprochement with the EU and TSI countries' significant role in supporting Ukraine's aspirations — point to a need to redefine some of the Three Seas Initiative's assumptions. Openness

to Ukrainian refugees and material support could be followed by enhanced cooperation between IT ecosystems, especially when it comes to business development and training staff.

Significant infrastructure investments, including in digital infrastructure in the region, are needed. This should be followed by programmes to improve digital skills and educate specialists in the field of IT and modern technologies. The region will attract further investments in production (as a result of relocation and the shortening of production chains), but the lack of qualified staff or the infrastructural deficiencies increasingly emphasised by companies could constitute a barrier. At the same time, the TSI countries have an opportunity to further strengthen their positions in services — not just services provided for foreign corporations, but also the development of their own competences. For example, this can be seen in cybersecurity, where further development can be based on solid foundations — the experience of leading companies (Czech Avast) and institutions in the region (ECCC in Bucharest), as well as the experience of recent years and the need to repel more cyberattacks.

As Europe implements the Digital Decade, the EU's new digital strategy, we need to define goals at the national level, as well as ways to achieve them, rethinking and redefining ambitions at the national level. At the same time, the growing emphasis on international projects as part of the Digital Decade and other EU initiatives could lead to closer regional cooperation; a uniform definition of goals and achievable synergies. These kinds of multilateral benefits could manifest themselves in joint projects seeking to develop skills or digitise companies, but also in the strengthening of the region's position in global value chains, attracting investments, and accelerating digital convergence and improving the TSI countries' position on the EU and global digitisation and innovation map.

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The Polish Economic Institute

The Polish Economic Institute is a public economic think tank dating back to 1928. Its research primarily spans macroeconomics, energy and climate, foreign trade, economic foresight, the digital economy and behavioural economics. The Institute provides reports, analyses and recommendations for key areas of the economy and social life in Poland, taking into account the international situation.

CEE Digital Coalition

CEE Digital Coalition is an informal gathering of the digital and advanced technologies industry of Central Eastern Europe. It brings the region together on its digital path and works to boost the digital transformation of the region's economy and informational society. The Coalition strives to promote close cooperation between the countries of CEE in the digital aspect. The Coalition has been initiated by the Digital Poland Association in 2020 and is made up of 18 organisations from 11 CEE countries.

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