Comparative Analysis of ICT Utilization in Trade: The Case of Serbia and Türkiye

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Abstract

In this paper, the authors analyse the effects of information and communications technology (ICT) on international trade. The aim of this work is to point out the importance of the technology in facilitating trade and reducing trade costs. In particular, we consider the role of internet connectivity, e-commerce development and the use cases of some particular aspects of the technology, namely, websites, social media and artificial intelligence. Our descriptive study compares the patterns of the application of the aforementioned technologies in the trade of Serbia and Turkey, using the European Union adoption levels as benchmark. Based on the results of our comparative study, we highlight the most notable differences in terms of business and trade adoption of information and communication technology and exemplify the required support activities. The use of ICT is an important tool in facilitating trade and speeding up trade procedures.

Keywords: ICT, comparative study, international trade, artificial intelligence, Serbia.

1. Introduction

The rapid advancement of digital technologies had a transformative impact on global economies, reshaping industries and redefining the ways in which international trade is conducted. As businesses increasingly adopt digital tools, the ability to participate in and benefit from the global economy is becoming more dependent on the effective utilisation of these technologies. In the beginning the use of new technologies in business gave companies strategic advantage, but not is a necessity to keep them competitive.

However, the inclusiveness of this digital transformation is a significant concern, as not all countries or regions are equally equipped to capitalise on the opportunities it presents (Bjelić, 2012, p. 12; Lythreatis, Singh, & El-Kassar, 2022). Digital divides, though gradually narrowing, still pose substantial barriers to many developing nations. While global internet access has increased, many businesses and individuals in emerging markets continue to face challenges in leveraging the full potential of the data-driven digital economy.

The uneven distribution of value creation from information and communication technology highlights the disparities in how different regions and enterprises benefit from the digital economy. In this context, understanding the role of information and communication technology in trade is crucial for fostering more inclusive economic growth and ensuring that developing economies can integrate more fully into the global trade system (Adeleye, Adedoyin, & Nathaniel, 2021). There is whole new body of literature dedicated researching links between export and ICT, most of them we presented in literature review section.

The objective of this paper is to examine the state of information and communication technology adoption in business, with particular emphasis on its implications for international trade. The study focuses on Serbia and Türkiye, two countries at different stages of digital transformation, and uses the European Union as a benchmark for comparison.

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Through a comparative analysis based on the most recently available data, this paper evaluates the performance of enterprises in Serbia and Türkiye, identifying key patterns and differences in information and communication technology utilisation. The analysis highlights the strengths and weaknesses of each country in relation to their technology adoption and the extent of its use as well as development levels of necessary infrastructure, offering valuable insights into how digital technologies can drive international trade and economic integration in general. This study also underscores the importance of closing digital divides to ensure that the benefits of the digital economy are more equitably distributed, enabling greater participation in global trade.

The remainder of this paper is structured as follows. The next section provides an overview and synthesis of the existing theoretical and empirical literature that investigates the links between information and communication technology and trade. The results of our comparative analysis are presented and discussed in Section 3. The final section concludes.

2. Literature Review

Many studies emphasize the significant role of ICT in promoting international trade. The first works on this topic were carried out by Freund and Weinhold (2002). They assessed the impact of the Internet on the provision of international services and found that a 10 percent increase in the Internet was associated with a 1.7 percent increase in exports and a 1.1 percent increase in imports. The work of Suh and Kan (2003) is also from that period, where they investigate the impact of increased investments in information and communication technology infrastructure on exports in 26 developing markets over the period from 1995 to 2000. The results show that increased investments in ICT infrastructure bring positive and significant yields at the national export level.

Clarke and Wallsten (2006) examine whether developing countries export more to developed countries, but not to other developing countries, when Internet penetration is higher. The results showed that Internet access improves export performance in developing countries, but not in developed countries. This is interpreted to mean that the increased use of the Internet stimulates exports from poor countries to rich ones.

Hinson and Adjasi (2009) in their study, they report on the effects of Internet use on exports in Africa. They used a panel data regression approach with data from secondary sources in selected African countries. Results showed that Internet use of 1 percent was associated with an increase in exports of 2.2 percent, indicating the importance of the Internet in reducing the cost of exports of African economies.

The panel data model was used by Vemuri and Siddiqi (2009). They observed data for 64 countries for the period from 1985 to 2005 and made a comparison of international trade before and after the commercialization of the Internet. The results showed an unequivocal and strong impact of ICT infrastructure and Internet availability on commercial transactions and the volume of international trade.

Studies have shown that the effect of ICT on trade growth depends not only on ICT infrastructure but also on its use. In this regard, Liu and Nath (2013) used panel data for forty developing countries from 1995 to 2010 and found that Internet subscriptions and Internet access have significant positive effects on both exports and imports in developing countries. Gelvanovska, Rogi, and Rossotto (2014) report that broadband access contributes to trade in this region. The study showed that a one percentage point increase in Internet use increases exports by 4.3 percentage points.

The positive impact of ICT infrastructure on trade and trade costs was also supported by study of Donaubauer et al. (2018). The study evaluates the impact of infrastructure on bilateral trade for a panel of 150 developed and developing economies over the period 1992-2011. The paper uses a gravity approach to disentangle the impact of infrastructure on trade and trade costs. The decomposition of the effects indicates that better infrastructure encourages higher export flows relative to domestic trade flows. Similar conclusions are reached in their work by Portugal-Perez and Wilson (2012). Based on data for more than 100 countries in the period 2004-07, statistical findings prove that the impact of physical infrastructure and information and communication technology on exports becomes more important as the country becomes richer.

Next, Thiemann, F., Flemming, E., and Mueller, R. A. E. (2012) test the hypothesis of the impact of ICT on trade in individual agricultural products. They use a gravity model of international trade between exporting and importing countries for the period 1995–2009. The model explains the value of trade in terms of the level of Internet and mobile phone penetration in exporting and importing countries, as well as a wide range of factors that can also affect bilateral trade. The model results suggest that mobile phone penetration significantly stimulates trade. Using an extended panel gravity model framework, which includes 35 countries that import Turkish goods and 34 countries that export goods to Turkey, the effects of information and communication technology (ICT) on international trade between Turkey and its trading partners are examined (Ozcan 2018). He results show that ICT has a positive and significant impact on Turkey's import and export volumes. Another study explores the interdependence of the Internet and bilateral trade flows using a panel of 21 developing and least developed countries and 30 OECD countries. Empirical results suggest that easier access to modern information technologies and the adoption of e-commerce applications stimulate bilateral trade flows at different levels.

Some studies analyzed the importance of information and communication technology (ICT) in relation to the volume of international trade and undertook a comparative analysis of the BRICS countries using panel data from 2000 to 2016 (Wang and Choi 2019; Wang and Li 2017). The findings were very mixed. They showed that (1) the effect of ICT was more positive on exports than on imports, (2) the effect of the level of ICT on trade increased over time, and (4) the level of ICT improvement had more positive effects on trade in labour-intensive countries than in resource-intensive BRICS countries. Similar results are obtained in studies that focus on individual countries. For example, Feiguine and Solovyova (2014) analyzed the impact of investments in information infrastructure on Russia's international activities. The results show that investments in ICT are considered a factor of the international competitiveness of the Russian economy, and the dynamics of export volumes and the openness of national economies are used as the main criteria for comparison. In examining trade liberalization in Asia, Ismail, N. W. and Mahyideen, J. M. (2015), the impact of ICT infrastructure and the volume of trade, imports and exports was also investigated. The results clearly indicated that soft infrastructure significantly improves trade and so on a 10% increase in the number of fixed and mobile phone subscribers in both exporter and importer countries increases trade by 2.6% and 2.2%, respectively. In the same vein, they estimate the impact of aggregate indicators of soft infrastructure on the export performance of developing countries Portugal-Perez, A. and Wilson. J. (2010). Four new indicators are derived for more than 100 countries in the period 2004–07. The estimates show that the impact of information and communication technology on exports becomes increasingly important as a country becomes richer.

With the appearance of longer time series, it has become possible to investigate the relationship between ICT and exports. Among the first researchers to do so is Lin (2015), who analyzed 200 countries from 1990 to 2006 year. Estimated the effect of the Internet on trade by augmenting the gravity equation with the Internet. The empirical results show that a 10% increase in the

Internet users increases international trade by 0.2%–0.4%. Dynamic gravity model also used by Rodriguez-Crespo, Marco, and Billon (2021). They examine panel data for 2004–2013 and find a significant and positive relationship between each type of ICT and bilateral exports, although the effects vary by technology type.

3. Comparative Analysis

As previously discussed, information and communication technology have a great potential for application in business in general. Furthermore, it is conductive for international trade (Freund & Weinhold, 2004). In this section we consider various applications of information and communication technology in business and, in particular, trade.

We make a comparison between Serbia and Türkiye based on the data provided by Eurostat. By doing this, we exemplify differences in patterns of technology applications and highlight the most important differences between the countries. Thereby, both countries are compared to the EU-27, which serves as a benchmark.

The application of information and communication technology in international trade relies heavily on the existence of proper infrastructure. This includes the access to the internet, which allows for information exchange and sophisticated applications of technology in business processes. Thus, we begin our analysis by comparing the share of companies with the access to the internet in Serbia, Türkiye, and the EU-27 countries. Considering that the Internet became widespread, to exemplify the differences in the quality of infrastructure, we focus on the access to higher speed DSL or broadband Internet. In addition to the levels of internet access, we also consider how internet access for the enterprises has evolved in the observed countries since 2017. This is presented in Figure 1.

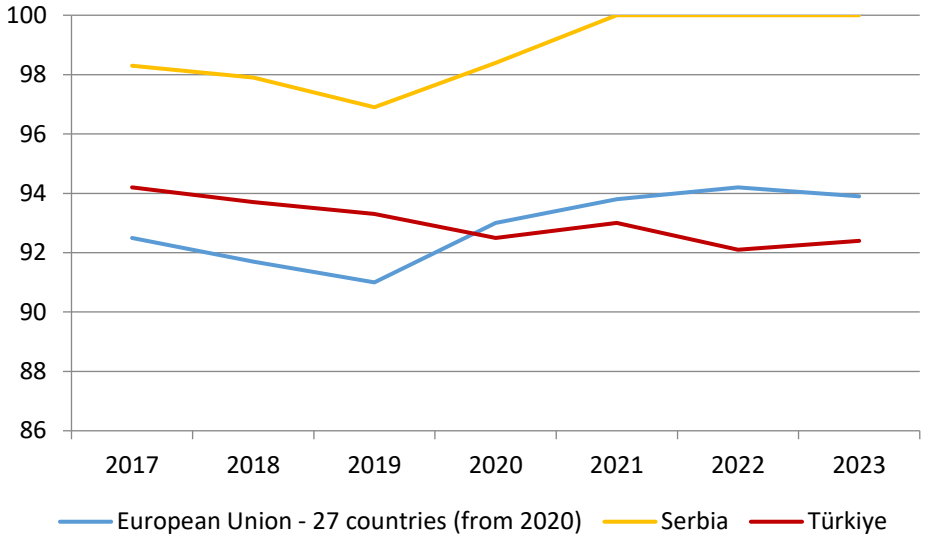

Figure 1. Enterprises using DSL or broadband internet (2017-2023)
Source: Authors, based on the Eurostat data.

In 2017, all the observed countries exhibited a remarkably high percentage of enterprises with Serbia leading, having 98.3% enterprises with broadband internet access, surpassing both Türkiye at 94.2% and the EU-27 at 92.5%. This suggests that Serbian enterprises had comparatively robust Internet connections and solid basis for further implementation of information and communication technology in business processes.

Over the years, the EU-27 showed a steady improvement in broadband internet access among enterprises, with a slight dip in 2019 but recovering to reach 94.2% in 2022. This consistent high level of connectivity indicates a strong digital infrastructure across the EU-27, essential for maintaining competitiveness and integration in the global market. In contrast, Türkiye experienced a gradual decline in broadband access, dropping from 94.2% in 2017 to its lowest at 92.1% in 2022. This downward trend could reflect challenges in upgrading digital infrastructure within Turkish enterprises.

Serbia's trajectory is notably distinct, showcasing a complete broadband access among its enterprises since 2021. The maximum level of broadband internet access has been maintained over the following years. This could indicate robust development of the infrastructure. In addition, the consistent full coverage of broadband internet is in line with Serbia's policy prioritisation of digitalisation.

To investigate potential heterogeneity of internet access within enterprises of different characteristics, we consider the Internet access by firm size. The results of this comparison are presented in Table 1.

Table 1. Internet access by size of enterprise (2011-2018)

Country / Year	2017	2018	2019	2020	2021	2022	2023
Small enterprises							
European Union - 27	97.0	97.1	97.3	97.9	98.3	98.9	98.9
Serbia	99.7	99.1	99.8	100	100	100	100
Türkiye	95.7	95.2	94.2	94.7	95.2	95.9	95.9
Large enterprises							
European Union - 27	99.7	99.7	99.7	99.8	99.8	99.9	99.9
Serbia	100	100	100	100	100	100	100
Türkiye	99.7	99.2	99.6	99.4	99.9	99.8	99.7

Source: Authors, based on Eurostat data (accessed on 10 September 2024)
Note: The values are expressed in percentages. Small enterprises denote enterprises with up to 250 employees, whereas large enterprises denote enterprises with over 250 employees.

The comparison reveals that both groups of enterprises in all countries exhibit exceptionally high levels of access to the Internet. However, there are some notable differences across types of enterprises and countries alike. For instance, there is a clear pattern of nearly all large enterprises having the access to the Internet. Smaller enterprises, albeit also having a high level of internet access, do systematically access the internet less than their large counterparts.

For small enterprises, Serbia demonstrated an almost perfect internet access rate among small enterprises, achieving 100% from 2020 onwards. This could indicate maximal potential for adoption of information and communication technology in trade in all small enterprises, which could be crucial for improving the efficiency of their operations and, thus, their international competitiveness. Türkiye, however, experienced a slight decline in internet access among small enterprises, dropping by 1.5 percent points between 2017 and 2019.

During the Covid-19 period, the use of internet among small enterprises grew, helping the rate recover to 95.9% by 2023.

At the same time, the EU-27 showed a steady increase in internet access in the observed period, starting at 97% in 2017 and reaching 98.9% by 2023. This gradual improvement reflects the adaptation of small enterprises to increasing digitalisation and changing demand. This suggests that the increasing number of small enterprises across Europe has the potential to take advantage of the information and communication technologies in their business processes, which is comparable to two countries in the focus of our analysis.

For large enterprises, the EU-27 maintained a consistently high level of internet access. This stability indicates that large enterprises in the EU-27 have long enjoyed reliable internet access, which is essential for their complex and extensive operations and their trade activities. The access to internet among the large enterprises is comparable in Serbia, where the data indicates that practically all enterprises in this category has access to the Internet from 2017 to 2023. Türkiye's large enterprises also maintained high levels of internet access, with minor fluctuations, starting at 99.7% in 2017 and ending at 99.7% in 2023. Despite these minor changes, the overall high level of internet access indicates that large enterprises in Türkiye have access to the Internet.

The differences in internet access among small and large enterprises in these regions have significant implications for international trade. Serbia's near-perfect internet penetration rates for both small and large enterprises suggest that Serbian businesses are well-equipped to engage in international trade, leveraging digital tools and platforms requiring internet (and other ICT infrastructure) to reach global markets. This high level of connectivity provides a platform for implementation of other technologies that could affect their international competitiveness, allowing them to efficiently manage supply chains, communicate with international partners, and access the information on foreign markets. In contrast, Türkiye's slight decline in internet access among small enterprises could pose challenges for these businesses in engaging in international trade. Inconsistent internet access may hinder their ability to fully utilize digital tools, potentially limiting their competitiveness. However, it should be noted that a significant change in this direction would require a more drastic fluctuation in Internet access.

The methods of accessing the internet are also changing over time. Previously, the access to the internet was mainly tied to the use of computers by the workforce. Over 2010s and 2020s, there has been a significant increase in mobile internet use in enterprises as well on the global level. The extent to which the mobile connections to the internet are used and how they evolved between 2018 and 2022 is presented in Figure 2.

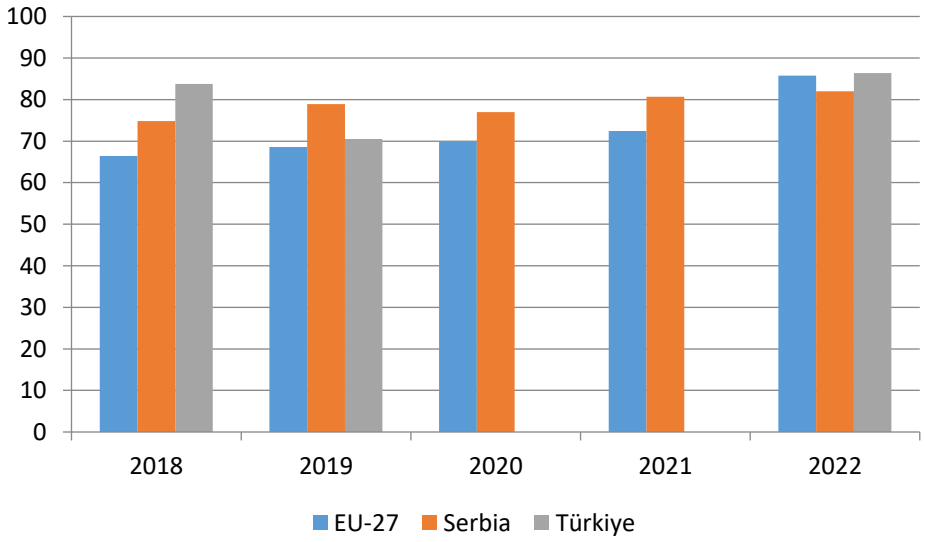

Figure 2. Percentage of Enterprises Providing Their Employees with Mobile Devices with Connection to the Internet (2017-2023)

Source: Authors, based on the Eurostat data.

Both Serbia and Türkiye are characterised by relatively large and increasing use of mobile internet in enterprises. The growth is higher in Serbia, where the number of enterprise providing their employed with mobile devices with connection to the internet grew by 9.6%. The growth rate in Türkiye was over three times lower. However, due to higher initial usage of mobile

internet, the extent in which the enterprises provide this type of internet access to their employees is higher in Türkiye than in Serbia by 4.4 percent points. The use of mobile internet in the enterprises in EU-27 countries is comparable to that of Turkey.

The access to the Internet via mobile devices could be particularly relevant for promoting international trade, as it improves the possibilities of the employees to communicate and collaborate internationally, while not necessarily be tied by the hardware located in the firms' premises. Additionally, the access to mobile devices with Internet has become increasingly important during and after the Covid-19 period as it enhances the possibilities of employees to work remotely and conduct foreign trade operations more effectively, while reducing the need to physically travel and attend the meeting and trade negotiations. As a result, the use of this technology has the potential to increase efficiency in conducting foreign trade overall.

The aforementioned remote work and work-related meeting which potentially improve efficiency and flexibility of conducting international trade differ among countries, as well as among different types of firms. The patterns of these differences are explored in Table 2.

Table 2. Meetings via the Internet by Size Class of Enterprise (2023)

Country / Year	Serbia	Türkiye	EU-27
Enterprises, which conducted remote meetings via the internet			
Small	44.0	26.6	34.9
Medium	76.0	45.8	57.7
Large	93.0	76.0	82.4
Enterprises, which have ICT security guidelines for conducting remote meetings via the internet			
Small	26.5	12.1	19.3
Medium	53.9	28.5	41.3
Large	75.8	57.0	58.7
Enterprises, which have guidelines for favouring remote meetings via the internet instead of business travelling			
Small	18.2	14.6	11.2
Medium	37.1	26.7	25.7
Large	58.3	47.8	41.5

Source: Authors, based on Eurostat data (accessed on 11 September 2024)
Note: The values are expressed in percentages. Small denote enterprises with up to 49 employees, medium – enterprises with 49-250, whereas large denotes enterprises with over 250 employees.

The data reveals a clear pattern of the use of internet for remote work growing with the size of the company. In small enterprises category, the firms conducting remote meeting over the Internet are a minority in all the observed countries, with Türkiye notably lagging behind. Serbian small enterprises, in contrast, have a higher usage of internet for remote meeting even when compared to the levels of the European Union. On one hand, it could indicate greater adoption of information and communication technologies for improving the flexibility of employees and reducing the effects of physical distance, which is essential for increasing participation of small enterprises in international trade. On the other hand, it could also be the effect of more lax labour regulation in Serbia in comparison to the European Union, which could allow greater involvement of employees in work outside the regular hours, aided by the adoption of new technology. Similar differences among countries are present is the other two categories of enterprises, where Serbia has a strikingly high adoption of this novel approach of conducting meeting with 93% large enterprises conducting them over the Internet.

The increase in flexibility and the effects of remote work on costs are underlined by the data describing the approach of firms in regards to substituting business travel with remote meetings. This is, again, more common in large enterprises, where around half enterprises in both Serbia and Türkiye favour Internet meeting over business travelling. In both countries, the share of such enterprises is higher than in the European Union. This could suggest cost sensitivity of large enterprises in Serbia and Türkiye in this aspect of their operations. It implies that the adoption of new technologies of conducting work remotely could significantly reduce costs of negotiating and conducing international trade deals, and, thus, improve the competitiveness of enterprises in the two countries. Surprisingly, small and medium enterprises appear to substitute business meeting less with remote online meetings. The adoption of remote meeting is particularly low in small enterprises. This could be caused by lower geographic dispersity of their economic activities, reducing the potential cost savings effects of remote work adoption. However, the low adoption rates also highlight great potential for small and medium enterprises for reducing costs of conducting international trade, particularly in regards to the activities requiring travelling.

It is worth mentioning that conducting work remotely is not without risks. Remote works poses challenges to the information security of the enterprises. Therefore, it is recommended to have guidelines for managing the ensuing risks arising from remote work. This is recognized by large enterprises, where the majority of enterprises in Serbia and Türkiye, as well as the European Union, have such guidelines in place. However, the shares of enterprises adopting the guidelines do not match a much greater share of enterprises adopting remote meetings. This implies heightened cybersecurity risks for the enterprises. The discrepancy is, however, lower in both Serbia and Türkiye, compared to the difference level in the European Union. Expectedly, with the decrease in the enterprise size, the formal regulation of the use of remote meetings also decreases, which increases the associated risks of adopting remote work strategies for the small and medium enterprises.

Remote work, however, implies more than merely online meetings. In addition to this, the effective conduit of business operations remotely, requires the remote access of the employees to the business documents, enterprise software applications, as the like. This aspect of remote work adoption is explored in Figure 3.

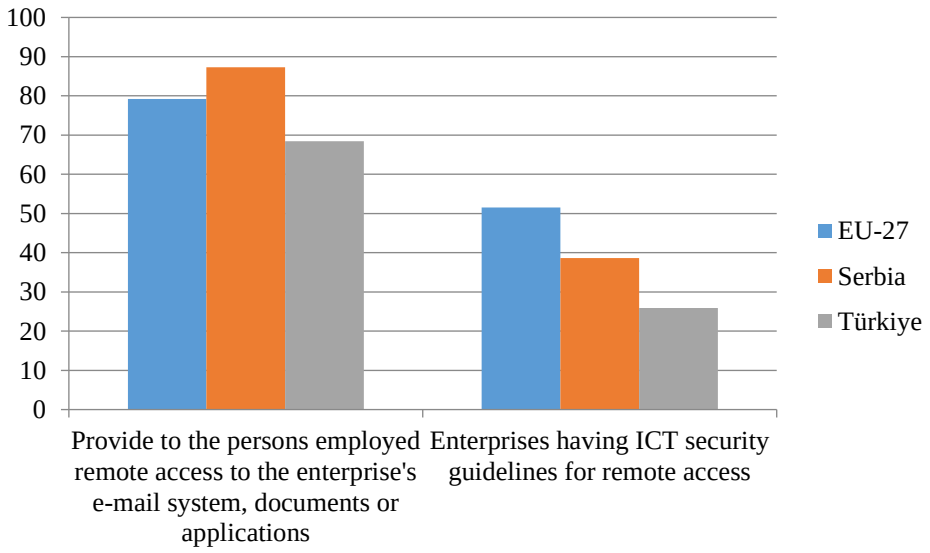

Figure 3. Share of Enterprises Providing Remote Access to Work (2022)
Source: Authors, based on the Eurostat data.

Remote work, observed more broadly, is adopted in higher share of enterprises in Serbia compared to Türkiye. In the case of Serbia, this share is above the European Union level, indicating a notably high adoption of remote work. However, this high share is not followed by adequate security solutions. Namely, approximately half of enterprises in Serbia providing the workers with remote access to work do not have adequate ITC security guidelines in place. The problem is even more notable in Türkiye, where only 25.9% of enterprises had such guidelines in 2022. Both in Serbia and Türkiye, the aforesaid share is lower than that of the European Union. This implies that while extensive adoption of remote work in Türkiye and, in particular, Serbia does provide benefits do large number of enterprises, potentially increasing their international competitiveness, this raises challenges of cybersecurity which need to be addressed in order to effectively realise the benefits of this technology's adoption.

A more directly linked aspect of the use of information and communication technology in trade is related to e-commerce. The e-commerce represents an increasingly important channel of trade both nationally and internationally. Different economic activities provide different opportunities and potentials for increasing international trade in firms through the adoption of this technology (Kastratović & Bjelić, 2022). For this reason, we observe patterns of e-commerce adoption in enterprises not only across the countries in the focus of our comparative analysis, but also across economic activities in Figure 4.[4]

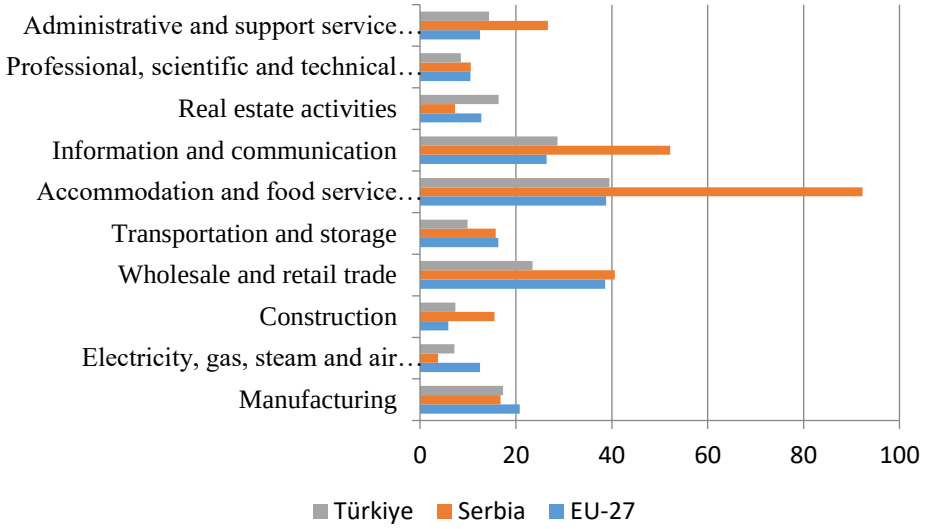

Figure 4. E-commerce sales of Enterprises by Economic Activities (2023)
Source: Authors, based on the Eurostat data.
Note: Values refer to share of e-commerce in sales.

Overall, the differences in e-commerce adoption across economic activities in Serbia and Türkiye highlight the varying levels of digital integration and potential growth areas, as well as potentials of trade-enhancing technology implementation. Namely, robust e-commerce adoption can enhance international market reach, helping the enterprises overcome trade hurdles. Additionally, the adoption of e-commerce provides notable operational efficiencies in foreign trade activities and competitiveness. Relatively high levels of e-commerce adoption in Serbia and Türkiye present a good platform for greater integration of their respective economies into the world economy.

Serbia has a distinctive advantage in terms of e-commerce usage in its enterprises compared to Türkiye, particularly in various service sectors. Strongest performances of Serbian enterprises

[4] Thereby, we employ NACE rev. 2 classification of economic activities.

in this regards (not only compared to Türkiye, but also the European Union) are present in accommodation and food services (where over 90% of sales are made through e-commerce), information and communication technology (where the share of e-commerce in sales is over 52.2%, supporting strong export already performances of this sector[5]), wholesale and retail, and administrative and support services. Enterprises from Türkiye, in contrast, have notably stronger e-commerce performances in real estate and utilities sectors. In most sectors, the performances of enterprises from both countries are comparable to the level of the European Union, with some sectors in Serbia that were previously emphasised even have a significantly higher use of e-commerce.

We continue by considering differences across countries for individual economic activities. In the manufacturing sector, the EU-27 leads with 20.8% of enterprises engaging in e-commerce sales, followed closely by Türkiye at 17.3% and Serbia at 16.8%. In the sector of electricity, gas, steam, and air conditioning supply, as well as water supply, sewerage, waste management, and remediation activities, the EU-27 again shows a higher percentage of e-commerce sales at 12.5%, compared to Türkiye's 7.2% and Serbia's significantly lower 3.8%.

The construction sector presents a stark contrast, with Serbia having an unusually high percentage of 15.5% of enterprises engaging in e-commerce sales, significantly higher than both the EU-27 at 5.9% and Türkiye at 7.4%. This could reflect specific market conditions or digital initiatives within the Serbian construction industry that encourage online transactions, as well as strong growth this industry has been experiencing in Serbia in 2020s. Enhanced e-commerce adoption in construction can improve the efficiency of procurement processes and project management. This presents a potential for higher intensity of cross-border collaborations and trade supporting the dynamic growth of this sector.

In wholesale and retail trade, Serbia leads with 40.6% of enterprises engaging in e-commerce sales, followed by the EU-27 at 38.6%, while Türkiye trails at 23.5%. The high figures for Serbia suggest robust adoption of e-commerce, which can be leveraged to expand into international markets, given its strategic location.

The transportation and storage sector shows lower e-commerce adoption across all three regions, with the EU-27 leading slightly at 16.3%, followed by Serbia at 15.8%, and Türkiye at 9.9%. Improving e-commerce adoption in this sector can optimize logistics and supply chain management, which could be important factor of supporting and facilitating international trade of other sectors.

As previously mentioned, accommodation and food service activities present an outlier, with Serbia's extraordinarily high percentage of enterprises' sales through e-commerce standing at 92.3%, compared to the EU-27's 38.8% and Türkiye's 39.5%. This striking statistic for Serbia indicates a highly digitalised hospitality sector, which can attract foreign tourists and facilitate cross-border service delivery, supporting the already expanding sectors of Serbian exports (Bjelić, Jaćimović, Kastratović, & Baćović, 2024).

Similar situation can be observed in the information and communication sector. Serbia again leads with 52.2% of enterprises engaging in e-commerce sales, significantly higher than the EU-27's 26.4% and Türkiye's 28.7%. This high level of digital engagement can drive innovation and competitiveness, enhancing Serbia's position in the global digital economy. Moreover, developments in this sector have a strong potential for spillovers in other sectors, improving the access to foreign market for Serbian enterprises overall.

5 The strong export performances of the sector are discussed by Kalinović, Todorović and Marković (2022).

Real estate activities show lower e-commerce adoption, with the EU-27 at 12.8%, Türkiye at 16.4%, and Serbia at 7.3%. Professional, scientific, and technical activities, as well as administrative and support service activities, show moderate e-commerce adoption across all regions. The EU-27 and Serbia have similar figures in professional activities, while Serbia leads in administrative services. Enhancing e-commerce in these sectors can improve service delivery and operational efficiencies, establishing contact, accessing the market information, and, generally, supporting international trade.

The disparities identified in this segment of the analysis suggest that Serbia and Türkiye have substantial room for growth in adopting e-commerce solutions within manufacturing and utility sectors. In the case of manufacturing sector, such change has a particularly strong potential positive effect of integrating Serbian and Turkish enterprises with foreign partners, resulting in stronger international trade performances.

Despite relatively strong performances of Serbian and Turkish enterprises in terms of e-commerce adoption, a question remains whether these performances are driven by locally implemented innovations or if they require outsourced technology and platforms. This is explored by considering the extent of e-commerce sales using enterprises' own capacities (websites and applications). The results of this comparison are presented in Table 3.

Table 3. Enterprises with E-sales from their own Websites and Applications (2017-2023)

Country / Year	2017	2018	2019	2020	2021	2022	2023
European Union	8.9	9	9.9	10.5	11.4	12.4	12.2
Manufacturing	8.3	8.2	7.4	9.1	7.2	8.4	9.1
Electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	2.8	2.1	2.7	3.9	3	3.4	3.2
Construction	21.5	22.7	24.4	25.3	28.6	29.4	31
Wholesale and retail trade; repair of motor vehicles and motorcycles	8.6	8.5	8.1	9.2	8.7	9.1	8.6
Transportation and storage	25.5	26.8	26.1	29.1	33.9	31.3	30.8
Accommodation and food service activities	20.3	20.5	21.5	20.8	21.3	20.9	21.4
Information and communication	7.2	8.3	8.2	8.9	9.9	11.1	10
Real estate activities	n/a	n/a	n/a	n/a	6.6	8.3	7.5
Professional, scientific and technical activities	9.6	9.4	9.7	10.5	10.8	11.8	9.7
Administrative and support service activities	8.9	9	9.9	10.5	11.4	12.4	12.2
Serbia							
Manufacturing	23.2	19.8	n/a	17.6	17.6	13.1	13.6
Electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	8.2	3.9	n/a	6.7	2.8	0.3	2.5
Construction	14.9	19.9	n/a	8.6	7.7	8.4	6.3
Wholesale and retail trade; repair of motor vehicles and motorcycles	21.1	15.7	n/a	21.8	25.4	33.8	37.9
Transportation and storage	17.6	24.3	n/a	23.3	7.8	8.1	9.8
Accommodation and food service activities	38.3	31.8	n/a	48.4	64.6	63	65.3
Information and communication	34.6	22.7	n/a	50.9	49.3	49.6	50.9
Real estate activities	4.1	5.1	n/a	12.2	8	18.1	4.1

Country / Year	2017	2018	2019	2020	2021	2022	2023
Professional, scientific and technical activities	n/a	n/a	n/a	n/a	12.3	5.1	9.1
Administrative and support service activities	41.8	23.9	n/a	33.2	34.1	28.5	26.4
Türkiye							
Manufacturing	n/a	6	6	5.4	6.1	8.4	11.8
Electricity, gas, steam and air conditioning supply; water supply; sewerage, waste management and remediation activities	n/a	0.6	4.3	2.9	2.7	6.4	6.2
Construction	n/a	2.1	2.3	2.1	2.1	3.2	4.5
Wholesale and retail trade; repair of motor vehicles and motorcycles	n/a	8.1	8.9	9.5	11.8	13.9	15.4
Transportation and storage	n/a	4.5	3.7	5.3	3.9	5.8	6.4
Accommodation and food service activities	n/a	15.6	13.3	14.9	16	16.1	20.4
Information and communication	n/a	13.4	12.3	11	8.6	16.9	24.4
Real estate activities	n/a	4.4	6.2	4.3	4.8	9.8	13.3
Professional, scientific and technical activities	n/a	n/a	n/a	n/a	3.7	5.5	5.9
Administrative and support service activities	n/a	4.4	6.4	8.5	6	9.4	10.1

Source: Authors, based on Eurostat data (accessed on 12 September 2024)
Note: The values are expressed in percentages.

The patterns of e-commerce sales from enterprises' own websites and applications reveals significant differences across Serbia and Türkiye, particularly in sectors with the highest growth and absolute values.

In Serbia, the 'Accommodation and food service activities' sector demonstrates the highest engagement in e-commerce, with 65.3% of enterprises utilizing their own websites and apps for sales in 2023. This sector has seen a remarkable increase from 38.3% in 2017, highlighting a significant shift towards digital sales channels. This is in line with the general use of e-commerce in the sector identified previously. The majority of sales in the sector come through the use of own e-commerce capacities, indicating relatively high levels of innovation within the sector. Similarly strong performances are, as expected, characterising the information and communication sector. High levels of e-commerce sales using their own capacities could be explained by generally strong performances of the sector which allow it to digitalise international trade activities not only for the enterprises within sector but also for other enterprises in Serbian economy. Finally, the wholesale and retail sector also shows impressive growth, reaching 37.9% in 2023, up from 21.1% in 2017. These figures suggest a strong digital transformation in consumer-oriented sectors in Serbia. Unlike the first two considered sector, in this sector, the pace of growth is not slowing down and further increase in applications of own e-commerce capacities are expected in the future. This could strongly impact the competitiveness of the enterprises in the sector and is a requirement for expansions of their business activities across borders.

Türkiye is in a somewhat different situation, with the information and communication sector leading in e-commerce engagement using own capacities, reaching 24.4% in 2023. This sector has experienced substantial growth from 13.4% in 2018, indicating a possible reaction to the demand shock introduced by the shift in economic models applied in the pandemic period. The real estate sector also shows notable growth, with 13.3% of enterprises engaging in e-sales in 2023, up from 4.4% in 2018. Overall, however, enterprises in Türkiye appear to rely less on

their own capacities in conducting e-commerce, than their Serbian counterpart, indicating a strong potential for growth in the future.

Within the EU-27, the transportation and storage sector stands out with the highest percentage of enterprises engaging in e-sales using their own capacities, reaching 31% in 2023, which is the only sector with e-sales levels notable above those of enterprises stemming from Serbia and Türkiye. The possible improvement in e-commerce in this sector in both countries could substantially contribute to trade facilitation in other economic sectors. The high engagement in consumer-facing service sectors in the EU-27 and Serbia suggests a strong potential for cross-border e-commerce, particularly in retail and hospitality industries. The untapped potential of e-commerce adoption in Türkiye provides opportunities for growth not only for Turkish enterprises but also for cross-border investment in information and communication technology development and implementation that could contribute to greater linkages between Turkish with the global economy.

Own capacities for conducting electronic business and applying it in international trade activities are further investigated by considering the data on enterprises' websites functionalities. The results of this comparison are provided in Table 4.

Table 4. Websites and their functionalities in enterprises (2014-2023)

Country / Year	2014	2015	2016	2017	2018	2019	2020	2021	2023
Serbia									
Enterprises with a website	73.7	n/a	n/a	80.1	81.8	83.4	84.4	84.5	85.1
Enterprises where the website provided description of goods or services, price lists	68.6	n/a	n/a	74.5	67.6	71.9	73.9	72.1	73.4
Enterprises where the website provided online ordering or reservation or booking, e.g. shopping cart	15.8	n/a	n/a	15	20.5	24.1	23.7	16.2	15.9
Türkiye									
Enterprises with a website	n/a	65.5	66	72.9	66.1	51.5	53.7	49.4	55.9
Enterprises where the website provided description of goods or services, price lists	n/a	42.4	46	62.7	54.2	50.8	53	48.4	55.7
Enterprises where the website provided online ordering or reservation or booking, e.g. shopping cart	n/a	7.7	7.6	6.9	6.0	8.0	6.4	7.4	9.2
EU-27									
Enterprises with a website	72.7	74.5	76.1	75.8	76.4	76.7	76.7	77.8	78.1
Enterprises where the website provided description of goods or services, price lists	55.0	53.4	55.2	55.7	55.8	52	61.0	62.1	63.1

Country / Year	2014	2015	2016	2017	2018	2019	2020	2021	2023
Enterprises where the website provided online ordering or reservation or booking, e.g. shopping cart	16.4	17	18.4	19.6	18.4	18.8	20.4	21.7	22.2

Source: Authors, based on Eurostat data (accessed on 12 September 2024)
Note: The values are expressed in percentages.

The enterprises in Serbia have already built their web presence by 2014, as suggested by the comparable share of enterprises with a website. This share in Serbia grew dynamically over the next 10 years significantly surpassing the levels of the EU-27 since 2017. Most of the enterprises in Serbia use websites not only to promote the existence of the enterprise and provide basic contact information, but also to provide detailed information about their products and services. As this marketing channel is less costly than comparable traditional channels, it comes as no surprise that the number of Serbian enterprises adopting websites as a tool of promotion is large and growing. This is further supported by conductive economic policies focused on digitalisation and innovation, as well as well-developed digital infrastructure that enables the creation and hosting of websites at relatively low. Additionally, well-developed infrastructure also means better connectivity to these websites, allowing for their wider reach. More sophisticated systems integrated within websites are used by a smaller share of enterprises. This share has been on a steady decline since 2019, and it reached 15.9% in 2023, which is significantly lower than in the European Union. This could indicate limited information and technology capacities and capabilities in Serbian enterprises, which could limit greater extent of more sophisticated applications. This issue needs to be addressed for stronger effects of information and communication technologies on international trade.

Türkiye, in contrast, significantly lags behind on both use and functionalities of its enterprises' websites. The share of enterprises with a website has recently been fluctuating at around a half. Particularly notable is the drop in use of website in the period following the pandemic. This could be explained by exacerbated economic conditions in the country. High inflation and currency depreciation increase the costs of conducting business, and in some cases this made it unfeasible for firms to maintain adequate digital infrastructure and presence. Simultaneously, however, the pandemic exerted pressure on more resilient Turkish enterprises to innovate, resulting in increased functionality of websites that were maintained in this period (Koca, Eğilmez, Akçakaya, & Hatipoğlu, 2021).

In addition to websites, an increasingly popular method of promoting products and services are social media. This is evidenced by the strong growth of adoptions of social media channels by enterprises. In the case of Serbia and Türkiye, a comparison was made using the Figure 5.

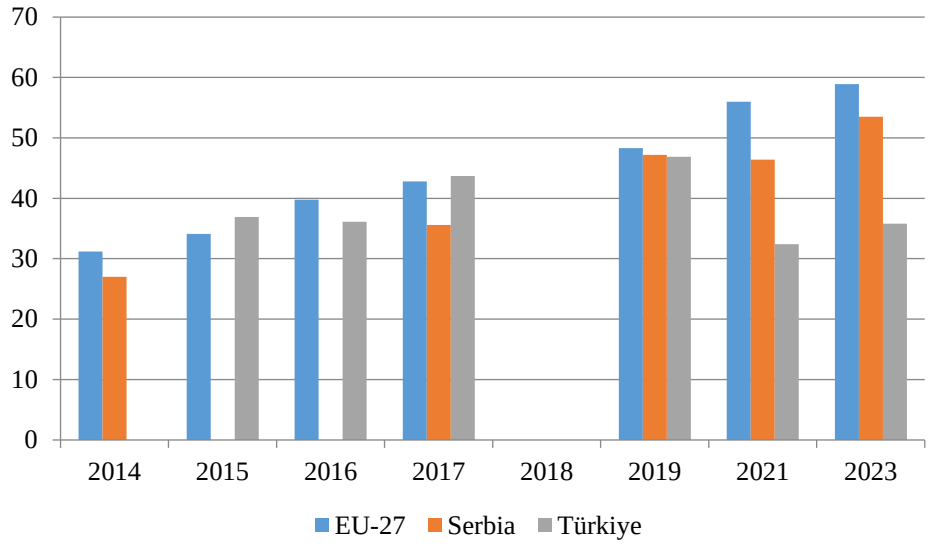

Figure 5. Enterprises having a social network presence (2014-2023)
Source: Authors, based on the Eurostat data.

Serbia's trajectory in social network adoption by enterprises shows significant growth. Starting at 27% in 2014, the percentage rose to 35.6% in 2017 and further to 53.5% in 2023. This trend suggests that Serbian enterprises are increasingly recognising the importance of social media and use it effectively as a marketing channel. It could also indicate a shift towards more modern business practices, which can enhance its enterprises' competitiveness in international markets by improving communication with global customers and partners. Still, the adoption rate of social networks is lower compared to the levels of EU-27 countries, suggesting that there is further potential for improvement.

Türkiye presents a more varied picture. The percentage of enterprises with a social network presence was 36.9% in 2015, slightly decreasing to 36.1% in 2016, then rising to 43.7% in 2017. However, there was a notable decline to 32.4% in 2021, with a modest recovery to 35.8% in 2023. This change in trend could be due to several factors, including economic instability, regulatory changes, and potentially political factors affecting the perceptions of social media users (Budak, 2019; Oz & Yanik, 2024). Although the use of social networks by Turkish enterprises remains significant, they lag behind considerable compared to their Serbian and EU-27 counterparts.

In the EU-27, the percentage of enterprises with a social network presence has shown a steady increase from 31.2% in 2014 to a projected 58.9% in 2023. This consistent growth reflects the increasing recognition of social media as a vital tool for business operations, marketing, and customer engagement. The widespread use of social media platforms enables EU enterprises to reach a broader audience, enhance brand visibility, and engage in more effective marketing strategies, which could have significant implications for international trade. We could, thus conclude, that there is a potential for both Serbian and Turkish enterprises to increase their reach of customers, even across borders, though greater use of modern social media. Namely, enterprises with a strong social media presence can engage more effectively and at lower costs with international customers. The social media platforms also provide solutions and data that enable enterprises to conduct targeted marketing campaigns that could be beneficial in planning and executing internationalisation strategies.

Finally, the latest expansion of the technology which opens significant opportunities for its application in business and international trade in particular is related to artificial intelligence and data analysis. Its application could improve efficiency of conducting international trade and

improve productivity of enterprises in general, again making the successful implementers of this new technology more internationally competitive. For instance, artificial intelligence shows great potential for automating numerous tasks related to supply chain management and optimisation. It can streamline administrative tasks, through its strong and efficient performances in analysing vast bodies of text and other data. In the international financing aspects it has a potential application in fraud detections, which could improve the stability of financial constructions of foreign trade operations. Finally, it is already facilitating localisations and translations and customer service activities, which improve efficiency in operating across various countries.

Despite these potentials, the adoption rate of artificial technology in business is still low. The most recent data provided by the Eurostat suggests that only 8.4% of enterprises already implement artificial technology in their business processes in EU-27 countries. Interestingly, the adoption rate is higher in Turkish enterprises, standing at 9.3%. Serbian enterprises lag strongly in this regard with only 0.8% of all enterprises adopted this technology. This could indicate higher levels of *inertia* and reluctance to change and adapt business processes in Serbian enterprises, compared to Turkish counterparts. However, it is expected, that if current user of artificial intelligence report positive effects of its use on their performances, other new users will follow, which could lead to strong growth in artificial intelligence use in Serbian enterprises in the future.

In addition to general extent of artificial intelligence use in enterprises, we consider in which aspects of business operations they are mainly implemented. These patterns are described graphically in Figure 6.

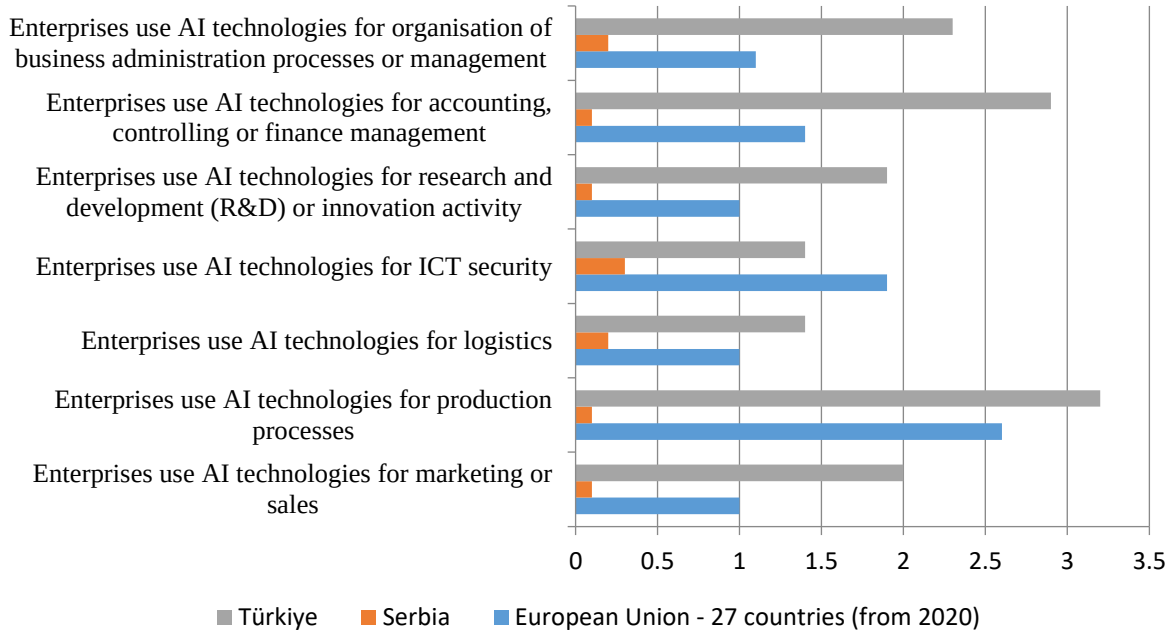

Figure 6. Artificial intelligence use in Enterprises (2023)
Source: Authors, based on the Eurostat data.

The data indicates that enterprises in Türkiye a relatively high adoption of artificial intelligence in nearly all aspect of business operations, with adoption rates significantly higher than those of EU-27 enterprises. The only exception is the use of artificial technology in information and communication technology security. Serbia, in contrast, lags behind Türkiye and EU-27 in all aspects of artificial intelligence applications. However, early use of the technology is concentrated on cybersecurity, administrative processes and logistics, all of which could

significantly contribute to improving the efficiency of Serbian enterprises conducting international trade.

In the realm of marketing or sales, Turkish enterprises lead with 2% of firms utilizing AI technologies, compared to 1% in the EU-27 and a mere 0.1% in Serbia. This suggests that Turkish businesses are more proactive in leveraging AI to enhance customer engagement. For production processes, Türkiye again shows a higher adoption rate at 3.2%, surpassing the EU-27 average of 2.6% and Serbia's minimal 0.1%. This indicates that Turkish enterprises are more advanced in integrating AI into their manufacturing workflows, which can lead to increased efficiency, reduced costs, and higher product quality. The lag in Serbia suggests a need for investment in AI technologies to remain competitive in the manufacturing sector, if the technology brings the expected gains in productivity for its current users.

In logistics, the EU-27 and Turkey show similar adoption rates of 1% and 1.4%, respectively, while Serbia lags behind at 0.2%. When it comes to ICT security, the EU-27 leads with 1.9% of enterprises using AI, followed by Turkey at 1.4% and Serbia at 0.3%. AI technologies in ICT security are crucial for protecting digital assets and ensuring data integrity. The lower adoption rate in Serbia (but also in other considered countries) suggests a vulnerability to cybersecurity threats, particularly if we consider the insufficient regulation and development of this aspect of information and communication technology in the region in general.

For research and development (R&D) or innovation activities, Turkey again shows a higher adoption rate at 1.9%, compared to 1% in the EU-27 and 0.1% in Serbia. In accounting, controlling, or finance management, Turkey leads with 2.9% of enterprises using AI, compared to 1.4% in the EU-27 and 0.1% in Serbia. Artificial intelligence can streamline financial operations, improve accuracy, and reduce the risk of fraud (Kastratović, 2023b, p. 373). Finally, in the organization of business administration processes or management, Turkey again shows a higher adoption rate at 2.3%, compared to 1.1% in the EU-27 and 0.2% in Serbia.

4. Conclusion

In this paper, we explored the relationship between international trade and information and communication technology, focusing the analysis on the patterns of technology applications. Our comparative study, focused mainly on the period between 2017 and 2023 reveals interesting differences between enterprises in Serbia and Türkiye.

In conclusion, both Serbia and Türkiye demonstrate significant progress in developing the necessary infrastructure for advanced applications of information and communication technology in international trade, with Serbia even surpassing the EU-27 average in some respects. The rising use of mobile internet technology in both countries mirrors the broader European trend, highlighting the changing patterns of integration of digital tools in international business operations.

The increasing application of technology, particularly in e-commerce and remote work, shows immense potential for reducing the costs of conducting international trade and, particularly, reducing costs of trade negotiations. Large Serbian enterprises, in particular, have embraced remote work to a much greater extent than their Turkish counterparts, as well as compared to the European Union, a trend that could have significant implications for enhancing trade efficiency. Small and medium enterprises, in comparison, underutilise this opportunity, that could be particularly important in reducing costs of negotiating trade deals.

E-commerce has emerged as increasingly important channel for conducting trade in both countries, with distinct patterns of use depending on the sector. Serbian enterprises have shown strong performance in tourism, trade, and information and communication sectors, while Turkish enterprises excel in the real estate and utilities sectors. Furthermore, Serbian businesses

demonstrate a greater reliance on their own websites for interacting with customers, though they still fall short of the advanced functionalities seen in EU-27 countries. Social media has also become an important tool for promoting businesses in both nations, with Serbia leading in its usage, though both countries still lag behind the EU in this regard.

One area where Türkiye stands out is the application of artificial intelligence in business processes, where its enterprises have adopted this technology at notably high levels, even surpassing the EU in most cases. In contrast, Serbian enterprises have yet to fully embrace artificial intelligence, with current usage levels being negligible, leaving room for growth in this emerging field.

The findings of this comparative analysis have important implications for policymakers in both Serbia and Türkiye. The well-developed information and communication infrastructure in both countries, particularly in the case of Serbia, suggests that policies should focus on fully utilising these existing digital capabilities. Policymakers can leverage this potential to foster deeper economic integration with the world economy. However, to fully realise this potential, there is a pressing need for targeted investments in innovation, especially in emerging technologies like artificial intelligence, and developing e-commerce solutions with advanced functionalities.

Moreover, the uneven use of e-commerce across different sectors, as observed in both countries, points to the need for sector-specific policies. Policymakers in Serbia could further support industries like tourism and information and communication technology, where e-commerce is already strong, while simultaneously promoting the adoption of digital trade platforms in other sectors. Both countries should aim to improve the functionalities of business websites and digital marketing strategies to match the higher standards observed in the EU-27. This could enable businesses in these economies to engage in international trade more efficiently.

While Türkiye is already a regional leader in artificial intelligence adoption, surpassing even many EU-27 countries, there is a need for both countries to invest further in not only the application of this technology in international trade but also in developing their own artificial intelligence capacities. Understanding the specific benefits artificial intelligence can bring to different sectors of the economy is important, and policymakers should support both research into these impacts and the creation of domestic capabilities to innovate in this field. Such investment in innovation could improve competitiveness in international markets of the two economies. Policymakers should also collaborate with the private sector and international partners to create environments that nurture artificial intelligence research, data-driven business models, and digital transformation strategies in enterprises of all sizes.

Investment in education and workforce skills is also essential for driving the future adoption of information and communication technology in trade activities. The comparative analysis reveals significant underutilisation of advanced digital tools like remote work and e-commerce in smaller enterprises, which could otherwise benefit greatly from these technologies, particularly in terms of their international competitiveness. Policymakers must prioritise educational programmes that improve the digital competencies of the workforce, particularly in small and medium enterprises. Such educational initiatives, combined with targeted financial support for digital adoption, would create a more inclusive digital transformation.

The findings of this study also have some important implications for businesses in both Serbia and Türkiye, particularly with regard to the potential of information and communication to reduce operational costs and facilitate international trade. For small and medium enterprises, which often face high fixed costs associated with trade, the adoption of remote work and related technologies presents a promising avenue for cost reduction. By integrating remote work as a substitute to business travelling, especially during the negotiation stages of business transactions, small and medium enterprises could significantly lower expenses, thereby alleviating one of the most substantial barriers to their participation in international markets.

In Serbia, the well-developed information and communication sector has the potential to drive broader technological adoption across industries, particularly in the area of e-commerce. The strength of these enterprises in developing their own e-commerce capacities not only positions them as leaders within the domestic e-commerce activities but also offers opportunities for spillovers to other sectors, fostering innovation and reducing technology-related costs. By contrast, Türkiye faces the challenge of strengthening its own information and communication sector in this regard. One possibility is to attract foreign investment in sector in order to hasten its development. However, this poses a risk of over-reliance on established foreign e-commerce platforms, which could hinder local competition (Kastratović, 2018; Kastratović, Lončar, & Milošević, 2019).

The study also highlights the potential for greater partnerships and cooperation between information and communication enterprises and enterprises in other sectors in both countries. Such collaboration could drive improvements in the functionalities and technological capabilities of Serbian and Turkish businesses, facilitating greater involvement in international trade. This is in line with broader commonly determined positive effects of foreign investment on international trade (Brkić, Kastratović, & Salkica, 2021; Kastratović, 2023a, 2024).

The increased use of social media platforms in both Serbia and Türkiye presents another untapped opportunity for expanding international trade. Social media could serve as a cost-effective means of reaching geographically dispersed customers, offering businesses a new channel for trade engagement and promotion. In addition, these platforms can play a critical role in maintaining relationships with foreign clients, providing a low-cost alternative to traditional customer service and engagement methods.

Finally, the adoption of artificial intelligence technology presents divergent prospects for the two countries. In Türkiye, artificial intelligence is already making significant advances, offering strong potential for improving efficiency and risk management in international trade transactions. However, the extent to which artificial intelligence has directly contributed to trade outcomes remains unclear, and further research is needed to fully assess its effects. In Serbia, by contrast, the negligible adoption of artificial intelligence may prove to be a limiting factor in the future. It is crucial for Serbian businesses to address this gap by exploring the adoption of artificial intelligence in areas where it has a proven track record of increasing productivity. Future artificial intelligence integration could offer Serbian enterprises a strategic advantage in the increasingly competitive international trade landscape.

Our findings also carry implications for the workforce, particularly in relation to the growing demand for digital skills. As enterprises increasingly adopt new technologies to enhance their international trade activities, the skills required to navigate this evolving environment will become crucial. Employees will need to adapt to the integration of information and communication technology into business processes to fully capitalise on its benefits. Acquiring digital competencies will be essential for workers to remain competitive.

For researchers, this study opens up several important avenues for future inquiries. There is a need to establish clearer links between the adoption of new technologies and international trade performance, both at the macroeconomic level and within individual enterprises. Understanding these relationships more deeply could provide valuable insights into how digitalisation shapes international trade dynamics. Additionally, quantifying the specific trade effects of information and communication technology adoption would be beneficial. A more precise measurement of the impact of these technologies on trade could guide policymakers and businesses in making informed decisions about future investments.

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