Journal of Research in Economics • Volume: 8 / Issue 2 • October 2024 pp. 116-144
ISSN: 2636-8307 • DOI: http://dx.doi.org/10.29228/JORE.36

RESEARCH ARTICLE

ARE INFORMATION AND COMMUNICATION TECHNOLOGIES EFFECTIVE IN SERVICE EXPORTS IN SOUTH CAUCASIAN COUNTRIES?

Eser ÇAPIK*

Abstract

The advancement of information and communication technologies (ICT) in Caucasian countries has begun to have an impact on the service sector. ICT has made many firms in the service sector more competitive and innovative, enabling them to achieve high productivity at a low cost. These effects of ICT in the service sector can lead to economic growth and development in Caucasian countries.
This study examines the impact of information and communication technologies on service exports in Caucasian countries. The time period covering 2003-2022 is analyzed using time series. Given the differences in internet infrastructure, internet access, and internet availability across each country, a distinct ICT indicator is utilized for each country. The empirical findings reveal that fixed telephony contributes to service exports in Azerbaijan, service exports are influenced by individual internet usage rates in Georgia, and mobile telephony plays a role in service exports in Armenia.
Keywords: Service Export, ICT, Time Series, South Caucasian Countries
JEL codes: C3, L8, L86, N75

1. Introduction

Today, unlike many physical products, service sectors based on direct human interaction such as education, law, tourism, health and beauty services have become one of the most important sectors contributing to the development levels of countries. Rapid developments in Information and Communication Technologies in the last two decades have contributed to the fast growth of new service sectors and have significantly affected the consumption of all goods and services. In this process, it is inevitable to say that the rapidly developing internet actually plays an important role in the services traded (OECD, 2000).

In terms of information and communication technologies, especially the Internet has contributed to the globalisation of the world economy by playing an effective role in accessing information, ideas, various expertise and innovations across borders (Choi, 2010). As a result of the revolutionary developments in the ICT sector in the 90s, there have been significant changes

* Süleyman Demirel University, E-mail: esercapik32@gmail.com, ORCID: 0000-0002-2754-023X

Submission Date: 08.03.2024
Revision Date: 19.05.2024
Acceptance Date: 27.05.2024

in economic activities in the world such as increased diversity, productivity and global trade (Fink et al. 2005). Developments in ICT have significantly reduced the importance of physical distance in trade (Freund and Weinhold, 2004). Because the innovations in ICT have brought communication tools such as telephone, e-mail and virtual conference to the forefront and thus distance has become unimportant. In other words, Bloom, Sadun and Van Reenen (2012) argue that information and communication technologies have enabled businesses to become independent from geographical constraints by enabling remote working and virtual business environments. Thus, thanks to ICT, international communication costs are significantly reduced and international co-operation and trade are increasing (Clarke, 2008).

In fact, ICT has several mechanisms that affect trade (Nath & Liu, 2017). With these mechanisms, it facilitates both the flow of information, the automation of business processes and the increase in productivity with the effect of digitalisation, and the sharing of information and cooperation of businesses and individuals on a global scale (Jungmittag and Welfens, 2009). With advances in information and communication technologies, delays in obtaining and transmitting information can be reduced (Nath and Liu, 2017). With the development of ICT, the operational efficiency of enterprises increases and costs decrease (Brynjolfsson and Hitt, 2000), and competitive advantage can be gained by improving the decision-making processes of enterprises with big data and analytics (McAfee et al., 2012). Of course, it should be emphasised that the Internet, which has the potential to create large global markets for certain goods (Freund and Weinhold, 2002), requires a strong ICT infrastructure to function effectively. Because ICT infrastructure constitutes the basic condition for the Internet to become an effective tool for collecting, processing and disseminating information (Vemuri and Siddiqi, 2009).

With information and communication technologies (ICT), the trade in services can be revolutionised in a variety of ways. For example, ICT enables firms to reach a global customer base and facilitates services to reach potential customers around the world through the Internet, social media and digital marketing tools such as Amazon, Alibaba and Upwork. This facilitates cross-border trade in services and increases the international mobility of labour and services.

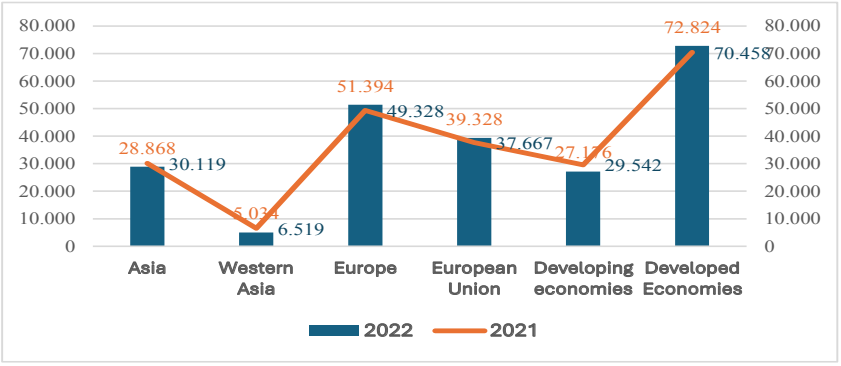


Figure 1. World Services Exports (2018-2022, %)

Source:(*UNCTADstat*, 2023), International Trade Statistics

When Figure 1 is analyzed, it can be observed that Asian countries accounted for approximately 29% of the world's service exports in 2021-2022, while West Asian countries accounted for 5%. European countries contributed to 51% of the world's service exports, with European Union countries comprising 39%. Looking at developed economies, it is evident that developing countries accounted for 73% of the world's service exports, while developed country economies accounted for 27%. In 2022, there was a noticeable increase in Asian countries and developing country economies, whereas there was a decreasing trend in the economies of other countries (UNCTAD, 2023). Of particular importance to us are the South Caucasian countries within the Western Asian country group.

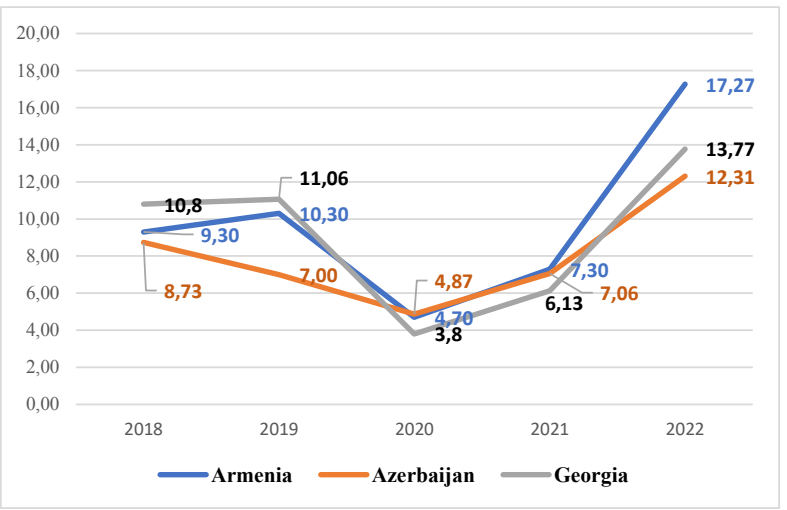


Figure 2. Exports of Services in the South Caucasus Countries (2018-2022, %)

Source: (*UNCTADstat*, 2023), International Trade Statistics

In recent years, changes in the global economy, especially driven by developments in Information and Communication Technologies (ICT), have led to economic diversification in the South Caucasus countries, which are situated in the heart of the oil-rich region, and this has had significant implications for the service sector. According to Figure 2, Georgia ranked first in service exports in 2018 with 11%, followed by Armenia in second place with 9%, and Azerbaijan in third place with 8%.

These service exports consist of various categories. The proportion of the sectors that constitute service exports in South Caucasian countries is shown in Table 1.

Table 1 Sectoral Services Exports in South Caucasus Countries (2022, $ billion)

Types of services	Azerbaijan	Armenia	Georgia
Transport services[1]	17,54491779	63,14048855	32,29859419
Travel services	45,19242181	8,24016753	48,88187694
Air transport, freight[2]	1,347896	3173,72377	0,11335
Air transport, passengers carried	179200	1102455	84591
Air transport, registered carrier departures worldwide	1598	15844	1000
Computer, communications and other services[3]	33,00553918	27,22953872	14,66987281

NOT: (% of service exports, BoP)
[2](Million ton-km)
[3] (% of commercial service exports)

Source: (*UNCTADstat*, 2023), International Trade Statistics

Table 1 shows that in 2022, transport services ranked first in Armenia's service exports, while Georgia ranked first in the travel sector and Azerbaijan ranked second. Azerbaijan ranks first in computer, communication and other services.

It can be argued that the service sector, which has recently been identified as the engine of economic growth, has demonstrated significant performance with the process of digitalization, based on innovation activities (OECD & Eurostat, 2018, p. 81). While innovation occurs through the utilization of knowledge (Antonelli, 2000), both innovation and access to knowledge are facilitated by the Internet, which serves as a powerful tool in the national economy (see, for example, Myovella et al., 2020). Data from The World Bank (2023) regarding Internet usage, which is crucial for the economy, indicates that Caucasian countries exhibit low performance in terms of Internet usage. According to the latest data published by The World Bank for 2021, it is evident that the percentage of GDP attributed to individual Internet use in Armenia, Azerbaijan, and Georgia is 0.19%, 0.18%, and 0.28%, respectively. It is believed that the level of Internet usage plays an influential role in the service sector, as it does in many other sectors.

In light of this information, to the best of our knowledge, no studies have yet addressed the impact of the ICT sector on trade in services in the South Caucasus. Therefore, this study aims to analyze the impact of ICT, which is at a developing level in South Caucasus countries (Doyar et al., 2023), on the success of service exports. These exports constitute an important pillar of economic growth in South Caucasus countries (Çapık & Ören, 2023).

Detailed answers to the question of the determinants of Internet use in the region are discussed in (Doyar et al., 2023). In this study, total service sector exports in South Caucasian countries, which have not been examined before, will be analysed with the effect of ICT determinants in this study and the weakness of the literature will be strengthened.

The paper is organised as follows: in the first part, the history of the service sector and ICT is briefly reviewed and the situation of the South Caucasus countries is discussed. The second section provides a literature review on the subject. After the empirical in the third section, the data, model and methodology are explained in the fourth section. Following comparing the

findings with the literature in the fifth section, the last section discusses the policy implications of the findings and presents various conclusions.

2. A Brief Historical Overview of the Service Sector and Information and Communication Technologies

The development process of the economy in history includes a very interesting story. Trade in services has played an important role in this story of the economy and the way of thinking on the subject has changed over time. Looking at the economic history of the countries, after the first and second industrial revolutions, there has been an important shift from agriculture to industry, and in the last fifty years, a shift from industry to services has been realised. Fisher (1939) and Clark (1941), two prominent economists of the 1930s, developed models for the stages of economic growth. In these models, the production of raw materials is defined as "primary", manufacturing goods as "secondary" and the production of services, which play an important role in the development of a country, as "tertiary" (Grubel & Walker, 1989; Kuźnar, 2016; Shanmugam & Latha, 2014).

Since the realisation of any goods production depends on raw materials, raw material production is defined as the primary sector, the manufacturing sector is defined as the secondary sector since it also depends on raw materials, while the production of services is defined as the tertiary sector since it depends on both the primary and secondary sectors (Shanmugam and Latha, 2014). Based on differences in product labour productivity and the size of the labour force in various economic activities, (Clark, 1941, p. 121), defined the primary sector as activities that use and transform natural resources (agriculture, forestry and fishing), the secondary sector as production activities that continuously transform natural resources into transportable products, and the tertiary sector as service activities (consumer and producer services, construction and labour productivity per worker). Important economists such as Adam Smith, David Ricardo and Karl Marx, while studying labour productivity and valorisation, treated services differently from goods and products.

In the period of the industrial revolution, the labour force in the agricultural sector shifted towards the manufacturing sector and it was observed that human needs reached a saturation point, incomes increased and the demand for food and goods consumption decreased. With the increase in consumer income, there has been an orientation towards preferences for leisure and entertainment (Hospers, 2004, p. 12). Consequently, there has been an evolution towards the service sector. As such, the growth of the service sector in most developed countries has been associated with the level of income (Ramakrishna, 2010; Schettkat, 2007; Witt & Gross, 2020). The service sector, whose contribution to economies has steadily increased over time, contributes to productivity and economy-wide growth as it provides basic inputs to other products and services (Çapık and Ören, 2023). The service sector, which is now recognised as the fastest growing area of international trade (Bradley et al., 1995), as (Vandermerwe & Chadwick, 1989, p.

79) put it: "the whole world is today a field of service activities". However, technological advances and globalisation in the last decade have radically changed the definition of services and the way economists view services.

In the service sector, which has become a major economic centre, most of the economic value produced is based on information. Due to significant advances in information and communication technology (ICT), it has recently come to be recognised as an innovative sector and has been the subject of considerable trade (Miles, 2000). ICT has changed the nature of the production of services as well as the nature of service exports in particular, paving the way for both a rapid increase in service exports and a significant share of services in the GDP pie.

The history of ICT dates back to the time when people started to use objects to communicate with each other. In other words, ICT started with the rise of mankind (Duque et al., 2006, p. 33-39). It can be said that the basic concept of ICT, which appeared clearly in the 1970s, actually dates back to the Second World War alliance of the military and industry, which played an active role in the development of electronics, computers and information theory. Going back a little further, after the 1940s, the military was the main source of R&D funding for the expansion of automation in order to replace manpower with machines. After the 1950s, computer types started to develop, which became more capable but smaller in size. The study, design, development, support or management of computer hardware constitutes information and communication technologies (ICT) (Sakenov, 2018). Information and communication technologies include computers, the Internet, broadcasting technologies (radio and television) and telephones (UNDP, 2001, p. 29) As a result of the closeness of information and communication, a technological revolution has been created, and the most striking aspect of this situation is that it has revealed important results for its application in different fields of economic activities.

Information and communication technologies have revolutionised the way most traditional services are produced and sold, offering various opportunities in different areas of the service industry and playing an important role in firms' innovation activities (Evangelista & Sirilli, 1995). Services now include digital and remote services such as online shopping, digital education, telecommunications, consultancy, software development and many many other different areas. These technological changes have contributed to the transformation of services into a sector that is not only based on physical interactions, but also has a major impact on global markets and has become a fundamental component of the economy (Baumol, 1967). Information technologies are in the service sector, especially in the application of sub-sectors such as financial services and communication services (Biswas, 2020). It can be said that information and communication technology has also made itself more and more felt in the internationalisation of services.

In recent years, the changes that have occurred with the global economy, especially in line with the developments in Information and Communication Technologies (ICT), have started to show themselves in the South Caucasus Countries, which are located in the centre of oil.

2.1 Armenia

ICT in Armenia, which is one of the leading information technology countries in the Commonwealth of Independent States and the Middle East, suffered a major blow with the collapse of the Soviet Union but managed to overcome this by going through a recovery process in the mid-1990s. In this case, especially in the 1990s, the opening of branches of US software companies in Yerevan, the capital of Armenia, played an active role. Thus, a new era began in Armenia with the US diaspora (Vardanyan & Sarkisyan, 2004). The ICT industry globally. The ICT industry of Armenia is demonstrating its potential in different service sectors, drawing the interest of investors, policy makers and professionals (USAID, 2009, p. 12-13).

Armenia, formerly described as the "Silicon Valley of the Soviet Union", received backing from organisations including the United States Agency for International Development (USAID) and the World Bank (Krikorian, 2010). In recent years, the information and communications technology (ICT) industry in Armenia has experienced significant growth and has emerged as a highly dynamic sector of the economy (Vardanyan & Sarkisyan, 2004, p. 7-8)

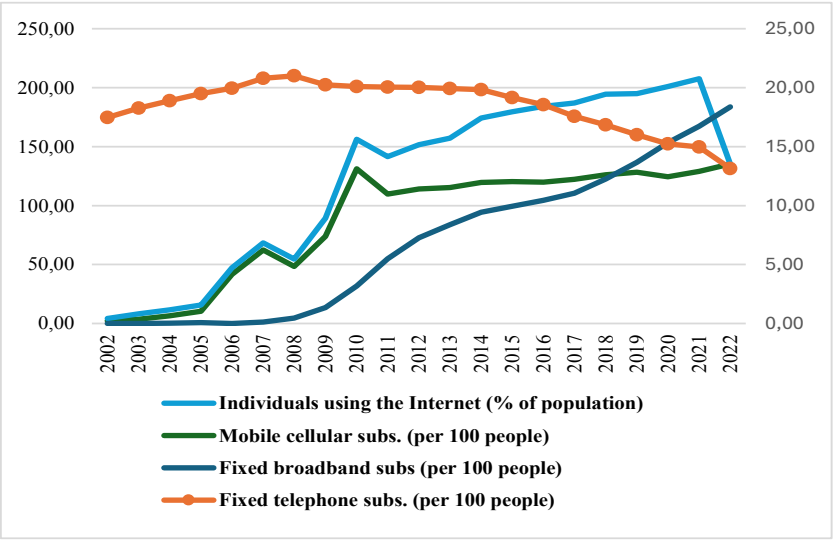


Figure 3. Timeline of the ICT Indicators in Armenia (%)

Source: Visualised using data from (ITU, 2023a, 2023b, 2023c, 2023d)

Figure 3 reveals that the proportion of internet users in Armenia's population was 5% in 2005 and soared to 55% in 2015 and to 79% in 2021. Mobile networks accounted for 110% of the total internet access in 2011, and this percentage increased to 120% in 2015, reaching 129% by 2021 (ITU, 2018). Fixed broadband subscriptions were responsible for only 0.03% of internet access in 2005, reaching 8.38% in 2014, and this rate further surged to 17% in 2021 (ITU, 2023). Finally, while 17% of internet access was provided by fixed telephone subscriptions in 2002, this rate

decreased to 20% in 2012 and to 13% in 2022. In fact, it is possible to say that the demand for mobile phones has an effect on this situation

2.2. Georgia

In Georgia, computer technologies were introduced in the late 1960s when the country was under Soviet Union rule. Numerous computer centres were established in ministries, factories, universities, and research institutions during this period. The economic crisis triggered by the Soviet Union's collapse led to swift closures of computer centres. In 1995, with backing from the United States, the American NGO Parliamentary Human Rights Foundation facilitated the first Georgian Parliament Internet access. Consequently, the official parliamentary website became the inaugural site (Karumidze, 2001). With the escalating use of the Internet and personal computers in Georgia, the 1980s saw the official introduction of personal computers that were actively employed in accounting services. The development of the Internet in Georgia is closely linked to both local content websites and Internet access (Karumidze, 2001).

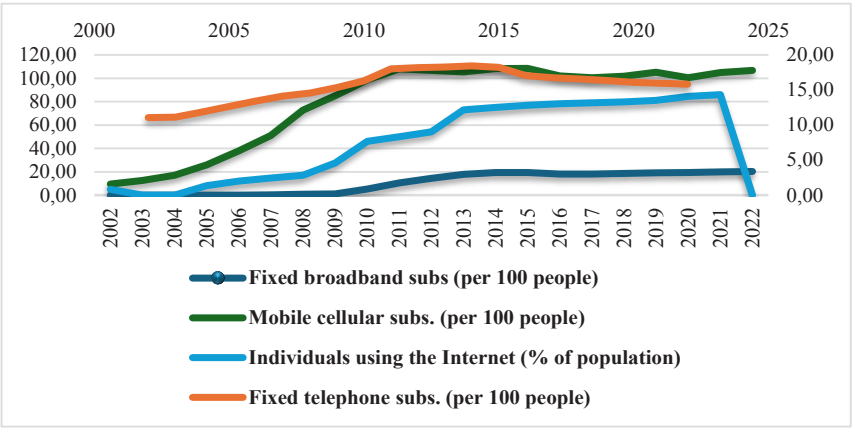


Figure 4. Timeline of the ICT Indicators in Georgia (%)

Source: Visualised using data from (ITU, 2023a, 2023b, 2023c, 2023d)

An of Figure 4 shows that in 2005, around 4% of the population in Georgia had access to the internet. This percentage increased to 20% in 2010 and further to 76% in 2021. In 2000, mobile networks provided 5% of internet access, rising to 110% in 2010 and 148% in 2021 (ITU, 2023). Fixed broadband subscriptions accounted for approximately 5% of internet access in 2010, rising to 27% by 2021 (ITU, 2023). In 2002, 16% of internet access was provided by fixed telephone subscription, while this rate dropped to 8% in 2022.

2.3. Azerbaijan

Information and communication technologies (ICT) are considered integral to the development of the Republic of Azerbaijan. The National Strategy highlights its significant role. Since 1991, when internet technology was introduced in Azerbaijan, international connectivity was established in 1993 with the help of British Petroleum and Turkey. The first Azerbaijani website was launched in 1994 (MINCOM, 2021).

Permanent internet access was provided to Azerbaijan through the Azerbaijani Academy of Sciences in 1995. Despite undergoing challenging processes in information and communication technologies, Azerbaijan's most unfavorable aspect in terms of internet accessibility is the unsuitable state of the country's telecommunications infrastructure. Although UNDP, Soros Foundation, IREX and NATO have endeavored to assist in the development of the country's internet infrastructure, positive results have not been achieved. When compared to the 1990s, it can be said that Azerbaijan has made significant progress in terms of internet development (Izmaylov, 2001). In the mid-2000s, there was a rapid increase in mobile cellular subscriptions. In the years 2005-2008, the State Program on the development of information and communication technologies was adopted in the Azerbaijan Republic. Following the launch of 3G services in 2009, there was an expansion of mobile broadband subscriptions (MINCOM, 2021).

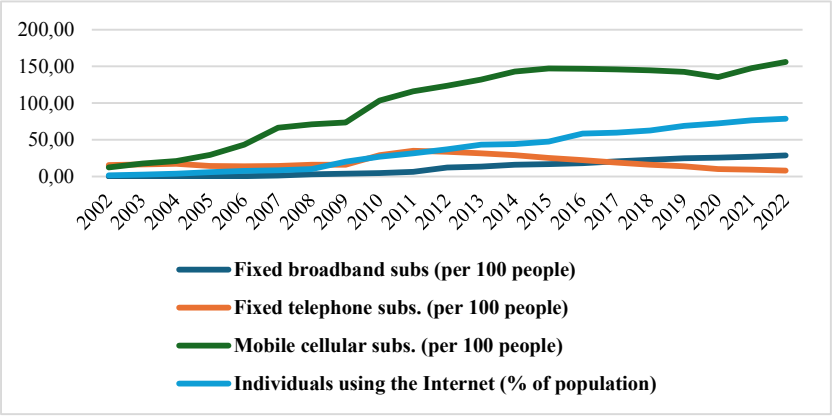


Figure 5. Timeline of the ICT Indicators in Azerbaijan (%)
Source: Visualised using data from (ITU, 2023a, 2023b, 2023c, 2023d)

Looking at Figure 5, we can see that in 2005, 8% of Azerbaijan's population were internet users. This figure increased to 50% in 2011 and will reach 86% in 2021. In 2010, 5% of internet access in Azerbaijan was provided through fixed broadband subscriptions, while this figure has risen to 20% towards 2021. Also, it can be observed that the proportion of internet usage through mobile networks has grown from 26% in 2005 to 105% in 2021 (ITU, 2023). In 2002, 11 per cent

of internet access was provided by fixed telephone subscription, while this rate increased to 16 per cent in 2022.

3. Literature Review

With the development of technology, empirical studies on the determination of business performance (Wakelin, 1998) generally stem from two different theoretical traditions. The first is based on the Heckscher-Ohlin-Samuelson trade model in which trade is determined by the relative factor. The second theoretical tradition is the Technology Gap Theory of Trade (Posner, 1961) and the Product Cycle Approach to Trade (Vernon, 1966). According to Kaldor's empirical evidence, sometimes price-related factors are insufficient for exports. Therefore, differences in the price level are not sufficient to explain the differences in export performance between countries. In this case, it is stated that non-price factors should be considered (Visús & Zayas, 2003).

Onyeiwu (2002) analysed the extent to which technology, one of the non-price factors, is integrated into the global economy of a country. Freund and Weinhold (2002) argue that the Internet, the most important determinant of technology, can help create global markets for traded goods by reducing fixed costs. Chatti & Haitham Khoj (2020) aimed to examine the causal relationships between service exports and internet penetration for 116 countries in the period 2000-2017, and concluded that there is a bi-directional causality between service exports and internet adoption for developed countries. Nasir and Kalirajan (2016) examined the export performance of developed Asian economies in selected modern services and found that the ICT and innovation performance of the emerging economies in South Asia and the Association of Southeast Asian Nations in realising the export potential of the emerging economies in South Asia and the Association of Southeast Asian Nations is quite weak compared to the developed economies in North America and Europe. It has shown that ICT infrastructure quality is among the key factors in realising service export potential.

Aydınbaş and Erdinç (2023) investigated the effects of information and communication technologies on human capital and found that the share of ICT exports in total exports increases human capital. Kırca and Akkuş (2020) examined the effects of internet use and economic growth on electricity consumption in EU-15 countries, and the results showed that for all EU-15 countries, the change in internet use can decrease electricity consumption very slightly, but the change in economic growth can increase electricity consumption. Ozcan (2018) analysed the effects of information and communication technologies (ICT) on international trade between Turkey and its trading partners and the results showed that ICT has positive and significant effects on both import and export volumes of Turkey.

Table 2. Literature Review

Author	Country	Method	Period	Variables												
				lngdp	lngdpp.	enxhange	Pop	lnCO emsyn	unemp	Emp.	Lang.	lndist.	ICT (1)	(2)	(3)	(4)
Nath & Liu (2017)	49 developed and developing countries	Panel data	2000-2003	-	(+)***	-	(-)*	-	-	-	-	-	(+)	(-)	(+)**	(+)
Wang & Choi (2019)	BRICS country	Panel data	2000-2016	(+)***	-	-	(+)	-	(+)***	-	-	-	(+)***	(+)	(+)***	(+)***
Lichy et al. (2022)	44 high-income 36 low – and middle-income countries	Panel data	2000-2019	(+)***	-	(+)***	-	-	-	-	-	-	-	-	(+)***	(+)***
Aijaz et al. (2022)	China	Zaman serisi	1990-2020	-	-	-	-	(+)***	-	(+)	-	-	(-)	-	(-)***	-
Nasir & Kalirajan (2016)	Asean countries	Panel data	2005-2017	(+)***	-	-	-	-	-	-	(+)***	(-)***	-	(+)***	(+)***	-
Wardani et al. (2020)	Asean countries and Indonesia	Gravity model	2005-2017	(+)***	-	-	-	-	-	-	(+)***	(-)	-	(+)***	-	-
Freund & Weinhold (2002)	The US	Panel data analysis	1995-1999	(+)**	-	(+)	(-)***	-	-	-	-	(-)	-	(+)***	-	-
Choi (2010)	151 countries	Panel data analysis	1990-2006	(+)***	-	-	(-)***	-	-	-	-	-	-	(+)***	-	-
Mattes et al. (2012)	The US	Panel data analysis	1995-2007	(+)***	-	-	-	-	-	-	(+)	(-)***	-	-	-	-
Clarke & Wallasten (2006)	Developing countries, developed countries, and total exports (i.e., to all countries)	OLS and 2SLS	2001	(-)***	-	-	(+)*	-	-	-	-	(-)***	-	-	(+)***	-
Clarke (2002)	Low and middle-income economies in Eastern Europe	OLS	1999	-	(-)	-	(-)	-	-	-	-	(+)	-	(+)***	-	-

Vemuri & Siddiqi, (2009) in the study examining the impact of information and communication technology (ICT) and the Internet on international trade for 64 countries from 1985 to 2005, it was found that the ICT infrastructure and the Internet's openness to commercial transactions had a positive and significant effect on the international trade volume. In Clarke and Wallasten (2006), it was concluded that access to the Internet improves export performance in developing countries. The study showed that when Internet penetration is high in developing countries, more exports are made to developed countries. In the empirical literature, ICT infrastructure, particularly the Internet, has been found to have a significant impact on trade in services (Choi, 2010). Liu and Nath (2017) examined the relationship between the Internet and trade in services in developing countries over the period 1995-2010, and the results showed that Internet penetration positively affects trade in developing countries. Luong and Nguyen (2021) investigated the effects of information and communication technology (ICT) on trade in services and found that this effect yields similar results on both imports and exports.

Although there are many factors affecting service exports such as trade agreements, infrastructure development, human capital, etc., the model was constructed based on the variables used in the literature studies in Table 2. Table 2 summarises the relevant literature by showing the separate effects of each of the variables usually targeted for trade in services, such as GDP, GDP per capita, population, international distance, technological skills and technological ownership.

4. Research Design

This study aims to contribute to the literature by utilizing the most up-to-date datasets. Firstly, it considers a comprehensive dimension of ICT for South Caucasus countries, taking into account their specific characteristics. What sets our study apart from others is its approach, which examines service exports in three different countries using three separate models and various ICT indicators tailored to their specific characteristics.

This paper analyses the role of the ICT index in services exports for the economies of Armenia, Georgia and Azerbaijan for nineteen consecutive years from 2003 to 2022. The selected years cover global trends such as the rise of the Internet. The choice of period is based on data availability, and the data used in this study were obtained from the World Bank's World Development Indicators (WDI) database (2023). Data collection methods may differ in some countries, and missing or outdated data may lead to incorrect relationships in analyses of services exports. However, reliable and consistent data on ICT and services exports between 2003 and 2022 for all three countries are available at the World Bank. The data set is based on time series and the variables used in the study are presented in Table 3.

Table 3. Variable Definitions

Variables	Variable definitions	Data
Log of SE	Service exports (BoP, current USD)	WDI (2023)
Log of GDP	Per capita GDP (constant, 2010 USD)	WDI (2023)
Log of POP	Population (total)	WDI (2023)
Log of Offical Exchange rate	1 US$ = country currency	WDI (2023)
Log of individuals using the internet	(% of population)	WDI (2023)
Log of fixed-telephone subscriptions	(per 100 inhabitants)	WDI (2023)
Log of mobilecellular telephone subscriptions	(per 100 inhabitants)	WDI (2023)

Kaynak: World Bank, WDI (2023)

4.1. Model and Methodology

Following Clarke and Wallasten's (2005) of ICT indicators as determinants of service export, we can present the following model.

$$SE_t = \alpha_0 + \beta 1 lngdp_t + \beta 2 lnpop_t + \beta 4 exc_t + \beta 5 ict_t + \varepsilon_t$$

SE, which is included in the model as the dependent variable, is considered as total service exports. Subsequently, the control variable lngdp represents the per capita GDP of countries at time *t* in constant prices. Individuals who are socio-economically privileged, meaning financially well-off, have a greater likelihood of adopting and benefiting from technological innovations such as the internet (Mills & Whitacre, 2003). Although income facilitates Internet access, it cannot be considered as the sole driving force behind Internet usage. Hence, other variables have been included in the model by drawing inspiration from the literature. Specifically, lnpop has been incorporated as the final variable, reflecting the total population of countries at time *t*. As population and density increase, internet usage also increases, leading to lower internet access costs (Stoneman & Karshenas, 1995). exc also represents the official exchange rate of a country at a given point in time. Since the exchange rate is a determining factor for international trade activities, the relationship between international trade and exchange rate has been extensively researched by scholars (Lichy et al., 2022). The model includes ICT as the dependent variable, which comprises fixed-line subscriptions (per 100 inhabitants), mobile phone subscriptions (per 100 inhabitants), and the percentage of individuals using the Internet. When referring to service exports between 2003-2022, t represents time, and ε indicates the error term.

To identify the stationary states of the series, we utilized the Augmented Dickey-Fuller (ADF) unit root test (Dickey & Fuller, 1981) in our study. Because non-stationary time series can lead to the problem of spurious regression (Granger & Newbold, 1974, p. 111), this can risk showing a relationship between variables that do not exist and can also result in the misinterpretation of the coefficients. Therefore, we performed the Augmented Dickey-Fuller (ADF) test as a first step to determine the stationarity of the variables. The functional form of ADF can be expressed as follows (Malik & Velan, 2020):

$$\Delta Y_t = \alpha + \emptyset Y_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{i-t} + et \quad (1)$$

$H_0 = \beta_i = 0$ (*i.e., time series has unit root)*

$H_1 = \beta_i \neq 0$ (*i.e., time series has not unit root)*

In order to carry out the causal in the next step, we require the value of $\boldsymbol{m_{max}}$, which represents the maximum integrated order obtained from the unit root test.

It is necessary to establish their co-integration in order to gain insight into the causal relationship between service exports and ICT indices. Since the model includes more than two variables, the Johansen cointegration technique developed by Johansen (1988) and Johansen and Juselius (1990) is used. When more than two variables are involved, more than one long-term equilibrium relationship may emerge. As a first step in the cointegration test, all variables included in the model must not be stationary at the level, but rather become stationary when first differenced. This model is not applicable when there are varying levels of stationarity. To apply this model, a VAR model must be established first, and the lag order should be determined using Akaike and Schwarz information criteria. Once the model with the lowest AIC and SBC was selected, it was identified as the optimal lag length and denoted as p.

In our study, we utilize the Toda-Yamamoto causality test (TY) developed by Toda and Yamamoto (1995). In Granger causality analysis, if variable X yields better results than predicting variable Y using all available information, it suggests causality from X to Y (Granger, 1969). Additionally, Toda and Yamamoto (1995) describe the estimation of VAR models for integrated or cointegrated series at various levels and testing parameter matrix restrictions. For the purpose of conducting the test, the maximum integration degree $\boldsymbol{m_{max}}$of the variables has been determined using unit root tests. Information criteria were used to determine the optimal lag length, denoted as p, for the VAR model, a multivariate time series model proposed by Sims (1980). Later, a VAR model with $\mathbf{p^+}$ lags was forecasted. The direction of causality was determined by applying a Wald test with an asymptotic chi-square distribution to the p-lag values to determine whether the coefficients were statistically different from zero.

When the $\boldsymbol{p}$ optimum delay length, $\boldsymbol{m_{max}}$ maximum integration order, and $\boldsymbol{u}$ white noise term are used, the VAR model to be estimated for the *lngdp, lnpop, lnict1, lnict2, lnict3,* and *lnexc* variables for the SE procedure can be written as follows:

$$loggdp_t = \alpha_0 + \sum_{i=1}^{p} \beta_{1i}\, logpop_{t-i} + \sum_{j=p+1}^{m_{max}} \beta_{2j}\, logpop_{t-j} + \sum_{i=1}^{p} \delta_{1i} exc_{t-i} + \sum_{j=p+1}^{m_{max}} \delta_{2j}\, exc_{t-j} + \sum_{i=1}^{p} x_{1i} ict1_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, ict1_{t-j} + \sum_{i=1}^{p} \vartheta_{1i} ict2_{t-i} + \sum_{j=p+1}^{m_{max}} \vartheta_{2j}\, ict2_{t-j} + \sum_{j=p+1}^{m_{max}} \partial_{1i} ict3_{t-i} + \sum_{j=p+1}^{m_{max}} \partial_{2j} ict3_{t-j} + u_{1t} \quad ((2)$$

$$logpop_t = \alpha_0 + \sum_{i=1}^{p} \rho_{1i} logdp_{t-i} + \sum_{j=p+1}^{m_{max}} \rho_{2j}\, loggdp_{t-j} + \sum_{i=1}^{p} \delta_{1i} exc_{t-i} + \sum_{j=p+1}^{m_{max}} \delta_{2j}\, exc_{t-j} + \sum_{i=1}^{p} x_{1i} ict1_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, ict1_{t-j} + \sum_{i=1}^{p} \vartheta_{1i} ict2_{t-i} + \sum_{j=p+1}^{m_{max}} \vartheta_{2j}\, ict2_{t-j} + \sum_{j=p+1}^{m_{max}} \partial_{1i} ict3_{t-i} + \sum_{j=p+1}^{m_{max}} \partial_{2j} ict3_{t-j} + u_{1t} \quad ((3)$$

$$logexc_t = \alpha_0 + \sum_{i=1}^{p} \rho_{1i} logdp_{t-i} + \sum_{j=p+1}^{m_{max}} \rho_{2j}\, loggdp_{t-j} + \sum_{i=1}^{p} \delta_{1i} pop_{t-i} + \sum_{j=p+1}^{m_{max}} \delta_{2j}\, pop_{t-j} + \sum_{i=1}^{p} x_{1i} ict1_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, ict1_{t-j} + \sum_{i=1}^{p} \vartheta_{1i} ict2_{t-i} + \sum_{j=p+1}^{m_{max}} \vartheta_{2j}\, ict2_{t-j} + \sum_{j=p+1}^{m_{max}} \partial_{1i} ict3_{t-i} + \sum_{j=p+1}^{m_{max}} \partial_{2j} ict3_{t-j} + u_{1t} \quad ((4)$$

$$logict1_t = \alpha_0 + \sum_{i=1}^{p} \rho_{1i} logdp_{t-i} + \sum_{j=p+1}^{m_{max}} \rho_{2j}\, loggdp_{t-j} + \sum_{i=1}^{p} \delta_{1i} pop_{t-i} + \sum_{j=p+1}^{m_{max}} \delta_{2j}\, pop_{t-j} + \sum_{i=1}^{p} x_{1i} exc_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, exc_{t-j} + \sum_{i=1}^{p} \vartheta_{1i} ict2_{t-i} + \sum_{j=p+1}^{m_{max}} \vartheta_{2j}\, ict2_{t-j} + \sum_{j=p+1}^{m_{max}} \partial_{1i} ict3_{t-i} + \sum_{j=p+1}^{m_{max}} \partial_{2j} ict3_{t-j} + u_{1t} \quad ((5)$$

$$logict2_t = \alpha_0 + \sum_{i=1}^{p} \rho_{1i} logdp_{t-i} + \sum_{j=p+1}^{m_{max}} \rho_{2j}\, loggdp_{t-j} + \sum_{i=1}^{p} \delta_{1i} pop_{t-i} + \sum_{j=p+1}^{m_{max}} \delta_{2j}\, pop_{t-j} + \sum_{i=1}^{p} x_{1i} exc_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, exc_{t-j} + \sum_{i=1}^{p} x_{1i} ict1_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, ict1_{t-j} + \sum_{j=p+1}^{m_{max}} \partial_{1i} ict3_{t-i} + \sum_{j=p+1}^{m_{max}} \partial_{2j} ict3_{t-j} + u_{1t} \quad ((6)$$

$$logict3_t = \alpha_0 + \sum_{i=1}^{p} \rho_{1i} logdp_{t-i} + \sum_{j=p+1}^{m_{max}} \rho_{2j}\, loggdp_{t-j} + \sum_{i=1}^{p} \delta_{1i} pop_{t-i} + \sum_{j=p+1}^{m_{max}} \delta_{2j}\, pop_{t-j} + \sum_{i=1}^{p} x_{1i} exc_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, exc_{t-j} + \sum_{i=1}^{p} x_{1i} ict1_{t-i} + \sum_{j=p+1}^{m_{max}} x_{2j}\, ict1_{t-j} + \sum_{i=1}^{p} \vartheta_{1i} ict2_{t-i} + \sum_{j=p+1}^{m_{max}} \vartheta_{2j}\, ict2_{t-j} + u_{1t} \quad ((7)$$

The inclusion of lagged values of dependent variables in the VAR model, in which all variables are lagged along with their own lags, makes it possible to make strong forecasts for the future (Kumar et al., 1995). In VAR models, which are used when there is no cointegration between variables and the series are stationary, the error correction model (VEC model) is estimated if the variables are cointegrated. One of the biggest advantages of the VAR model is that it takes into account the effect of all variables included in the model and performs the co-integration test without any restrictions.

4.2. Empirical Results

This section presents the results obtained from unit root and causality tests for each of the three countries separately.

Results for Azerbaijan

Table 4. Unit Root Test Results

ADF (Constant)				ADF (Constant and trend)		
	Level	1^{st} ***dif.***	2^{nd} ***dif.***	**Level**	1^{st} ***dif.***	2^{nd} ***dif.***
LogSE	-2.034	-2.709*	-5.315***	-1.421	-2.789	-5.311***
LogGDP	-3.579	-1.571	-3.787***	-1.185	-2.088	-4.523***
LogPOP	-1.924	-1.350	-4.112***	-0.796	-1.823	-5.029***
LogICT1	-1.932	-2.035	-6.181***	-0.228	-2.922	-6.022***

*** and * represent significance at 1% and 10%, respectively. Lag length for ADF test is chosen by Schwarz Information Criteria.

The unit root test results in Table 4 indicate that our series are not stationary at the same level. According to the ADF unit root test results in the table, all variables are stationary at the second level. For the equation with constant and trend, all variables become stationary at the second difference at 1% significance level. Considering all these outputs, the maximum order of integration is m_{max}=2. Therefore, the number of additional lags for the VAR model to be estimated by stationarising is set as 2.

The next step is to determine the lag length of the model. The lag value determined with the help of Akaike Information Criterion (AIC), Schwart Criterion (SC), and Hannan Quinn Criterion (HQ) is shown in Table 5. According to Table 5, the fact that the maximum number of stars is two led us to determine our lag value as ***m=2*** according to SC and HQ values. Therefore, two lag length will be used in our model.

Table 5. Determination of the Appropriate Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	66.12224	NA	2.36e-08	-6.212224	-6.013077	-6.173348
1	183.8120	176.5346*	9.43e-13	-16.38120	-15.38546*	-16.18682
2	207.4962	26.05265	5.53e-13*	-17.14962*	-15.35730	-16.79974*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

After determining the lag length, the VAR (4) model with $p+m_{max}=4$ lags was estimated and the Wald test with $p=2$ lags was applied to perform the Toda-Yamamoto causality test in order to observe the causality relationship between the variables.

Table 6. Causality Test Results

H_0	χ^2	Prob.	Decision
LOGICT1 does Granger-cause LOGSE	5.429815	0.0662	logICT1→logSE
All does Granger-cause LOGSE	14.63776	0.0233	All → logSE
LOGSE doesn't Granger-cause LOGICT1	0.342912	0.8424	logSE ··· logICT1
All doesn't Granger-cause LOGICT1	5.711052	0.4563	All ··· logICT1
A → B means causality runs from A to B. A ··· B means no causality between A and B			

Table 6 shows that in the model where the dependent variable is total service exports, fixed telephone internet subscription, which is the variable used as an ICT indicator, causes service exports, and at the same time, there is a causality from all variables in the model towards service exports. In the model where the dependent variable is ICT1, it is seen that there is no causality from service exports to ICT1 and there is no causality from all variables to ICT1. In other words, it is determined that there is a unidirectional causality relationship between service exports and ICT for Azerbaijan.

Results for Georgia

Table 7. Unit Root Test Results

ADF (Constant)				ADF (Constant and trend)		
	Level	$1^{st}\ dif.$	$2^{nd}\ dif.$	Level	$1^{st}\ dif.$	$2^{nd}\ dif.$
LogSE	-2.578	-4.248***	-4.1525**	1.182	-3.874***	-3.923***
LogGDP	-1.835	-3.816***	-4.367***	-2.148	-3.875***	-3.238**
LogPOP	-1.974	-1.738	-5.423***	-0.738	-2.583	-5.175***
LogICT2	-5.262***	-2.412	-4.133***	-1.463	-4.159***	-4.119***

*** and * represent significance at 1% and 10%, respectively. Lag length for ADF test is chosen by Schwarz Information Criteria.

As can be seen from the unit root test results, the series are not stationary at the same level. Regarding the ADF unit root test results given in the table, it is observed that the unit root hypothesis of the LOGICT2 variable is accepted at the 1% significance level in the first difference for equations with a constant. LOGGDP and LOGGSE variables become stationary at the 1% significance level in the first difference, and all variables are accepted at the 1% significance level in the second difference and become stationary. For the equation with a constant and trend, it is observed that LOGSE, LOGGDP, and LOGICT2 become stationary at the 1% significance level

when the first difference is applied, and all variables become stationary at the 1% significance level in the second difference.

Considering all these outputs, the maximum order of integration is $m_{max}=2$ Therefore, the number of additional lags for the VAR model to be estimated by stationarising is set as 2. As the second step, the lag value determined with the help of Akaike Information Criterion (AIC), Schwart Criterion (SC), and Hannan Quinn Criterion (HQ) is shown in Table 8. According to the data in Table 8, since the maximum number of stars is two, our lag value is determined as two according to SC and HQ values.

Table 8. Determination of the Appropriate Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	81.21459	NA	5.21e-09	-7.721459	-7.522312	-7.682583
1	170.3740	133.7392	3.62e-12	-15.03740	-14.04167	-14.84303
2	207.6558	41.00990*	5.44e-13*	-17.16558*	-15.37326*	-16.81570*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

As seen in Table 8, the optimum lag length for the VAR model was determined as $p=2$ by using a number of information criteria.

Table 9. Causality Test Results

H_0	χ^2	Prob.	Decision
LOGICT2 doesn't Granger-cause LOGSE	3.378351	0.3369	logICT2···logSE
All does Granger-cause LOGSE	15.99780	0.0669	All → logSE
LOGSE does Granger-cause LOGICT2	13.56926	0.0036	logSE → logICT2
All does Granger-cause LOGICT2	20.88649	0.0132	All → logICT2

A → B means causality runs from A to B.
A ··· B means no causality between A and B

In Table 9, in the model where the dependent variable is total service exports, it is seen that there is no causality from the number of individual internet users in the model as an ICT indicator to service exports, but there is a causality from all variables to service exports. In the model where the dependent variable is the number of internet users, it is seen that there is a causality from the service sector to ICT2 and again there is a causality from all variables to ICT2. For Georgia, it is determined that there is a unidirectional causality between the number of internet users and service exports, that is, the number of internet users does not cause service exports, but service exports cause internet usage.

Results for Armenia

Table 10. Unit Root Test Results

ADF (Constant)				ADF (Constant and trend)		
	Level	1^{st} $dif.$	2^{nd} $dif.$	Level	1^{st} $dif.$	2^{nd} $dif.$
LogSE	-4.293***	-4.104***	-4.573***	-1.461	-4.549***	-4.117***
LogGDP	-2.523	-3.205***	-5.586***	-3.002	-3.182	-5.579***
LogPOP	-3.541***	-0.796	-3.384***	-0.703	-2.569	-3.401***
LogICT3	-4.627***	-1.640***	-6.377***	-3.136	-2.065	-5.067***

*** and * represent significance at 1% and 10%, respectively. Lag length for ADF test is chosen by Schwarz Information Criteria.

As can be seen from the unit root test results, our series are not stationary at the same level. Regarding the ADF unit root test results in the table, it is seen that the variables other than LOGGDP are stationary for the equations with constant, the variables other than LogPOP are stationary in the first difference, and all variables are stationary in the second difference and accepted at 1% significance level. For the equation with constant and trend, it is observed that all series are non-stationary at level values, only LOGSE becomes stationary when the first difference is applied, and all variables become stationary at 1% significance level at the second difference. Considering all these outputs, the maximum order of integration is $m_{max}=2$

The next step is to determine the lag values of the model. The lag values determined with the help of Akaike Information Criterion (AIC), Schwart Criterion (SC), and Hannan Quinn Criterion (HQ) are shown in Table 11. According to the data in Table 11, since the maximum number of stars is two, our lag value is determined as two according to SC and HQ values.

Table 11. Determination of the Appropriate Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	52.13991	NA	9.54e-08	-4.813991	-4.614844	-4.775115
1	158.7183	159.8676	1.16e-11	-13.87183	-12.87610	-13.67745
2	184.3062	28.14666*	5.62e-12*	-14.83062*	-13.03830*	-14.48074*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion

As shown in Table 11, the optimum lag length for the VAR model was determined as p=2 using a number of information criteria.

Table 12. Causality Test Results

H_0	χ^2	Prob.	Decision
LOGICT3 does Granger-cause LOGSE	6.136701	0.0465	logICT3→logSE
All does Granger-cause LOGSE	24.34792	0.0005	All → logSE
LOGSE does't Granger-cause LOGICT3	0.461584	0.7939	logSE ··· logICT3

All does Granger-cause LOGICT3	5.776997	0.4486	All ··· logICT3
A → B means causality runs from A to B.			
A ··· B means no causality between A and B			

Table 12 indicates that in the model where the dependent variable is total service exports, there is causality from mobile phone subscriptions, an ICT indicator, to service exports, and there is also causality from all variables to service exports. In the model where the dependent variable is ICT3, it is observed that there is no causality from service exports to ICT3, and there is no causality from all variables to ICT. In other words, there is a unidirectional causality between service exports and ICT3 in Armenia; while ICT influences service exports, service exports do not influence ICT3.

4.2.1. Diagnostic Tests

Breusch-Godfrey Test was used to test the existence of autocorrelation problem in the series. It is seen that the probability values in Table 13 are greater than 0.05.

H_0: *There is no autocorrelation.*

H_1: *There is autocorrelation.*

In this case, based on the hypothesis " H_0 = *There is no autocorrelation*", no autocorrelation problem is found in the model up to three lags in all three country groups. At 5% significance level, the hypothesis is accepted and it is decided that there is no autocorrelation problem in the analysis.

Table 13. Diagnostic Test Results

Diagnostic test results for Azerbaijan				
Lag	**VAR Autocorrelation LM test results**		**VAR Variable variance problem**	
1	17.10356	0.3789	Ki-Kare	Olasılık değeri
2	15.81703	0.4658		
3	20.55995	0.1961	182.7510	0.1051
Diagnostic test results for Georgia				
1	15.61667	0.4800	Ki-Kare	Olasılık değeri
2	8.231093	0.9417		
3	19.06692	0.2652	176.5079	0.1762
Diagnostic test results for Armenia				
1	30.74254	0.0145	Ki-Kare	Olasılık değeri
2	22.27137	0.1346		
3	18.30567	0.3063	156.0231	0.3514

For the detection of the problem of varying variance, which is the last stage of satisfying the stability condition

Breusch-Pagan-Godfrey Test was used.

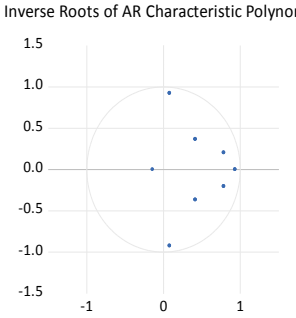
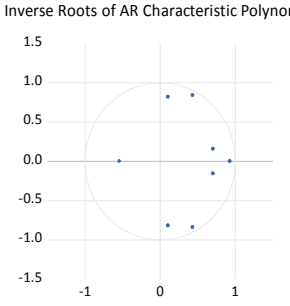
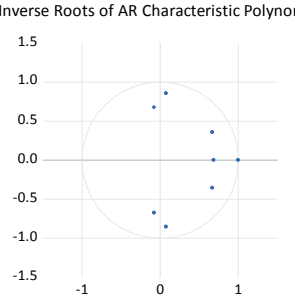
H_0: *There is no variance.*

H_1: *There is variable variance.*

According to the varying variance test results given in Table 13, the hypothesis is accepted at 5% significance level and therefore, it is determined that there is no varying variance problem in the analysis.

Table 14 shows the characteristic inverse roots of the model. It is seen that all inverse roots for all countries remain within the unit circle and satisfy the stability condition.

Table 14. Stability Condition Table

AZERBAJIAN	GEORGIA	ARMENIA
		

5. Discussion, Conclusion and Policy Recommendations

In this study, which examines the impact of information and communication technologies on services exports for the period 2003-2022, the ICT indicator is used separately for each country, taking into account differences in internet infrastructure, internet access and internet usability. The literature summarized in Table 2 (Wang & Choi, 2019; Lichy et al., 2022; Nasir & Kalirajan, 2016; Freund & Weinhold, 2002) suggests that country income, technology utilization level, technology skills, and technology ownership have a positive and significant effect on trade in services. On the other hand, in the same literature table, it is observed that service exports (Freund & Weinhold, 2002; Choi, 2010; Nath & Liu, 2017) are negatively affected by population. The exchange rate (Lichy et al., 2022) and the level of employment in the service sector (Wang & Choi, 2019) are also very important in trade in services. This study analyzes the relationship between service exports and information and communication technologies in the context of the service industry in the South Caucasus using time series data.

In the study, it was analysed that fixed telephone subscription, which is the variable included as an ICT indicator, causes service exports in Azerbaijan, service exports cause individual internet usage in Georgia, and mobile telephone subscription causes service exports in Armenia. In all three countries, a unidirectional causality relationship was found between ICT and services exports. Factors affecting exports have always been one of the most researched topics both in terms of literature and governments. Although there are no direct empirical studies on the subject, based on studies examining the relationship between ICT and trade, this study, which investigates the role of ICT in service exports in the South Caucasus, concludes that the relationship between mobile phone subscriptions as an ICT indicator and service exports in Armenia is in line with Nasir and Kalirajan (2016), Wardani et al. (2020), Choi (2010), and Freund & Weinhold (2002). On the other hand, individual internet use, which yields the best results as an ICT indicator for Georgia, is found to be effective in service exports as in (Wang and Choi, 2019; Lichy et al., 2022). It can be said that the result obtained for Azerbaijan is similar to (Nath & Liu, 2017; Wang & Choi, 2019).

In the late 20th century, ICT, which started to develop and spread rapidly, marked the first step in stimulating international trade and the global economy. It is crucial for service exports, which play a significant role in increasing foreign exchange earnings, creating new employment opportunities, and generally contributing to economic development. The findings of this research make important contributions to the development of service trade in the South Caucasus. It is emphasized that prioritizing ICT is essential to develop service exports in the South Caucasus countries, enabling them to reach the level of developed countries in the service sector and even surpassing these developed countries. This is because, as in many other sectors, prioritizing ICT in the service sector enhances industrial productivity and global competitiveness performance. Moreover, ICT is frequently preferred by many institutions, organizations, and individuals for its advantages such as time and cost savings. Therefore, the importance of knowledge-based digital production in the economy is increasing. In the South Caucasus countries, especially in Azerbaijan, fixed telephone subscriptions were identified as the reason for service exports, while in Armenia, mobile telephone subscriptions were identified as the key factors in facilitating and developing service trade.

In the study, the ICT variables that have the most significant impact on service sector exports are individual internet usage and mobile phone subscriptions. At this juncture, it is crucial to ensure that other ICT indicators are also effective in countries. This would facilitate the increase in service exports through the influence of ICT. Encouragement should be provided to ICT-related departments in existing universities, and high-quality software developers should be trained at reputable universities. ICT initiatives and advancements in service sector areas such as accounting, finance, and law should be prioritized, enabling the transformation of ideas into successful businesses. This is because the development of ICT enhances communication possibilities, reduces transaction costs, and thus can positively affect international trade by promoting greater commercial participation in the foreign trade process.

As internet coverage in Caucasian countries increases, it is imperative to expand, improve, and strengthen internet infrastructures. Otherwise, the digital divide is inevitable. In the study, the ICT

variables that have the most significant impact on service sector exports are individual internet usage and mobile phone subscriptions. At this point, it is of great importance to ensure that other ICT indicators are also effective in countries. This will facilitate the increase in service exports with the impact of ICT. As internet coverage increases in Caucasian countries, it is imperative to expand, improve and strengthen internet infrastructures. In Azerbaijan in particular, efforts should be made to reduce income inequality, and improvement and development policies should be established to reduce economic inequalities and poverty, thus preventing the digital divide caused by insufficient internet access for a significant part of the population. Public-private partnerships should be established to extend broadband internet access to rural areas in Azerbaijan. Data centres in accordance with international standards should be established in major cities such as Baku and investments should be made for the security and sustainability of these centres. ICT related departments in existing universities should be encouraged and high quality software developers should be trained in reputable universities. The curricula of ICT and software engineering programmes in universities should be updated and emphasis should be placed on practical skills. ICT initiatives and advancements in service sector areas such as accounting, finance and law should be prioritised to transform ideas into successful businesses. This is because the development of ICT increases communication possibilities, reduces transaction costs and thus can positively affect international trade by encouraging greater business participation in the foreign trade process. Technology incubation centres should be established in Baku and other major cities, providing financing and mentoring services for start-ups. Special incentive programmes should be created for R&D projects in the ICT field. New trade agreements should be negotiated to incentivise exports of digital services. Tax reductions and incentives should be provided for companies operating in the ICT sector. Effective political and macroeconomic management should prioritise the use of technology in all service areas, especially internet infrastructure. Robotic coding education should be integrated into pre-school education and ICT education should be encouraged. Otherwise, ICT facilities alone will not be sufficient and service sector exports will not reach the desired level.

Since there is a risk of a digital divide in Georgia and Armenia, as in many other countries, necessary incentives and support should be provided for R&D activities in the Caucasus countries and universal access to ICT should be ensured for all individuals at minimal or no cost. This would facilitate the development of various service sectors and thus increase service exports. Infrastructure investments should be made for the rapid adoption of 5G technology in Armenia. The establishment of 5G networks through public-private partnerships should be encouraged and the regulations on this issue should be updated rapidly. Venture capital funds should be established with the participation of local and international investors. Innovation competitions and hackathons should be organised regularly to encourage innovative ideas. Patent and intellectual property rights laws should be strengthened to protect ICT innovations. Grant and support programmes should be established for ICT projects. Microfinance and microcredit programmes should be initiated to meet the financing needs of small-scale enterprises. Regional cooperation with neighbouring countries in the field of ICT should be developed. High-speed internet access should be expanded in Georgia,

especially in Tbilisi and other big cities, and should be extended to rural areas. Local cloud service providers should be supported and international co-operation should be encouraged. Support the development of the entrepreneurship ecosystem by establishing technology parks and incubation centres in Tbilisi. E-commerce and data protection laws should be updated and regulations should be made to ensure the security of digital services. Special state support programmes should be established for the ICT sector and innovative projects should be financed.

Investments should be made to expand high-speed internet access in rural and urban areas to help the South Caucasus countries strengthen their ICT sector and increase competitiveness in services exports. The development of digital infrastructure such as data centres, cloud computing and secure internet networks should be encouraged. ICT-focused education programmes in schools and universities should be established and updated, tax reductions and subsidies should be provided for research and development activities in ICT, innovation centres and incubation programmes should be established for start-ups and technology companies. Legal arrangements should be made to facilitate and protect the export of digital services, and tax incentives should be applied for ICT investments and companies exporting services. Free trade agreements that facilitate the export of ICT services should be concluded. Marketing campaigns should be organised to ensure that the country is internationally recognised for ICT services. Co-operation between the public and private sectors for ICT services and innovation projects should be encouraged. In addition, knowledge sharing and co-operation in ICT fields between developing countries and Caucasian countries can be encouraged.

In future studies, the impact of ICT in specific service sectors such as health, education, finance and tourism can be analysed separately. The effects of ICT use in these sectors on exports can be analysed. Furthermore, research can be conducted on analysing the potential target markets for service exports of the South Caucasus countries and developing entry strategies for these markets. Collaboration models in the field of ICT among the South Caucasus countries and the impact of these collaborations on service exports can be analysed. The impact of ICT infrastructure (internet penetration, broadband access, mobile connections) on service exports can be analysed by making a cross-country comparative analysis of how the development of ICT infrastructure affects service exports in different countries. The contribution of the use of leading digital platforms (freelancing sites, e-commerce platforms) to service exports can be analysed on a sectoral basis to see how digital service platforms increase service exports and in which sectors they are most effective. How small and medium-sized enterprises (SMEs) can increase their service exports by using ICT can be analysed through surveys and case studies among SMEs. Laws and regulations governing the export of digital services, how they can be harmonised with ICT and how this harmonisation affects exports can be determined by comparing digital service export regulations in different countries. The impact of ICT on service exports can be analysed by comparing regions with different levels of development.

The most important constraint in carrying out this study was the lack of reliable and up-to-date data.

References

Aijaz, U., Bano, S., & Lodhi, K. S. (2022). Internal determinants of the service trade exports of China: A time-series analysis. *Pakistan Journal of International Affairs*, *5*(2).

Antonelli, C. (2000). Collective knowledge communication and innovation: the evidence of technological districts. *Regional studies*, *34*(6), 535-547.

Aydınbaş, G., & Erdinç, Z. (2023). The Effects of Information Communication Technologies on Human Capital: A Panel Data Analysis. Journal of Economy Culture and Society, (68), 119-129.

Baumol, W. J. (1967). Macroeconomics of unbalanced growth: the anatomy of urban crisis. *The American economic review*, *57*(3), 415-426.

Biswas, S. (2020). *Hizmet Sektöründe Bilgi Teknolojisi—Hindistan için Bir Vizyon*. http://itt.nissat.tripod.com/itt9703/itvision.htm. Accessed November 10, 2021.

Bloom, N., Sadun, R., & Reenen, J. V. (2012). Americans do IT better: US multinationals and the productivity miracle. American Economic Review, 102(1), 167-201.

Bradley, J., Modesto, L., & Sosvilla-Rivero, S. (1995). Hermın: A macroeconometric modelling framework for the EU periphery. *Economic Modelling*, *12*(3), 221-247.

Brynjolfsson, E., & Hitt, L. M. (2000). Beyond computation: Information technology, organizational transformation and business performance. Journal of Economic perspectives, 14(4), 23-48.

Chatti, W., & Khoj, H. (2020). Service export sensitivity to Internet adoption: evidence from dynamic panel data analysis. *Res World Econ*, *11*(6), 259-268.

Choi, C. (2010). The effect of the Internet on service trade. *Economics Letters*, *109*(2), 102-104.

Clark, C. (1941). The Conditions of Economic Progress. *The Economic Journal*, *51*(201), 120. https://doi.org/10.2307/2225658

Clarke, G. R. (2002). *Does internet connectivity affect export performance? Evidence from the transition economies* (No. 2002/74). WIDER Discussion Paper.

Clarke, G. R., & Wallsten, S. J. (2006). Has the internet increased trade? Developed and developing country evidence. *Economic Inquiry*, *44*(3), 465-484.

Clarke, G. R. G. (2008). Has the internet increased exports for firms from low and middle-income countries? Information Economics and Policy

Çapık, E., & Ören, H. G. Ü. (2023). Analysis of the Relationship between Service Export and Economic Growth in the Framework of South Caucasus Countries. *Sosyoekonomi*, *31*(55), 233-252.

Dickey, D. A., & Fuller, W. A. (1981*). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root.* Econometrica, *49*(4), 1057. https://doi.org/10.2307/1912517

Doyar, B. V., Rzali, S., & Dikkaya, M. (2023). Development of the ICT sector and the determinants of Internet use in the Southern Caucasus. *Telecommunications Policy*, *47*(1), 102455.

Duque, R., Collins, M., Abbate, J., & Azambuja, C. C. (2006). *Past, present, and future of research in the information society* (W. Shrum, K. R. Benson, W. E. Bijker, & K. Brunnstein, Ed.). Springer.

Evangelista, R., & Sirilli, G. (1995). Measuring innovation in services. *Research Evaluation*, *5*(3), 207-215. https://doi.org/10.1093/rev/5.3.207

Fisher, A. G. B. (1939). Productıon, Prımary, Secondary and Tertıary. *Economic Record*, *15*(1), 24-38. https://doi.org/10.1111/j.1475-4932.1939.tb01015.x

Fink, C., Mattoo, A., & Neagu, I. C. (2005). Assessing the impact of communication costs on international trade. Journal of International Economics.

Freund, C., & Weinhold, D. (2002). The Internet and International Trade in Services. *American Economic Review*, *92*(2), 236-240. https://doi.org/10.1257/000.282.802320189320

Granger, C. W. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: journal of the Econometric Society*, 424-438.

Granger, C. W. J., & Newbold, P. (1974). *Spurıous Regressıons in Econometrıcs*. 111.

Grubel, H. G., & Walker, M. (1989). *Service industry growth: Causes and effects*. Fraser Institute.

Hospers, G. J. (2004). *Regional economic change in Europe: A neo-Schumpeterian vision* (Vol. 3). LIT Verlag Münster.

ITU. (2018). Measuring the information society report 2018, ume 2. The International Telecommunication Union. https://www.itu.int/en/ITU-D/Statistics/Documents/ publications/misr2018/MISR-2018-Vol-2-E.pdf.

ITU. (2023a). Percentage of individuals using the internet. International Telecommunications Union. Retrieved from https://datahub.itu.int/data/?i=19303.xlsx Accessed November 10, 2023

ITU. (2023b). Fixed broadband subscriptions. International Telecommunications Union. Retrieved from https://datahub.itu.int/data/?i=19303.xlsx Accessed November 10, 2023

ITU. (2023c). Mobile cellular subscriptions. International Telecommunications Union. Retrieved from https://datahub.itu.int/data/?i=11623.xlsx Accessed November 10, 2023

ITU. (2023d). Fixed telephone subscriptions. International Telecommunications Union. Retrieved from https://datahub.itu.int/data/?i=15.xlsx Accessed November 10, 2023

Izmaylov, V. (2001). In Information technology prospects in the Caucasus 1st ISN executive conference. *Internet DEvelopment in Azerbaijan*, 1-12.

Jungmittag, A., & Welfens, P. (2009). Liberalization of EU telecommunications and trade: theory, gravity equation analysis and policy implications. International Economics and Economic Policy

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, *12*(2-3), 231-254. https://doi.org/10.1016/0165-1889(88)90041-3

Johansen, S., & Juselius, K. (1990). Maxımum Lıkelıhood Estımatıon and Inference on Coıntegratıon-Wıth Applıcatıons to The Demand For Money: Inference on Coıntegratıon. *Oxford Bulletin of Economics and Statistics*, *52*(2), 169-210. https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x

Karumidze, S. (2001). Information Tecnology Prospects in the Caucasus 1st ISN Executive Conference. *Development of Internet in Georgia*, 1-17.

Kırca, M., & Akkuş, Ö. (2020). Internet usage, economic growth and electricity consumption: The case of EU-15. *Ekonomi Politika ve Finans Araştırmaları Dergisi*, *5*(3), 576-594.

Krikorian, O. (2010). Caucasus analytical digest 15/10. *Caucasus Analytical Digest*, *10*, 2-4.

Kumar, V., Leone, R. P., & Gaskins, J. N. (1995). Aggregate and disaggregate sector forecasting using consumer confidence measures. *International Journal of Forecasting*, *11*(3), 361-377. https://doi.org/10.1016/0169-2070(95)00594-2

Kuźnar, A. (2016). *Value creation in the service economy*. Warsaw School of Economics.

Luong, T. A., & Nguyen, T. H. (2021). The Impact of Ict on Servıce Trade. *The Singapore Economic Review*, *66*(04), 1073-1086. https://doi.org/10.1142/S021.759.082049003X

Malik, M. H., & Velan, N. (2020). An analysis of IT software and service exports from India. *International Trade, Politics and Development*, *4*(1), 3-25. https://doi.org/10.1108/ITPD-12-2019-0012

Mattes, J. (2012). Dimensions of Proximity and Knowledge Bases: Innovation between Spatial and Non-spatial Factors. *Regional Studies*, *46*(8), 1085-1099. https://doi.org/10.1080/00343.404.2011.

McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data: the management revolution. Harvard business review, 90(10), 60-68.

Mills, B. F., & Whitacre, B. E. (2003). *Understanding the Non-Metropolitan—Metropolitan Digital Divide*.

MINCOM. (2021). Information technologies. Retrieved from https://mincom.gov.az/en/view/pages/10/ Accessed November 10, 2021.

Miles, I. (2000). Services innovation: coming of age in the knowledge-based economy. *International Journal of Innovation Management*, *4*(04), 371-389.

Myovella, G., Karacuka, M., & Haucap, J. (2020). Digitalization and economic growth: A comparative analysis of Sub-Saharan Africa and OECD economies. *Telecommunications Policy*, *44*(2), 101856.

Nasir, S., & Kalirajan, K. (2016). Information and communication technology-enabled modern services export performances of Asian economies. Asian Development Review, 33(1), 1-27.

Nath, H. K., & Liu, L. (2017). Information and communications technology (ICT) and services trade. *Information Economics and Policy*, *41*, 81-87.

OECD. (2000). The Service Economy. *Busıness and Industry Polıcy Forum Series*.

OECD & Eurostat. (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition*. OECD. https://doi.org/10.1787/978.926.4304604-en

Onyeiwu, S. (2002). *Inter-country variations in digital technology in Africa: Evidence, determinants, and policy implications* (No. 2002/72). WIDER Discussion Paper.

Ozcan, B. (2018). Information and communications technology (ICT) and international trade: evidence from Turkey. *Eurasian Economic Review*, *8*, 93-113.

Posner, M. V. (1961). Internatıonal Trade and Technıcal Change. *Oxford Economic Papers*, *13*(3), 323-341. https://doi.org/10.1093/oxfordjournals.oep.a040877

Ramakrishna, G. (2010). Open Policies and Service Sector Growth in India: Does Service Sector Growth Influence Economic Growth of India? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1633238

Sakenov, D. (2018). *History of ICT (Information and communications technology)*. Sutori. https://www.sutori.com/en/story/history-of-ict-information-and-communications-technology—N7J51bQqSU7vLWcVfdn5M9qa. Accessed December 12, 2021.

Schettkat, R. (2007). The Astonıshıng Regularıty of Servıce Employment Expansıon. *Metroeconomica*, *58*(3), 413-435. https://doi.org/10.1111/j.1467-999X.2007.00276.x

Shanmugam, V., & Latha, C. (2014). Growth of Service Sector in India. *IOSR Journal of Humanities and Social Science*, *19*(1), 08-12. https://doi.org/10.9790/0837.191.40812

Sims, C. A. (1980). Macroeconomics and Reality. *Econometrica*, *48*(1), 1. https://doi.org/10.2307/1912017

Stoneman, P., & Karshenas, M. (1995). Technological diffusion. İçinde *Handbook of the economics of innovation and technological change* (ss. 265-297). Oxford: Blackwell.

Toda, H. Y., & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of econometrics*, *66*(1-2), 225-250.

UNCTADstat. (2023). Retrieved from https://unctadstat.unctad.org/datacentre/dataviewer/US.TradeServCatTotal Accessed October 27, 2023

UNDP. (2001). *Making new technologies work for human development*. United Nations Development Programme (UNDP).

USAID. (2009). *Armenıan Informatıon Technology Sector Software and Servıces*.

Vandermerwe, S., & Chadwick, M. (1989). The Internationalisation of Services. *The Service Industries Journal*, *9*(1), 79-93. https://doi.org/10.1080/026.420.68900000005

Vardanyan, N., & Sarkisyan, Y. (2004). *Armenıan Informatıon Technology Sector Software and Servıces*.

Vemuri, V. K., & Siddiqi, S. (2009). Impact of Commercialization of the Internet on International Trade: A Panel Study Using the Extended Gravity Model. *The International Trade Journal*, *23*(4), 458-484. https://doi.org/10.1080/088.539.00903223792

Vernon, R. (1966). International Investment and International Trade in the Product Cycle. *The Quarterly Journal of Economics*, *80*(2), 190. https://doi.org/10.2307/1880689

Visús, S. B., & Zayas, J. M. (2003). Service export flows: empirical evidence for the European Union. *Documentos de trabajo= Working Papers (Instituto Complutense de Estudios Internacionales): Serie previa*, (3), 1.

Wajda-Lichy, M., Fijorek, K., Denkowska, S., & Kawa, P. (2022). The impact of information and communication technology on services exports: Evidence from developed and developing economies. *International Entrepreneurship Review*, *8*(3), 69-80. https://doi.org/10.15678/IER.2022.0803.05

Wakelin, K. (1998). Innovation and export behaviour at the firm level. *Research Policy*, *26*(7-8), 829-841. https://doi.org/10.1016/S0048-7333(97)00051-6

Wang, M. L., & Choi, C. H. (2019). How information and communication technology affect international trade: A comparative analysis of BRICS countries. *Information Technology for Development*, *25*(3), 455-474. https://doi.org/10.1080/02681.102.2018.1493675

Wardani, D. T. K., Nahar, F. H., & Hairunnas, H. (2020). The Role of Information and Communication Technology on Service Trade: Case Study of Indonesia's Export to ASEAN Countries. *Media Trend*, *15*(2), 236-248. https://doi.org/10.21107/mediatrend.v15i2.5858

World Bank. (2023). World development indicators. Retrieved from. https://databank.worldbank.org/source/world-development-indicators Accessed October 29, 2023.

Witt, U., & Gross, C. (2020). The rise of the "service economy" in the second half of the twentieth century and its energetic contingencies. *Journal of Evolutionary Economics*, *30*(2), 231-246. https://doi.org/10.1007/s00191.019.00649-4