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Shedding Light on the Drivers of Services Tradability over Two Decades

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Services have become significantly more tradable in the first two decades of the 21st century. This paper documents that trade costs for financial services, communication services and business services fell by between 30% and 60% between 2000 and 2019. Information and communication technology and growth of air traffic have acted as key drivers of this development. While there is some variation across sectors, the analysis suggests that these two determinants jointly account for a quarter to half of the aggregate decline in trade costs for services during this 20-year period. Furthermore, services provisions in regional trade agreements (RTAs) can explain between 3% and 14% of the reduction in trade costs for communications services and financial and insurance services. These findings demonstrate the importance of whole-of-government strategies to promote services trade competitiveness, inter alia market access, regulatory reform, as well as investment in physical and digital infrastructure and adoption of new technologies.

Keywords: Services trade, digital trade, trade costs, digitalisation, trade policy, trade liberalisation

JEL Codes: F13, F14, F15, F68, O33

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Executive Summary

Historically, services have often been categorised as “non-tradable”, meaning that production and consumption of a service must take place in the same geographic location. However, the last decades have witnessed a tremendous surge in the volume of international services trade, implying that this label no longer fits.

This study investigates changes in services tradability, defined as the possibility of geographical separation between consumption and production of services. The analysis covers the years 2000-2019 and exploits information on cross-border services trade between 47 economies in three sectors: financial and insurance services, communication services and business services. It relies on variations of a gravity specification, including international cross-border services trade and domestic consumption of domestically produced services (“domestic trade”). Trends over time are described by time-varying regression coefficients, indicating structural changes in global trade patterns. The contribution of major determinants is analysed in a structural gravity analysis, allowing for a decomposition of trade cost changes.

The results reveal a significant trend towards the globalisation of services trade and a corresponding drop in the costs of cross-border services trade over time. Compared to the beginning of the millennium, the share of services traded internationally has grown by between 70% and 200%. The analysis simultaneously reveals large scope for further growth of services trade.

The detrimental impact of geographic distance on international services exports has fallen and we estimate reductions in services trade costs by between 30% and 60% over the last 20 years. The trend towards globalisation of services can be identified for all three sectors covered in this analysis. It is most pronounced for the economically most advanced exporting countries.

To a large extent, this trend is driven by the expansion of information and communication technology (ICT), the growth of air transport, and services liberalisation through regional trade agreements (RTAs). Adoption of ICT since 2012 can explain at least one quarter of the total reduction in trade costs for communications services. The contribution of ICT to reductions in the cost of cross-border trade of financial services and business services seems to be even larger. There is evidence that the importance of ICT as a determinant of services trade costs has increased over time.

The expansion of air travel can account for a further 10% to 50% of the reduction in cross-border services trade costs, depending on the sector. This suggests that services exporters rely on a set of complementary channels for the exports and imports of services, including both the exchange of data, as well as in-person contact and business meetings.

Services provisions in new or updated RTAs are estimated to explain between 3% and 14% of the drop in trade costs for communications services and financial services. In financial services, a new services RTA can increase bilateral trade by up to 80%. For business services, there is no significant evidence on the beneficial impact of services RTAs. Yet, it should be noted that this variable is only a rough proxy for the extent of services liberalisation, which also depends strongly on domestic regulation and measures behind the border.

All results rely on data until 2019 and structural relationships between services trade and ICT or air travel may clearly have changed since then. While the findings presented in this paper highlight the importance of international travel but also affordable and efficient internet access to services trade, future studies covering the years after 2019 will help improve our understanding of structural changes induced by the COVID-19 pandemic and may also examine the potential for ICT adoption to limit the need for business travel and thereby reduce total CO2 emissions caused by air transport.

Key messages

- *Tradability of services has surged in the 21st century:* The tradability of services rose dramatically in the last decades, creating new opportunities for exporters. Financial services, communication services and business services are increasingly traded across national borders and have experienced reductions of trade costs by between 30% and 60%. The expansion of services tradability is most pronounced for the most advanced economies.
- *Technology, transport and RTAs are breaking down barriers and lowering trade costs:* The detrimental impact of geographical distance on cross-border services trade has fallen significantly between 2000 and 2019. The analysis provides support for the role of ICT and air transport in reducing the costs of exporting to remote destinations. ICT adoption and growth of air traffic have been key drivers for the increase in cross-border services trade and an equivalent reduction in trade costs for services. While there is some variation across sectors, overall the analysis suggests that these two determinants jointly account for a quarter to half of the aggregate decline in trade costs for services during the last two decades. Furthermore, services provisions in regional trade agreements (RTAs) can explain between 3% and 14% of the reduction in trade costs for communications services and financial and insurance services. In financial services, a new RTA is estimated to increase cross-border trade by up to 80%.
- *Trade policy can drive further growth:* The results cast a spotlight on the vast potential for further growth in services trade. Cross-border flows remain far below the trade volume that would be expected if trade costs for international trade were reduced to the level of costs for within-country exchanges. There is significant policy scope to promote services trade. The findings demonstrate the importance of whole-of-government strategies to promote services trade competitiveness, *inter alia* market access, regulatory reform, as well as investment in physical and digital infrastructure and adoption of new technologies.

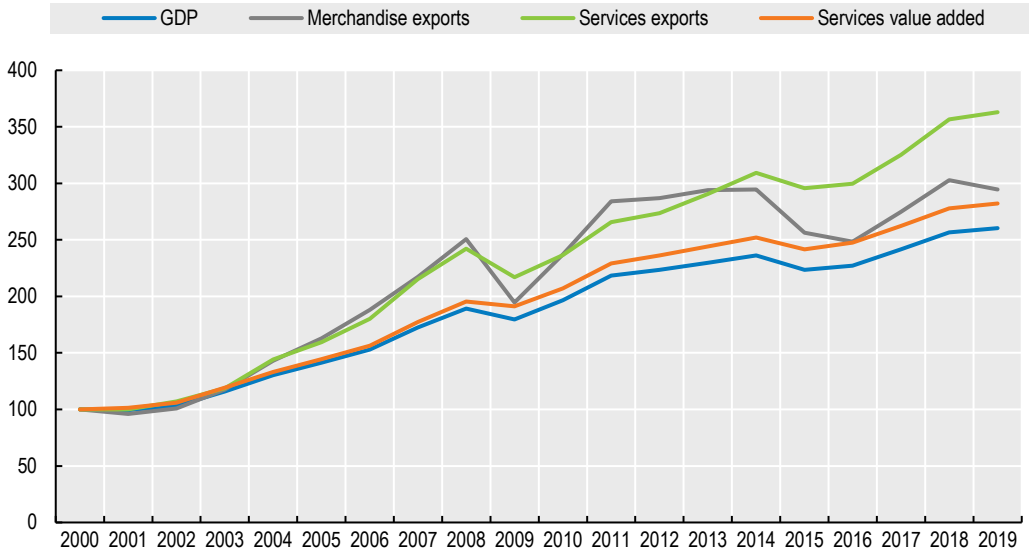
1. Introduction

Services account for three-quarters of GDP in advanced economies. Exports of services constitute a major source of employment in many countries and traded services are key inputs to manufacturing activities in global value chains. At the same time, the structure of market access is asymmetric, with the average level of regulatory restrictions in OECD non-Members approximately 180% higher relative to OECD countries as measured by the Services Trade Restrictiveness Index (STRI). There is therefore a growing recognition that untapped economic potential could be exploited through a reduction of trade costs in services (OECD, 2021[1]).

Exchanges of services tend to be facilitated by geographical proximity of the provider and the buyer of a service. Many services are tailored to specific user-requirements and customisation hinges upon fast and reliable communication between producer and purchaser.[1] Face-to-face contact generally constitutes the most efficient way of exchanging complex, context-specific information and establishing trust (Storper and Venables, 2004[2]).

The need for close interaction between supplier and consumer has long been considered an impediment to services trade, especially cross-border trade across large distances (Francois, 1990[3]). This perspective resonates with studies showing that trade costs are substantially higher for services than for goods (Miroudot, Sauvage and Sheperd, 2013[4]; Gervais and Jensen, 2019[5]). However, there are reasons to suspect that this "proximity burden" of services trade may have decreased in recent years. In the last two decades, global services exports have grown faster than merchandise trade and also faster than services value added (Figure 1).

Figure 1. Global services output and services exports



Note: All indicators refer to the global economy. All indicators normalised to 100 in the year 2000.
Source: World Bank World Development Indicators database.

Several factors related to policies, technology and infrastructure might have raised the tradability of services, defined as the capacity to facilitate geographic separation between consumption and production. Consequently, services tradability encompasses two overlapping, closely related perspectives. First, it refers to the capacity to trade services across national borders. Second, it also refers to the possibility of selling a service to a trade partner that is geographically remote from the location where the service is

[1] For example, a manufacturing firm sourcing specialised design services will often go through multiple rounds of feedback and revisions before arriving at the final creative output corresponding to its expectations.

produced. In line with this definition, the empirical analysis investigates: (i) changes in the evolution of cross-border trade relative to domestic consumption of domestically sourced services; and (ii) changes in the effect of geographical distance on international services trade.

In a first step, this paper documents evolving patterns of services tradability, covering changes across time and cross-country differences. In a second step, it examines major drivers of services tradability in a comprehensive framework across three dimensions:

- Regional trade agreements (RTAs)[2] with legally enforceable services provisions;
- Information and communication technology (ICT), measured by two different indicators related to access to the internet and expansion of computer networks;[3]
- Air traffic, measured by annual numbers of air passengers.

RTAs primarily relate to the effect of national borders on trade flows, i.e. they correspond to an interpretation of services tradability that focuses on the comparison of international trade with domestic consumption of domestically sourced services. Conversely, air transport and ICT are likely to be particularly relevant to trade flows between geographically distant trade partners.[4] Their relative effect is likely to be less pronounced in border regions where providers and buyers of services can travel by car or by train in order to meet in person and discuss details of the cross-border services transaction.

Motivated by this framework, the econometric analysis aims at identifying the impact of international travel and ICT adoption, as well as RTAs on services trade. For example, it quantifies the expected growth of services exports resulting from an expansion of air traffic or from increased use of ICT technologies. The analysis also explores the extent to which these factors lower the cost of international services trade and facilitate services exports towards remote destinations.

The study uses data for the period between 2000 and 2019 (although it should be noted that not all analytical steps exploit data for the full period, due to limited data availability for specific variables).[5] All data refer to cross-border services exports according to the definition in the balance of payments. The balance of payments measures the value of transactions between a resident and a non-resident institutional unit.[6] In the context of services, this includes Mode 1 (cross-border services trade), Mode 2 (consumption abroad) and Mode 4 (movement of people). A disaggregation is possible by the type of service included in the transaction, allowing to categorise Mode 2 as travel services, which is excluded from the analysis. The analysis focuses on communications services, financial and insurance services, as well as business services, where balance of payments data measure the sum of Mode 1 and Mode 4

[2] The term regional trade agreements (RTAs) is used throughout this document in line with WTO nomenclature, defining RTAs as reciprocal preferential trade agreements between two or more partners. It is acknowledged that RTAs can also be concluded between partners that are not located in the same geographic region.

[3] Particular challenges arise from the necessity to identify relevant indicators covering the entire period of analysis (2000-2019). Rapid technological progress with respect to information technology implies that relevant measures from the beginning of the millennium may be obsolete in the year 2019. For example, access to the internet used to be measured by indicators relating to the share of households with internet or the number of businesses with a website. These indicators may be less relevant in the present, where mobile broadband and adoption of artificial intelligence (AI) or cloud computing may be more relevant measures. We think that this challenge can be solved at least partly by using country level data on the number of IP addresses as our preferred measure of ICT adoption. Further specifications rely on a measure of household access to the internet.

[4] Mostly due to reasons of data availability, we cannot quantify the impact of ICT or air transport on services transactions within large countries. However, we control for the impact of domestic distances in all our specifications.

[5] The length of the period of analysis is mostly determined by the availability of data, with 2019 being the most recent year available at the time of writing.

[6] The residence of each institutional unit is the economic territory with which it has the strongest connection, expressed as its centre of predominant economic interest. A household is resident in a territory where it has been present or intends to be present for one year or more (International Monetary Fund, 2009[73]).

transactions.[7] Trade flows between the 47 countries included in the sample jointly account for roughly two-thirds of global trade in these three sectors in 2019.[8]

Results reveal a significant increase in the globalisation of services trade. Compared to the year 2000, a larger share of services is now traded internationally. Services are also exchanged over larger distances, even when controlling for other trade determinants, such as the growing importance of services relative to manufacturing. Moreover, we show that this increase in services tradability is at least partly driven by adoption of ICT, growth of air transport capacity and services trade agreements. The findings suggest that services trade relies on a set of complementary channels of communication between provider and customer, including the exchange of digital data but also in-person contact and business meetings.

The rest of the paper is structured as follows. Section 2 briefly reviews the related literature on the tradability of services. Section 3 discusses variation in the effect of national borders and geographic distance on services trade over time and across different economies. Section 4 analyses the determinants of changes in the effects of national borders and distance and quantifies the contribution of ICT adoption, air transport, and trade agreements to the overall reduction in services trade costs. Section 5 concludes.

2. Existing evidence and related literature

Existing research highlights the general relevance of trade liberalisation, ICT and air transport to global trade flows. Several early studies identified a positive and significant association between RTAs and bilateral services trade (Ceglowski, 2006[6]; Kimura and Lee, 2006[7]; Egger, Larch and Staub, 2012[8]), including when focusing on services RTAs (Park and Park, 2011[9]) and taking into account the depth of agreements (Guillin, 2013[10]). More recent studies increasingly emphasize econometric robustness (through stringent fixed effects) and look at disaggregated services sectors (Borchert and Di Ubaldo, 2021[11]). Research on the importance of services RTAs is complemented by studies highlighting the importance of domestic policy barriers (Benz and Jaax, 2020[12]; Borchert et al., 2019[13]) and other institutional characteristics (Anderson et al., 2018[14]; Beverelli et al., 2018[15]).

The rapid expansion of new forms of electronic communication from the 1980s onwards has been particularly highlighted as a development that may mitigate the “proximity burden” hampering international services trade (Bhagwati, 1984[16]; Francois and Hoekman, 2010[17]; WTO, 2019[18]). Yet, systematic empirical research focused on the effect of ICT adoption on trade is relatively rare (Greenstein, Forman and Goldfarb, 2018[19]), particularly regarding services trade. For trade in goods, existing estimates indicate that a 10% increase in internet penetration can raise bilateral exports by between 0.2% (Freund and Weinhold, 2004[20]) and 1.9% (Osnago and Tan, 2016[21]). For services trade, there is some evidence of a positive impact of digital connectivity on bilateral exports (López González and Ferencz, 2018[22]). Equally, higher broadband density is correlated with exports of computer services across larger distances (Nordås, 2020[23]). Bilateral connectivity via undersea fibre-optic cables is positively associated with exports of data-intensive services (Haltenhof, 2019[24]).

[7] See Annex C for details on data sources. For the purpose of this analysis, business services encompass sections M (professional, scientific and technical activities) and N (administrative and support service activities) of the ISIC rev. 4 classification. Table A A.1 in the appendix provides further details regarding the definition of the sectors included in the analysis and on the mapping of sectoral classifications across different sources.

[8] More specifically, bilateral trade flows recorded in the database used for the analysis accounted for 63% of global exports of communications services in 2019 as reported by the WTO, for 59% in the case of financial and insurance services and 69% regarding business services.

Box 1. The gravity model

The gravity model is known as the workhorse model of the international trade literature. Traditionally employed to analyse patterns of trade in goods, gravity equations have also been widely applied to cross-border trade in services (Kimura and Lee, 2006[7]; Anderson et al., 2018[14]; Nordås and Rouzet, 2017[34]). In its simplest form, the model relates bilateral trade patterns to the economic size of two trading partners and the physical distance between them — in analogy to Newton's law of gravitation. It thereby explains two key features of trade data: First, exports and imports increase proportionately with the exporter's GDP and importer's GDP. Second, there is a strong and persistent negative relationship between physical distance and trade (Disdier and Head, 2008[35]).

Whereas the first applications adopted an atheoretical, intuitive perspective (Tinbergen, 1962), a series of influential contributions (Anderson, 1979[36]; Bergstrand, 1985[37]; Anderson and van Wincoop, 2003[38]; Arkolakis, Costinot and Rodríguez-Clare, 2012[39]) have developed strong theoretical foundations for the structural gravity model. Formally, it can be expressed as follows:

$$Exports_{ijkt} = \frac{Y_{ikt}\, E_{jkt}}{Y_{kt}} \left(\frac{tradecost_{ijkt}}{\Pi_{ikt} P_{jkt}} \right)^{(1-\sigma)}$$

The left-hand side variable represents the trade flow from exporter i to importer j in sector k in the year t. The second term reflects output in country i, expenditure in country j, and global output, whereas the third term captures the role of trade costs encompassing two main components: First, pair-specific costs of economic transactions between two countries i and j. Second, country-specific multilateral trade barriers, here represented by Π_i and P_j. The parameter σ is the elasticity of substitution between foreign and domestic goods and services.

Country-specific trade costs — so-called multilateral resistance terms; Anderson and van Wincoop (2003[38]) — are a theory-consistent measure of a country's remoteness. For a given level of bilateral trade costs, two countries will trade more with each other if both of them are surrounded by oceans (e.g. New Zealand and Australia) than if both of them are surrounded by large trading economies, as in the case of the Netherlands and Belgium being close to Germany and France. With panel data, country-year-specific fixed effects are usually employed to control for these terms. In addition, unobservable time-invariant trade costs shaping trade relations of a specific country pair (e.g. related to differences in consumer preferences) should be controlled for through the inclusion of pair-specific fixed effects (Yotov et al., 2016[40]).

Recently, there is a growing emphasis on the benefits of adding domestic trade flows to the analysis. Calculated as the value of gross production that is consumed domestically, the addition of a country's trade with itself aligns the gravity estimations with the modelling of choices between domestic and foreign products (Yotov, 2012[29]; Yotov et al., 2016[40]; Yotov, 2022[41]). The coefficient of a border dummy – equalling one if the corresponding flow is international – captures the extent of "home bias", i.e. how much more countries trade domestically than with international partners.

For recent reviews of the gravity literature, see Baier and Standaert (2020[42]) and (Yotov, 2022[43]).

In addition, the growth of passenger air transport networks may have altered the tradability of services. By reducing the costs of face-to-face communication, improvements in air transport infrastructure can reduce the relevance of spatial proximity in the location of firms for the diffusion of knowledge (Boschma, 2005[25]; Hovhannisyan and Keller, 2014[26]; Coscia, Neffke and Hausmann, 2020[27]). Further evidence shows that larger airports in US metropolitan areas induce specialisation in tradeable services (Sheard, 2014[28]).[9] However, there is a lack of empirical work on the direct link between air transport and services exports.[10]

While empirical evidence for a declining burden of distance on international trade was missing before 2012, this gap has been filled by a number of studies (Yotov, 2012[29]; Bergstrand, Larch and Yotov, 2015[30]; Borchert and Yotov, 2017[31]; Freeman and Lewis, 2021[32]).[11] Focusing mostly on aggregate trade in goods, these studies show a significant reduction in distance coefficients over time, indicating that global trade is less affected by geographical distance than it used to be in the past. The impact of distance on international cross-border banking has fallen over time as well (Brei and von Peter, 2018[33]). However, there is only limited evidence for other services sectors.

3. Patterns and trends of services tradability between 2000 and 2019

3.1. Global increase of cross-border services tradability over time

Frictions to cross-border services trade can be identified through structural differences between international trade and domestic consumption of domestically produced services. In modern gravity models, these differences are captured in the coefficient of the border dummy (equalling one for observations referring to international trade). This coefficient thereby measures the extent of "home bias", capturing the impact of unobservable determinants that shape trade flows in addition to the explicit covariates included in the model. It measures the difference between internal trade – through consumption of domestically sourced services – and international trade that is not explained by observable differences between the domestic country and foreign trading partners. Interactions of the border dummy with year dummies reveal changes in this border effect on services trade over time.

Drawing on sector-specific gravity regressions with exporter-year and importer-year fixed effects, Figure 2 displays changes in the impact of borders on services trade over time.[12] Regression coefficients are converted into measures of actual services trade as a percentage of frictionless trade, i.e. the hypothetical volume of cross-border services trade in the absence of all border frictions.[13] An increase in this ratio indicates a reduction of the home bias and an increase of international trade flows relative to the consumption of domestically sourced services.

[9] Moreover, several contributions have demonstrated a positive association between business air travel and exports of differentiated goods (Cristea, 2011[60]; Poole, 2010[61]). Recent research also highlights the pivotal role of business travel in reducing search and contracting frictions for businesses based in developing countries (Startz, 2018[62]).

[10] For trade in goods, there is evidence using micro price data that direct flights facilitate market integration at the city level (Yilmazkuday and Yilmazkuday, 2016[72]).

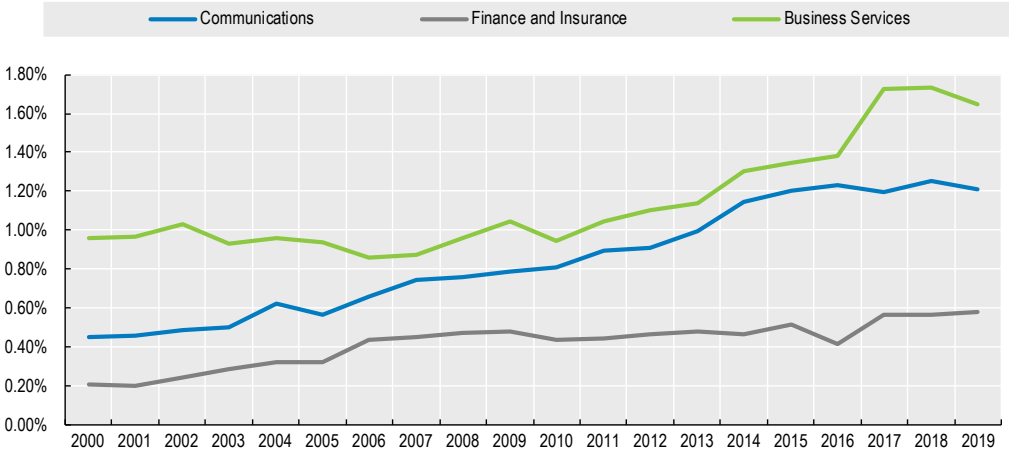
[11] Despite anecdotal evidence for globalisation and the 'death of distance', a number of studies published before the early 2000s failed to identify a falling burden of distance on international trade. This failure was labelled *distance puzzle*. The puzzle can be solved, however, when adhering to the properties of the structural gravity model and measuring the negative impact of international distance relative to the corresponding impact within national markets (Yotov, 2012[29]).

[12] Exporter-year and importer-year fixed effects control for country-specific drivers of observed trade volumes, such as the rapid economic growth in East Asia during this period.

[13] The exponential of the coefficients is multiplied by 100 to convert regression coefficients into measures of services trade as a percentage of frictionless trade. Frictionless trade refers to a hypothetical scenario where borders are no longer an obstacle to trade and the costs of cross-border trade are the same as the costs of trade within national markets.

Figure 2 shows that international trade in communication services, finance and business services has grown relative to domestic consumption of these services. Compared to the frictionless scenario, cross-border trade in finance and communications services roughly tripled between 2000 and 2019.[14] The increase is less pronounced but still clearly visible in the case of business services. This general picture is similar to the findings of Anderson et al. (2018[14]) who identify a trend towards smaller border effects in five services sectors between 2000 and 2006. The pattern displayed in Figure 2 also resonates with studies reporting a decrease of border effects for trade in manufactured products (Bergstrand, Larch and Yotov, 2015[30]; Freeman and Lewis, 2021[32]). In addition, Figure 2 shows that cross-border services trade remained remarkably stable through the global financial crisis of 2008/09. The robustness of services exports during this episode is confirmed by other studies (Borchert and Mattoo, 2010[44]; Ariu, 2016[45]).

Figure 2. Cross-border service trade as a percentage of frictionless scenario (in %)



Note: The graph displays exponential transformations, based on the coefficients of interacted border-year dummies. Numbers express percentages of the expected trade volume in a scenario where there are no frictions to cross-border services trade. For example, the blue line indicates that cross-border trade in communications services amounted to only 0.45% of the frictionless trade volume in 2000. By 2019, this percentage share had increased to 1.21%. This graph relies on sector-specific gravity regressions encompassing variables referring to distance, contiguity, common language, common religion, common legal origin, shared colonial history as well as exporter-year and importer-year fixed effects.
Source: Authors' calculations.

Overall, there is large scope for further growth of international trade in communication services, financial services and business services. In 2019, actual volumes of cross-border trade only represented between 0.6% and 1.6% of potential trade in a hypothetical world without border frictions, i.e. a scenario where trade costs for international trade are reduced to the level of costs for within-country exchanges. This means that domestic trade – i.e. the sourcing of domestically produced services – was roughly 60 to 170 times larger than cross-border services trade in these sectors in 2019.[15] This finding is consistent with existing evidence on trade costs regarding cross-border services flows (Benz and Jaax, 2020[12]).

Services tradability is not only the capacity to sell services across national borders. It also refers to the possibility of selling a service to a trade partner that is geographically distant from the location where the service is produced. In a gravity analysis, changes in this dimension of services tradability can be explored through interactions of distance variables with time dummies.

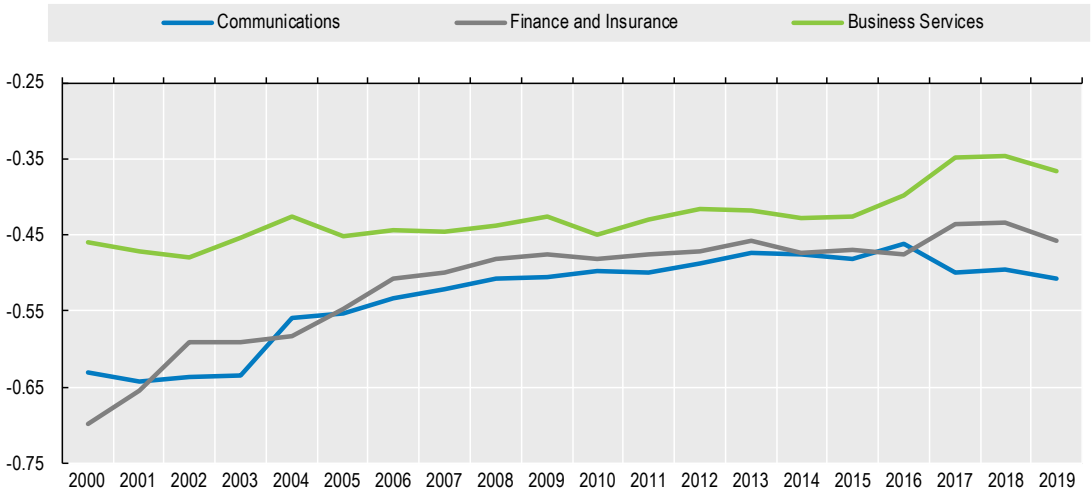
[14] The estimates displayed in Figure 2 rely on gravity regression that do not incorporate pair fixed effects, as this approach allows for the illustration of differences in the size of the border effect across sectors. When using a specification with pair fixed effects, we obtain a similar picture regarding the evolution of the border effect relative to the level in the year 2000 (see Figure A D.1 in Annex D).

[15] Focusing on manufacturing trade, Yotov et al. (2016[40]) find that domestic trade is 12 times larger than cross-border trade.

In addition to a reduction in the home bias of cross-border services trade, the analysis also provides strong evidence for a reduction in the impact of geographical distance on services trade over the last two decades. This empirical step is based on sector-specific gravity regressions with exporter-year and importer-year fixed effects, where changes in distance effects are quantified through interactions of a year dummy with a variable measuring international distance and with a variable measuring domestic distance within countries. Figure 3 displays differences between time-varying coefficients of the two variables, revealing that the relative impact of international distances over domestic distances has fallen over time.[16]

Figure 3. Changes in the effect of distance on cross-border services trade

Difference between international distance coefficient and domestic distance coefficient



Note: The graph shows differences between year-specific coefficients of the domestic distance variable and the corresponding year-specific coefficients of the international distance variable. The upward trend indicates that the effect of geographical distance on cross-border trade flows moved closer to the impact of distance on trade flows within countries. This graph relies on sector-specific gravity regressions encompassing variables referring to domestic distance, international distance, interactions of the domestic distance variable with year dummies, interactions of the international distance variable with year dummies, contiguity, common language, common religion, common legal origin, shared colonial history as well as exporter-year and importer-year fixed effects.
Source: Authors' calculations.

3.2. Higher levels of services tradability in most advanced economies

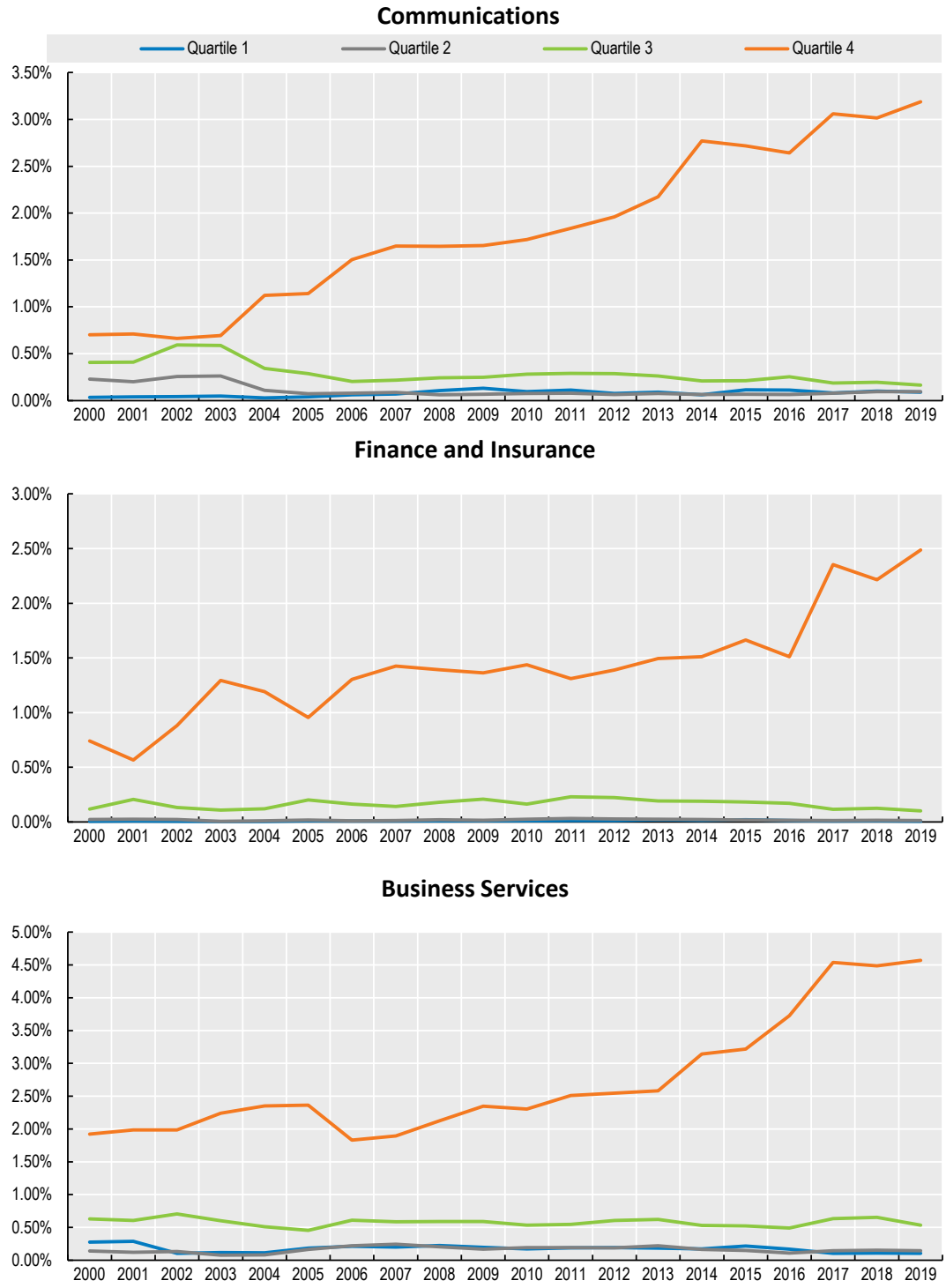
Services tradability – i.e. the extent to which services can be sold across national borders and between geographically distant trade partners – does not only vary over time but also across countries. This section first explores heterogeneity in the effect of borders on services trade across different levels of economic development. It then sheds light on differences in the effect of distance on services trade of different groups of economies.

Figure 4 displays the evolution of the border effect on trade in the three sectors for four groups of economies. These groups are created by dividing the 47 countries included in the analysis into quartiles of the distribution of the exporting economy's GDP per capita in 2000.[17] As described above, border coefficients are converted into a measure of observed trade as a percentage of total trade in a hypothetical scenario without border frictions. A smaller percentage indicates a larger home bias for countries in the corresponding quartile. Accordingly, an increase in this measure over time reflects growth in international trade relative to the sourcing of domestically produced services.

[16] This approach for the examination of changes in the effect of geographical distance on trade flows is consistent with the theoretical solution to the "border puzzle" (Yotov, 2012[29]). The result is robust when using pair fixed effects instead of standard gravity variables to control for time-invariant determinants of bilateral trade costs (Figure A D.2).

[17] These effects are estimated using interactions between quartile-specific border dummies and year dummies.

Figure 4. Evolution of border effect by income quartile



Note: The graph displays exponential transformations, based on the coefficients of border-year dummies interacted with dummies for the income quartile of the exporter. Numbers express percentages of the expected trade volume in a scenario where there are no frictions to cross-border services trade. This graph relies on sector-specific gravity regressions encompassing variables referring to distance, contiguity, common language, common religion, common legal origin, shared colonial history as well as exporter-year and importer-year fixed effects.
Source: Authors' calculations.

For all three sectors, exporters at higher levels of economic development display higher levels of services tradability across international borders. The smallest border barrier effect is observed for exporters with the highest level of GDP per capita in 2000 among the 47 countries included in the sample.[18] By contrast, border frictions to international services trade are still relatively higher for economies in the other groups.

While this pattern is already visible at the beginning of the period of analysis, the findings suggest that the most advanced countries experienced a further boost to services tradability over the last 20 years. By contrast, economies below the median of the income distribution did not manage to benefit from an increase of services tradability in this period. Particularly regarding trade in financial and insurance services, the economically less advanced countries even seem to have seen a reduction in services tradability in recent years. A similar picture can be seen in the case of trade in business services. A tightening of the regulatory framework for international financial transactions in the aftermath of the global financial crisis might partly explain this pattern. In addition, a trend towards higher barriers to the movement of people in the late 2010s may have hampered less advanced economies' chances of achieving improvements in services tradability.

In analogy, we also investigate whether the effect of distance varies across different groups of economies. Akin to the pattern observed with respect to border effects, the smallest distance effects are observed for services exports of the most advanced economies (see Figure A D.3 in Annex D). A hierarchy is visible, with countries at lower levels of economic development experiencing larger negative distance effects on their services exports. These stark differences can be illustrated, for example for business services: in the economically most advanced group (fourth quartile) of exporters, an increase in the distance between the exporting economy and the importer from 1 000 kilometres to 2 000 kilometres is estimated to decrease exports in this sector by 15%. The same increase in distance for exporters in the economically least advanced quartile is expected to reduce exports by 66%.

While the ranking of country groups remained relatively stable throughout the period of analysis, a reduction in the distance effect is visible in all three sectors for the fourth quartile encompassing the most advanced economies. Signs of a reduction of the distance effect on services exports of economies in the first and second quartile are observed for the early 2010s. Yet, in recent years, this trend seems to have reversed, especially in the case of business services. A tightening of rules concerning the mobility of individuals may shape this renewed increase in the distance effect for less economically advanced economies towards the end of the period of analysis. A pronounced reduction in the distance effect for less advanced economies (1st quartile) is observed in the case of communications services. The trend towards the offshoring of back office functions and ICT-related tasks to countries such as India and Malaysia may partly explain this pattern.[19]

Combining information on the GDP per capita of exporter and importer in the year 2000 reveals that the negative effect of distance on services trade is most pronounced for flows where both partners are below the median among the 47 countries included in the analysis. In communications services, distance effects are relatively low when the importing economy is in the top half of the GDP per capita distribution – even if the exporting economy is in the lower half. This pattern may reflect the offshoring of ICT-related services. Conversely, in financial and insurance services the exporting economy's level of development seems crucial, with low distance effects for exports of relatively more advanced countries. The high distance effects for flows involving economically less advanced economies – either as an exporter or as importer – in this sector may relate to differences in the adoption of ICT as well as financial regulation.

The breakdown by income group is further complemented by an analysis of global macro regions. In particular, the analysis distinguishes between the European Economic Area (EEA), Asia-Pacific and the Americas. For this purpose, economies are classified according to their geographic location, allowing to

[18] Table A C.2 in Annex C provides the list of the countries included in each quartile.

[19] Note that these patterns regarding the border effect as well as the distance effect hold in several robustness checks: The overall picture described in Section 3 remains similar when excluding a set of economies (Belgium, Hong Kong (China), Ireland, Luxembourg, Netherlands and Switzerland) frequently mentioned in the literature on profit shifting by multinational enterprises. In addition, the findings also hold when excluding intra-EEA flows or considering only flows between trade partners without missing observations in 2000. Moreover, the general picture is also confirmed in robustness checks using the OECD TiVA database as an alternative source for trade flows.

calculate a region-specific indicator of services tradability based on the average border coefficient of the countries in each of these regions.[20]

Due to the deep political economic integration in the EEA, this region generally exhibits the highest levels of services tradability and also experienced the fastest increase in services tradability of all macro regions. The share of actual services trade as a percentage of the hypothetical frictionless trade volume increased from 0.7% to 1.9% in communication services, from 0.3% to 1.1% in financial services and from 0.9% to 3.2% in business services. In the Americas, this measure of services tradability increased from 0.3% to 0.7% in communications services, from 0.1% to 0.4% in financial services, but decreased from 1.7% to 1.3% in business services. For Asia-Pacific, we find an increase of services tradability from 0.2% to 0.5% in communication services and business services, but a stagnating level of 0.1% in financial services. These results are also displayed graphically in Figure A D.4 in Annex D.

4. Drivers of changes in services tradability

This analysis builds on the evidence presented in the previous section, which highlighted pronounced differences in services tradability across countries and a trend towards expansion of services tradability over time. These observations call for an exploration of determinants and drivers of services tradability. Are there any factors that explain the home bias in services consumption or the importance of trade with more remote partners relative to neighbouring countries?

A distinct but related question concerns the impact of potential policy interventions. What are the levers that policy makers can use to promote cross-border services trade? Which measures raise the probability that businesses can benefit from services opportunities on foreign and remote markets?

This section aims to answer these questions through a structural gravity model, where policy factors (RTAs), air transport connectivity and ICT are included as explanatory variables. In addition, the analysis decomposes global trade costs to quantify the relative contribution of individual determinants on cross-border services trade.

4.1. Gravity analysis

The gravity specification described in this section explores the impact of air connectivity, ICT adoption and services RTAs on cross-border services trade, providing insight on the relevance of these determinants to changes in the border dimension of services tradability. All regressions use panel data and include information on domestic services trade. Exporter-year and importer-year fixed effects control for country-specific determinants of services trade, such as a natural catastrophe hitting a specific economy in a given year. Asymmetric pair fixed effects control for bilateral and time-invariant trade cost determinants, such as distance or common language. These pair fixed effects also control for country-specific differences between cross-border services trade and domestic services consumption, i.e. the home bias in services trade.[21]

The estimations rely on two main specifications of the gravity model. The first one incorporates only one border variable, which captures the extent of home bias across all years covered by the analysis. The second, more restrictive specification introduces year-specific border effects to control for global changes in the costs of cross-border services trade over time. To some extent, these changes could be driven by digital transformation and the emergence of new digital services and service-based business models. The use of time-varying border dummies absorbs any general shifts affecting trade patterns for all economies

[20] Five economies are not included in any of the three regions (Israel, Russian Federation, South Africa, Switzerland, and Türkiye).

[21] See Annex B for further details regarding the methodology.

included in the sample. It also accounts for the transition towards digital transformation in services, to the extent to which it evenly affects international services trade across all country pairs.[22]

Some changes associated with ICT adoption, such as the ability to gather information by accessing websites of companies and communicate via videoconferencing software, are likely to affect all countries in a quasi-simultaneous way. The effects of these general changes are only visible in the parsimonious specifications without time-varying border effects, which provides an upper bound estimate of the effect of ICT, air travel and RTAs on cross-border services trade. By contrast, the econometrically restrictive specification with time-varying border effects provides a conservative estimate (or "conservative bound").

Indicators of ICT adoption and air transport connectivity (Table A C.1 in the annex provides an overview of data sources for key variables) are included with a one-year lag to address the risk of reverse causality. Robustness of results is tested by using different indicators from each group of variables, described in more detail below.

Table 1 shows regression results for communications services. Overall, there is very robust evidence for a significantly positive impact of air transport connectivity on services tradability. Services tradability also seems to be positively impacted by ICT adoption and services RTAs, even though the effect cannot be identified in all specifications.

Table 1. Communications services

	(1)	(2)	(3)	(4)	(5)	(6)
Services RTA	0.122	0.117	0.346***	0.342***	0.368***	0.294***
	(0.173)	(0.173)	(0.114)	(0.115)	(0.102)	(0.103)
Goods RTA	0.393	0.379	0.439**	0.435**	-0.250	-0.058
	(0.274)	(0.287)	(0.201)	(0.203)	(0.274)	(0.281)
% households internet (lag1)	0.011***	0.002				
	(0.004)	(0.006)				
Ln IP (lag1)			0.130***	0.095	0.238***	0.031
			(0.035)	(0.063)	(0.022)	(0.034)
Ln air passengers (lag1)	0.234***	0.250***	0.245***	0.243***		
	(0.074)	(0.078)	(0.084)	(0.082)		
Ln air travel (lag1)					0.391***	0.216***
					(0.087)	(0.080)
Observations	10,388	10,388	12,897	12,897	25,083	25,083
Exporter time F.E.	YES	YES	YES	YES	YES	YES
Importer time F.E.	YES	YES	YES	YES	YES	YES
Pair F.E.	YES	YES	YES	YES	YES	YES
Time-varying border	NO	YES	NO	YES	NO	YES

Note: Standard errors clustered by country-pair in parentheses *** p<0.01, ** p<0.05, * p<0.1. Additional dummy for EEA membership included but not reported in specifications covering years of EEA expansion.

[22] For example, modern business strategies based on intangible assets often rely upon the rapid scale-up and entry into multiple markets (Cadestin et al., 2021[69]). To some extent, the potentially transformative effects of new digital business models are therefore likely to affect many countries at the same time.

Column 1 and column 2 rely on OECD data on the share of households with access to the internet.[23] The regression coefficient in column 1 suggests that an increase in internet access by one percentage point is associated with a 1.1% increase in cross-border services trade relative to domestic services consumption. The effect is still positive but becomes statistically insignificant when controlling for time-varying border effects in column 2, suggesting that the impact of ICT as captured by this variable could primarily be driven by general changes in the characteristics of communications services over time rather than country-specific differences in ICT adoption.

Regressions with alternative data on the number of IP addresses that are available for a larger number of countries show a similar picture. A positive and strongly significant coefficient in the specification without time-varying border dummies turns statistically insignificant even at the 10% confidence level when adding the time-varying border. However, it is noteworthy that the coefficients remain positive in all specifications.

Air transport connectivity is positively associated with cross-border trade in communications services. The coefficients suggests that a 10% increase in air traffic could boost international trade flows by between 2% and 4%. Results are quantitatively very similar for both air transport variables used in this analysis.[24]

Similarly, services RTAs seem to play a role for cross-border trade in this sector. A significantly positive coefficient is identified in the larger sample of countries in columns 3 to 6, facilitated by the broader coverage of the IP variable as a measure of ICT adoption. According to these specifications, an RTA with binding services provisions could lead to an increase in bilateral cross-border trade in communications services by between 35% and 45%.

In the case of financial services, there is also evidence of a significant impact of ICT, air transport and RTAs on cross-border services trade (Table 2). A one-percentage point increase in the rate of internet access in private households is associated with 2.2% growth of financial services exports in the specification without time-varying border dummies. As already observed for communications services, this effect disappears when adding border-year interactions to control for the global trend towards globalisation of financial services. The border-year interaction hence seems to absorb all relevant variation in the internet access variable that explains changes in cross-border trade relative to the sourcing of domestically produced services. This suggests that this variable, which displays an upward trend for all economies in the sample, mostly captures a general global shift towards digital technologies (e.g. availability of Voice over Internet Protocol telephony or cloud computing services) affecting all countries in the sample.

The impact of ICT on financial services trade is more robustly identified when using IP addresses to capture ICT adoption. A 10% increase in the number of IP addresses in a country is estimated to boost cross-border trade in financial services by between 2% and 3.2%, depending on the specification. Coefficients are robust to the inclusion of time-varying border dummies and they are relatively similar over the full period 2000 to 2019 and in the restricted sample from 2012 to 2019.

For air transport, there is mixed evidence regarding its impact on financial services trade. With the variable on annual bilateral air passengers between a country pair, available for the period 2012 to 2019, there is relatively robust evidence for a positive association with cross-border trade in financial services. A 10% growth of bilateral air traffic is linked with growth in bilateral services trade by between 1.3% and 3%. Even controlling for time-varying border dummies, the regression coefficient is significant in the specification with broader country-coverage, using IP addresses as measure for ICT adoption.

With the country-specific measure of air transport passengers, however, the association between air travel and financial services trade turns negative. As mentioned above, this variable also includes information on domestic air passengers. Therefore, it only is a rough proxy for the growth of international air transport.

[23] These data are only available for a limited number of non-OECD economies, reducing the number of observations compared to other specifications.

[24] The variable “air passengers” is available between 2012 and 2019 and measures the annual number of airline passengers travelling from an origin country to a destination country. By contrast, “airtravel” is a country-specific measure of air traffic, indicating the annual number of international and domestic air passengers carried by air carriers registered in a country. This variable is available between 2000 and 2019, but only can be considered a rough proxy for the growth of international air traffic between a pair of countries. Further information on the respective data sources is provided in Annex C.

Services provisions in trade agreement contribute substantially to growth in cross-border trade of financial services, with an impact that is highly significant and robust across all specifications. Overall, a services RTA can promote financial services exports by between 30% and 80%. This result shows the beneficial impact of market access and regulatory integration for the financial services sector.

Table 2. Financial and insurance services

	(1)	(2)	(3)	(4)	(5)	(6)
Services RTA	0.540**	0.585**	0.343***	0.343***	0.344***	0.275***
	(0.244)	(0.241)	(0.065)	(0.071)	(0.087)	(0.094)
Goods RTA	-0.519***	-0.427***	1.026**	1.058**	-0.435**	-0.096
	(0.129)	(0.145)	(0.425)	(0.425)	(0.169)	(0.162)
% households internet (lag1)	0.022***	-0.001				
	(0.007)	(0.008)				
Ln IP (lag1)			0.273***	0.284***	0.321***	0.201***
			(0.058)	(0.072)	(0.028)	(0.041)
Ln air passengers (lag1)	0.300***	0.133	0.175**	0.155*		
	(0.095)	(0.104)	(0.083)	(0.093)		
Ln airtravel (lag1)					-0.113	-0.316**
					(0.096)	(0.123)
Observations	6,940	6,940	8,699	8,699	15,935	15,935
Exporter time F.E.	YES	YES	YES	YES	YES	YES
Importer time F.E.	YES	YES	YES	YES	YES	YES
Pair F.E.	YES	YES	YES	YES	YES	YES
Time-varying border	NO	YES	NO	YES	NO	YES

Note: Standard errors clustered by country-pair in parentheses *** p<0.01, ** p<0.05, * p<0.1. Additional dummy for EEA membership included but not reported in specifications covering years of EEA expansion.

ICT adoption and air transport connectivity also play a decisive role for business services exports (Table 3). A one percentage point increase in internet household access is associated with an increase in cross-border exports of around 5%. However, the effect turns insignificant in the specification with time-varying border dummies. A more robust result on the relationship between ICT adoption and cross-border trade in business services is identified with the measure of IP addresses. The coefficient is highly significant in all specifications. The significant effect persists when using time-varying border dummies to control for a general globalisation trend and potential changes in the characteristics of business services over time. A 10% increase in the number of IP addresses can boost cross-border exports by between 1% and 2.5% in this specification. The relationship seems to have strengthened over time, with the larger coefficient being identified in the specification covering the years 2012 to 2019 only (columns 3 and 4).

A positive and significant impact of air transport on exports of business services can be identified in four of the six main specifications. Across all regressions, a 10% increase in air traffic is associated with growth of business services exports by between 1% and 3.5%. The effect is robust to the introduction of time-varying borders with the country-specific air traffic data covering the last two decades. Regression coefficients are still positive and quantitatively similar to those in the other sectors in the specification with bilateral air traffic data and time-varying border dummies, but no longer statistically different from zero.

Unlike in the other sectors, for business services there does not seem to be a significant impact of trade agreements on cross-border services exports. Regression coefficients are mostly insignificant for both,

services RTAs and goods RTAs. In the specification covering the last two decades, we find a significantly negative relationship between services RTAs and cross-border services trade.[25]

Table 3. Business services

	(1)	(2)	(3)	(4)	(5)	(6)
Services RTA	-0.058	-0.025	-0.040	-0.137	-0.341***	-0.496***
	(0.188)	(0.206)	(0.149)	(0.149)	(0.114)	(0.124)
Goods RTA	-0.091	-0.191	-0.360	-0.317	0.021	-0.068
	(0.309)	(0.334)	(0.350)	(0.391)	(0.084)	(0.089)
% households internet (lag1)	0.050***	0.016				
	(0.005)	(0.010)				
Ln IP (lag1)			0.458***	0.249***	0.274***	0.097**
			(0.067)	(0.079)	(0.028)	(0.041)
Ln air passengers (lag1)	0.340***	0.088	0.326***	0.099		
	(0.086)	(0.084)	(0.075)	(0.080)		
Ln airtravel (lag1)					0.359***	0.149**
					(0.068)	(0.070)
Observations	10,842	10,842	13,490	13,490	25,639	25,639
Exporter time F.E.	YES	YES	YES	YES	YES	YES
Importer time F.E.	YES	YES	YES	YES	YES	YES
Pair F.E.	YES	YES	YES	YES	YES	YES
Time-varying border	NO	YES	NO	YES	NO	YES

Note: Standard errors clustered by country-pair in parentheses *** p<0.01, ** p<0.05, * p<0.1. Additional dummy for EEA membership included but not reported in specifications covering years of EEA expansion.

Overall, these results suggests that the impact of ICT adoption on cross-border services trade is largest for business services and financial services, with a relatively smaller impact for communications services. The impact of ICT adoption is not only statistically significant, but also quantitatively large. Between 2000 and 2019, the global number of IP addresses increased by a factor of 6.6. Using the coefficients from the most robust specification controlling for time-varying border dummies, this increase suggests a growth of cross-border trade in business services and financial services between 20% and 70%.

Air traffic seems to be of relatively similar importance for all three services sectors. According to the two data sources used in this study, air transport volumes increased by around 160% between 2000 and 2019 and by around 60% between 2011 and 2019. For the three services sectors, these growth rates imply an increase in the volume of cross-border services trade between 8% and 13% since 2011 and between 15%

[25] This result is consistent with other studies finding a significantly negative impact of services RTAs on cross-border trade in business services, e.g. Khachaturian and Oliver (2021[68]) for legal services. A growing literature analyses heterogeneity with respect to the impact of RTAs on services trade, e.g. Borchert and Di Ubaldo (2021[11]). Moreover, it is possible that services RTAs promote exports of business services through Mode 3, i.e. commercial presence abroad, due to the need for direct communication with clients in the destination market (Oldenski, 2012[70]). Focusing on Japanese exports and foreign direct investment (FDI) in manufacturing, Baek and Hayakawa (2022[71]) find that RTAs reduce fixed costs for FDI more than for exports – potentially explaining negative RTA effects on trade. Further analysis dedicated to these aspects, however, is outside the scope of this paper.

and 23% since 2000. RTAs with services provisions achieve the most significant creation of cross-border services trade in communications services and financial services.

Main results described in this section are robust to a number of checks. Results broadly support the conclusions of this section when experimenting with other measures of ICT adoption and other air transport indicators. Estimations with gravity variables (bilateral distance, contiguity, common language, etc.) instead of pair fixed effects yield very similar results. Coefficients on the impact of ICT and air travel remain unchanged when experimenting with other measures of services RTAs, including heterogeneity of RTA effects.[26]

Additional regressions (see Table A D.1 and Table A D.2 in the appendix) using data on merchandise trade show that ICT and air traffic have a larger impact on cross-border services trade compared to trade in goods. A 10% growth of air traffic is associated with a 0.5% to 1% increase in international merchandise trade, whereas the impact of air traffic on services trade is two to three times larger.[27] Similarly, a 10% increase in the number of IP addresses can stimulate goods trade by between 0.3% and 1%. This effect is quantitatively similar to what is found for communications services, while the impact of ICT adoption on cross-border exports of financial services and business services is two to three times larger.

4.2. Drivers of changes in distance effect

By exploring changes in cross-border services trade relative to changes in the consumption of domestically sourced services (or "internal trade"), the analytical steps discussed in section 4.1 place emphasis on the capacity to trade services across national borders. Results highlight the role of air transport, ICT adoption and services RTAs in promoting cross-border exports of services. This section instead focuses on the second dimension of services tradability and investigates determinants of changes in the effect of geographical distance on cross-border services trade. As highlighted in Section 3.1, the "proximity burden" has become smaller between 2000 and 2019. We investigate drivers of these changes in a two-step analytical approach.

Inspired by Borchert and Yotov (2017[31]), we rely on a set of gravity regressions that include exporter-year dummies interacted with the distance variable.[28] For each sector, this specification allows for the estimation of distance coefficients that are specific to every exporter-year combination.[29] We save these coefficient estimates and employ them as the dependent variable in a second set of regressions, exploiting variation at the exporter-year level. As the main variables of interest, the regressions include a country-specific time-varying measure of air transport as well as a variable referring to ICT adoption.[30] All regressions use exporter fixed effects as well as year fixed effects and control for GDP per capita.[31]

[26] Main results also hold when using the OECD TiVA database as the main source of data for international and domestic trade, when exclusively relying on the OECD-WTO Balanced Trade in Services (BaTIS) dataset for international trade or when using different threshold years to combine ITPD-E and BaTIS.

[27] The impact of ICT on manufacturing trade identified in our analysis is within the range of existing estimates (Freund and Weinhold, 2004[20]; Osnago and Tan, 2016[21]).

[28] In addition, these gravity regressions include exporter-year fixed effects, importer-year fixed effects, pair fixed effects, as well as controls for trade agreements (services RTA, goods-only RTA, dummy for intra-EEA flows), interactions of the border dummy with year dummies, and interactions of year dummies and the distance variable.

[29] These exporter-specific time-varying distance coefficients indicate the extent to which the focus of services exports of a given economy has shifted from trading partners in the same geographic region towards a more global set of trading partners. A shift towards exports to geographically remote destinations would be reflected by a pattern where distance coefficients become smaller in absolute terms in more recent years of the analysis.

[30] As the RTA variable is specific to pairs of trade partners (rather than being specific to individual exporters), the role of RTAs is not investigated in these exporter-specific regressions. However, RTAs are controlled for in the first-stage gravity regression aimed at estimating exporter-specific time-varying distance coefficients.

[31] The inclusion of year fixed effects controls for unobserved shocks affecting the distance coefficient for all economies in a given year, e.g. due to a global economic crisis. Conversely, the use of exporter fixed effects controls for country-specific time-invariant aspects, such as geographical remoteness from major markets, and implies that all coefficients are identified only based on variation over time.

Table 4. Communications services

	(1)	(2)	(3)	(4)	(5)
Ln airtravel (lag1)	0.009*			0.009*	-0.009
	(0.005)			(0.005)	(0.011)
Ln IP (lag1)		-0.001		-0.005	
		(0.019)		(0.019)	
% households internet (lag1)			0.001		0.001
			(0.001)		(0.001)
Ln GDP per capita (lag 1)	0.213***	0.238***	0.311***	0.228***	0.313***
	(0.052)	(0.053)	(0.073)	(0.054)	(0.073)
Observations	878	859	503	859	503
R-squared	0.809	0.809	0.916	0.810	0.916
Year FE	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' calculation.

The results point to an important role of ICT and air transport in shaping reductions in the distance effect on services trade. Yet, there is considerable heterogeneity across sectors. In the case of communications services (Table 4), we find tentative support for the role of air travel: For two of the three specifications that include the variable referring to air travel (number of air passengers carried), the corresponding coefficient is positive and marginally statistically significant. The positive sign indicates that an increase in air travel is associated with a reduction of the distance effect for the corresponding exporter. However, the picture remains inconclusive regarding the role of ICT in shaping changes in the distance effect on trade in communications services: none of the coefficients of the ICT variables is statistically significant.[32]

Conversely, the findings for financial and insurance services (Table 5) provide strong support for the role of ICT and air transport as drivers of the decline of the "proximity burden" on trade in this sector. Growing adoption of ICT and the expansion of air traffic are associated with a more balanced composition of financial services exports between remote and nearby destinations. By contrast, exporters with slowing ICT adoption and sluggish air traffic growth would display an export pattern that is more skewed towards nearby trading partners. In the case of business services (Table 6), the results confirm that ICT adoption mitigates the impact of distance on services exports in this sector. The association between air travel and the distance effect is not statistically significant.

[32] The inclusion of year-specific border dummies aimed at capturing general globalisation trends in the first-stage gravity regressions may partly explain the lack of statistical significance regarding the ICT variables in the second stage for communications services. In addition, the use of year fixed effects in the regressions corresponding to Table 5 also absorbs global implications of ICT on services trade that affect all countries.

Table 5. Financial and insurance services

	(1)	(2)	(3)	(4)	(5)
Ln airtravel (lag1)	0.018***			0.016***	0.014
	(0.005)			(0.005)	(0.011)
Ln IP (lag1)		0.095***		0.088***	
		(0.021)		(0.021)	
% households internet (lag1)			0.005***		0.005***
			(0.001)		(0.001)
Ln GDP per capita (lag 1)	-0.077	-0.099*	-0.146*	-0.117*	-0.147*
	(0.058)	(0.060)	(0.081)	(0.060)	(0.080)
Observations	847	828	479	828	479
R-squared	0.766	0.769	0.906	0.771	0.907
Year FE	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' calculation.

Table 6. Business services

	(1)	(2)	(3)	(4)	(5)
Ln airtravel (lag1)	-0.003			-0.005	0.006
	(0.004)			(0.004)	(0.011)
Ln IP (lag1)		0.073***		0.076***	
		(0.016)		(0.016)	
% households internet (lag1)			0.006***		0.006***
			(0.001)		(0.001)
Ln GDP per capita (lag 1)	-0.091**	-0.145***	-0.110	-0.139***	-0.110
	(0.045)	(0.046)	(0.072)	(0.046)	(0.072)
Observations	877	858	499	858	499
R-squared	0.814	0.820	0.915	0.820	0.915
Year FE	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' calculation.

4.3. Trade cost decomposition

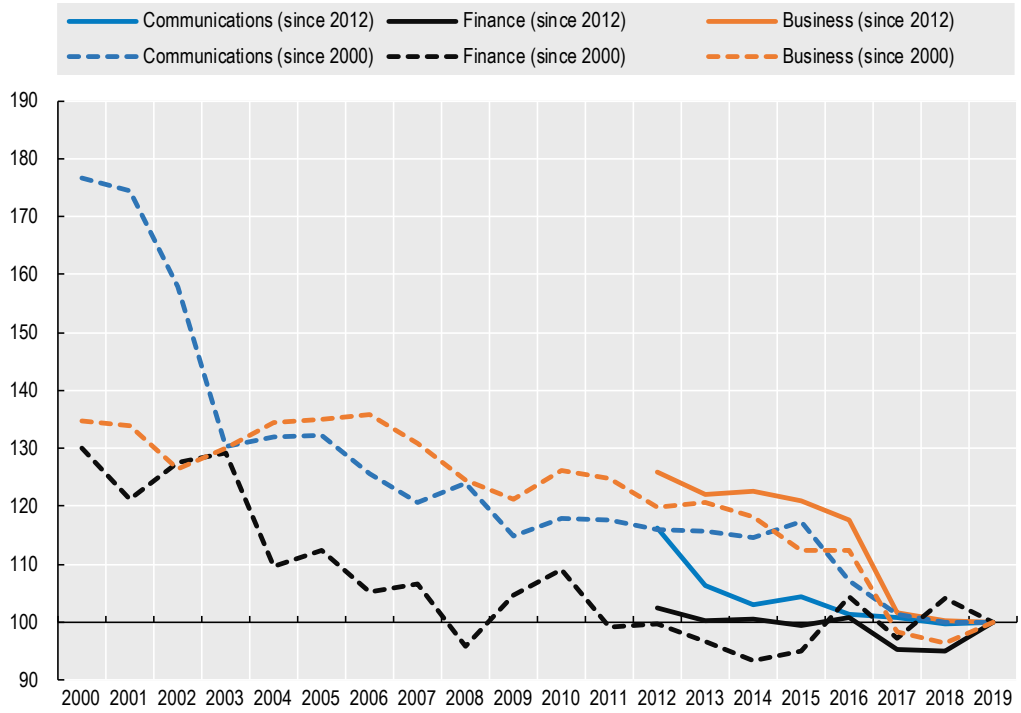
Coefficients from the gravity regressions (Section 4.1) can be used for a decomposition of services trade costs. This decomposition arises directly from the specification of the structural gravity equation. A main advantage of the technique is that the contribution of specific trade cost determinants can be benchmarked against theory-consistent trade cost terms for all country pairs.

The approach is based on the analysis of changes in bilateral trade costs from the beginning to the end of the observation period. Changes in trade costs obtained through the combination of estimation and calibration (see Annex B for details) are used as a benchmark. These "estibrated" trade costs account for all observable and unobservable bilateral determinants of services trade, including residuals from a

structural gravity regression.[33] For the vast majority of country pairs, these trade costs have fallen throughout the period covered in this analysis. Components of these trade cost changes can be attributed to specific determinants, using the coefficients from the structural gravity analysis. Further technical information on this approach is provided in Annex B.[34]

Results show a significant reduction of services trade costs over the last two decades, consistent with a rise of services tradability over this period (Figure 5). All values are normalised, showing deviations from trade cost levels in 2019. The most pronounced decline in the costs of cross-border services trade is identified for communications services, where theory-consistent "estibrated" trade costs have fallen by around 60% since the year 2000.[35] Trade cost reductions for finance and business services are somewhat smaller, in the range of 30%.

Figure 5. Trend in "estibrated" trade cost reductions



Note: This graph shows "estibrated" trade costs over time for three sectors.
Source: Authors' calculations.

The same pattern can also be identified in the estimation of trade cost reductions since 2012, using data on bilateral air traffic (that is not available for earlier years). Costs of cross-border services trade have fallen by around 20% for business services and 15% for communications services. Trade costs for financial services have only declined slightly during this period, partly due to a rebound of trade costs in the year

[33] The residual captures measurement error and stochastic shocks to bilateral cross-border services trade that are unrelated to any of the determinants explicitly included in the regression or controlled for with fixed effects. Examples include country-pair-specific changes in preferences (such as in the case of a sudden increase in geopolitical tensions between two countries) and changes in cross-border services trade related to the establishment of a foreign subsidiary (e.g. a large subsidiary of a mining company attracted by natural resource discoveries in one of the two countries).

[34] All results rely on the specifications with time varying borders reported in columns (4) and (6) of Tables 1, 2 and 3.

[35] The strong drop in trade costs for communications services before 2003 might also be related to an imprecise measurement of trade flows in this period, which might be due to changes in the classification of cross-border services trade between EBOPS 2002 and EBOPS 2020, most notably the switch of postal and courier services from communications services to transport services.

2019. The similarity of estimates since 2000 and estimates since 2012 suggests that measurement of air traffic does not affect aggregate trade cost estimates.

Some parts of these trade cost reductions are due to forces that are difficult to identify empirically. These forces include the digital transformation that has changed characteristics of many services and has led to the emergence of new business models based on network effects and close-to-zero marginal costs. Other parts of these trade cost reductions, however, can be explained by progress in ICT adoption and the expansion of air transport or by bilateral or regional services liberalisation (Table 7).

Table 7. Trade cost changes

	Communications services		Finance and insurance services		Business services	
	2012-2019	2000-2019	2012-2019	2000-2019	2012-2019	2000-2019
Percentage changes in total trade costs and trade cost component						
Total (estibrated)	-14.6%	-64.6%	-4.6%	-27.8%	-23.0%	-32.8%
ICT	-3.3%*	-2.6%*	-10.9%	-18.2%	-10.0%	-10.0%
AIR	-4.9%	-6.3%	-2.3%	8.9%	-2.3%*	-3.6%
RTA	-0.6%	-2.0%	-0.6%	-2.4%	0.2%*	5.0%*
Residual	-5.8%	-53.7%	9.1%	-16.1%	-10.9%	-24.2%
Share of total trade cost change explained by:						
..ICT	22.8%*	4.1%*	235.1%	65.6%	43.6%	30.5%
..AIR	33.9%	9.8%	48.6%	-32.2%	9.8%*	11.0%
..RTA	4.3%	3.1%	13.7%	8.5%	-1.0%*	-15.3%*

Note: Upper panel reports percentage changes in total trade costs and percentage changes in trade cost components over time. Negative values indicate a reduction of services trade costs. Values are based on simple averages over all country pairs in the sample. For example, total trade costs for communications services declined by 14.6% between 2012 and 2019. In this period, growth of air transport reduced communication services trade costs by 4.9%. Lower panel reports changes in trade cost components as shares of total trade cost changes. For example, air transport accounts for 33.9% of the total trade cost reduction since 2012, calculated as -4.9% divided by -14.6%. * indicates calculation based on a statistically insignificant regression coefficient.
Source: Authors' calculations.

This decomposition of trade cost changes highlights the importance of ICT adoption and air transport to services trade costs. Even though results differ somewhat across sectors and regression specifications, it can be noted that these two drivers of services trade play a central role for the aggregate decline in trade costs for services during the last two decades.

For communications services, there is tentative evidence that the importance of ICT and air traffic as determinants of services trade costs has increased over time. ICT adoption over the period 2012 to 2019 can explain nearly one quarter of the drop in cross-border services trade costs. The growth of air traffic during the same period accounts for 34% of the reduction. Respective contributions over the last two decades are somewhat smaller, standing at only 4% and 10%. Regarding RTAs, their role in recent years (2012-2019) seems similar to the one they played throughout the 20-year period accounting for a further 3% to 4% of the overall decline in trade costs for communications services.

Trade cost reductions for financial services can be primarily explained by ICT adoption. In fact, over the period 2012 to 2019, the contribution of ICT to services trade costs is more than twice as large as the overall drop in trade costs in this period. This suggests that other forces not explicitly considered in this analysis must have brought up the costs of cross-border trade in financial services. This observation could hint at the importance of prudential regulation implemented after the global financial crisis, limiting the scope and scale of cross-border financial services activities.

Over the same period, growing air traffic accounts for roughly half of the total decline in trade costs for financial services, while a further 14% is explained by the entry into force of RTAs with binding services provisions. Between 2000 and 2019, ICT adoption and RTAs still have a critical function in the reduction

of services trade costs, while there is no evidence for air transport to act as a driver of trade cost reductions for cross-border trade in financial services.

ICT adoption is responsible for between 30% (over the period 2000-2019) and 45% (over the period 2012-2019) of the total decline in trade costs for business services. In this sector, air traffic growth roughly explains an additional 10% of the trade cost reduction. As already mentioned above in Section 4.1, services RTAs do not emerge as drivers of trade costs reductions for cross-border trade in this sector.

While we do not find statistically significant coefficients for ICT and air traffic in all regression specifications providing the basis for the trade cost decomposition presented in this section, this should not be considered evidence for the ineffectiveness of these factors regarding the reduction in services trade costs. In several cases, coefficients are significant with the expected sign in the specification without time-varying border dummies. This could indicate that it is predominantly global availability of ICT and air transport shaping services trade costs, with country-specific variation in adoption (among the economies included in the analysis) playing a secondary role. Moreover, technological or regulatory constraints could cause the impact of ICT and air traffic on services trade to materialise primarily through the establishment of foreign subsidiaries and Mode 3 services trade, which is not included in this analysis.

5. Conclusion

This paper first sheds light on patterns of services tradability, defined as the capacity to facilitate geographic separation between consumption and production of a service. This definition simultaneously refers to services trade across national borders and to the ability to trade services with geographically distant partners.

Regarding the border dimension of services tradability, the analysis reveals that cross-border services trade has grown relative to the consumption of domestically sourced services since the early 2000s. Compared to the beginning of the millennium, a larger share of services is now traded internationally and the “home bias” in services consumption has declined.

With respect to the effect of distance on services trade, we show that the period 2000-2019 has also seen a reduction in the impact of geographical distance on cross-border services trade. Moreover, there is strong evidence that the detrimental effect of distance on services trade is less pronounced for economies at more advanced stages of economic development. The results cast light on air transport and ICT adoption as major drivers of a lowering of the “proximity burden” affecting services trade, particularly regarding financial and insurance services.

The analysis shows that the expansion of cross-border services trade is at least partly driven by ICT adoption, growth of air transport capacity, as well as services liberalisation in bilateral and regional trade agreements. Adoption of ICT since 2012 can explain at least one quarter of the total decrease in services trade costs in communications services. The contributions of ICT to reductions in the cost of cross-border trade of financial services and business services seem even larger. There is tentative evidence that the importance of ICT as a determinant of services trade costs has increased over time.

The expansion of air travel can account for a further 10% to 50% of the reduction in cross border services trade costs. This suggests that services exporters rely on a set of complementary channels for exports and imports of services, including the exchange of data, as well as in-person contact and business meetings.

Services RTAs can explain between 5% and 15% of the drop in trade costs for communications services and financial services. For business services, there is no significant evidence on the beneficial impact of services RTAs. That said, it should be noted that this variable is only a rough proxy for the openness of services sectors, which also depends strongly on domestic regulation and measures behind the border.

Using data until 2019, the analysis is not able to identify changes in the structural relationships between services trade and ICT or air transport resulting from the pronounced increase in the adoption of digital technologies induced by the repercussions of the COVID-19 pandemic. It is possible that ICT has gained even higher importance recently, as indicated by the rapid spread of software for videoconferencing and working from home. Nonetheless, it is clear that the results presented in this paper do not only emphasize the need for affordable and efficient internet access but also provide strong support for efforts to ensure

safe international travel in the context of the pandemic, such as steps towards greater interoperability among travel regimes (Scarpetta et al., 2021[46]).

In light of large differences in services tradability across different levels of economic development, efforts aimed at ensuring all workers and firms are sharing the benefits of services trade liberalisation should adopt a holistic approach spanning across several policy areas. The empirical findings of this paper highlight the importance of policies seeking to address gaps in access to digital technologies through a combination of infrastructure improvements and support for the adoption of new technologies (López González and Sorescu, 2019[47]). At the same time, high-quality transport infrastructure and the reduction of regulatory barriers to services trade constitute core elements of global "connectedness" policies (Van Assche, 2020[48]) that can help workers and firms to benefit from increases in services tradability.

The limitations of this study point towards potential directions for future research. For example, more fine-grained data linking trade flows to firms and different categories of workers may help to deepen our understanding of heterogeneity in services tradability across countries. Similarly, improvements in the availability of data on changes in language skills over time could allow researchers to add a further dimension to the analysis presented in this paper. In addition, more research – possibly drawing on data on services trade by mode of supply – is needed to enhance our understanding of the link between RTAs and cross-border services trade. Furthermore, detailed data on trade and investment activities of multinational enterprises could allow for an in-depth analysis of region-specific patterns and could provide insight into drivers of changes in services traded through commercial presence, including aspects related to taxation.

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Annex A. Sectoral classification

Table A A.1. Sectoral classification and mapping

Description	EBOPS 2010	EBOPS 2002	ISIC rev. 4	ITPD sector code
Finance + insurance	SF+SG	S253+ S260	K: 64-66	159+160
Communication	SI+SK1	S245+S262	J: 58-63	162
Business services	SJ	S268	M+N: 69-82	163

Source: Authors' compilation.

Annex B. Methodology

In line with related empirical work (Borchert and Yotov, 2017[31]; Anderson et al., 2018[14]; Benz and Jaax, 2020[12]), the analysis relies on a structural gravity model covering international cross-border services trade and consumption of domestically sourced services. All specifications are based on the PPML (Poisson Pseudo Maximum Likelihood) specification and include exporter-year and importer-year fixed effects, controlling for all time-varying country-specific unobservables, including multilateral resistance terms (Anderson and van Wincoop, 2003[38]).

Time-varying border estimates and time-varying distance estimates

The first part of the analysis (Section 3) aims to shed light on the overall trends in international trade in services since the year 2000. For this purpose, we estimate time-varying border coefficients and time-varying distance coefficients, using interactions of these variables with a year-dummy. Time-varying border coefficients reveal whether the home bias has become more or less pronounced: They indicate the extent to which international services trade has grown compared to the domestic consumption of services produced domestically. While international borders have been shown to have a negative effect on services exports (Anderson et al., 2018[14]), a reduction in the absolute size of the negative border coefficients in recent years would indicate an increase in international services exports relative to the consumption of domestically produced services.

Conversely, time-varying distance coefficients indicate the extent to which the focus of services exports has shifted from trading partners in the same geographic region towards more geographically distant trading partners. A shift towards exports to remote destinations would be reflected by a pattern where distance coefficients become smaller in absolute terms in more recent years of the analysis. The estimation equations for time-varying border coefficients and time-varying distance coefficients can be written as follows:

$$X_{ijt,k} = \exp\left(\sum_{T=2000}^{2019} \beta_1^T INTLBRDR\_T_{ij} + \beta_4 G_{ij} INTLBRDR_{ij} + \eta_{it,k} + \mu_{jt,k} + \varepsilon_{ijt,k}\right)$$

$$X_{ijt,k} = \exp\left(\begin{array}{c} \beta_1 INTLBRDR_{ij} + \sum_{T=2000}^{2019} \beta_2^T INTLDIST\_T_{ij} + \sum_{T=2000}^{2019} \beta_3^T DOMDIST\_T_{ij} \\ + \beta_4 G_{ij} INTLBRDR_{ij} + \eta_{it,k} + \mu_{jt,k} + \varepsilon_{ijt,k} \end{array}\right)$$

In both equations, G_{ij} is a set of gravity control variables, including bilateral distance, contiguity and common language. INTLBRDR indicates a cross-border dummy that is equal to one when *i* and *j* refer to different countries and equal to zero when *i* and *j* refer to the same country. Results reported in Figure 3 are based on the difference between the impact of international distance on cross-border services trade and the impact of domestic distance on cross-border services trade, β_2^T-β_3^T. All results are robust when adding pair fixed effects to control for time-invariant bilateral trade costs and for cross-country heterogeneity with respect to home bias.

Sources of services tradability

In a further step (Section 4.1), we estimate a gravity regression to identify sources of services tradability. As mentioned above, all specifications include exporter-year and importer-year fixed effects to control for multilateral resistance. Pair fixed effects control for bilateral time-invariant trade cost determinants, including geographic, historic and cultural factors.

Pair fixed effects also control for cross-country differences in the “home bias” in international trade. All regressions also include a dummy variable indicating the existence of a services RTA. Potential

determinants of services tradability are captured through different variables measuring the spread of services RTAs[36], growth of global air traffic, and the availability and use of digital technologies. These variables are summarised in the vector of time-varying tradability variables T_{ijt}.

$$X_{ijt,k} = \exp(\beta_1 INTLBRDR_{ij} + \beta_5 T_{ijt} INTLBRDR_{ij} + \eta_{it,k} + \mu_{jt,k} + \vartheta_{ij,k} + \varepsilon_{ijt,k})$$

In a second set of regressions, we add time-varying border dummies. As explained above, these dummies absorb changes in the "home bias" of services trade that could results from a general trend towards services globalisation or a potential shift in consumer preferences regarding cultural diversity. The use of time-varying border dummies also ensures that all coefficients are identified exclusively from cross-country heterogeneity in the speed towards ICT adoption or air transport growth, not from general changes in the speed of adoption that are identical across all countries. The focus on specific sources of variation for identification also supports the interpretation of coefficients as causal effects.[37]

$$X_{ijt,k} = \exp\left(\sum_{T=2000}^{2019} \beta_1^T INTLBRDR\_T_{ij} + \beta_5 T_{ijt} INTLBRDR_{ij} + \eta_{it,k} + \mu_{jt,k} + \vartheta_{ij,k} + \varepsilon_{ijt,k}\right)$$

Drivers of changes in distance effects

The results presented in Section 4.2 rely on a two-stage approach aimed at analysing the determinants of changes in the effect of distance on services trade. In the first stage, we draw inspiration from Borchert and Yotov (2017[31]) and estimate a gravity regression for total services exports which includes interactions of country-by-year dummies with the distance variable.

The estimation of exporter-time-varying distance coefficients relies on a specification with pair fixed effects that absorb all time-invariant bilateral trade cost factors and also account for all cross-country variation with respect to the "home bias" of services trade. In addition, the specification also controls for the existence of an RTA between the two trade partners.

$$X_{ijt,k} = \exp\left(\sum_{T=2000}^{2019} \sum_{i=1}^{I} \beta_1^{TI} lnDIST_{ij} + \beta_4 T_{ijt} INTLBRDR_{ij} + \eta_{it,k} + \mu_{jt,k} + \vartheta_{ij,k} + \varepsilon_{ijt,k}\right)$$

We store the estimates of exporter-specific time-varying distance coefficients obtained from this gravity specification. In the second step, these estimated coefficients are employed as the dependent variable in fixed effects regressions that link the estimated distance coefficients to a set of independent variables, most importantly variables referring to air transport capacity and ICT adoption. Given that RTAs are inherently specific to bilateral relationships, their role is not considered in these exporter-specific second stage regressions (but they are included as a control variable in the above-mentioned first stage gravity regression).

The use of year-specific fixed effects and exporter fixed effects in the second stage regressions implies that identification only relies on changes over time. This empirical strategy controls for all time-invariant unobservable characteristics of a given exporter (e.g. specific cultural preferences) and all time-varying aspects affecting all countries (such as a global economic crisis).

[36] The European Economic Area (EEA) is not considered an RTA. Instead, we insert a dummy equalling one if both trade partners are EEA members in order to control for the profound economic integration and institutional coordination among EEA member states.

[37] The coefficients are causal effects as long as the "border dummy" is not correlated with our variables of interest or with potentially omitted variables (Nizalova and Murtazashvili, 2016[65]). The first condition is necessarily satisfied, since the "border dummy" is one for all international trade flows, irrespective of a specific country. The introduction of a large number of fixed effects reduces the likelihood of omitting variables that are correlated with the border dummy (Beverelli et al., 2018[15]).

Trade cost decomposition

The trade cost decomposition in Section 4.3 relies on "estibrated" trade costs as measure of changes in the costs of cross-border services trade. "Estibration" is a hybrid approach between estimation and calibration, that relies on estimated trade cost components and the residuals of the gravity regression. In our specification, "estibrated" trade costs can be written as:

$$t_{ijt,k}^{estbr} = \left[exp\left(\hat{\beta}_1^t INTLBRDR\_T_{ij} + \hat{\beta}_5 T_{ijt} INTLBRDR_{ij} + \hat{\vartheta}_{ij,k}\right) \times \varepsilon_{ijt,k}\right]^{\frac{1}{1-\sigma}}$$

In this equation, $\hat{\beta}_1^t$ is the estimated coefficient for the time-varying border dummy in a specific year *t*. As above, T_{ijt} is a vector of the time-varying variables corresponding to potential determinants of services tradability, including the spread of services RTAs, growth of global air traffic, and the availability and use of digital technologies, while $\hat{\beta}_4$ refers to a vector of estimated coefficients for these variables. $\hat{\vartheta}_{ij,k}$ are estimates of pair fixed effects. In this framework, individual components of trade costs can be related to specific determinants of cross-border services trade. For example, the component of trade costs related to ICT adoption can be written as:

$$t_{ijt,k}^{ICT} = \left[exp\left(\hat{\beta}_5^{ICT}\, ICT_{ijt}\, INTLBRDR_{ij}\right)\right]^{\frac{1}{1-\sigma}}$$

In this equation, ICT_{ijt} is a measure of ICT adoption that is included in the term of time-varying tradability variables T_{ijt} and $\hat{\beta}_4^{ICT}$ is the estimated regression coefficient of the ICT variable. The calculation requires an assumption on sector-specific elasticities of substitution. We rely on estimates from a recent publication, choosing $\sigma = 4.27$ for communications services, $\sigma = 4.18$ for finance and insurance services and $\sigma = 4.02$ for business services (Egger et al., 2021[49]).

These individual trade cost terms are multiplicatively linked. In particular, with our specification "estibrated" trade costs can be written as:

$$t_{ijt,k}^{estbr} = t_{ijt,k}^{ICT} \times t_{ijt,k}^{AIR} \times t_{ijt,k}^{RTA} \times t_{ijt,k}^{GRAV} \times t_{ijt,k}^{BORD} \times \varepsilon_{ijt,k}^{\frac{1}{1-\sigma}}$$

In this equation, $t_{ijt,k}^{GRAV}$ refers to trade costs due to estimates of country pair fixed effects and $t_{ijt,k}^{BORD}$ refers to trade costs due to time-varying border dummies. Using this structure, trade cost changes between 2000 and 2019 can be decomposed as

$$ln\left(\frac{t(2019)_{ij,k}^{estbr}}{t(2000)_{ij,k}^{estbr}}\right) = ln\left(\frac{t(2019)_{ij,k}^{ICT}}{t(2000)_{ij,k}^{ICT}}\right) + ln\left(\frac{t(2019)_{ij,k}^{AIR}}{t(2000)_{ij,k}^{AIR}}\right) + ln\left(\frac{t(2019)_{ij,k}^{RTA}}{t(2000)_{ij,k}^{RTA}}\right) + ln\left(\frac{t(2019)_{ij,k}^{GRAV}}{t(2000)_{ij,k}^{GRAV}}\right) + ln\left(\frac{t(2019)_{ij,k}^{BORD}}{t(2000)_{ij,k}^{BORD}}\right) + ln\left(\frac{\varepsilon(2019)_{ij,k}^{\frac{1}{1-\sigma}}}{\varepsilon(2000)_{ij,k}^{\frac{1}{1-\sigma}}}\right)$$

The contribution of changes in trade cost components to changes in "estibrated" trade costs can be calculated by dividing each of the right-hand-side terms by the term on the left.

Annex C. Data sources and description of key variables

This research project exploits data covering the period between 2000 and 2019. We analyse cross-border services trade flows in three services sectors: communications, finance plus insurance and business services. In line with the related literature (Anderson et al., 2018[14]; Benz and Jaax, 2020[12]; Yotov, 2021[50]), cross-border flows and domestic flows – calculated as a country's total production minus total exports – are taken into account. Data for cross-border flows and domestic flows for 2000 to 2016 come from the International Trade and Production Database for Estimation (ITPD-E) (Borchert et al., 2021[51]). For the years 2017, 2018 and 2019, sectoral cross-border flows are based on the OECD-WTO Balanced Trade in Services Statistics (BaTIS) and domestic flows were computed using national accounts data from the OECD and the UN.[38] While the database created for the analysis incorporates mirrored values, it excludes any observations for which the corresponding value in the BaTIS database relies on an estimation procedure involving gravity regressions.

Data for standard gravity controls (distance, contiguity, common language, former colony, common legal system, common religion) are provided by the Centre d'Études Prospectives et d'Informations (CEPII). A control variable capturing the difference in corporate income tax rates (calculated as the importer's rate minus the exporter's rate) relies on OECD data.

In addition, the analysis incorporates several variables corresponding to the four above-mentioned potential drivers of changes in services tradability. Regarding policies, a variable capturing the existence of regional trade agreements (RTAs) with legally enforceable services provisions relies on the World Bank Deep RTAs database (Hofmann, Osnago and Ruta, 2017[52]). These agreements became more common during the period covered by the analysis. For the 47 economies covered in this study, the number of bilateral linkages covered by an agreement with such provisions increased from 41 in 2000 to 269 in 2019.[39]

Regarding air transport, the analysis includes two variables. Information on bilateral passenger numbers between country pairs comes from the data provider OAG. The number of air passengers increased by nearly 70% between 2012 and 2019 on average across all pairs.[40] Moreover, the analysis incorporates a variable taken from the World Bank World Development Indicators that varies at the exporter-year level (but not across country pairs) and captures the number of air passengers carried in a given year. While it is available for the full period of analysis, it is important to note that this variable includes both domestic and international aircraft passengers and only refers to passengers of air carriers registered in the country. The average – across all exporting economies included in the database – number of air passengers carried increased by 164% between 2000 and 2019.[41]

A comprehensive measure of the extent of ICT adoption is the number of internet protocol (IP) addresses. IP addresses play a key role in the routing of data packets from its origin to its destination. Such a numerical identifier is assigned to any device connected to a computer network for the exchange of data based on the Internet protocol – for example, to computers, mobile phones, remotely controlled "smart home" security systems, or predictive maintenance sensors of CNC machines. Drawing on data provided by the

[38] The construction of the dataset for the years 2017, 2018 and 2019 closely follows the methodology of the ITPD-E database. For the year 2016, there is a lower number of observations in the ITPD-E database than in 2014 and 2015. Missing observations for international flows in the ITPD-E dataset were therefore replaced by information from BaTIS in case the same observation was non-missing in the BaTIS dataset.

[39] Consequently, the number of exporters that are not linked to any of the economies included in this analysis through an agreement with services provisions declined during the period of analysis. In the year 2000, 20 economies had not signed such an agreement with any of the other 46 potential trade partners. By contrast, in 2019 all but three economies were signatories to at least one agreement with a trade partner covered by this study.

[40] Data from the OAG on bilateral air travel refer to all cabin classes. For this analysis, this information is available the years 2012-2019 only.

[41] This variable is not available for Hong Kong (China). Its coverage is incomplete in the case of Denmark, Norway, Slovakia, and Sweden.

Asia-Pacific Network Information Centre, we compute the total number of unique IPv4 and IPv6 addresses. As every device connected to the internet requires an IP address, we consider this number as a proxy for the extent of ICT adoption in a given economy.[42] The average number of IP addresses per billion USD of GDP across all economies included in the analysis increased by a factor of nearly eight between 2000 and 2019. In further specifications, we rely on OECD data on the percentage of households with internet access as further indicator for the country-specific adoption of ICT.

Table A C.1. Overview of key variables

Variable	Description	Source
Exports	Services exports (either cross-border exports or sourcing of domestically produced services	ITPD-E for cross-border exports and sourcing of domestically produced services (2000-2016); OECD-WTO BaTIS (2017, 2018, 2019) for cross-border exports, OECD and UN national accounts (2017, 2018, 2019) for sourcing of domestically produced services
Distance	Logarithm of population weighted distance (international as well as within-country)	CEPII
Contiguity	Dummy equaling 1 if trade partners share a border	CEPII
Common language	Dummy equaling 1 if trade partners share a language	CEPII
Common religion	Dummy equaling 1 if trade partners share a religion	CEPII
Common legal origin	Dummy equaling 1 if trade partners share same legal origin	CEPII
Shared colonial history	Dummy equaling 1 if trade partners share colonial history	CEPII
Services RTA	Dummy equaling 1 if trade agreement (between the two trade partners) with legally enforceable services provision is in force	World Bank Deep RTAs database
Goods RTA	Dummy equaling 1 if trade agreement without services provision is in force	WTO
% households internet	Percentage of households with internet access	OECD
Ln IP	Logarithm of number of IP4 and IP6 addresses	Asia-Pacific Network Information Centre
Ln air passengers	Logarithm of number of bilateral air passengers	OAG
Ln airtravel	Logarithm of number of air passengers carried	World Bank

Table A C.2. Allocation of countries to income quartiles

Quartile	Countries
1	BRA, CHN, COL, CRI, IDN, IND, LTU, LVA, MYS, RUS, THA, ZAF
2	CHL, CZE, EST, GRC, HUN, KOR, MEX, POL, PRT, SVK, SVN, TUR
3	AUS, AUT, BEL, CAN, DEU, ESP, FIN, FRA, HKG, ISR, ITA, NZL
4	CHE, DNK, GBR, IRL, ISL, JPN, LUX, NLD, NOR, SWE, USA

Note: The allocation of countries is based on GDP per capita in the year 2000.
Source: Authors' illustration using GDP per capita data from the World Bank World Development Indicators.

[42] For further details on the use of IP addresses in economic research, see Csonto, Huang and Tovar Mora (2019[63]).

Table A C.3. List of regional trade agreements – RTAs

Agreement	Entry into force	Participants
EFTA - Mexico	2001	CHE, ISL, MEX, NOR
Chile - Costa Rica (Chile - Central America)	2002	CHL, CRI
European Union - Chile	2003	AUT, BEL, CHL, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, LTU, LUX, LVA, NLD, POL, PRT, SVK, SVN, SWE
United States - Chile	2004	CHL, USA
Chile - Korea	2004	CHL, KOR
EFTA - Chile	2004	CHE, CHL, ISL, NOR
China (PRC) - Hong Kong (China)	2004	CHN, HKG
Japan - Mexico	2005	JPN, MEX
United States - Australia	2005	AUS, USA
Australia - Thailand	2005	AUS, THA
Japan - Malaysia	2006	JPN, MYS
EFTA - Korea	2006	CHE, ISL, KOR, NOR
CAFTA-DR	2006	CRI, USA
Trans-Pacific Strategic Economic Partnership	2006	CHL, NZL
Japan – Thailand	2007	JPN, THA
Chile – Japan	2007	CHL, JPN
Japan – ASEAN	2008	IDN, JPN, MYS, THA
China (PCR) - New Zealand	2008	CHN, NZL
Chile – Australia	2009	AUS, CHL
Chile – Colombia	2009	CHL, COL
Japan – Switzerland	2009	CHE, JPN
ASEAN – Australia – New Zealand	2010	AUS, IDN, MYS, NZL
New Zealand – Malaysia	2010	MYS, NZL
Korea – India	2010	IND, KOR
ASEAN-Korea	2010	IDN, KOR, MYS, THA
ASEAN-India	2010	IDN, IND, MYS, THA
Canada – Colombia	2011	CAN, COL
India - Japan	2011	IND, JPN
European Union - Korea	2011	AUT, BEL, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, KOR, LTU, LUX, LVA, NLD, POL, PRT, SVK, SVN, SWE
India - Malaysia	2011	IND, MYS
China (PRC) - Costa Rica	2011	CHN, CRI
Hong Kong (China) - New Zealand	2011	HKG, NZL
EFTA - Colombia	2011	CHE, COL, ISL, NOR
EFTA - Hong Kong (China)	2012	CHE, HKG, ISL, NOR
United States - Colombia	2012	COL, USA
Mexico - Central America	2012	CRI, MEX
Korea, Republic of – United States	2012	KOR, USA
European Union - Colombia and Peru	2013	AUT, BEL, COL, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, LTU, LUX, LVA, NLD, PER, POL, PRT, SVK, SVN, SWE
Malaysia - Australia	2013	AUS, MYS
European Union - Central America	2013	AUT, BEL, CRI, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, LTU, LUX, LVA, NLD, POL, PRT, SVK, SVN, SWE

Note: List of services RTAs included in the analysis ordered by year of entry into force. Criteria for inclusion require entry into force between 2001 and 2019, as well as a minimum of two participants with available services trade data. Last column only lists participants included in the analysis.
Source: Authors' compilation based on World Bank Deep RTAs database.

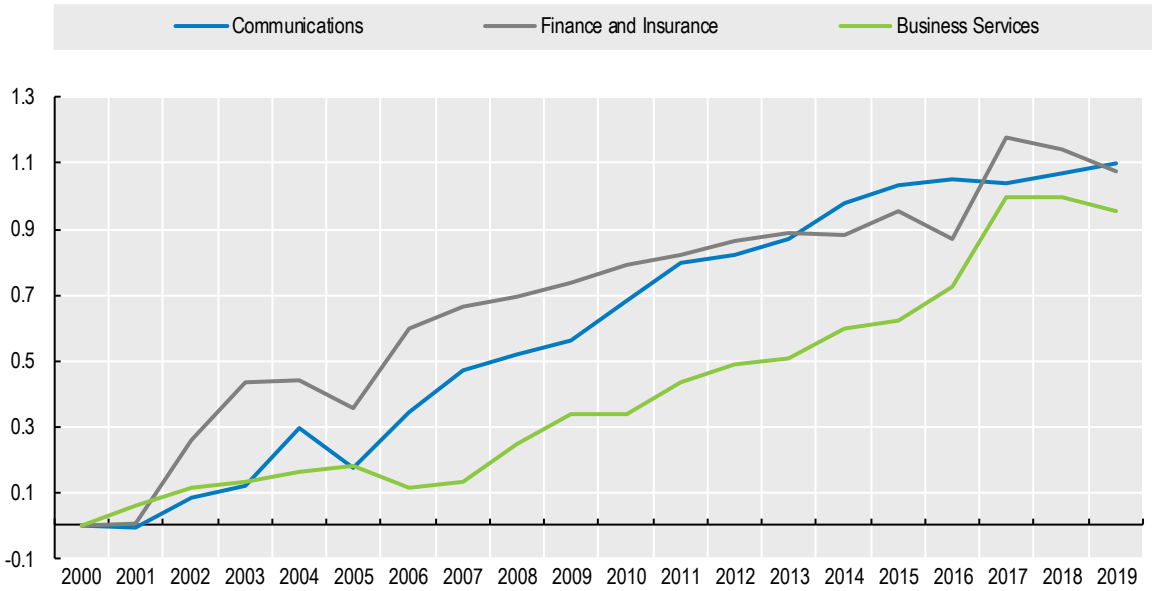
Table A C.4. List of regional trade agreements – RTAs (continued)

Agreement	Entry into force	Participants
European Union - Central America	2013	AUT, BEL, CRI, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, LTU, LUX, LVA, NLD, POL, PRT, SVK, SVN, SWE
Switzerland – China (PRC)	2014	CHE, CHN
EFTA - Central America (Costa Rica and Panama)	2014	CHE, CRI, ISL, NOR
Korea, Republic of - Australia	2014	AUS, KOR
Hong Kong (China) - Chile	2014	CHL, HKG
Iceland – China (PRC)	2014	CHN, ISL
Japan – Australia	2015	AUS, JPN
Canada – Korea	2015	CAN, KOR
Australia – China (PRC)	2015	AUS, CHN
Chile – Thailand	2015	CHL, THA
China (PRC) - Korea	2015	CHN, KOR
Türkiye – Malaysia	2015	MYS, TUR
Costa Rica - Colombia	2016	COL, CRI
Korea – Colombia	2016	COL, KOR
Pacific Alliance	2016	CHL, COL
European Union – Canada	2017	AUT, BEL, CAN, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, LTU, LUX, LVA, NLD, POL, PRT, SVK, SVN, SWE
Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP)	2018	AUS, CAN, CHL, JPN, MEX, MYS, NZL
European Union - Japan	2019	AUT, BEL, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ITA, JPN, LTU, LUX, LVA, NLD, POL, PRT, SVK, SVN, SWE

Note: List of services RTAs included in the analysis ordered by year of entry into force. Criteria for inclusion require entry into force between 2001 and 2019, as well as a minimum of two participants with available services trade data. Last column only lists participants included in the analysis.
Source: Authors' compilation based on World Bank Deep RTAs database.

Annex D. Additional results and robustness checks

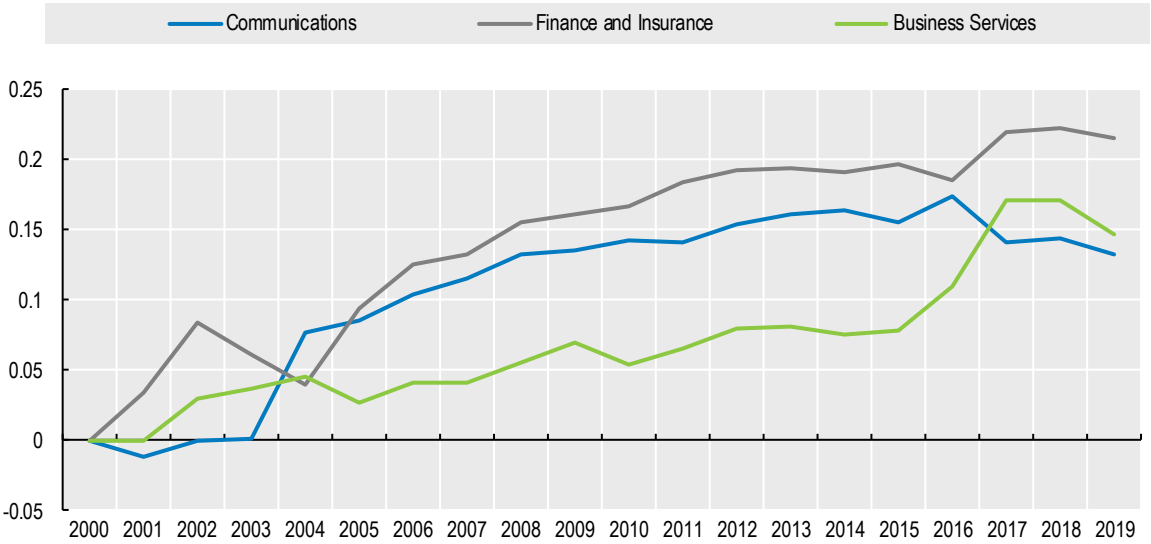
Figure A D.1. Changes in the effect of borders on cross-border services trade



Note: The vertical scale measures deviations from baseline border coefficient in the year 2000. A value of 0.5 indicates around 65% growth in cross-border trade relative to domestic consumption; a value of one indicates around 170% growth in cross-border trade relative to domestic consumption. This graph relies on year-specific border coefficients estimated through sector-specific gravity regressions encompassing variables referring to distance, contiguity, common language, common religion, common legal origin, shared colonial history as well as pair fixed effects, exporter-year fixed effects and importer-year fixed effects.
Source: Authors' calculations.

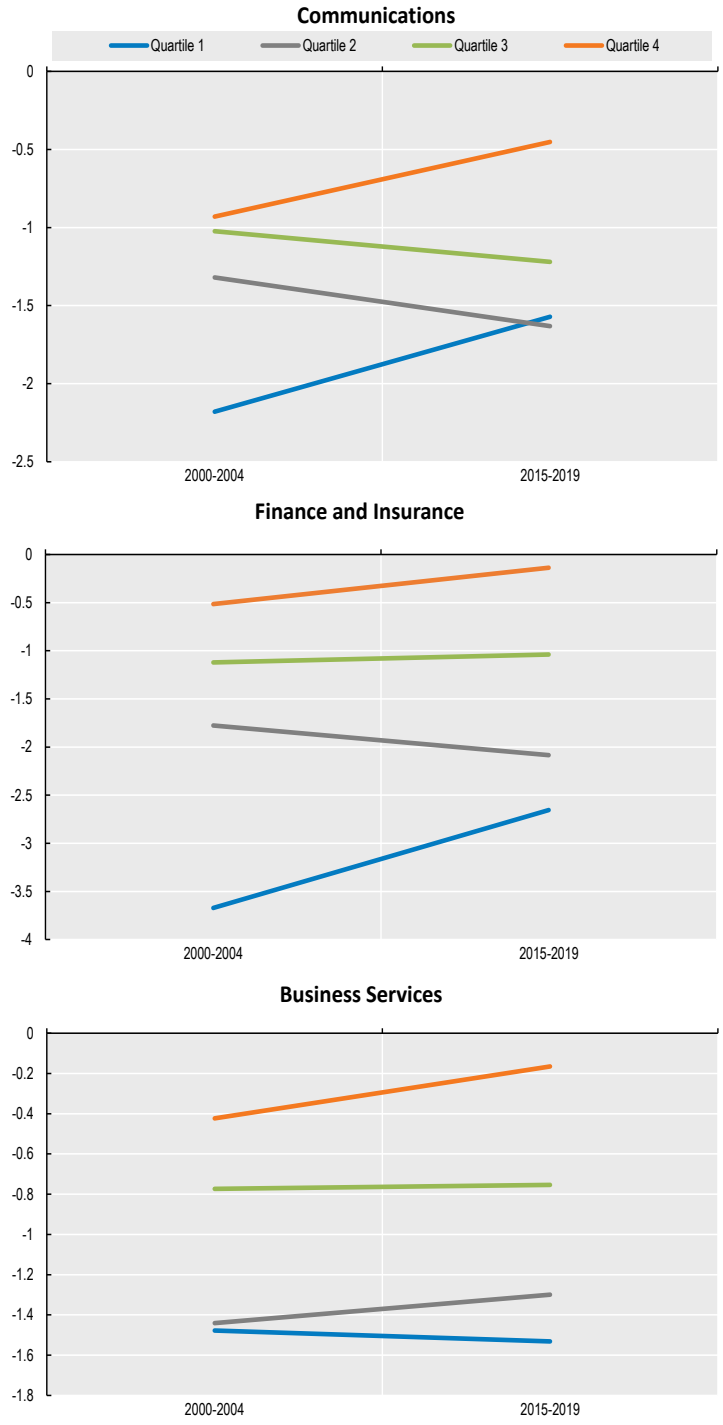
Figure A D.2. Changes in the effect of distance on cross-border services trade

Change in difference between international distance coefficient and domestic distance coefficient relative to year 2000



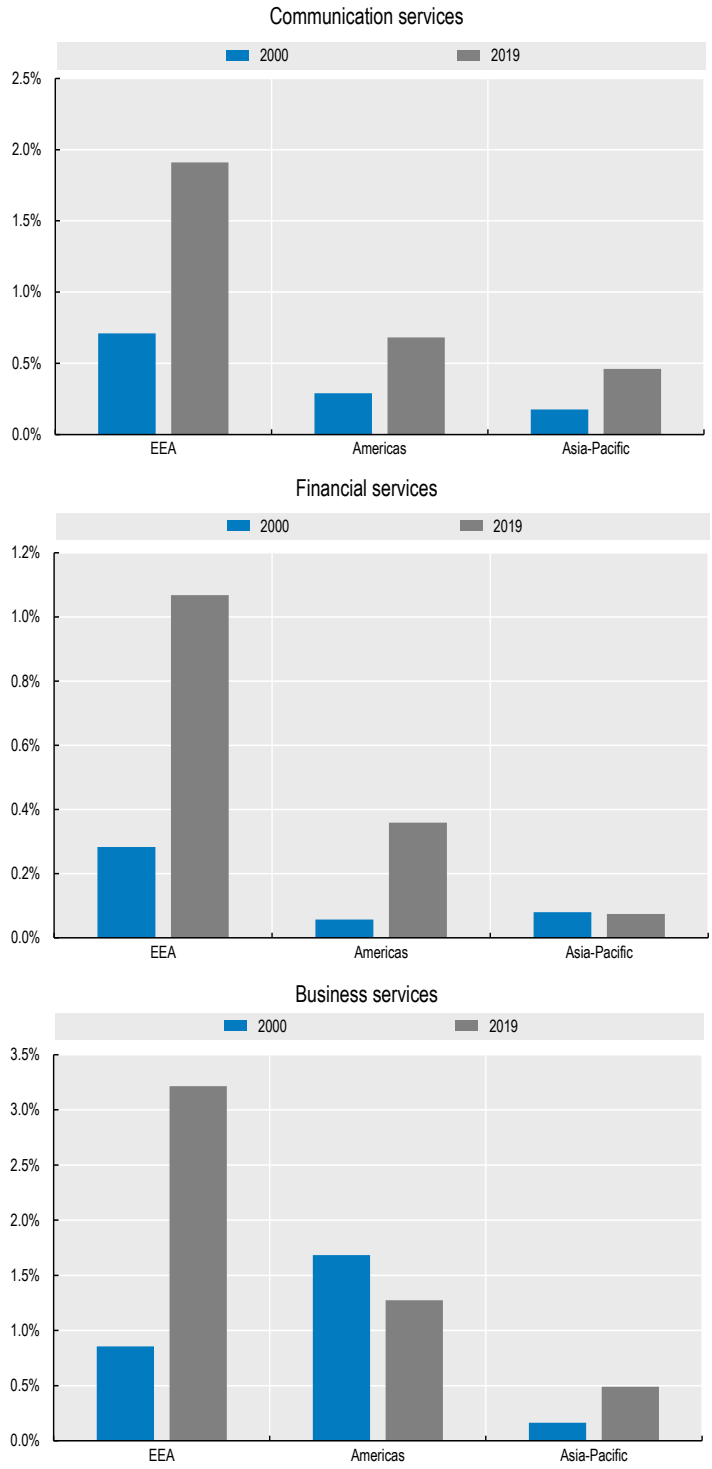
The graph shows the change – relative to the level in the year 2000 – in the differences between year-specific coefficients of the domestic distance variable and the corresponding year-specific coefficients of the international distance variable. The upward trend indicates that the effect of geographical distance on cross-border trade flows moved closer to the impact of distance on trade flows within countries. This graph relies on sector-specific gravity regressions encompassing variables referring to domestic distance, international distance, interactions of the domestic distance variable with year dummies, interactions of the international distance variable with year dummies, pair fixed effects as well as exporter-year and importer-year fixed effects.
Source: Authors' calculations.

Figure A D.3. Distance effects by quartile of GDP per capita distribution in 2000



Note: This graph displays changes in the effect of distance on cross-border services trade for the quartiles of the GDP per capita distribution in 2000 among the 47 countries included in the sample. This graph relies on sector-specific gravity regressions encompassing variables referring to distance, interactions of the distance variable with year dummies, interactions of the border-year dummies with dummies for each quarter, contiguity, common language, common religion, common legal origin, shared colonial history as well as exporter-year and importer-year fixed effects. The values shown in the graph are averages for the first five years and the last five years of the period of analysis. An upward trend (e.g. in the case of the first quartile and financial and insurance services) indicates a reduction of the detrimental effect of geographical distance on services trade for the corresponding group of economies.
Source: Authors' calculations.

Figure A D.4. Border effects by global macro region



Note: The graph displays exponential transformations, based on the coefficients of border-year dummies interacted with dummies for the geographic macro region of the exporter. Numbers express percentages of the expected trade volume in a hypothetical scenario where there are no frictions to cross-border services trade. This graph relies on sector-specific gravity regressions encompassing variables referring to distance, contiguity, common language, common religion, common legal origin, shared colonial history as well as exporter-year and importer-year fixed effects.
Source: Authors' calculations.

Table A D.1. Augmented gravity: Merchandise trade (IPTD-E data)

	(1)	(2)	(3)	(4)	(5)	(6)
Services RTA	0.088	0.088	0.088**	0.088**	0.045**	0.029
	(0.066)	(0.066)	(0.043)	(0.043)	(0.018)	(0.019)
Goods RTA	-0.211***	-0.208***	-0.171***	-0.169***	0.009	0.010
	(0.074)	(0.075)	(0.060)	(0.060)	(0.021)	(0.021)
% households internet (lag1)	0.010***	0.004				
	(0.002)	(0.005)				
Ln IP (lag1)			0.103***	0.070***	0.091***	0.045***
			(0.025)	(0.025)	(0.006)	(0.007)
Ln air passengers (lag1)	0.046***	0.046***	0.041***	0.037***		
	(0.014)	(0.014)	(0.012)	(0.013)		
Ln air travel (lag1)					0.051***	-0.013
					(0.015)	(0.016)
Observations	7,770	7,770	10,355	10,355	32,088	32,088
Exporter time F.E.	YES	YES	YES	YES	YES	YES
Importer time F.E.	YES	YES	YES	YES	YES	YES
Pair F.E.	YES	YES	YES	YES	YES	YES
Time-varying border	NO	YES	NO	YES	NO	YES

Note: Standard errors clustered by exporter, importer and year in parentheses *** p<0.01, ** p<0.05, * p<0.1. Additional dummy for EEA membership included but not reported in specifications covering years of EEA expansion.

Table A D.2. Augmented gravity: Merchandise trade (TiVA data)

	(1)	(2)	(3)	(4)	(5)	(6)
Services RTA	0.052**	0.049**	-0.013	-0.019	0.012	0.008
	(0.022)	(0.022)	(0.018)	(0.017)	(0.012)	(0.012)
Goods RTA	0.007	0.005	-0.068	-0.068	0.006	0.000
	(0.058)	(0.057)	(0.059)	(0.058)	(0.022)	(0.021)
% households internet (lag1)	0.009***	0.005***				
	(0.001)	(0.001)				
Ln IP (lag1)			0.030***	0.006	0.055***	0.048***
			(0.008)	(0.010)	(0.003)	(0.006)
Ln air passengers (lag1)	0.095***	0.078***	0.076***	0.048***		
	(0.011)	(0.011)	(0.011)	(0.012)		
Ln air travel (lag1)					0.073***	0.056***
					(0.011)	(0.011)
Observations	11,110	11,110	14,930	14,930	36,891	36,891
Exporter time F.E.	YES	YES	YES	YES	YES	YES
Importer time F.E.	YES	YES	YES	YES	YES	YES
Pair F.E.	YES	YES	YES	YES	YES	YES
Time-varying border	NO	YES	NO	YES	NO	YES

Note: Standard errors clustered by exporter, importer and year in parentheses *** p<0.01, ** p<0.05, * p<0.1. Additional dummy for EEA membership included but not reported in specifications covering years of EEA expansion.

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Comments are welcome and can be sent to tad.contact@oecd.org.