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The ICT service trade and goods trade: Are they complementary in the digital era?

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ABSTRACT

Objective: This article aims to examine whether the exports of information and communication technology (ICT) services are complementary to trade in ICT goods and overall merchandise exports.

Research Design & Methods: We used panel regression models (log-log specification, Driscoll-Kraay robust standard errors accounting for cross-sectional dependence, heteroscedasticity, and serial correlation) to explore how the ICT service exports depend on trade in ICT goods (both exports and imports) and total merchandises exports. The research sample covered data for 37 developed economies over the 1998-2017 period.

Findings: The results show that both the exports and the imports of ICT goods are complementary to the exports of ICT services. We also identified complementarity between total merchandise exports and ICT service exports. Moreover, global demand for services and broadband digital connectivity have been proven to be significant determinants of ICT service exports.

Implications & Recommendations: The detected dependencies imply that in the digital era, export-promoting policies should not treat trade in goods and trade in ICT services separately. Moreover, policymakers should consider factors such as broadband digital connectivity and world demand as important drivers of ICT service exports.

Contribution & Value Added: This study provides new evidence on determinants of one of the most rapidly growing export categories, i.e. the exports of ICT services. We identified three sources of potential complementarities arising in the digital era between trade in goods and services. Moreover, while most researchers examined the role of traditional internet, we tested our models for broadband connectivity as a determinant of ICT service exports.

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INTRODUCTION

From 2000 to 2021, the volume of the world service exports tripled. Even more spectacular growth was recorded in the exports of information and communication (ICT) services, which more than quadrupled over this period. Both the global exports of total services and the exports of ICT services have been predominated by the developed countries, but their leading positions have been weakening. In 2000, nearly 85% of the worldwide exports of ICT services exports were performed by high-income countries, whereas in 2021 this share shrank to 75% (WDI database). Despite the declining shares in global service exports, developed countries have registered positive balances both in total services and in ICT service trade, allowing many of them to correct deficits in the ICT goods trade. However, the increasing global competition, especially in the area of new digital technologies, poses challenges for developed countries in

maintaining their leadership position as the exporters of ICT services. Designing effective policy measures supporting the exports of ICT services requires identifying the factors fostering digital trade.

Our research article provides new evidence on ICT service exports from 37 developed countries, which account for 70% of global ICT services exports. By identifying three sources of complementarities between tradable goods and services, we pointed to important intersectoral linkages influencing ICT services exports. Moreover, we examined how digital infrastructure affects ICT service exports. This factor-endowment approach is rooted in the theory of economic growth, which accounts, among others, for technological progress as a determinant of economic growth and examines the channels through which technology can drive growth. While most researchers consider the role of the traditional internet, which covers, on average, 90% of developed countries' population, we included broadband connectivity, which covers high-capacity transmission techniques with penetration of around 35%, indicating promising investment opportunities.

The remainder of this article is organised as follows. The first section presents the literature review focusing on the studies on the determinants of services exports, which cover trade in ICT goods and information and communication infrastructure. Drawing on the relevant literature, this section describes the channels through which goods trade can interact with exports of ICT-related services. In the next section, we will present the model specification, explain the data used in the empirical part of the study, and describe the estimation methods. We will present the results, their interpretation, and a comparison with previously published studies in the section results and discussion. In conclusions, we will provide further discussion on the results suggesting their economic policy implications.

LITERATURE REVIEW

It has been well documented that trade in services has been expanding rapidly worldwide owing partly to multilateral liberalisation initiatives traced back to the Uruguay round resulted in the General Agreement on Trade in Services (GATS) enacted in 1995 (Nordås, 2010; Nordås & Rouzet, 2017; Gnangnon, 2021) and partly to intensively developing digital technology which made services more tradable (Hoekman & Mattoo, 2013; Nath & Liu, 2017; López González & Ferencz, 2018; Ariu *et al*., 2019). A relatively large number of empirical studies also point to human capital, foreign investments, and the quality of institutions as important drivers of service exports (Eichengreen & Gupta, 2013; Sahoo & Dash, 2014). The role of goods trade in fostering service exports has been less discussed in the literature. Given that ICT technology has been rapidly developing giving rise to new linkages between goods and services, more intensive studies should cover the nature of interdependencies between tradable products and services, particularly in the ICT sector.

Previous studies on the nexus between tradable goods and services have mainly focused either on single-country cases, for instance, India's economy (Sahoo & Dash, 2014; Sahoo *et al*., 2019), German economy (Aquiland & Vendrell-Herrero, 2021), or on a one-way goods flow (for example, goods imports in López González & Ferencz, 2018) as a determinant of services exports. A comprehensive study by Eichengreen and Gupta (2013) covers 60 countries and explores the two-way impact of goods flows on service exports. They examined a spillover between goods exports, merchandise imports and service exports, accounting for their complementarity and network effects. They also consider how infrastructure such as telecommunication and capital openness proxied by foreign direct investment (FDI) inflows affect the exports of services. Their findings imply the importance of telephone connections and internet bandwidth, as well as goods exports and merchandise imports in explaining the determinants of the services exports. However, since the sample covered the 1990-2008 period, it did not include the recent development of information and communication technology, including broadband connectivity. Considering that rapid advances in digital innovations create new channels for trade and give rise to new intersectoral linkages, research on the relationships between tradable goods and services should be continued. The recent study by Wajda *et al*. (2022) examines the key drivers of services exports performed in high-income and low and middle-income economies, seeking to explore the role of the factors related to the information and communication sector. The authors take a close look at connectivity infrastructure and international trade in ICT

goods as potential determinants of overall services exports. This two-fold approach made it possible to examine the direct and indirect channels of digital technology's influence on services exports. The results of panel regressions run for 80 countries selected by the income per capita, and then separately for 44 high-income and 36 low and middle-income economies, shed light on the differences in the determinants of services exports between high-income and low and middle-income economies. High-income economies reveal stronger positive relationships between exports of overall services and imports of ICT goods than developing countries. Exports of ICT goods also appear to positively affect services exports and this relationship, also, turns out to be stronger for developed than for developing countries. Moreover, traditional internet connectivity appears to have a greater impact on service exports than broadband connectivity. This property was also identified with higher coefficients for high-income economies than for low and middle-income economies.

The review of prior empirical studies allowed us to conclude that there are several plausible mechanisms which explain how goods trade can interact with the exports of ICT-related services. Following the relevant literature, we pointed to three channels through which complementarities between goods trade and ICT service exports may operate. Firstly, exported goods may be supported by communication and information services, often delivered digitally as intangible assets. According to López González and Ferencz (2018) and Ariu *et al*. (2019), this kind of linkage increases the value and utility of manufactures and creates long-lasting relations with customers. On the one hand, cross-border ICT services help goods move faster, allowing for just-in-time information sharing between exporters and importers, and providing more efficient trade-related services, such as payment and insurance systems, which support international commercial exchange. On the other hand, information and telecommunication technology enables instant access to after-sale services, providing ongoing assistance to customers in the use of purchased goods. Such support contributes to the expansion of a customer base and makes foreign trade more efficient. Miroudot and Cadestin (2017) also point to customer loyalty resulting from the 'servicification of manufacturing' defined as a process relying on the intensive use of different service inputs and service output bundled with goods. Miroudot and Cadestin underline that servicification goes together with digitalisation and new business models, in which firms create new relationships with customers.

As the 'servicification of manufacturing' in international trade often operates within global value chains, Miroudot and Cadestin (2017) take a close look at the revealed comparative advantages in services, examining their role from the perspective of international production fragmentation. Using three approaches, *i.e.* the services value-added, the GVC income, and the business tasks, they calculate different types of comparative advantages in services to identify how OECD countries perform as the providers of particular services within manufacturing value chains, as well as the direct exporters of sub and final services delivered in the frameworks of service value chains. Their results show that over the years 2000-2014, a huge majority of OECD countries improved their advantages in commercial service industries, either increasing their specialisation in the existing fields or in the new ones. Moreover, they found that the stronger specialisation in final services, as well as in specific service activities provided within manufacturing value chains, the higher productivity growth and involvement in foreign markets. Aquilante and Vendrell-Herrero (2021) also identified the positive effects of complementarities between exported goods and ICT services at the firms' level. Surveying German SMEs, the authors found that complementarities which operate through product-service bundling were strongly associated with higher export intensity of both goods and services producers.

While in the ICT sector complementarities between exported goods and services, for instance between hardware products and communication or software services, seem intuitively obvious, demand for ICT-related services can be also driven by non-ICT goods, measured, for example, as the exports of all manufactures. According to Eichengreen and Gupta (2013), the expansion of the manufacturing sector resulted from trade liberalisation and it stimulates the service sector through backward linkages. These relationships may emerge from global value chains and the Internet of Things. In the internet era, merchandises are often embedded with sensors, software, and applications. Hence, their use requires ICT services, including programming, connectivity, and data processing. Moreover, many

studies show that ICT services allow for better tailoring of products to the tastes and needs of customers from different markets (Nordås, 2010; López González & Ferencz, 2018).

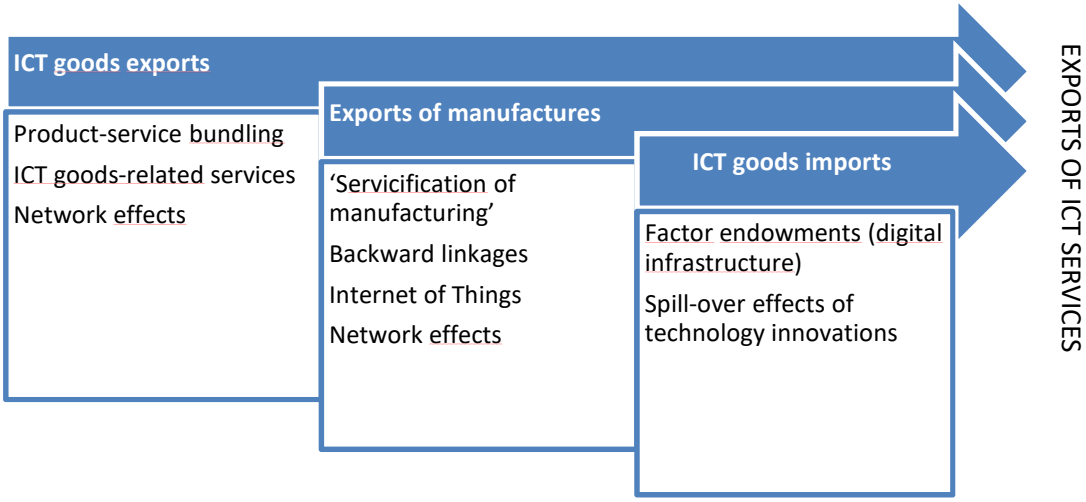

Figure 1. Channels of complementarities between the exports of ICT services and trade in goods
Source: own elaboration based on the reference literature.

Secondly, the channel through which goods affect service exports is related to network effects (Eichengreen & Gupta, 2013 and 2015; Sahoo & Dash, 2014) indicating that service suppliers benefit from the trade infrastructure previously set and used by goods exporters. In other words, a positive relationship between goods trade and services implies the spillover impact of goods export on service exports. Such linkages can result from technology diffusion, which often occurs through the spread of digital innovation from the manufacturing to the service sector. Auboin, Koopman, and Xu (2021) examined different international channels of promoting technology innovation, pointing to the importance of digital trade and trade in services. They also emphasize the role of governments and multilateral trading organizations in re-examining the rules of foreign investments, trade, as well as capital and labour mobility, in the context of digital technology. According to the authors, the rapid and far-reaching technological changes are calling into question the adequacy of the existing multilateral trading rules and countries' innovation policies, which do not account for many new effects that emerged in an increasingly digitalised global economy.

Thirdly, the exports of ICT services may be affected by imported goods as they contribute to factor endowments. Through this channel, the imports of goods – particularly related to information and communication –directly enable the production and exchange of ICT services and affect their exports indirectly. The latter was confirmed by López González and Ferencz (2018), who – using a proxy variable for the combined importance of digital connectivity and connected devices – found a statistically significant relationship between the imports of ICT goods and the exports of services (especially relevant for digitally deliverable services). According to González and Ferencz, the presence of this complementarity suggests that digitalisation is also indirectly linked to services through goods. Using panel regression models of 60 emerging and developed countries, Eichengreen and Gupta (2013) also explored the positive impact of goods imports on service exports. They identified a close relationship between trade in goods and services. Their finding implies that the implementation of protectionist measures resulting in limited access to imported goods, would hinder the export of services. Considering that many high-income economies are running trade deficits in ICT merchandise and that they have resorted to protectionism in the aftermath of the Covid-19 pandemic, the risk of service trade slowdown was relatively big.

Following the literature that points to different channels of influence of goods trade on services exports, as well as the growing role of ICT services in global trade, we constructed three models to test the following hypotheses:

H1: ICT goods exports positively affect ICT services exports.

H2: ICT goods imports positively affect ICT services exports.

H3: Exports of all manufactured goods positively affect exports of ICT services.

RESEARCH METHODOLOGY

We used annual country-level data on aggregate exports of ICT services, which was our dependent variable *ICTSE*, and related it to the exports of ICT goods, the imports of ICT goods, and overall manufactures exports, which allowed us to capture different channels of complementarities. Given different relationships which may emerge between trade in goods and services, we built the main panel regression model specified by equation (1) and tested it by inserting it as the *GT* variable, alternatively, the above-mentioned three types of tradable goods flow. Following the relevant literature, for example, Sahoo and Dash (2014) or López González and Ferencz (2018), our explanatory variables also included demand-side, supply-side, and price-related factors, such as the world demand for services, digital infrastructure related to broadband connectivity, and real effective exchange rate. The specification of the model was given by the following equation:

$$\ln ICTSE_{jt} = a_{j0} + a_1 \ln WDEM_t + a_2 \ln GT_{jt} + a_3 \ln INT_{jt} + a_4 \ln REER_{jt} + \varepsilon_{jt} \quad (1)$$

in which *j* stands for a country and *t* refers to the year.

We measured ICT services exports as a percentage of total service exports and they included international telecommunications or postal and courier services as well as information services including computer data and news-related service transactions between residents and non-residents. We derived the ICT goods exports and imports, as well as total merchandise exports, from the WDI database and deflated them by the GDP deflator. The definition of ICT goods exports and imports covers computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods. Our models included the imports of services worldwide, measured as a percentage of world GDP and expressed as the *WDEM* variable, which accounted for global demand for services. The development of digital infrastructure was proxied by fixed broadband subscriptions per 100 people and entered the model as *INT*. We used this measure to capture access to modern digital connectivity. The real effective exchange rate (REER) was a proxy for price effects and was expressed as an index. The concepts and definitions underlying the data used in the sample were based on the sixth edition of the IMF's Balance of Payments Manual. The graphs in the Appendix show the evolution of the variables used in the study for each country included in the panel. The panel sample consisted of 37 developed countries listed in the Appendix. We excluded a few small economies due to numerous data gaps. The sample covered the 1998-2017 period. Table 1 recaps the variables used in the study, gives their units of measurement, data sources, and presents the descriptive statistics.

We derived panel data from repeated observations over time of a selected set of countries. This kind of data typically displays both contemporaneous correlations across countries (cross-sectional dependence), country-level heteroscedasticity, and serial correlation making inferences from standard errors produced by ordinary least squares suboptimal. Panel-corrected standard errors or 'robust' standard errors help to account for these issues and allow for better inference. Different standard error estimators are preferred depending on a branch of applied econometrics. For moderately-sized panel time series in macroeconomics, Driscoll and Kraay (1998) usually recommend 'robust' standard errors. In this study, a linear fixed effects panel regression model (log-log specification) with country-specific fixed effects and with Driscoll-Kraay standard errors was fit to the data.

All the data used for estimating the models came from the World Bank's WDI database, except for the REERs of Croatia, Lithuania, Estonia, and Slovenia, which we took from the Eurostat due to data gaps in the WDI database.

Table 1. Descriptive statistics

Variable	No. of obs.	Percentage of not available data	Min.	Max.	Mean	Median	sd	CV	Skew.	Kurt.
Export of ICT services (% of service exports), Source: WDI	737	20%	0.395	48.517	7.794	5.593	7.621	0.978	2.923	9.472
Real Effective Exchange Rate (index for the year 2010 = 100), Source: WDI, Eurostat	925	0%	46.221	136.798	96.194	98.311	11.631	0.121	-0.841	2.639
Import of ICT goods (bln USD, deflated with GDP deflator), Source: WDI	739	20%	0.194	329.998	24.120	8.634	49.377	2.047	4.354	20.823
Export of ICT goods (bln USD, deflated with GDP deflator), Source: WDI	739	20%	0.015	210.871	16.134	4.180	30.705	1.903	3.108	10.275
Merchandise exports (bln USD, deflated with GDP deflator), Source: WDI	919	1%	1.088	1635.968	222.835	92.772	309.883	1.391	2.384	6.227
Digital connectivity (fixed broadband subscriptions per 100 people)	721	22%	0.003	46.901	20.762	22.985	12.774	0.615	-0.173	-1.081

Note: sd – standard deviation, CV – coefficient of variation, skew. – skewness, kurt. -kurtosis.
Source: own calculations based on World Bank database WDI [https://databank.worldbank.org/source/world-development-indicators] and Eurostat database [https://ec.europa.eu/eurostat/data/database].

RESULTS AND DISCUSSION

Table 2 presents the outcomes of three panel models estimated for identifying the complementarities between ICT service exports and trade in goods. We used model 1 to test for complementarity between ICT service exports and ICT goods exports, model 2 – for complementarities between ICT service exports and ICT goods imports, and model 3 – to identify complementarities between total merchandise exports and ICT service exports. Thus, we included ICT exports, ICT imports, and total merchandise exports as GT variables in the respective models. The identification of positive relationships between ICT services exports and different flows of goods trade would thus confirm the above-mentioned research hypotheses, indicating different channels of complementarity between goods and services trade.

Applying the ceteris paribus assumption, our findings show that both ICT goods exports and imports are significant predictors of ICT service exports. The regression coefficients, 0.19 and 0.20, respectively, are significant at the 1% level and have positive signs, which confirms the complementarity between ICT goods trade and the exports of ICT services. A similar effect is observed for total merchandise exports, which enters with an even bigger and still positive coefficient. The finding that a 1% increase in merchandise exports (on average) gives rise to ICT services exports by 0.24% implies, ceteris paribus, an important feature of modern trade, *i.e.* the bundling of goods and services. In other words, in the digital era, the exports of ICT services are positively and significantly associated with the exports of goods. Our findings, which confirmed the positive relationships between goods trade and service exports, are in line with the results obtained by Eichengreeen and Gupta (2013) for country-level data, and by Sahoo and Dash (2014) for firm-level data.

The regression results also point to the importance of modern digital infrastructure as a determinant of ICT service exports. Relying on the ceteris paribus assumption, the coefficients of broadband digital connectivity have expected signs and their values range from 0.05 and 0.08, depending on the model. These findings suggest that investments in broadband communication infrastructure foster the exports of ICT services. The importance of the endowment factors, covering modern information and

communication technology, implies continued investments in digital infrastructure to enable high-speed data transfer, which is essential for the provision of modern ICT services. The positive impact of broadband connectivity on total service exports was confirmed in the previous study by Wajda *et al*. (2022), whose panel regression coefficients estimated for high-income economies were of similar magnitude (0.06). The authors also identified that high-capacity digital network fosters service exports in low- and middle-income economies. However, the estimated coefficients had slightly lower values. Noteworthy, there is much to be done for the development of broadband communication, not only in developing countries, but also in developed countries, where in 2020 only 35 per 100 inhabitants had access to the wideband internet (WDI database).

Table 2. Model estimation results for ICT service exports

Independent variables	Model (1)	Model (2)	Model (3)
World demand for services	1.22*** (0.35/0.0006)	0.96*** (0.31/0.0018)	0.81*** (0.27/0.0029)
Broadband digital connectivity	0.07** (0.03/0.0322)	0.08** (0.03/0.0124)	0.05* (0.03/0.0672)
REER	-0.63** (0.32/0.0461)	-0.53 (0.32/0.1024)	-0.30 (0.33/0.3595)
ICT goods exports	0.19*** (0.04/0.0000)	–	–
ICT goods imports	–	0.20*** (0.07/0.0042)	–
Merchandise exports	–	–	0.24*** (0.07/0.0012)
R^2	0.847	0.840	0.823
Countries/Observations/Years	37/588/5-18	37/588/5-18	37/598/5-20

Notes: Asterisks denote statistical significance at 0.01 (***), 0.05 (**), 0.10 (*) level. Driscoll-Kraay robust standard errors and p-values are in parentheses.
Source: own elaboration in R.

Moreover, our results showed that in all three models, global demand positively affected ICT service exports by taking the highest coefficients (1.22, 0.96, and 0.81). As for the relatively high coefficients of global demand, they indicated that ICT service exports from developed countries were vulnerable to conditions of the world economy. This finding partly explains the increase in ICT exports of services in recent years, *i.e.* before the outbreak of the Covid-19 pandemic in 2020. It also implies the increasing trade dependencies between modern economies.

The REER coefficients, which cover the price-related determinants, have expected negative signs, but they are statistically significant only in one of our three models. When the price-related explanatory variable REER takes a negative sign, it means that the real appreciation of domestic currency reduces the export of ICT services making it more expensive for foreigners. This relationship was confirmed by Sahoo and Dash (2014), Sahoo *et al*. (2019), and Eichengreen and Gupta (2015), who identified a negative relationship between real exchange rates and service exports. However, while the latter showed that the real exchange rate is a particularly strong determinant of the exports of modern services, the former identified a less strong – but statistically significant – effect of the real exchange rate on the exports of traditional services. However, according to Sahoo *et al*. (2019), modern service exports, for example, ICT services, appeared to be negatively – but not significantly – affected by real exchange rates. Our results for model 1 showed that REER was negatively related to the exports of ICT services with a statistical significance of 0.05. The results we got from models 2 and 3 show a negative – but statistically insignificant – relationship between real exchange rate and ICT service exports. It may be explained by an easy access of developed countries to financial markets that offer them a wide range of advanced instruments used to hedge against the fluctuations of exchange rates. In other words, if exchange rate risk is reduced, the role of the exchange rate as a determinant of exports weakens.

CONCLUSIONS

Our study sheds light on certain aspects of foreign trade in the era of digitalisation. Using panel data for 37 developed countries, which account for a vast majority of global ICT services exports, we identified complementarities between ICT service exports and ICT tradable goods – both exported and imported ones. The overall merchandise exports also appeared to be complementary with ICT service exports, which suggests that digitalisation gives rise to the interlinkages between goods and services that go beyond the ICT sector. These relationships may operate through the Internet of Things or network effects. The revealed relationships between trade in goods and ICT service exports may also suggest the increasing role of complementarities between goods and services within global value chains. The statistically significant and positive coefficients for ICT goods exports, ICT goods imports, and total merchandise exports allow us to conclude that all three hypotheses were positively verified.

The regression results also point to the importance of broadband digital connectivity as a determinant of ICT service exports. As broadband is faster than traditional dial-up access, it allows the ICT services providers to transmit wide bandwidth data over a high-speed internet connection. For the ICT services consumers, this high-capacity transmission technology means a higher quality of information received in the form of multiple voice, video, and data files at the same time. Accounting for the increasing role of big data analysis as a pillar of modern ICT services adjusted to customer needs and tastes, the development of wideband networks also seems crucial for supporting the exports of sophisticated ICT services.

As for the relatively high coefficients that we obtained for global demand as a determinant of ICT service exports from developed countries, we can conclude that this export category is susceptible to the conditions of the world economy. These results suggest that with disruptions in the global economy, the countries specialising in ICT services exports may experience additional turbulences. However, the scale and scope of the effects on trade will depend on fluctuations' nature. For example, during the Covid-19 pandemic, the exports of ICT services increased substantially, because of the growing demand for remote and digital services, whereas most of the traditional services suffered from a huge collapse due to contingency policy, including restrictions in social distance implemented at that time.

The identified complementarities have important trade policy implications. They imply that regulations imposed on tradable goods may negatively affect the exports of ICT services. This observation is useful for domestic policymakers, especially in the aftermath of the Covid-19 pandemic, when many countries resorted to protectionism aimed at improving their current accounts or reducing their dependence on foreign suppliers. The barriers imposed on ICT goods imports would hinder the development of modern connectivity infrastructure, which in turn would hamper the exports of ICT services. Accounting for international production fragmentation, restrictions in bilateral trade may go beyond the two counterparties, implying far-reaching consequences on international trade. For example, the restrictive cross-border instruments implemented on goods may hamper the exports of ICT services, which are inputs used by the producers from the third country. As the length of global value chains substantially extended in the pre-pandemic era, our findings provide hints for international negotiators of multinational trading rules. In the times of globalization and the increasing competition in upgrading global value chains, countries aim to specialise in upstream activities which bring them high value-added. As ICT services contribute a substantial share of the final value-added of many modern products and services, this field of economic activities is extremely exposed to international competition. Therefore, the role of regulation at the multinational level is pivotal to deal with the problem of potential trade barriers which could negatively affect the exporters of services, either directly or indirectly. Our conclusions that domestic as well as international trade policymakers should not treat tradable services and goods separately coincide with those of López González and Ferencz (2018) who argue that trade in goods and services are intertwined, therefore, barriers to both need to be addressed in a coherent manner.

To sum up, to maintain comparative advantages in the ICT service exports, developed countries should continue to invest in broadband connectivity improving the quality of transmission of wide bandwidth data across long distances and at high speeds. Moreover, the policymakers responsible for trade should act more comprehensively, both as domestic and international actors, setting regulations that

account for complementarities that emerged between tradable goods and services. Also, exporters and importers of ICT services also need to incorporate the identified linkages in their trade strategies, which can contribute to upgrading their positions in global value chains and achieving higher value-added.

As this study focused on the determinants of ICT service exports, further research might investigate other categories of services, for example, financial, educational, business, and management services. Such an approach could certainly give a more comprehensive picture of the nature of contemporary trade, of which services are an increasing part. Owing to data limitations, our study eventually covered 37 developed economies, so further research could encompass more countries, including developing economies. In the era of dynamic digitalisation, we can assume that more and more services will be digitalised and exchanged, driven by the development of new trade channels or new complementarities, including those that emerged from bundling goods with different types of services.

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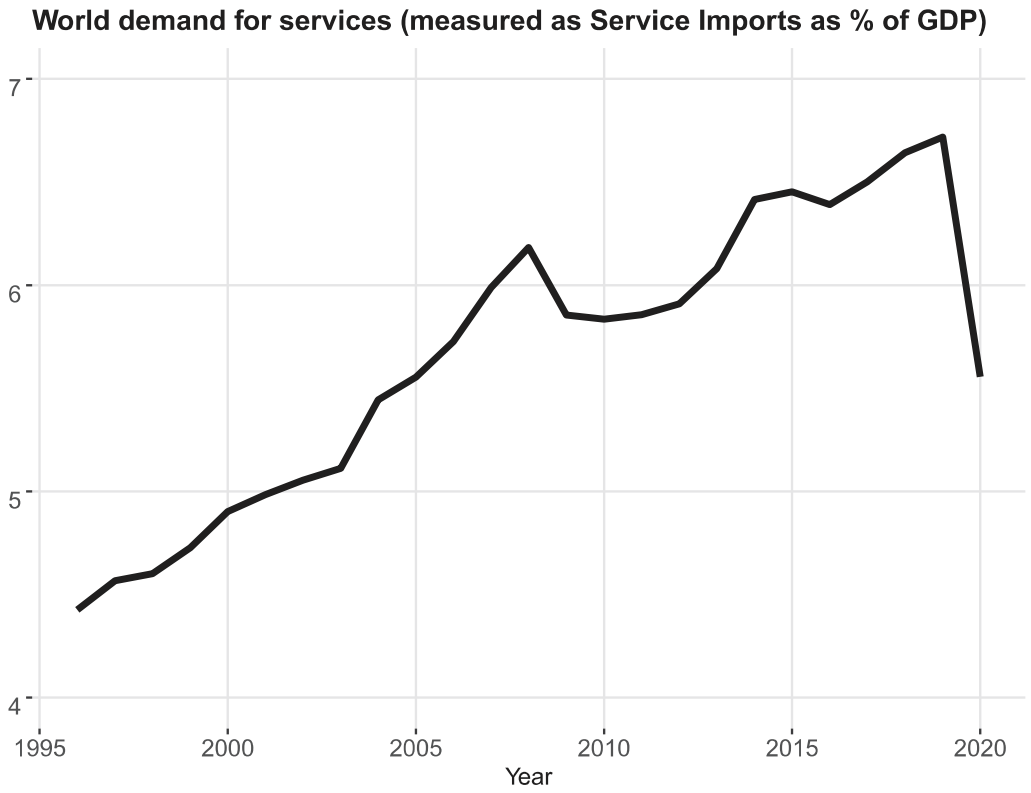
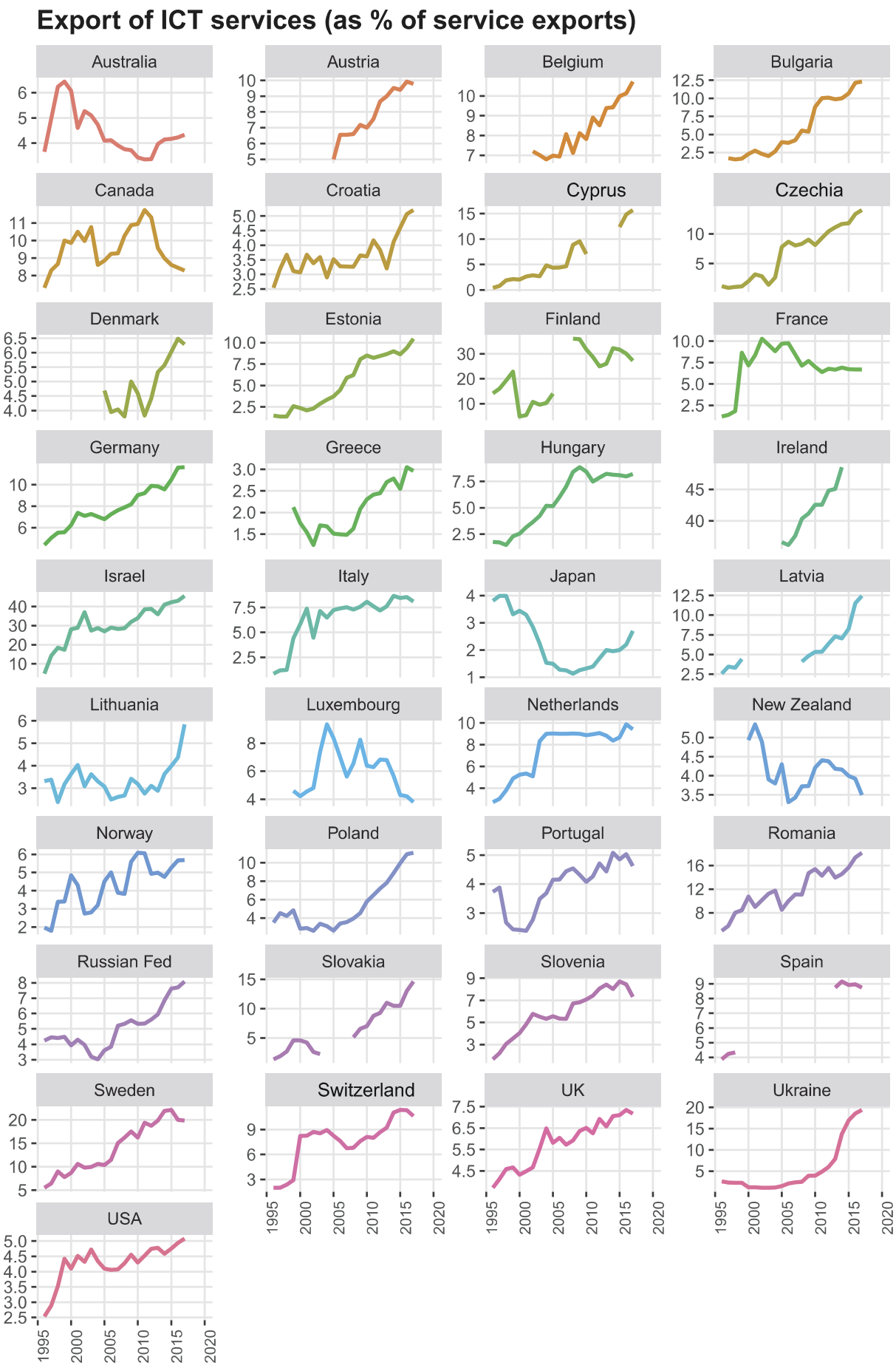
Appendix: List of the countries, source of data and illustration of data used in the study

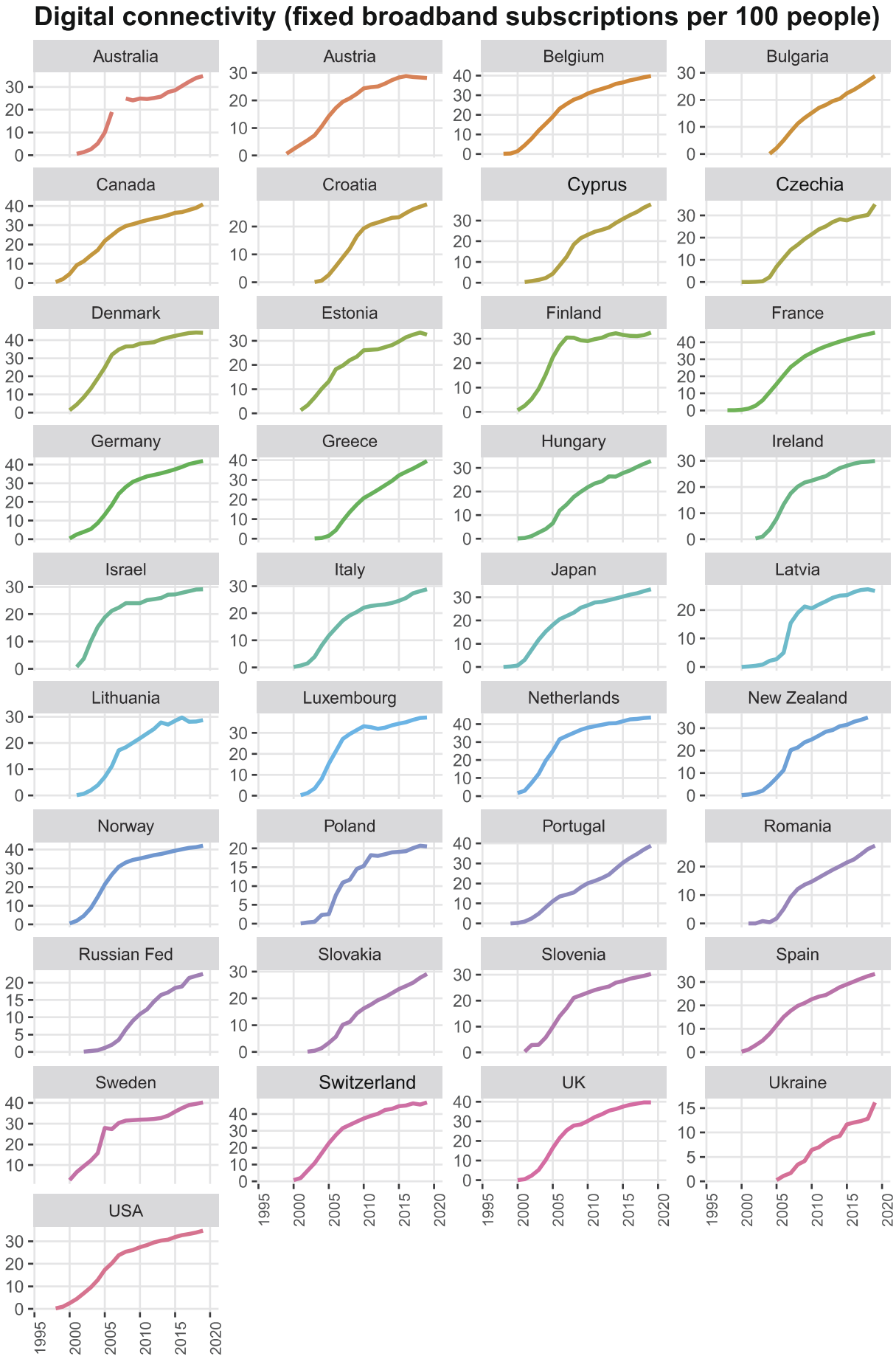
List of countries:

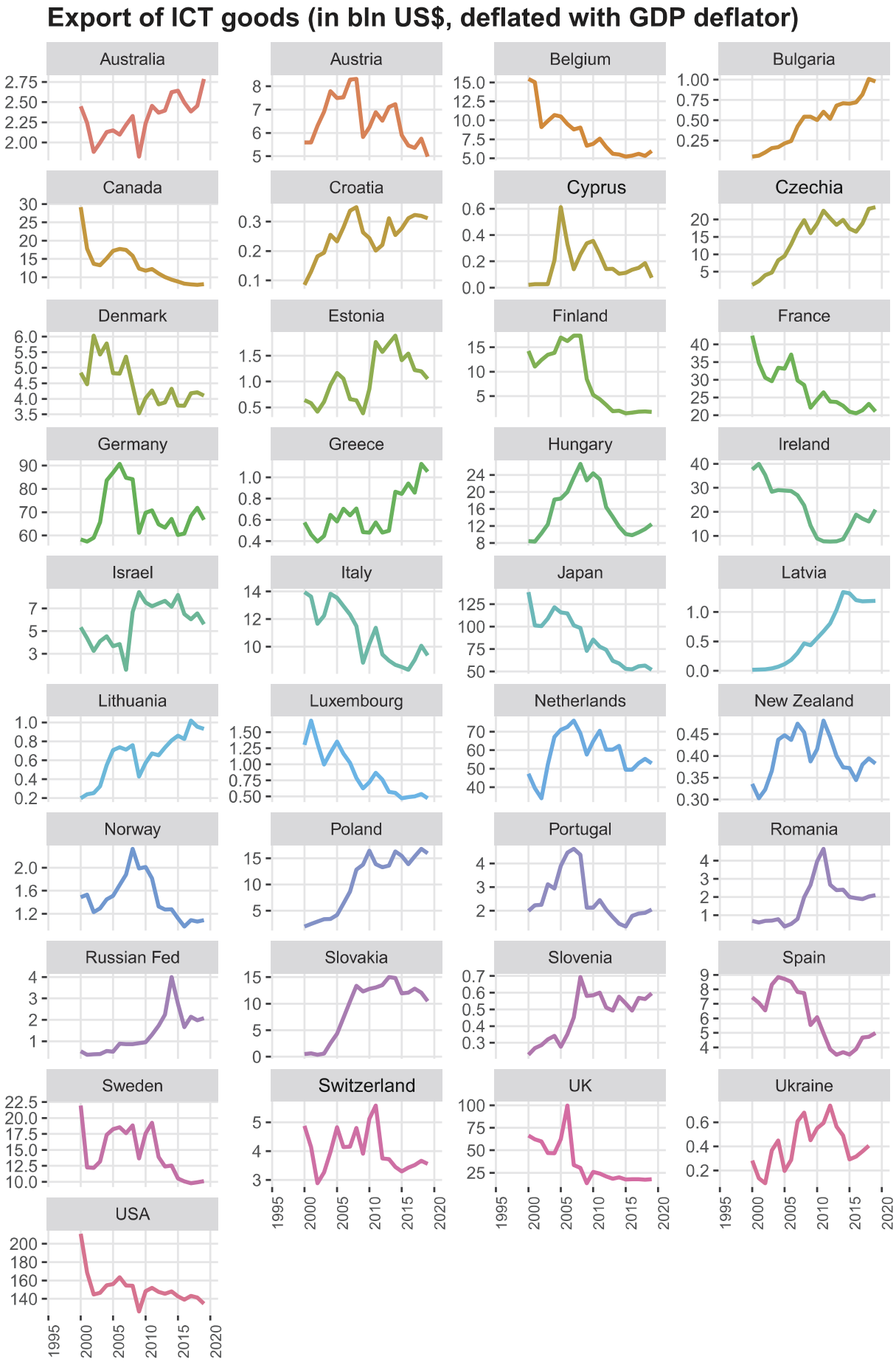
1. Australia	2. Austria	3. Belgium
4. Bulgaria	5. Canada	6. Croatia
7. Cyprus	8. Czechia	9. Denmark
10. Estonia	11. Finland	12. France
13. Germany	14. Greece	15. Hungary
16. Ireland	17. Israel	18. Italy
19. Japan	20. Latvia	21. Lithuania
22. Luxembourg	23. Netherlands	24. New Zealand
25. Poland	26. Portugal	27. Romania
28. Russian Federation	29. Slovakia	30. Slovenia
31. Norway	32. Spain	33. Sweden
34. Switzerland	35. United Kingdom	36. Ukraine
37. USA		

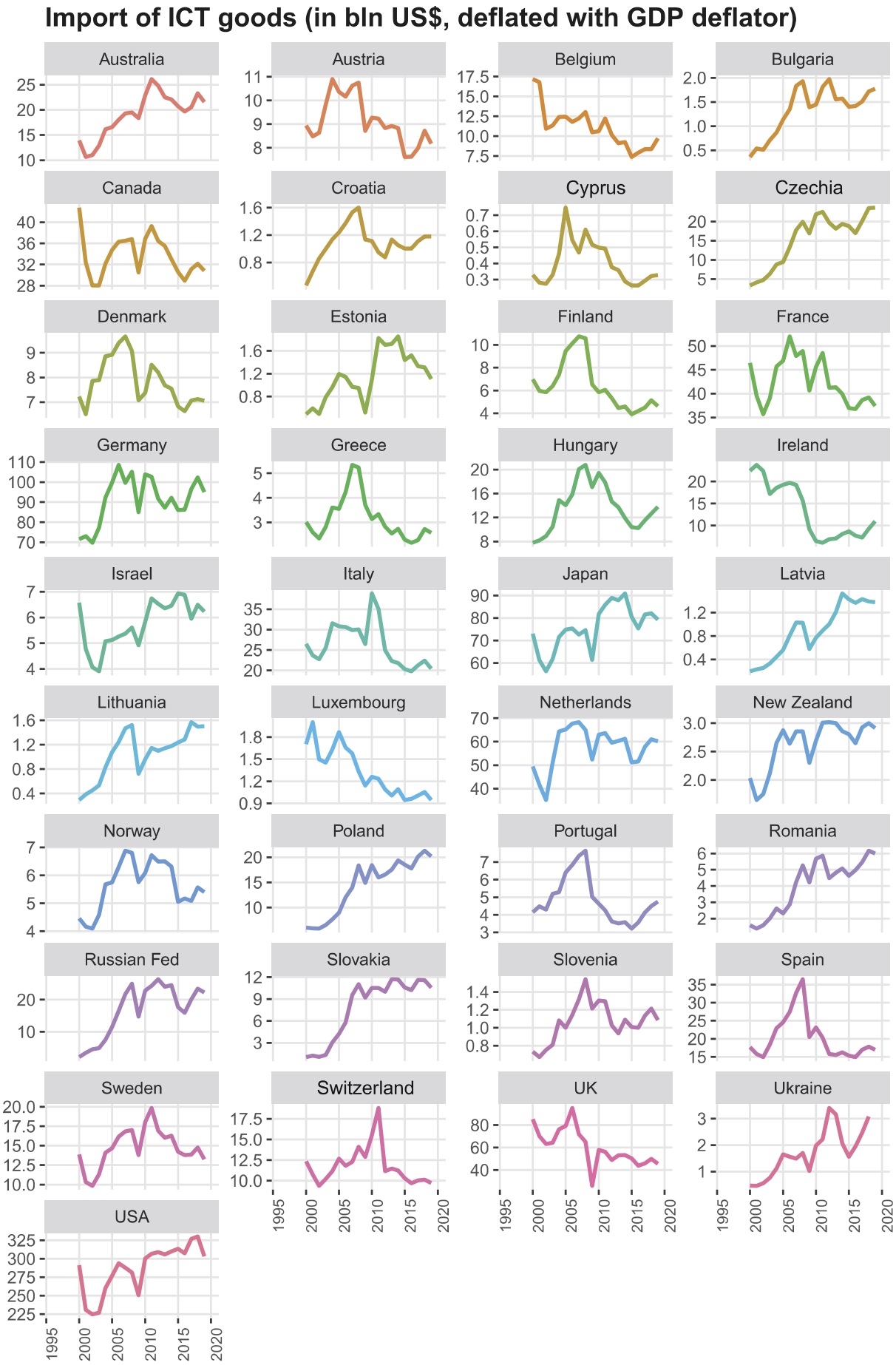
Source of data: All the data comes from the WDI database, except for REERs of Croatia, Lithuania, Estonia and Slovenia which were taken from the Eurostat due to data gaps in the WDI database. All charts have been prepared by the Authors in R.

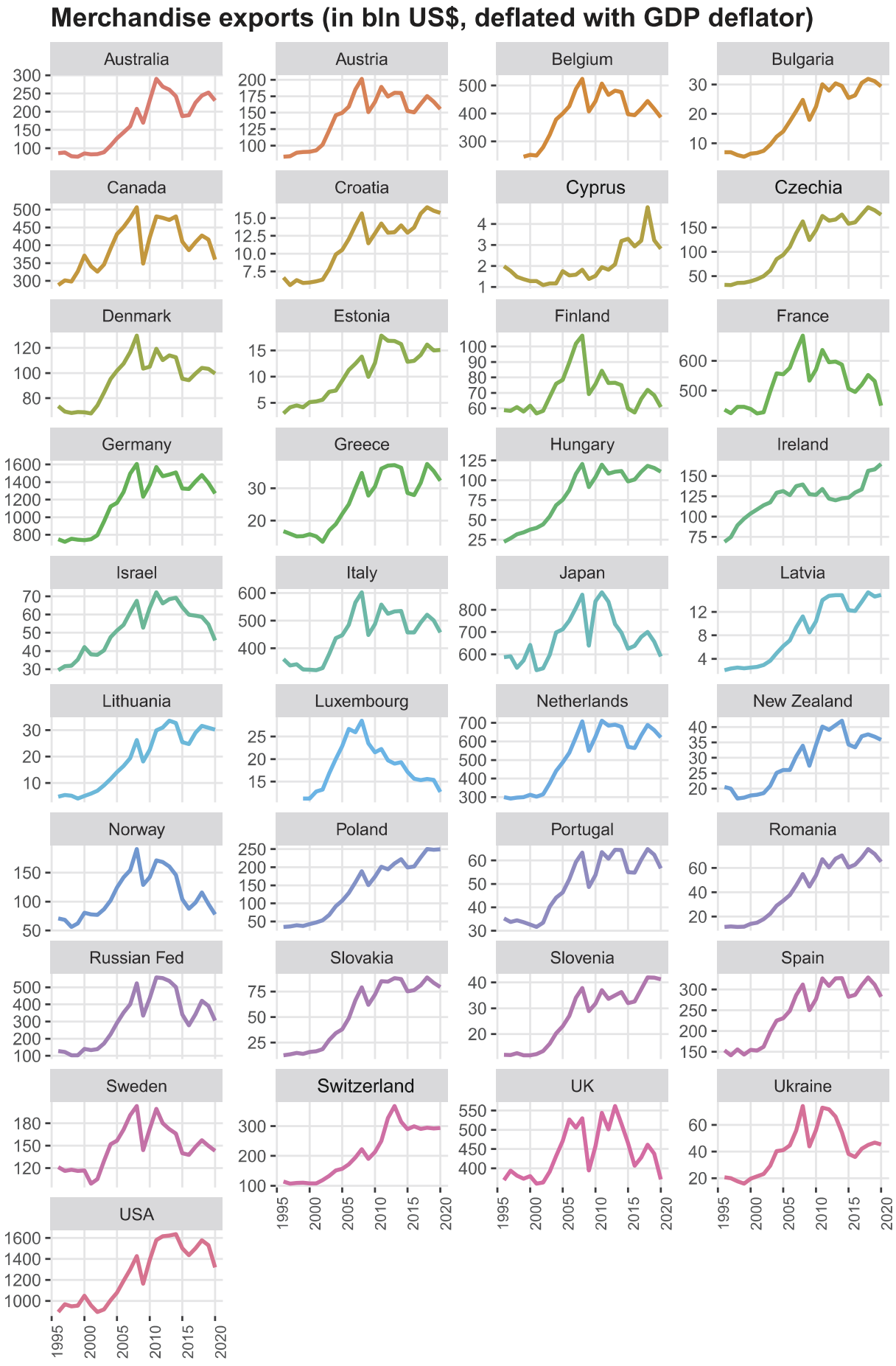


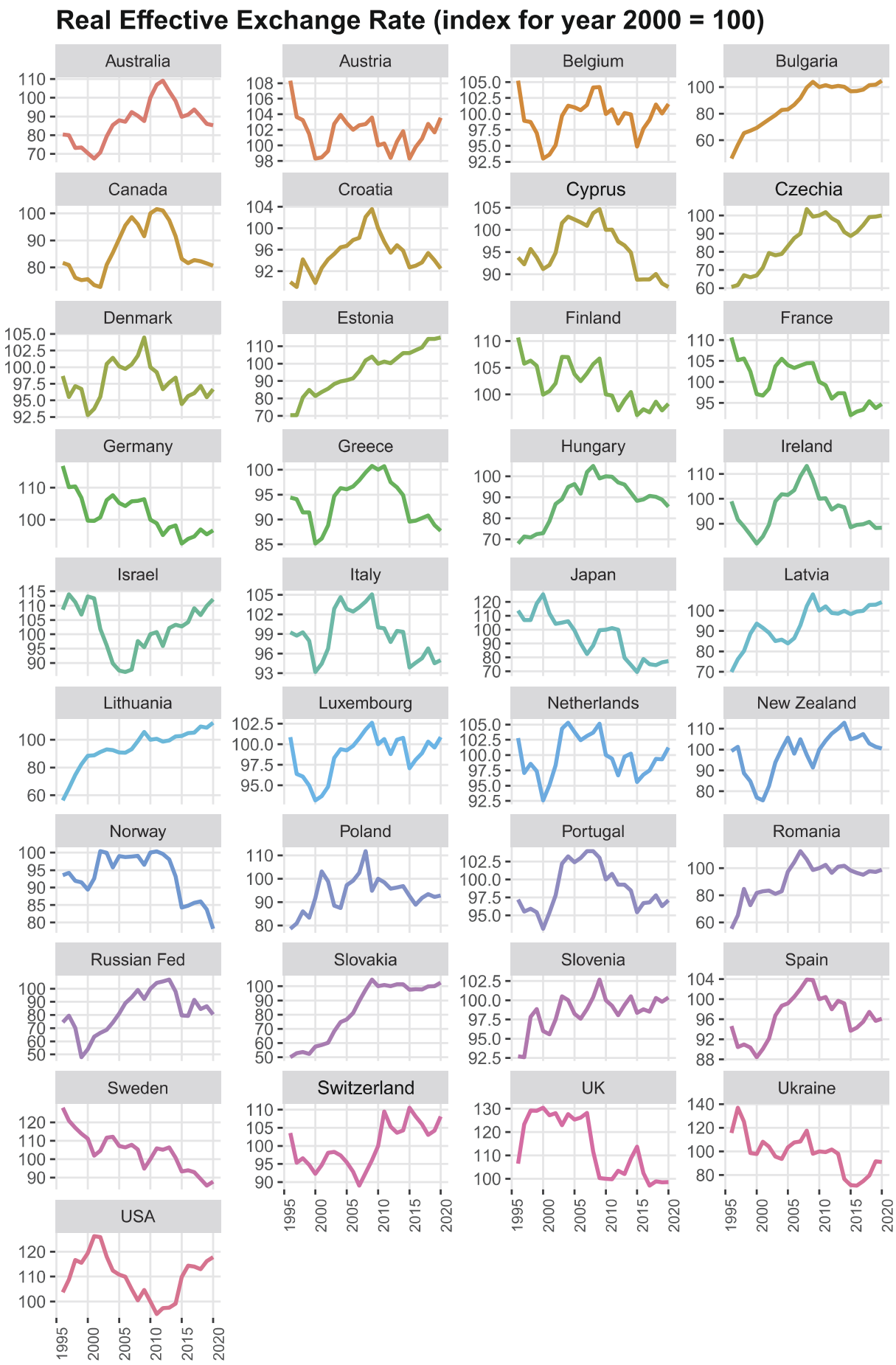

Export of ICT services (as % of service exports)
Australia
Austria
Belgium
Bulgaria
Canada
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russian Fed
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine
USA
1995
2000
2005
2010
2015
2020


Digital connectivity (fixed broadband subscriptions per 100 people)
Australia
Austria
Belgium
Bulgaria
Canada
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russian Fed
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine
USA
1995
2000
2005
2010
2015
2020


Export of ICT goods (in bln US$, deflated with GDP deflator)
Australia
Austria
Belgium
Bulgaria
Canada
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russian Fed
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine
USA
1995
2000
2005
2010
2015
2020


Import of ICT goods (in bln US$, deflated with GDP deflator)
Australia
Austria
Belgium
Bulgaria
Canada
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russian Fed
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine
USA
1995
2000
2005
2010
2015
2020


Merchandise exports (in bln US$, deflated with GDP deflator)
Australia
Austria
Belgium
Bulgaria
Canada
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russian Fed
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine
USA
1995
2000
2005
2010
2015
2020


Real Effective Exchange Rate (index for year 2000 = 100)
Australia
Austria
Belgium
Bulgaria
Canada
Croatia
Cyprus
Czechia
Denmark
Estonia
Finland
France
Germany
Greece
Hungary
Ireland
Israel
Italy
Japan
Latvia
Lithuania
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russian Fed
Slovakia
Slovenia
Spain
Sweden
Switzerland
UK
Ukraine
USA
1995
2000
2005
2010
2015
2020

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The contribution share of authors is as follows: Marta Wajda-Lichy – conceptualization, data collecting, literature review, discussion, results' interpretation, conclusions (65%); Kamil Fijorek – conceptualization, methodology, calculations, discussion (20%); Sabina Denkowska – methodology, calculations (15%).

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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