D Services trade in the future

This section attempts to provide some guidance as to how services trade patterns will change. Using a novel approach, this section begins by showing recent trends in trade costs related to services and identifying the factors affecting these costs. Then, major future trends in technology, demography, income and climate change are examined with a view to explaining how these trends can affect the choice of which services countries trade and with whom they trade, as well as how they trade. Finally, the potential impact of these trends on trade in services is quantified using the WTO Global Trade Model.

Contents

Some key facts and findings

- Trade costs are key in determining whether and how much a country trades.
- Trade costs in services are almost double those in goods, but they dropped by 9 per cent between 2000 and 2017 thanks to digital technologies, reduced policy barriers and investment in infrastructure.
- Four major trends will affect services trade in the future: digital technologies, demographic changes, rising incomes, and the impact of climate change.
- Analysis using the WTO Global Trade Model suggests that the share of services in global trade could increase by 50 per cent by 2040. If developing countries can adopt digital technologies, their share in global services trade could increase by about 15 per cent.

Predicting how services trade is likely to evolve in the future is not an easy task. Traditional economic theory points to technology and the relative abundance of factors of production (i.e. labour and capital) across countries as key drivers of trade patterns. A country with a relative abundance of labour will have a comparative advantage and therefore specialize in the production of goods and services whose production requires intensive use of labour. More recent economic theory predicts that countries with large economies will develop an advantage in exporting what they consume the most. Thus, not only factors of production and technology, but also preferences and consumption patterns, are key drivers of trade. This is true for goods trade as much as for services trade.

However, when services are traded through commercial presence in another country, comparative advantages take place at the level of the firm. A firm that establishes itself abroad will use its own technology, created in its home economy, and will match it with the host economy labour and capital. This is, for example, the case for a foreign hotel company, with very efficient managerial organization, that builds a hotel on a tropical island. Services are also traded by individuals who temporarily move abroad to provide a service. In this case, comparative advantage occurs at the level of the individual. A doctor who moves temporarily abroad to perform an operation using the physical infrastructure in the destination country is an example of this.

1. Trade costs

In order to understand how trade costs may evolve in the future, we need first to understand what the main determinants of trade costs in services are, and how they have evolved in the past.

This section uses a new approach to measure trade costs based on the comparison between domestic and international trade to capture the full range of obstacles confronted by a firm when it decides to sell or source its services internationally.[1] This measure builds on a recent WTO study on trade costs in the global economy (Egger et al., 2018) and is based on data that cover cross-border supply (mode 1 of the General Agreement on Trade in Services – GATS), such as via the internet, consumption abroad (mode 2), such as in the case of tourism, and the presence of individuals in the territory of another member (mode 4), such as consultants. Commercial presence in another country (mode 3), such as when an affiliate is established in a foreign country to serve the local market, is excluded due to a lack of data.[2]

Given this methodological approach, the trade costs in services include trade policy barriers, costs imposed by "behind-the-border" regulatory measures, and information and transaction costs related to cultural and institutional differences. Transport and travel costs also matter, as the exchange of services frequently requires the proximity of suppliers and consumers (Bhagwati, 1984; Francois, 1990; Hill, 1977; Sampson and Snape, 1985). Furthermore, trade costs also include any policies that disproportionately impact exporters and importers, for instance through their effect on firm competitiveness or availability of trade finance. Finally, since trade in many services is related to trade in goods,[3] costs specific to trading goods may impact services trade too.

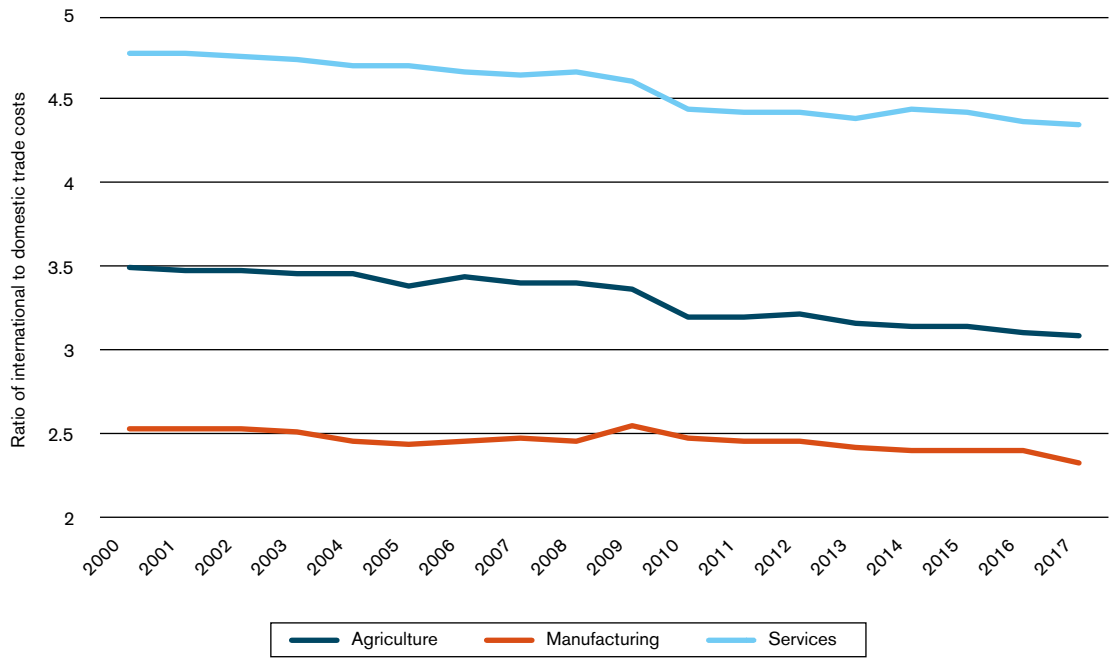
(a) Trade costs are higher in services

Figure D.1 illustrates the relatively higher trade cost of the services sector. Our estimates reveal that trade costs in the services sector are higher than those in manufacturing and agriculture. This finding is consistent with similar studies in the literature (e.g. Fontagné et al., 2011; Gervais, 2018; Miroudot et al., 2013). The estimated trade costs – defined as an average of both export and import costs – represent the ratio of international to domestic trade costs. Hence, an estimated trade cost for services in 2017 of 4.3 means that international trade is about four times more costly than domestic trade.[4]

It is also worth noting that trade costs in services have declined over the last two decades. Between 2000 and 2017, services sectors registered a cumulative decline in trade costs of around 9 per cent, about the same rate of decline as manufacturing. Notably, both services and manufacturing registered a slight increase in trade costs during the financial crisis of 2008-09, yet the declining trend in trade costs continued after 2010. Our findings differ from conventional estimates of trade costs, which generally find that trade costs in services have remained relatively steady. We are able to identify this trend thanks to our more refined estimation of trade costs compared to existing estimations, as our results stem from the use of a new set of estimated elasticity parameters that varies by sector.[5]

Trade costs also vary by income levels. Figure D.2 shows a breakdown of services trade costs among economies of different income levels.[6] Trade costs in services are lowest among advanced economies and highest for emerging economies. In 2017, trade costs in emerging economies were 66 per cent higher than in advanced economies. The decline in trade costs was faster in emerging economies before the financial crisis. However, the costs of services trade stopped declining and even grew in emerging economies after the crisis.

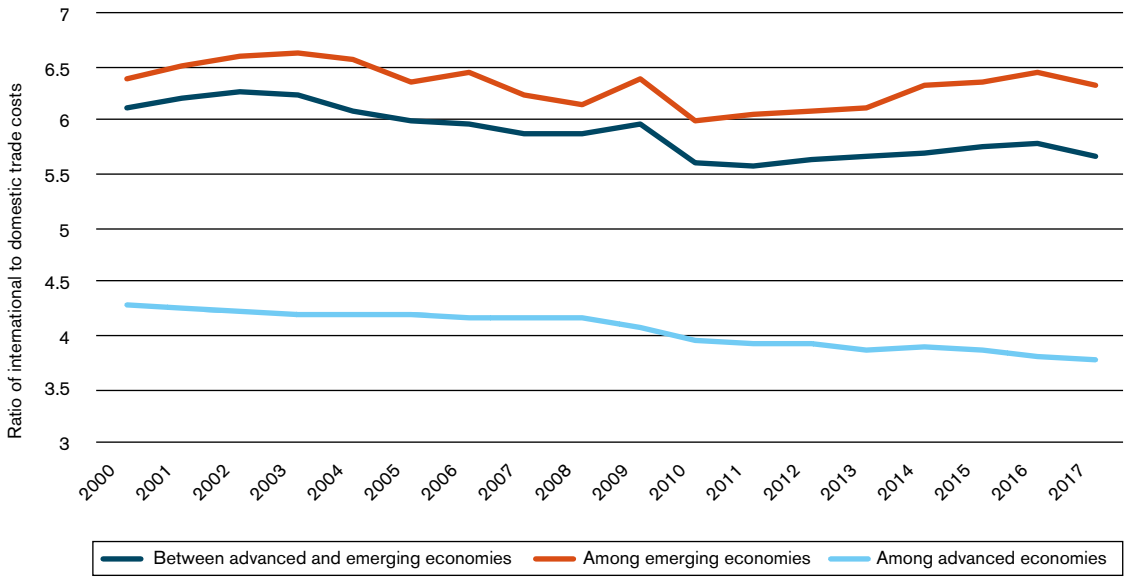
Figure D.1: Trade costs are highest for services
Trade costs by broad sector, 2000-17



Source: WTO estimates.

Note: The results are based on data for 43 economies. See Appendix D.1 for data sources and an explanation of the estimation methodology. The value of trade costs represents the ratio of international to domestic trade costs.

Figure D.2: Services trade costs are lowest among advanced economies
Services trade costs by economies of different income levels, 2000-17



Source: WTO estimates.

Note: The results are based on data for 43 economies. See Appendix D.1 for data sources and an explanation of the estimation methodology. The value of trade costs represents the ratio of international to domestic trade costs.

There is also considerable variation of trade costs across different services sectors. Figures D.3 and D.4 illustrate the evolution of trade costs by sector. In general, trade costs in many sectors have witnessed a declining trend since 2000.

Services sectors with low trade costs include transport and logistics, wholesale trade, other business and professional activities, post and telecommunications, financial intermediation and other services such as community, environmental, cultural and personal services. It is no surprise that transport, logistics and travel services have lower trade costs, as these services sectors often involve transactions across borders. Wholesale trade services have experienced a marked decline in trade costs, as did other business and professional activities.

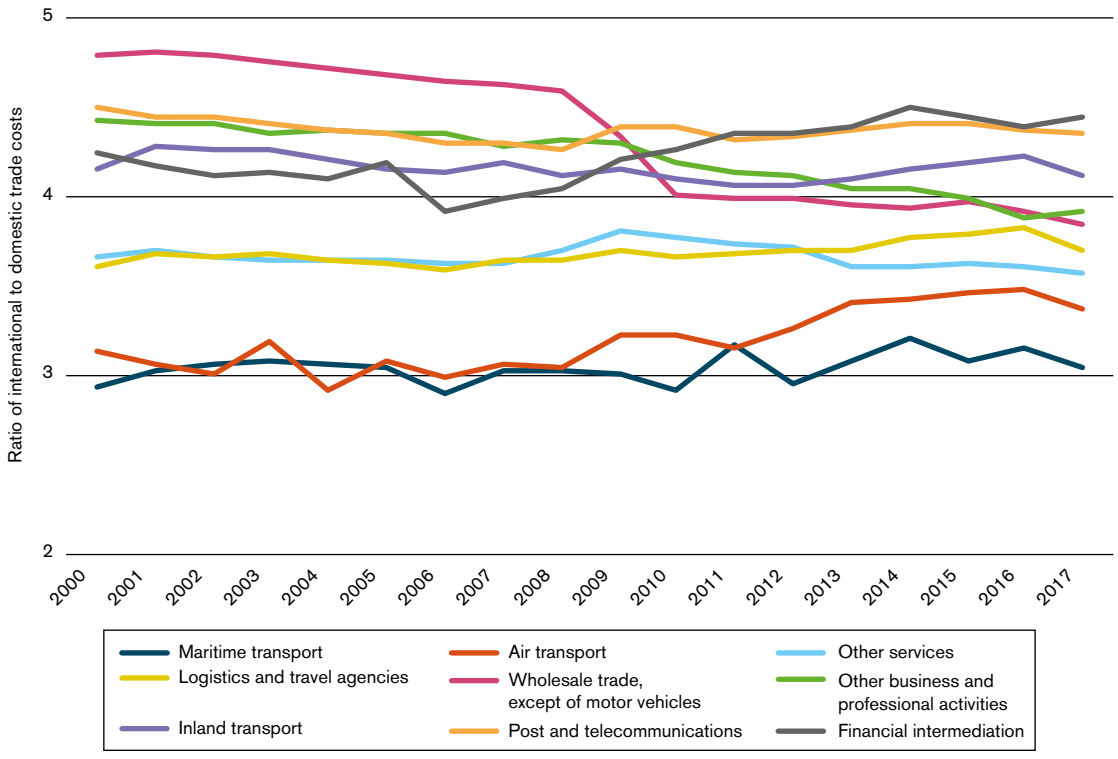
The largest trade costs are observed in services such as real estate activities, retail trade, the sale of motor vehicles, and construction. The high estimated costs for these sectors reflect the fact that these services are not highly tradable across borders and tend to be produced and consumed domestically (Jensen and Kletzer, 2005). However, retail trade and sale of motor vehicles saw a dramatic decline in trade costs, possibly reflecting the expansion of online sales. Sectors such as health and social work, education, electricity and water supply, and hotels and restaurants face medium trade costs.

(b) Trade policy, information barriers and distance drive trade costs

Trade costs include different components. Some barriers are related to geography and cultural or institutional differences, others are policy-induced. Being able to distinguish and quantify the different components of trade costs is essential to allow researchers to predict how trade costs may evolve in the future and to help policy-makers to identify areas where policy reforms can make a difference.

Figure D.5 presents the breakdown of bilateral trade costs into five components: transport costs, information and transaction costs, technology, trade

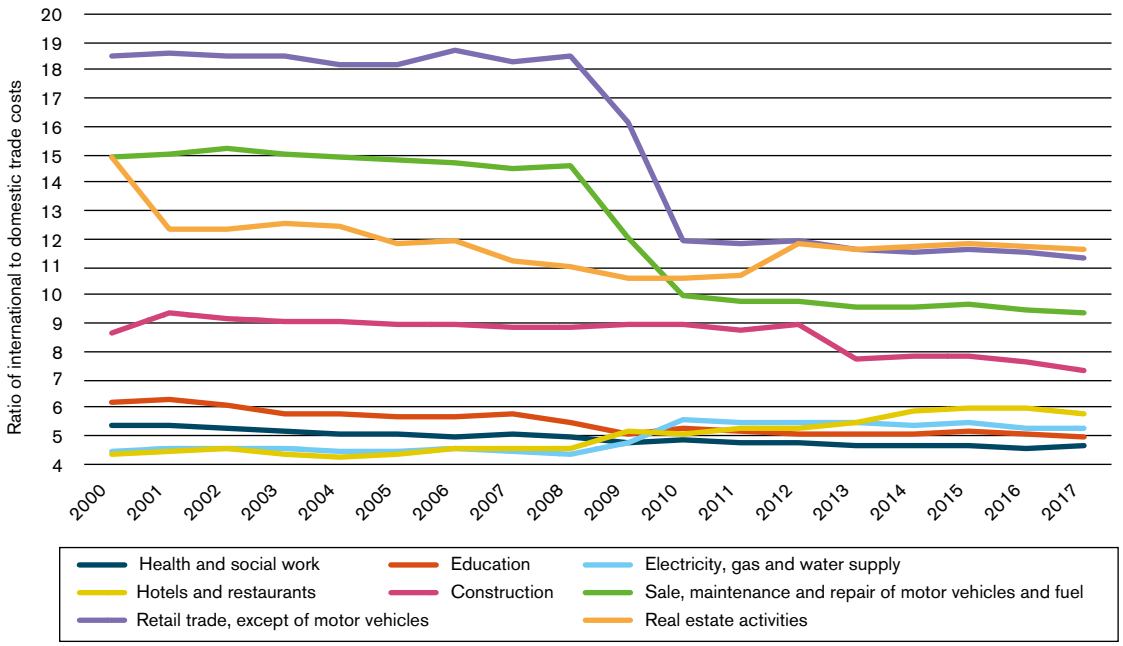
Figure D.3: Services sectors with low trade costs
Trade costs in services by sector, 2000-17



Source: WTO estimates.

Note: The results are based on data for 43 economies. See Appendix D.1 for data sources and an explanation of the estimation methodology. The value of trade costs represents the ratio of international to domestic trade costs. "Other services" include community, environmental, cultural and personal services.

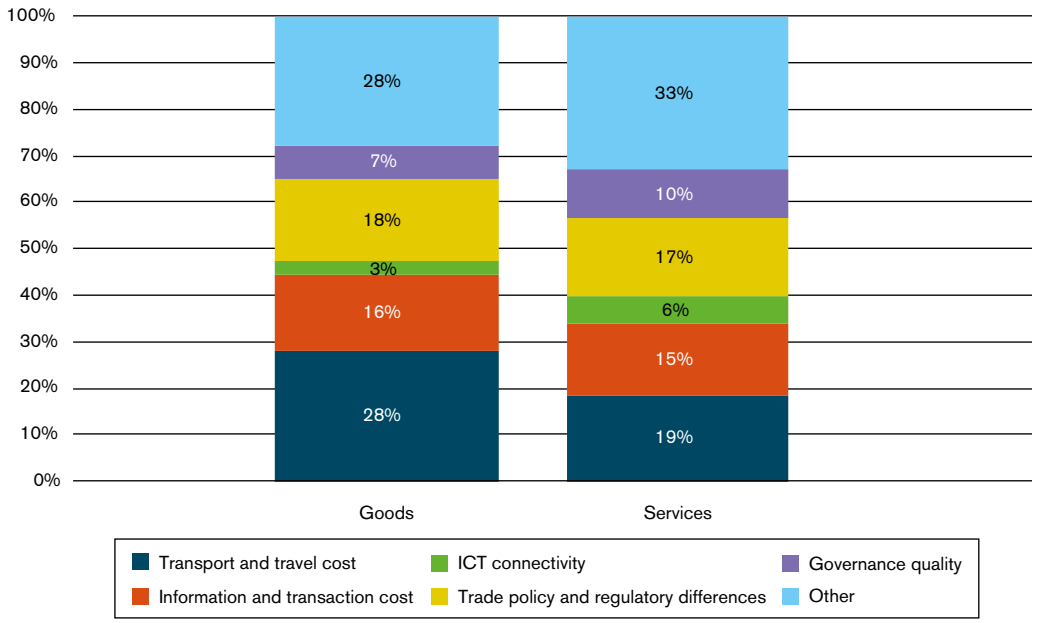
Figure D.4: Services sectors with high or medium trade costs
Trade costs in services by sector, 2000-17



Source: WTO estimates.

Note: The results are based on data for 43 economies. See Appendix D.1 for data sources and an explanation of the estimation methodology. The value of trade costs represents the ratio of international to domestic trade costs.

Figure D.5: Policy-related factors account for a significant part of trade costs
Breakdown of bilateral trade costs in services and goods in 2016



Source: WTO estimates.

Note: Figure D.5 shows to what extent various factors contribute to explaining the bilateral variance in goods and services trade costs. "Other" represents the part of bilateral variation in trade costs that remains unexplained in our analysis. See Appendix D.1 for data sources, an explanation of the methodology and definitions of trade cost categories.

policy and regulatory differences, and governance quality. The analysis captures the extent to which different components of trade costs contribute to the variation in bilateral trade costs. That is, how much a component can explain why costs to import to a country vary across its exporting partners and why costs to export from a country vary across its importing partners.[7]

Trade policy barriers and regulatory differences explain a large part of why trade with some partners is easier than with others. They account for 17 per cent of bilateral trade costs in services and 18 per cent in goods. Trade policy and regulatory differences include policy measures that make access to the domestic market relatively more difficult for foreign firms. In our estimation, their impact is captured by membership in regional trade agreements, in deeper economic agreements such as the European Union and the Euro-zone, and by heterogeneity in services trade regulation. In addition, they also include barriers pertinent to trade in goods, such as the average bilateral tariff or the efficiency of customs procedures.

Looking at the specific factors provides some more insights. The regression analysis that underpins our decomposition shows that regional trade agreements reduce trade costs in some goods sectors, but do not appear to affect trade costs in services significantly. Membership of the European Union, on the other hand, significantly decreases trade costs in many services sectors. On top of that, being part of the Euro-zone further reduces trade costs in retail trade, other business and professional activities and other services such as cultural and personal services. Heterogeneity in services trade regulation consistently increases trade costs, especially in telecommunication and other services such as cultural and personal services. Goods-specific barriers, such as the average bilateral tariff, significantly increase trade cost in retail and wholesale trade.

Information and transaction costs are also an important component of bilateral trade costs, accounting for 15 per cent of their variation in services and 16 per cent in goods. Information and transaction costs capture, for instance, the difficulty of obtaining information about buyers, sellers and products in a different country, understanding foreign business environments, securing contracts and establishing business networks. These costs decrease with cultural, linguistic, legal and institutional similarity.

Governance quality affects the ease, transparency, security and predictability of doing business in a foreign country. It is represented by perceptions of regulatory quality, corruption and the rule of law.[8] These factors account for 10 per cent of overall trade costs in services and 7 per cent of trade costs in goods, with differences in regulatory quality having an especially marked impact.

ICT connectivity captures the ease of connecting with foreign partners and using the internet. It is represented by fixed line, mobile phone, and broadband coverage. We take the lower value of ICT connectivity between trading partners because the benefits of technology are determined by the ICT penetration level of the less connected partner. Having fast internet access in an exporting country is of little use if nobody is connected in the importing country. The results show that mobile phone and broadband coverage are significant drivers of trade costs in most services sectors, much more so than in goods.

Finally, **transport and travel costs** are captured by geographical distance and the quality of transport infrastructure. They capture the costs of delivering services and goods from suppliers to customers, which accounts for 19 per cent of bilateral trade costs in services and 28 per cent in goods. The reason why distance still matters for services trade is that some services still require face-to-face interaction and hence involve travel for either the supplier or the customer. Furthermore, as seen in the case of tariffs, trade costs that matter for goods may also matter for services that are related to goods trade.

Overall, governance quality, trade policy and regulatory differences can account for more than a quarter of bilateral trade costs in services. Information and transaction costs are important components of trade costs, accounting for a major share of costs. The extent to which countries adopt ICT plays a much more important role for trade in services than for trade in goods. Transport and travel costs also play an important role, although their effect is less important compared with trade in goods. Thus, declines in these trade costs can bring substantial benefits to trade in services, and different services sectors may be impacted differently by reductions in these trade costs.

(c) Factors that affect trade costs

Several forces explain the patterns of trade costs observed so far. This section will look more closely at some of these factors, as they may be key to determining what trade costs in services will look like in the future and which services sectors can benefit from this. Three main factors are at play: technological developments and ICT penetration have brought down trade costs in services, particularly through

cross-border supply. Government regulations and trade policies also play a crucial role in ensuring policy coherence and facilitating services trade. Quality physical and digital infrastructure can further reduce trade costs and bring new opportunities for trade in digitally enabled services.

(i) Digital technologies lower trade costs in services and boost cross-border services trade

Advancements in digital technologies have made it possible to codify, digitize and transmit services activities globally, abolishing the requirement for physical proximity in some services sectors.

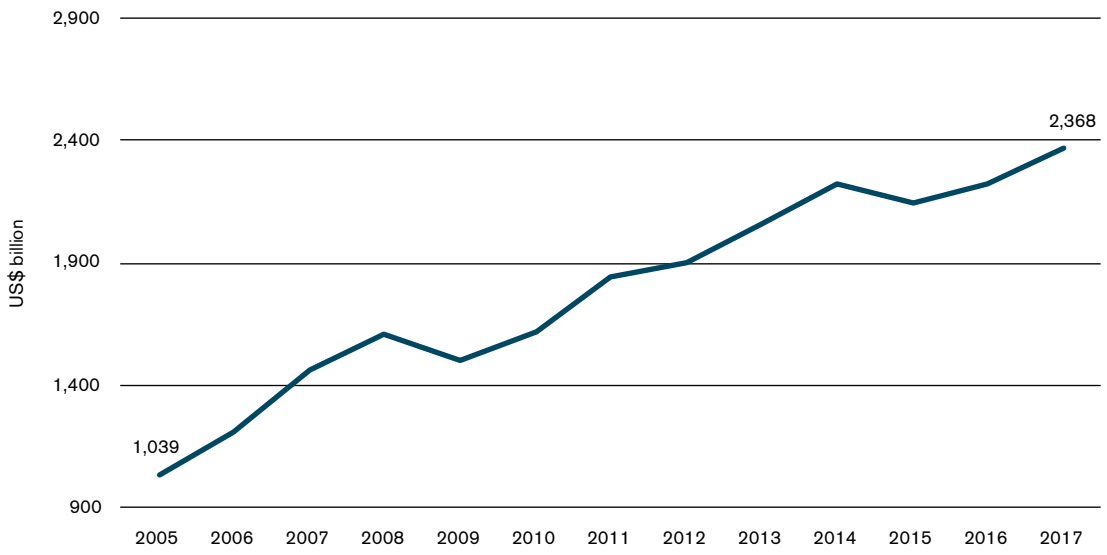
As a result, cross-border trade is progressively easier, especially through cross-border supply (mode 1 of the GATS). Figure D.6 illustrates the average yearly values of trade in potentially ICT-enabled services: the global exports of potentially ICT-enabled services[9] delivered through cross-border supply more than doubled between 2005 and 2017.[10]

Digital technologies significantly bring down the costs of searching for, matching, tracking and verifying information (Goldfarb and Tucker, 2017), thus reducing information and transaction costs in trade. Technologies to digitize contents have made it possible to produce and transmit services in large quantities over the internet at near-zero costs, making distance matter less.

Recent ICT developments have given rise to online platform and search engine services, which reduce the cost of searching for and obtaining information. Online platforms can match businesses with consumers, ordinary consumers with suppliers, firms with workers, investors with entrepreneurs, etc. The reduction in search costs and verification costs can lead to an increase in international hiring and offshoring, bringing new opportunities for services trade (see Box D.1).

As described in Box D.1, a number of online labour platforms have been developed to connect freelance service providers with worldwide clients. Individuals can offer their services across borders with more flexibility through online freelance marketplaces by using web collaboration software and video conferencing. Occupations such as software development, creative design and multimedia, and sales and marketing support, as well as professional services, are the most likely to be offered online (Kässi and Lehdonvirta, 2018). Workers operate more like entrepreneurs in a global marketplace. In many economies, the wages earned through such platforms exceed the averages for local companies (Lund and Manyika, 2016). Agrawal, Lacetera and Lyons (2016) show that online platforms with standardized

Figure D.6: Trade in ICT-enabled services has been growing steadily
Global exports of ICT-enabled services, 2005-17



Source: WTO experimental dataset on Trade in Services by Mode of Supply.

Note: Figure D.6 covers only services exports through cross-border supply (mode 1 of the GATS). Potentially ICT-enabled services include, in the balance-of-payment services classification, financial and insurance, charges for the use of intellectual property, telecommunications, computer and information services, business services and personal, cultural and recreational services.

Box D.1: Online workplace platforms stimulate trade in professional services

Recent years have seen the emergence of online marketplaces for services provided by skilled professionals. Platforms such as the United States' Catalant,[11] Germany's Comatch,[12] Denmark's Worksome[13] or the United Kingdom's Outsized[14] help companies to access highly-skilled and often highly-educated expertise in areas ranging from financial services to management consulting to IT services, including artificial intelligence (AI), machine learning and cybersecurity (Edgecliffe-Johnson, 2018).

These "white collar" platforms offer a useful contribution to enhancing firms' efficiency. In order to have access to the knowledge-intensive services they require, businesses were faced, prior to the development of such platforms, either with the fixed costs of hiring long-term staff, or with the large overheads occasioned by procuring the services of consultancy firms which assign employees at premium fees. Unless firms had projects of a scale that was sufficiently important to justify these costs, they might have chosen to forego these efficiency-enhancing opportunities. However, by connecting companies to freelancers, online platforms enable firms to transform fixed costs into variable ones, thereby increasing operational flexibility. They also contribute to lowering the cost of these services and are, as such, of particular value to micro, small and medium-sized enterprises (MSMEs). Given that the services they make available are targeted at solving problems that are significant, but generally one-off and short-term, they provide smaller firms with much-needed flexibility.

For their part, freelancers stand to benefit from the significant demand for the services they offer, which is driven by fast-moving technological developments and the linked evolving knowledge needs, as well as their high levels of skills and education. Online platforms also offer these service professionals an avenue to work independently and with more flexibility. They tap especially into retired staff and younger professionals, some of whom reportedly find freelance work more appealing than a permanent job with a single employer, particularly in senior roles (Deloitte, 2018).

Many of the platforms rely on algorithms that search the CVs on record and scour the feedback and ratings about freelancers' past services in order to offer the best match for the services requested by their users. Revenues come from the commissions charged on the services supplied. Many operate not exclusively in their market of origin, but also in foreign markets, and they present not only domestic professionals, but also foreign ones. These individuals then provide their services either on location, at home and abroad, or remotely. In this way, online platforms are not only supplying services themselves, but are also enabling trade in services by the suppliers using the platform (Edgecliffe-Johnson, 2018).

information disproportionately benefit workers from developing countries.

The reduced costs of searching information have led to the development of online "peer-to-peer" platforms dedicated to facilitating matching. This technological development, coupled with the growing demand for affordable services, has boosted the "sharing economy". Platforms allow apartments, cars and other items to be sold or rented by private owners directly to consumers. Horton and Zeckhauser (2016) emphasize that many of these markets are driven by an unused capacity for durable goods. Low search costs enable such unused capacity to be filled more efficiently. As consumers get more used to lodging and transportation services mediated through online platforms, the demand for services increases and the need to purchase durable goods declines.

The rise of international business-to-business (B2B) portals and online labour market platforms provides new avenues for international contracting and hiring of service suppliers, whether of companies or persons. B2B platforms are growing and expanding into offers of services such as transport, distribution, logistics, courier services and "handyman" services, as well as a host of personal services. The objective information available online, combined with the ability to send the output of the work by electronic means at a low cost over long distances, helps companies and workers who are far from the buyer to profit from international services trade. Head et al. (2008) investigate the extent to which services trade has managed to overcome the impediments created by geographic distance and institutional differences. They find that distance costs are high but are declining over time.

Box D.2: Online platforms and the digital transformation of logistics

The terms "digital" and "logistics" have gone together for at least two decades, as evidenced by the wide use of radio-frequency identification (RFID) in shipment tracking and inventory management, as well as the application of various types of software in supply chain management since the 1990s. Nevertheless, compared to most other industries, like media, telecommunications, banking, travel and retail, the logistics industry appears to be trailing behind the current wave of digitalization, which is characterized by Big Data analytics, the Internet of Things (the connection of physical devices and everyday objects via the Internet), AI and digital platform-based business models.

However, in recent years, tech start-ups such as Flexport,[15] Uship[16] and Freighthub[17] are transforming the logistics industry in the same way that Airbnb transformed hotel services, and Uber taxi services. There are now more than 400 start-ups worldwide that could undermine the competitive advantages of traditional logistics services providers (LSPs) and that have attracted remarkable investments – more than US$ 11 billion between 2005 and 2015 (Wyman, 2017).

A large percentage of the new logistics start-ups focus on online platforms and data-driven services – areas that are easily scalable and require little fixed-cost investment. Built on Big Data, cloud-based digital logistics platforms are taking over the intermediary role of LSPs with more efficiency. They can match shipping demand and freight capacity instantly, provide transport rates immediately, and coordinate all associated activities in a smooth and seamless way. As a result, shippers, especially those with less complex shipments, can now switch easily to these new, platform-based services, while carriers can use the online platforms to conduct business directly with shippers (Accenture, 2017).

Currently, only 40 per cent of freight transport volume is reliant on long-term forwarding contracts. The other 60 per cent is made up of short-term business, and it is this that is primarily attracting the interest of the newcomers. Uship, a Texas-based freight exchange start-up, has been particularly successful in this field. The company focuses on private individuals and small businesses looking for transport solutions for moving furniture, cars and even horses. Over 600,000 transport providers in 19 economies advertise their services on the platform, which now has 4 million registered clients.

There is a significant variety of digital logistics platforms in the market (Little, 2017). Simple platforms usually act as information brokers only, neither validating offer details nor taking any liability or risk for the services provided to the client. High-end digital freight exchange (DFE) platforms make extensive use of advanced algorithms to calculate and predict rates, capacities and means of optimization. Additionally, they tend to have wider value-chain focus. For example, some DFEs offer key account and operations management functions and take commercial responsibility for their offers. Some are aiming at establishing global networks, supporting regular freight flows and entering new modes of transport, especially air- and ocean freight. Flexport, the first e-freight forwarder, founded in 2013, is expanding exponentially, hiring more than 1,000 people across 11 offices around world, with valuation reaching US$ 3.2 billion; it has its own warehouses for consolidating cargo and has also started to chart its own aircraft.

The logistics industry is facing digital disruption along its entire value chain – from freight forwarding, brokerage and long-distance transportation, to warehousing, contract logistics and last-mile delivery.

Facing fierce competition, traditional LSPs have been forced to embark on the journey of digital transformation. Sixty per cent of LSPs are building or buying digital platforms. Some of these include Saloodo!,[18] which is backed by DHL, Drive4Schenker[19] by Schenker and Twill Logistics[20] by Damco, a Maersk-owned LSP. In addition to logistics start-ups, traditional LSPs are also facing competition from giant companies outside of the transport and logistics sector. For example, Amazon and Alibaba are investing in logistics start-ups to innovate last-mile delivery; BMW and Mercedes are developing passenger and cargo transport platforms as well as autonomous driving solutions; and venture capital is also quickly scaling up asset-light business models in fast-growing areas of logistics. It is digital platforms that are driving the digital transformation in the logistics industry. TradeLens,[21] for example, is a block-chain based industry platform that could transform the logistics sector by providing a single, secure source of shipping data to enable more efficient global trade.

By reducing trade and entry costs, online platforms enhance competition by opening the market to new entrants and facilitate the participation of MSMEs in trade (see Box D.2).

By enabling the recording and storage of digital footprints, digital technologies also facilitate tracking and verification, which in turn result in a reduction in the costs associated with the verification of entity and reputation. Platforms have developed mechanisms to overcome asymmetric information. Online platforms provide mechanisms such as online rating systems, in which ratings from past buyers and sellers are posted for future market participants to see, that improve consumer trust in online sellers. A number of studies empirically demonstrate that sellers with better ratings obtain higher prices and higher revenues (Houser and Wooders, 2006; Livingston, 2005; Lucking-Reiley et al., 2007; Melnik and Alm, 2002).

A benefit of improved online verification procedures for individuals has been the ability to make payments more securely and easily. Mobile banking allows consumers to send and receive money as easily as domestic payments, facilitating cross-border business transactions (see Box D.7 on fintech in sub-Saharan Africa). The peer-to-peer lending market has grown rapidly in emerging markets, owing to an increase in knowledge of marketplace lending, greater investment transparency and lower interest rates to consumers. Economides and Jeziorski (2017) show that the use of mobile devices to verify identity digitally in Tanzania enables the use of mobile payment networks to transfer money.

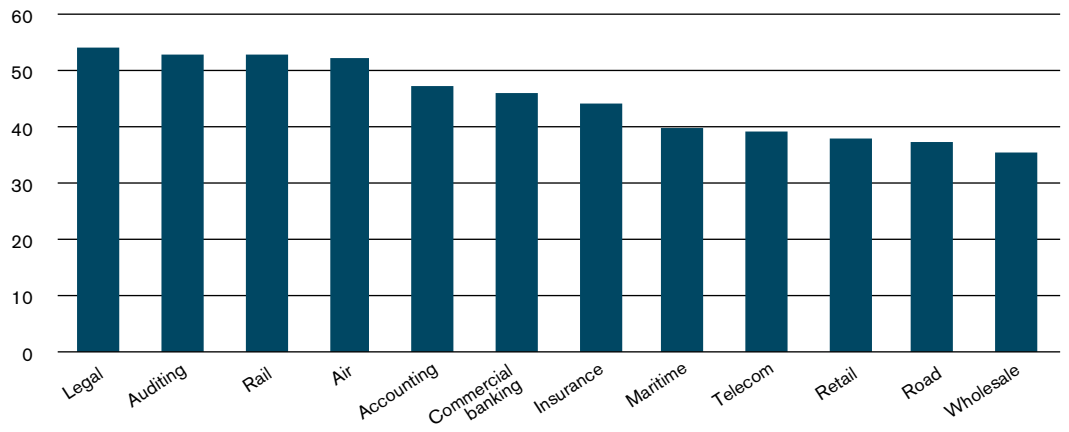
(ii) Policy restrictions in services trade

As discussed in Section C, government interventions in services sectors where market failures exist are not only necessary, but also desirable to improve economic efficiency. Trade policy barriers and regulatory measures, however, can account for a major share of trade costs in services. Restrictive services trade policies may induce higher trade costs on service suppliers and consumers. Differences in domestic regulations between economies, including the lack of regulatory capacity, can make it more costly for firms that operate across borders.

The openness or restrictiveness of services trade policies are reflected in the new World Bank Services Trade Restrictions Index (STRI). The regulatory database on which the STRI is based – a joint endeavour between the World Bank and the WTO – contains richly textured policy information as well as links to the quantification of policy measures (see Box D.3 for more information). It collects and makes publicly available information on services trade policy, which is assembled in a comparable manner and offers an important source of information on services trade policies.

Figure D.7 shows the STRI for selected services subsectors. Legal and auditing services are the most restricted, due, in particular, to many

Figure D.7: Some services sectors face high restrictions
Services Trade Restrictions Index by subsector, 2016



Source: World Bank STRI.

Note: To obtain the STRI, the trade restrictions by different modes of supply were weighted according to their importance for the supply of the respective services in each sector, and then aggregated.

Box D.3: World Bank-WTO Services Trade Policy Database and World Bank STRI

The STRI is a measure of the restrictiveness of an economy's de jure regulatory and policy framework based on a list of the most relevant impediments to trade in services. The World Bank recently updated its STRI. The raw regulatory information used to compute this STRI is derived from the World Bank-WTO Services Trade Policy Database (STPD), which is disseminated through the WTO Integrated Trade Intelligence Portal (I-TIP).[22] The information is currently available for 68 economies, representing the most important services traders around the world. For 25 of these economies, the information underlying the updated STRI was collected through a survey conducted jointly by the World Bank and WTO, while the information for the remaining 43 economies was sourced from the Organisation for Economic Co-operation and Development (OECD) STRI regulatory database, thanks to the cooperation of the OECD, which is gratefully acknowledged.

Out of the broad set of information available in this STPD, a subset of approximately 115 regulations and policies was selected to compute the index. Retaining such a subset ensures comparability with the previous World Bank STRI published in 2012, consistent coverage of measures across economies, and compatibility with the classification of restrictions by the OECD.[23] The types of restrictions covered include conditions on market entry (e.g. forms of entry authorized, quantitative limits, foreign equity limits), operational requirements that may be discriminatory, and other types of regulatory measures (e.g. transparency), which could also significantly contribute to the restrictiveness of policies.

The construction of the STRI comprises three steps (Borchert et al., 2019a): (1) the selection of key restrictions entering the STRI; (2) the determination of the level of restrictiveness of individual measures or, if necessary, bundles of measures if they are conceptually intertwined; and (3) the aggregation of measures into indices at the sector-mode level, sector level and country level, respectively. The STRI ranges from 0 to 100, where 0 indicates that none of the restrictions underlying the index is applied, and 100 means that the sector/mode is completely closed to foreign services and service suppliers.

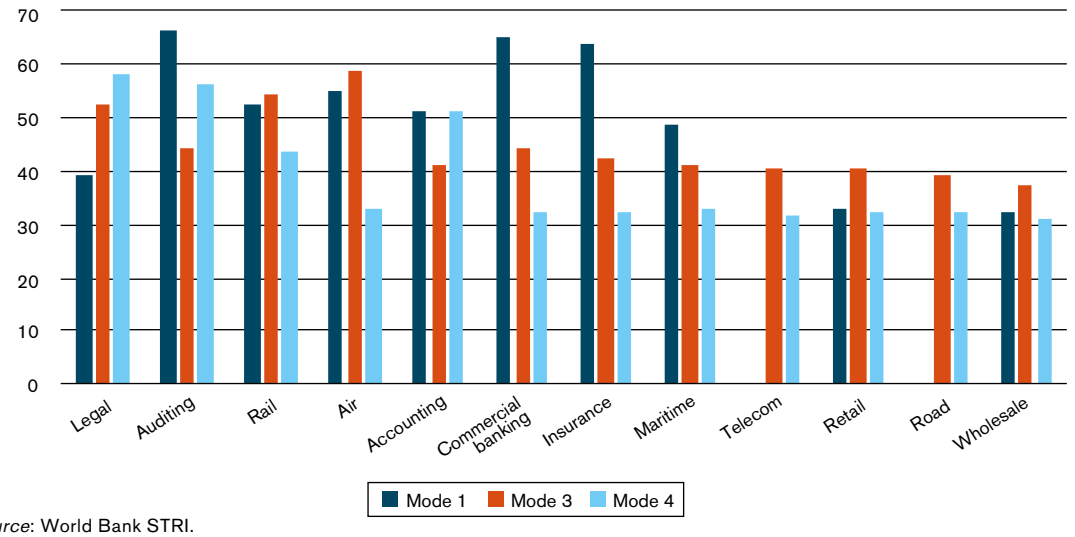
The STRI, and the accompanying STPD, covers five main services sectors – financial services (banking and insurance), telecommunications, distribution, transportation (air freight and passenger, rail and road freight, maritime freight and auxiliary services) and professional services (accounting and legal services) – further broken down into 23 subsectors. The STRI is computed for three out of the four modes of supply defined in the GATS, namely cross-border trade (mode 1), commercial presence in another country (mode 3) and presence of natural persons (individuals) (mode 4). Consumption abroad (mode 2) is a mode of delivery that is particularly important in services like tourism, education and health, but is not considered significant for the sectors covered in the database.

stringent requirements related to licensing and qualifications, e.g. relative to representing clients before a host country's courts, as well as other barriers affecting the international movement of professionals (GATS mode 4), which is critical for the supply of services in these sectors. The supply of rail and air transportation services is also quite restricted, reflecting in rail transport the difficulties of introducing competition, and in air transport the prevalence of policies traditionally aimed at protecting domestic suppliers from competition. On the contrary, the lowest relative policy restrictiveness is recorded for distribution (wholesale and retail trade services), telecommunications, maritime and road transportation services.[24] The generally lower level of trade costs for telecommunications (both fixed and mobile telephony) reflects the continuous opening up and regulatory reform of the sector across economies.

Not surprisingly, wholesale distribution is less restricted than retail distribution, where regulation in some countries tends to protect smaller retailers from competition. Commercial banking and insurance services – sectors that have gradually been opening up over the last two decades – constitute the midfield in trade restrictions.

Figure D.8 provides more information on service policy restrictions by sector and mode of supply. The level of restrictiveness of each mode varies significantly between and within sectors. This may reflect different technological feasibility (one mode of supply being more relevant than the other) and diverse regulatory concerns. Thus, cross-border supply of services (mode 1) is relatively more restricted in the case of auditing, maritime transportation, commercial banking and insurance services, while the other services

Figure D.8: Services trade restrictions vary by mode of supply
Services Trade Restrictions Index by sector and mode of supply, 2016



Source: World Bank STRI.

Note: The World Bank STRI ranges from 0 to 100. The STRI for mode 1 is not computed for the following sub-sectors: road transport, telecommunication, maritime cargo-handling, storage and warehousing, legal host country advisory and representation services. In other words, there is no mode 1 STRI for those subsectors.

sectors in transport, telecommunications, as well as retail and wholesale distribution services, face higher restrictions for supply through commercial presence in another country (mode 3). The presence of natural persons (mode 4) is highly restricted – relative to the other modes – in all the professions covered by the STRI, most notably in the case of legal services.

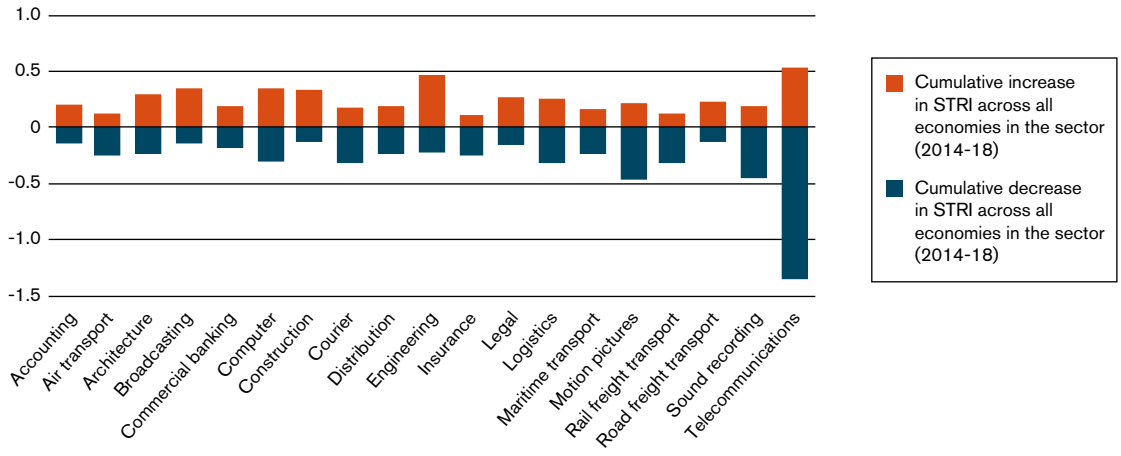
The question also arises of whether higher restrictiveness in one mode of supply leads to more or less trade in services via other modes of supply. Nordås and Kox (2009) find some evidence suggesting that the different modes are complementary or independent. They find that restrictions on cross-border trade have a negative impact on foreign direct investment, and that the reverse is also true: restrictions on foreign direct investment have a negative impact on cross-border trade, suggesting that the modes are complementary.

Higher restrictions in services trade can particularly penalize small firms. Recent empirical analysis shows that average services trade restrictions represent up to a 14 per cent additional tariff on small firms' exports compared to large firms that can absorb trade costs more easily (OECD, 2017b). Benz et al. (2019) show that smaller and less productive firms, as well as first-time exporters, are disproportionally affected by services trade barriers. Their analysis is based on micro-data from Belgium, Finland, Germany, Italy, Japan, Sweden, the United Kingdom and the United States. They found that, for these firms, both the propensity to export and volumes exported to less restrictive destinations are significantly higher than to more restrictive destinations. In contrast, policy barriers do not affect the export decisions of the largest, most productive and most experienced services firms. The pattern holds for two major modes of supply, i.e. cross-border services exports and foreign affiliate sales of services firms.

To illustrate the evolution of services trade policies, Figure D.9 compares the policy developments in all services sectors between 2014 and 2018 based on the OECD services trade restrictiveness index (STRI). The OECD index on services trade differs from the World Bank STRI in that it covers regulations affecting services trade in 44 economies and 22 sectors. Although the OECD index covers fewer economies, it has a broader sector coverage and provides a yearly update, therefore illustrating the development of services trade regulations.

Figure D.9 shows the cumulative change in the scores in each sector where policy changes occurred. Most opening reforms occurred in the telecommunications sector, motion pictures and courier services. For example, Mexico adopted a new telecommunications and broadcasting law in 2015, rolling back foreign equity restrictions in fixed-line and internet services segments of the sector. The law also introduced a new independent regulator and a series of pro-competitive measures to challenge the dominant position of

Figure D.9: Globally, services sectors saw changes in trade restrictions
Policy change in OECD services trade restrictiveness index (STRI) by sector, 2014-18



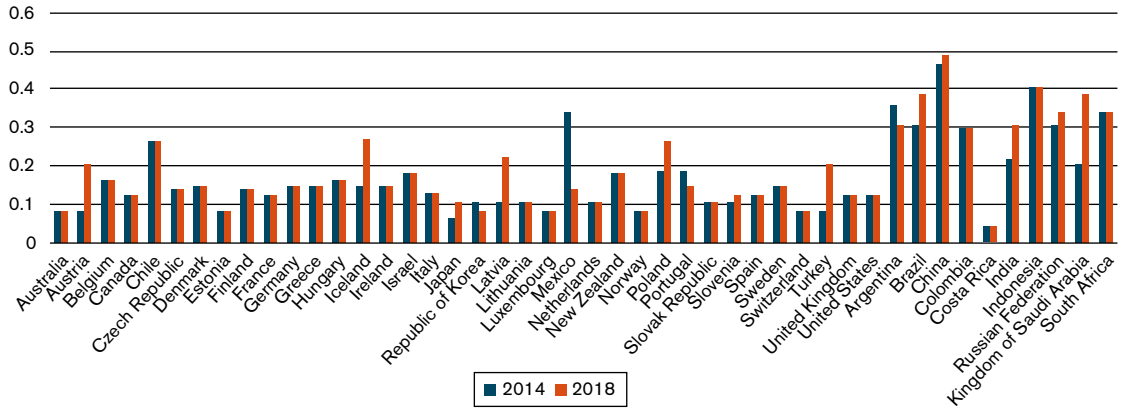
Source: OECD services trade restrictiveness index (STRI) 2014 and 2018.
Note: The OECD STRI ranges from 0 to 1 for each economy and each sector.

incumbent telecommunications firms (OECD, 2017b). However, in some sectors, the policy changes have shifted in the opposite direction, raising services trade barriers in services sectors such as construction or engineering and in some professional services.

The rise of digital technologies provides new opportunities for services trade, but also creates new challenges for trade policies and regulations. The OECD Digital STRI, based on the OECD STRI, quantifies barriers that affect trade in digitally enabled services. It covers measures affecting trade in digitally enabled services such as infrastructure and connectivity, electronic transactions, payment systems, and intellectual property rights.

Figure D.10 illustrates the evolution of the OECD Digital STRI over the period 2014-18. As the years pass, the indices show that the regulatory environment is tightening. Compared to 2014, the first data point

Figure D.10: The digital regulatory environment has tightened
OECD Digital Services Trade Restrictiveness Index, 2014 and 2018



Source: OECD Digital Services Trade Restrictiveness Index (Digital STRI).
Note: The OECD STRI ranges from 0 to 1.

in the digital STRI, 10 economies have higher index values in 2018, and only three economies have lower values. The average rate of increase in the index among the 10 economies is 32 per cent between 2014 and 2018, with the highest being 50 per cent over the same period.

The results are driven by measures affecting infrastructure and connectivity. The lack of efficient regulation on interconnection as well as burdensome conditions on cross-border data flows beyond those imposed to ensure the protection and security of personal data tend to be the main barriers to trade in digital services. In 11 economies, certain types of data (such as financial or business data) must be stored locally, but the transfer of copies abroad is permitted as long as authorities can have direct access to the data upon request. Specific licenses or authorizations for e-commerce activities in addition to ordinary business licenses are required in six economies, and in four of them, discriminatory conditions apply for foreign entities seeking to obtain such licenses (Ferencz, 2019).

As noted above, the growing scope for digital delivery allows service providers increasingly to supply services cross-border, overcoming the proximity requirement and circumventing traditional barriers to trade in some sectors. Data policies are becoming much more important, and their restrictiveness may put a break on the fast pace of growth in services trade enabled by digital technologies.

Recent research by Ferracane and van der Marel (2018) assesses whether regulatory data policies implemented in 64 economies between 2006 and 2015 have had a significant impact on an economy's ability to import services over the internet. More specifically, they develop and use a regulatory index of data policies that measures how restrictive economies are in regulating the usage and cross-border movement of data. This index of data policies is then related to trade in services over the internet to study whether indeed restrictive data policies reduce digitally enabled imports of services. The authors estimate that, if economies lifted their restrictions on the cross-border flow of data, the imports of services would rise on average by 5 per cent across all economies, with obvious benefits for local companies and consumers who could then access cheaper and better online services from abroad.

Other than the absolute score of services restrictiveness, regulatory differences between countries can also affect the cost of services trade. Although differences in regulation may be the legitimate result of differences in political systems, societal preferences or governmental objectives, heterogeneity of regulations across borders can give rise to some unavoidable compliance costs when companies export to different markets.

The OECD indices of regulatory heterogeneity captures the regulatory heterogeneity in services. The indices are built from assessing – for each country pair and each measure – whether or not the countries have the same regulation. The regulatory heterogeneity indices take values between zero and one, where zero represents the same regulatory requirement and one indicates regulatory heterogeneity. To give an example, Australia and Austria do not have the requirement that the majority of board of directors must be nationals or residents, while Iceland and Norway do. The heterogeneity index will score the country pairs Australia/Austria and Iceland/Norway zero on this measure because they have the same answer, while Austria and Norway, Australia and Norway, Austria and Iceland, and Australia and Iceland will be scored one because they have different answers (Nordås, 2016).

Figure D.11 illustrates the average regulatory heterogeneity across all services sectors in the database. The average regulatory heterogeneity is the lowest between OECD countries, while the regulatory requirements of China and Russia are relatively different than other economies.

Nordås and Kox (2009) estimate that if all economies harmonized or recognized each other's regulation to the extent that the heterogeneity index took its lowest bilateral value for all country pairs, total services trade through commercial presence in another country could increase by between 13 and 30 per cent depending on the economy. More recently, Nordås (2016) shows that on average, a reduction in the regulatory heterogeneity by 0.05 points is associated with 2.5 per cent higher services exports. Furthermore, improved regulatory coherence has a larger trade impact when the level of trade restrictiveness is low. For economies with an average score of the regulatory heterogeneity index (i.e. a heterogeneity index at 0.26), the trade costs amount to an ad valorem equivalent trade cost of between 20 per cent and 75 per cent at low levels of the STRI.

(iii) Investment in infrastructure

As discussed earlier, transportation and infrastructure-related costs account for at least one-third of overall trade costs in services. Most of the new commercial and technological advances in services would not be possible without the transformation that has taken place in the world's communications infrastructure. Investments in physical and digital infrastructures,

Figure D.11: Regulatory heterogeneity is lowest among OECD countries
Regulatory heterogeneity index by pairs of economies, 2018

	OECD	Brazil	China	Colombia	Costa Rica	India	Indonesia	Malaysia	Russian Federation	South Africa
OECD	0.24	0.33	0.41	0.30	0.29	0.40	0.41	0.30	0.37	0.29
Brazil	0.33		0.41	0.31	0.27	0.31	0.35	0.34	0.40	0.34
China	0.41	0.41		0.41	0.44	0.39	0.38	0.45	0.40	0.32
Colombia	0.30	0.31	0.41		0.23	0.36	0.39	0.30	0.36	0.30
Costa Rica	0.29	0.27	0.44	0.23		0.38	0.37	0.29	0.42	0.32
India	0.40	0.31	0.39	0.36	0.38		0.33	0.35	0.41	0.42
Indonesia	0.41	0.35	0.38	0.39	0.37	0.33		0.34	0.45	0.38
Malaysia	0.30	0.34	0.45	0.30	0.29	0.35	0.34		0.42	0.32
Russian Federation	0.37	0.40	0.40	0.36	0.42	0.41	0.45	0.42		0.36
South Africa	0.29	0.34	0.32	0.30	0.32	0.42	0.38	0.32	0.36	

Source: Author's calculation based on OECD regulatory heterogeneity index.

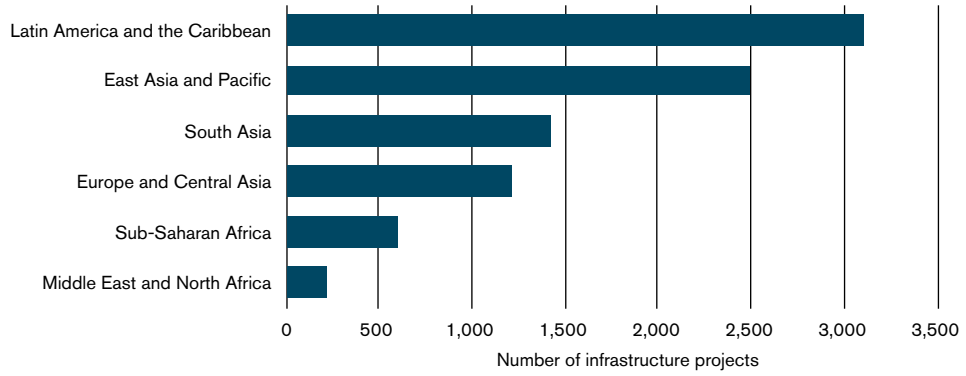
Note: The regulatory heterogeneity indices take values between zero and one. If two countries have the same answer on all the measures, their bilateral heterogeneity index is zero, and if they have a different answer to all measures, they have a heterogeneity index of one. The regulatory heterogeneity indices are aggregated by a simple average of the indices for different sectors. The indices for OECD countries are aggregated by taking the simple average of the indices for all OECD countries.

coupled with policies aiming at opening up to competition and liberalizing infrastructure-related services, could potentially reduce trade costs and foster services trade.

Infrastructure supports trade by reducing transport costs. High quality physical infrastructure – such as roads, railways, ports and airports – is crucial for the movement of both goods and people, bring services suppliers and consumers closer. The quality and the efficiency of the infrastructure system are important factors to boost trade and improve a country's trade performances. There has been a surge of studies documenting the importance of transport infrastructure. Several authors, such as Hummels (1999), Limão and Venables (2001), Glaeser and Kohlhase (2004), Redding and Turner (2015), find that transport infrastructure improvements have been the major cause of a general decline in direct transport costs. Although these studies mainly focus on trade in goods, the same trade costs would also affect services sectors and modes that involve movement of goods, consumers and services suppliers. The availability and quality of infrastructure are especially important in trade of services sectors in which mode 2 and mode 4 trade are important, such as tourism, education, healthcare and professional services.

According to the World Bank's Private Participation in Infrastructure (PPI) Database, close to 10,000 infrastructure projects were launched between 1990 and 2018 and only 2.2 per cent of these projects have been concluded. Figure D.12 shows the amount of investment in infrastructure in each region. Latin

Figure D.12: Investment in infrastructure differs across regions
Investment in infrastructure by region, 1990-2018



Source: Private Participation in Infrastructure (PPI) Database, World Bank

America and the Caribbean received 34.3 per cent of the total amount of investment in infrastructure, followed by East Asia and the Pacific (27.6 per cent), South Asia (15.8 per cent), Europe and Central Asia (13.4 per cent), sub-Saharan Africa (6.5 per cent) and the Middle East and North Africa (2.4 per cent).

ICT services are the main contributors to digital transformation. ICT services are provided via traditional copper wire technology, as well as mobile, fibre-optic, and satellite technologies. These technologies, individually and in combination, have enabled the internet to reach half the world's population. Cross-border trade in services largely depends on digital infrastructure as the channel for the transmission of information over the internet. Information and communications technologies are also the vehicles by which other innovative services, which deploy AI, cloud computing and the Internet of Things, can be delivered to businesses and ordinary consumers.

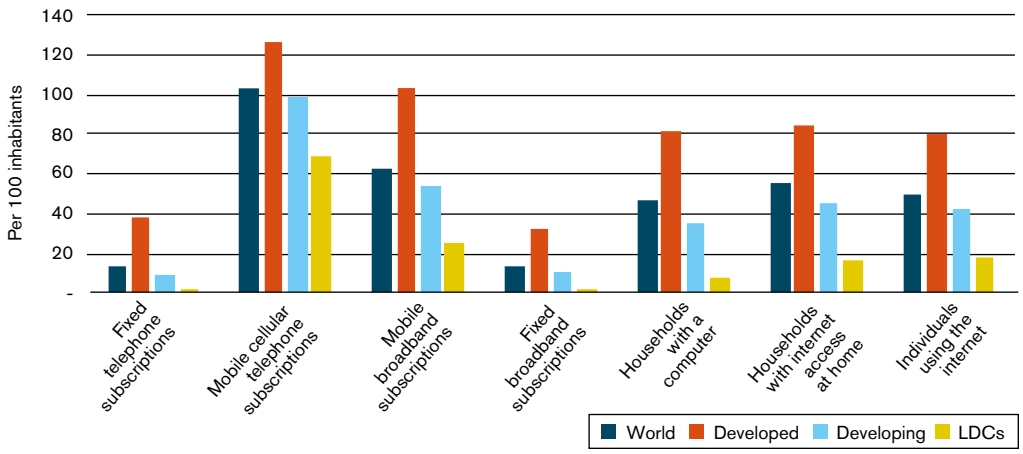
Digital development in developing and developed countries is based on the deployment of an internet infrastructure, but basic broadband coverage still constitutes a significant digital divide. Figure D.13 shows the access to digital infrastructure, such as mobile cellular, fixed broadband and mobile broadband, by development levels. Although connectivity has, in some respects, improved greatly over the past five to 10 years, major gaps still remain: while numbers of mobile cellular subscriptions are high in both developed and developing economies, mobile broadband subscriptions are at around 50 per cent in developing countries but at only 24 per cent in least-developed countries (LDCs). Only 42 per cent of individuals in developing countries and 18 per cent in LDCs use the internet, compared with more than 80 per cent in developed countries.

Developing economies hitherto not involved in services trade in a significant way can utilize investments in ICT infrastructure to make initial inroads into this increasingly important world market. Investments in telecommunications infrastructure can provide not only a short-term boost for the economy, but can also lay the groundwork for long-term improved growth and employment perspectives (Chavula, 2013; Wieck and Vidal, 2010). Investment in telecommunications infrastructure ranges from major long-term investments that include fibre-optic cables to connect a country or region, to fixed and wireless connections within a country, to connecting operators to each other, or to reaching end-users.

A reliable, comprehensive and affordable high-speed broadband network is central to competitiveness in the digital era. Developing countries have been fast catching up on broadband networks. Figure D.14 shows the evolution of mobile and fixed broadband subscriptions by development level from 2005 to 2017. Active mobile subscriptions in developing countries increased exponentially from 43 million to nearly 3,371 million between 2007 and 2018, and mobile subscription in LDCs also increased from nearly zero to 291 million during the same period. Similarly, from 2005 to 2018, fixed broadband subscriptions experienced an impressive growth in developing countries, from 71 million to 661 million.

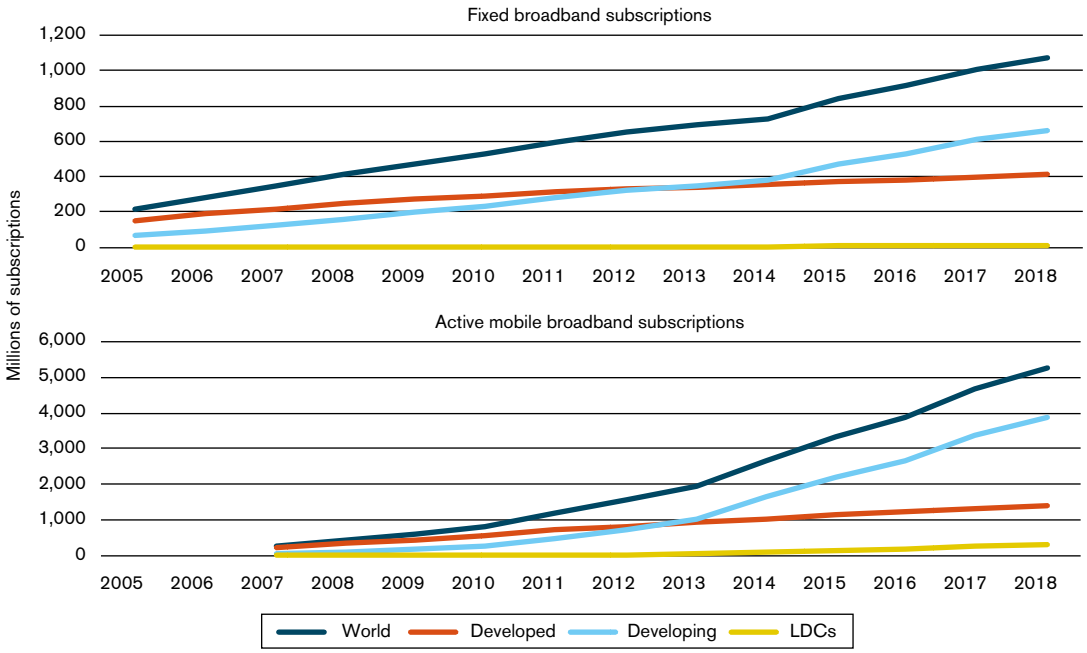
In 2018, fourth-generation (4G) services became the leading mobile technology, with 3.4 billion subscribers. As growth continues, particularly across

Figure D.13: Access to digital infrastructure differs according to development levels
ICT infrastructure per 100 inhabitants by development levels, 2017



Source: Author's calculation based on International Telecommunication Union (ITU) data.

Figure D.14: Broadband subscriptions grew exponentially over the past decade
Mobile and fixed broadband subscriptions by development levels, 2005-18



Source: Author's calculation base on ITU data.

developing markets, 4G is expected to reach 60 per cent of total mobile services in use by 2023. Meanwhile, high hopes are pinned on fifth-generation (5G) high-bandwidth mobile technology as a means of better quality connection of developing countries to the global economy that will allow them to enhance participation in e-commerce, trade in services and value-chains. Following commercial launches in the United States and South Korea towards the end of 2018, 16 more economies will have launched 5G networks by the end of 2019. By 2025, 5G services are predicted to be available in 116 markets (GSMA, 2019). The wide penetration of mobile devices, coupled with the development of mobile broadband, could bring new development opportunities.

Fibre-optic cables have been a significant enabler of connectivity, ensuring fast and reliable access to ICT and online services. As the majority of ICT services are at least partly delivered over fibre-optics, including mobile and fixed broadband, investment in and deployment of fibre-optics have become a policy priority for governments and mobile operators everywhere (Grijpink et al., 2018). The share of fibre-optic connections in total fixed-broadband subscriptions continues to increase in all regions, with the highest growth recorded in Asia and the Americas.

Technological advances in satellite technologies allows the provision of broadband capacity worldwide, permitting reliable connectivity to regions where other communication services are not readily available, and where the cost of their roll-out would be prohibitive. Satellites are an effective means of reaching remote and rural areas and can also be used by passengers in mobile environments, such as on aircrafts and ships. Once ranked as among the most expensive ICT services, the prices of satellite services have fallen as satellite construction has expanded and competitive pressures have taken hold.

However, investment in telecommunications infrastructure is not sufficient in itself to drive down the cost of digital transmission; government regulation plays an important role. Over the past decades, the telecommunications market has witnessed far-reaching changes, with the introduction of competition into a sector that was once principally a monopoly (ITU, 2016). Many WTO members have committed to allowing the establishment of new telecommunication companies, bringing foreign direct investment to existing companies and extending competition in basic telecommunications. Since the introduction of competitive markets for telecommunications, the availability of telecommunications services has increased, and costs have come down significantly over the past decades (Laffont and Tirole, 2001). For developing countries to reap the benefits of services trade, it is essential to provide digital infrastructure and maintain a competitive telecommunications market.

2. Major trends that will affect trade in services

Future patterns of trade in services will depend on what consumers will demand in the future, and on countries' patterns of specialization. Together with the future evolution of trade costs, digital technologies, demographic changes, predicted patterns of growth and climate change are some of the major global trends that will affect services trade. For each of these factors, this section will discuss how they can affect trade.

(a) How digital technologies will affect services trade in the future

As was discussed in Section D.1, digital technologies are the main force driving the reduction of trade costs in services, and they are fundamentally changing the ways in which business and trade are carried out. On the supply side, digitalization leads to a substantial decrease in the cost of entry, thus increasing contestability and spurring innovation. On the demand side, digitalization provides the consumer with a wider range of available varieties. All indicators point to the probability that digital technologies will continue to advance in the future (see Box D.4), thus raising expectations that these trends will continue to evolve in the future.

(i) Digital technologies will boost trade in services

Digital technologies have significantly contributed to the recent growth in trade in services (Loungani et al., 2017) and these trends are likely to continue in the future. In particular, in addition to reducing trade cost, digital technologies will boost trade in services through several channels.

Digital technologies will create new ways of delivering a service

As digital technologies evolve, traditional ways of delivering services are giving place to new ways of supplying services. As discussed in Section D.1, as trade costs in services fall, services that used to

Box D.4: Advancements in digital technologies are likely to continue in the future

Innovations in computer technology, digital communication and IT methods for management are growing at an impressive rate (see Table D.1). Over the last two decades, the global annual growth rate of patent publications for three digital technologies (computer, digital communication and IT methods for management) has been above the average growth rate of total patent publications. These trends were in parallel with the increasing use of these technologies and point at a further increase of their use in the future, as what is patented today will be used later.

Predictions on the future applications of 3D printing are going in the same direction. As the cost of 3D printing gradually decreases (WTO, 2018a), mainstream adoption of large-scale 3D printers (intended for use in enterprises) and small-scale desktop printers (acquired mainly by educational institutions and creativity hubs) is starting to take off (DHL, 2016).

As discussed in WTO (2018a), the exponential increase in the number of patents related to AI also suggests a large growth in the future use of this technology. Although many AI applications today are designed to perform relatively limited tasks (e.g. facial recognition or playing chess), the long-term goal is to create "general" AI which would outperform humans at nearly every cognitive task (WTO, 2018a).

Table D.1: Innovation in digital technologies grows fast
Patent publications, resident count by filing office

	Average annual growth rate 2000-17	Share of world total patent publication in 2000	Share of world total patent publication in 2017
Computer technology	8%	5.63%	7.72%
Digital communication	11%	2.20%	4.24%
IT methods for management	21%	0.52%	2.00%

Source: WTO Secretariat calculations based on the WIPO IP (i.e. intellectual property) Statistics Data Center, https://www3.wipo.int/ipstats/index.htm?tab=patent, accessed in March 2019.

Box D.5: Digital technologies give rise to new concepts, such as telemedicine and telesurgery

Telemedicine is the remote diagnosis and treatment of patients by means of telecommunications technology. Biometric measuring devices such as equipment monitoring heart rate, blood pressure and blood glucose levels are increasingly used to monitor and manage patients with acute and chronic illnesses remotely. This is likely to lead to healthcare services migrating from hospitals and clinics into patients' homes (WHO, 2009) and may increase the cross-border trade of healthcare services.

Telesurgery uses wireless networking and robotic technology to enable surgeons to operate on distantly located patients. This technology eliminates geographical and financial barriers that prevent timely and high-quality surgical intervention (Choi et al., 2018).

Avgousti et al. (2016) identify several challenges to telesurgery, such as the stability and security of networks, and legal and regulatory issues. Moreover, the current cost of acquiring and maintaining telesurgery systems is extremely high. However, as the challenges are resolved and the costs fall over time, such medical treatments are likely to flourish and benefit patients worldwide.

Unlike telesurgery, telepresence technology is already widely used in hospitals. Expert surgeons can mentor other surgeons in operating surgeries from a distance via cameras and microphones, thus allowing for higher quality medical treatments (Wall and Marescaux, 2013).

Fifth-generation networks (5G), by increasing internet capacity and improving data streaming, will enhance trade in services where data are time-sensitive, such as with telesurgery (ITU, 2018). This means that high-skill services such as medical services will be deployed faster and more accurately across borders through digital technologies. Not only will the services be of a higher quality, but some of the costs related to travelling will be unnecessary. Both of these trends point toward an increase in services trade.

be provided only through local presence in a single country begin to be supplied across borders. An increasing amount of professional services is being supplied across borders, and other services sectors may also benefit from digitalization. The advent of new digital technologies is likely to continue to allow more services to be delivered across borders, including services for which it was previously necessary to be face-to-face, for example telesurgery (see Box D.5).

Technological advancements may further bring down the information and transaction costs in international trade. Some researchers argue that blockchain technology, which provides a decentralized mechanism to verify the attributes of a transaction cheaply, promises to reduce networking and verification costs further (Catalini and Gans, 2016) and potentially reduce other trade costs, such as those related to coordination, transportation and logistics, financial intermediation and exchange rates (Ganne, 2018).

Digital technologies will create new services trade, often replacing goods trade

Digital technologies are blurring the distinction between trade in goods and services activities, while increasing the importance of data flows and intellectual property. We expect this trend to continue in the future as digital technologies develop and spread (Box D.6 discusses some of the challenges related to this trend).

First, digitalization has dramatically reduced the cost of creating, copying and accessing text, video content and music, leading to a gradual decline in the trade of physical products (WTO, 2018a).

In the music industry, consumer demand has shifted from physical records to digital downloads. There is a strong growth in subscription-based music-streaming services. The number of subscriptions quadrupled between 2014 and 2017 (WTO, 2018a). Goldman Sachs (2019) predicts that there will be 1.15 billion paying streaming subscribers globally in 2030, and that 68 per cent of those subscribers will come from emerging markets. According to the International Federation of the Phonographic Industry (IFPI, 2019), in 2018, 37 per cent of the recorded music industry (circa US$ 7 billion) was derived from paid streaming services. Goldman Sachs (2019) predicts that the overall annual global trade streaming revenues (including those funded by advertisements) will reach US$ 37.2 billion.

Second, platforms are increasing the demand for rental services. The current platform economy may be an intermediate phase between the traditional

Box D.6: Challenges to taxation arising from the digitalization of services activities

Issues raised by the digitalization of commercial activity have led to questions about the taxation, both domestic and international, of global service suppliers, particularly, but not only, in relation to international corporate taxation. The increasing use of digital technologies throughout the economy has given rise to the emergence of large firms that often provide services free of charge. Such firms are generally highly profitable, yet in many cases pay relatively little tax in any jurisdiction (IMF, 2019). Current discussions at the WTO offer another example. Some developing countries question whether the moratorium on applying customs duties to electronic transmissions should be maintained, due to concerns that, as cross-border trade in goods (e.g. books and CDs) gives way to digital downloads, they may be unable to make up for lost customs revenue.[25]

Features often associated with digitalization include a lesser need for physical presence, the provision of unremunerated services to customers, and hard-to-value intangible assets. Section C.1 showed how intangible assets have become an important source of value for many companies. In addition, user participation in social networks and users' generation of content, which are commercially valuable, have become increasingly common features of many digital companies. But if a digital company provides a service (e.g. via participation in a social network platform) without charging the user in return for personal information provided in the act of using it, the company makes no monetary gain from the consumer that is liable to taxation.

These features make it challenging for tax authorities to assess the tax liabilities of the individuals and companies concerned accurately and to collect revenues. However, these difficulties are not entirely new or unique, having long been a concern in non-digital contexts. For example, pharmaceutical companies traditionally have significant hard-to-value intangibles. Goods can be exported, and services provided, to a country in which an enterprise has no physical presence, without incurring any right for that country to tax the associated profits. Moreover, information about customers has long had commercial value (IMF, 2019).

Digitalization does not affect the nature of the problem, but it may exacerbate it, because digitalization further facilitates the internationalization of all aspects of business activities. In short, it becomes much easier for a company's shareholders, activities and customers to be located all over the world (Devereux and Vella, 2017). This raises the question of how taxing rights on income generated from cross-border activities should be allocated between different national authorities, and is a cause for concern about tax evasion or avoidance and possible erosion of tax bases. At the same time, in a cross-border setting, governments also face the complexity of trying to avoid double taxation and unintended non-taxation, for example arising from inconsistencies in the application of indirect taxes on services (Aslam and Shah, 2017).

In response to the emerging perception that digital companies are not carrying their fair share of the tax burden, governments are seeking to find equitable solutions. For instance, the European Commission estimates that the effective average tax rate for digital companies is 9.5 per cent in the European Union, which is less than half the rate for traditional companies (European Commission, 2018). As a result of these concerns, several economies have introduced digital services taxes (DST). For example, the European Union and the United Kingdom focus on social media, search engines and intermediation services; India, Chile and Uruguay have opted for withholding or equalization taxes on payments for advertising and other specified digital services made by residents to non-resident companies; and Benin, Tanzania, Uganda and Zambia have recently introduced taxes on the use of certain digital services (IMF, 2019). These DSTs aim at protecting and expanding the tax base in the country in which customers or users are located (OECD, 2018a). However, there is concern that such unilateral actions could reduce investment and innovation by technology companies and therefore adversely affect economic growth.

While tax authorities do face challenges, digitization can also contribute to expanding the tax base. For instance, online platforms that facilitate person-to-person services (e.g. Airbnb or Uber) can channel transactions that were conducted in the past from the informal economy to the formal economy and that make them more transparent to tax authorities (Devereux and Vella, 2017). Indeed, governments have become aware of the need to clarify tax obligations for users of person-to-person services, and some have already issued specific guidance. They have also recognized the potential benefits of access to the large amount of information held by digital platforms for enhancing compliance (Aslam and Shah, 2017).

Box D.6: Challenges to taxation arising from the digitalization of services activities *(continued)*

Digitalization can also help to alleviate information constraints that contribute to opportunities for tax avoidance and evasion. Governments can use digital technology to achieve better ways to verify the true income of taxpayers and to link existing information more easily in various parts of the tax system. In this way, digitalization can potentially improve tax enforcement. This can allow governments to raise the same revenue with lower taxes and more efficiently, or to raise more tax revenue with the same taxes. It can also allow governments to implement more sophisticated tax systems (Jacobs, 2017). Kenya, for example, has digitized its tax administration. The financial inclusion reforms in Kenya that were made possible by technology advances such as mobile money and banking, have also made possible the development of the iTax system adopted by the Kenya Revenue Authority (Ndung'u, 2017).

With the international tax system in a state of flux, ideas for far-reaching reform are gaining traction. Digitalization has probably increased the awareness of the authorities that the roots of taxation problems, e.g. vulnerability to avoidance and pressures from tax competition that pre-existed digitalization, need more urgently to be addressed. The destination-based cash flow tax has been widely discussed in the United States, and residual profit allocation schemes proposed by the European Commission, United Kingdom and United States (IMF, 2019). Also, countries are being encouraged to adopt an internationally coordinated response. This has led to on-going discussions in international fora such as the OECD/G20 Inclusive Framework on Base Erosion and Profit Shifting (BEPS) Project, which currently involves 110 economies, to consider what changes in international tax rules may be necessary as a result of digitalization.

past model of ownership and a future model in which everything is a service. PwC (2016) estimates that total transactions for Europe's five key platform economy sectors – collaborative finance, person-to-person (P2P) accommodation, P2P transportation, on-demand household services and on-demand professional services – could see an increase from €28 billion in 2016 to €570 billion by 2025. Platform economy could replace traditional rentals and ownership of a wide range of goods (Wallenstein and Shelat, 2017).

For example, the growing expectation is that car ownership will decline as transportation becomes a widespread service-on-demand (Araya, 2019). Some survey results point out that the impact of platform economy on the demand of durable goods may be negative. For example, one YouGov survey (Smith, 2018) says that 43 per cent of Londoners believe that services like Uber are a genuine alternative to owning a car. Di et al. (2017) look at users' responses to an online survey completed by 1,840 former Uber and/or Lyft users in Austin, Texas further to the suspension of Uber and Lyft services. The survey revealed that the majority of respondents switched to a personal vehicle (45 per cent). Self-driving vehicles will further increase the likelihood of ride-sharing. According to Wallenstein and Shelat (2017), by 2030, one-quarter of the miles driven in the United States will be driven in shared self-driving cars, thus decreasing incidences of car ownership. Self-driven cars could potentially affect many services sectors, such as insurance, logistics, tourism, transportation and healthcare services (Garret, 2017).

Third, 3D printing is fostering trade in software design rather than final products. Through smart apps, firms can scan any product and turn it into a digital design file. Then the consumer can view and configure it before picking up the product, which is produced via 3D printing (A.T. Kearney, 2015). Increases in the cross-border transmission of data as a service to produce goods in a particular location with technologies such as 3D printing could spur services trade. As mentioned in Section B, the construction sector is increasingly making use of 3D printing by sending construction designs to distant locations through digital networks. In addition, some manufacturing-related services such as trade finance, transport and logistics may decline, but other 3D printer-related services like installation, repair and design could increase.

Digital technologies will allow firms to exploit economies of scale and scope

Digitalization allows firms to reach larger numbers of digitally connected customers across the globe and facilitates outsourcing of activities for easier scaling of production. Services based on digital content tend to

have near-zero or marginal costs of distribution, while firms selling such services can respond to the growing demand more easily than those engaging in traditional trade with physical production and delivery constraints.

However, there have been growing concerns about market concentration in the digital era. Digital markets differ from conventional markets due to three significant forces: network effects, switching costs and "scale without mass" (WTO, 2018a).

Network effects pertain to the increase in the value of the network for all participants that arises from each additional user, which makes large digital platforms indispensable to achieve an efficient utilization. Take the online social media platform Facebook as an example: a user's decision to join the social network will be based on the number of other users that are already using the platform.

High switching costs means that the more consumers use an online service and provide data to this service, the costlier and the harder for them to switch away.

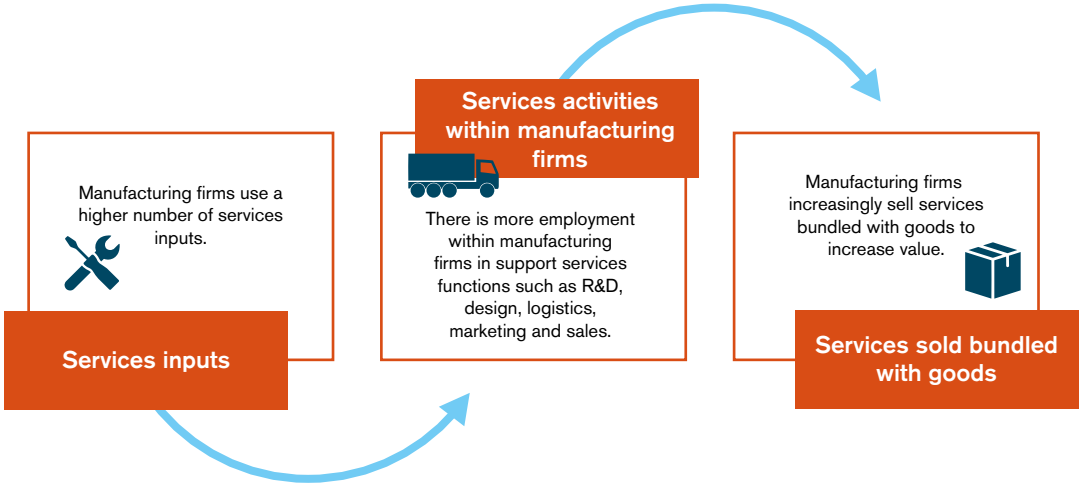
Finally, the "scale without mass" feature of digital platforms allows companies to add new users vastly at no cost (OECD and WTO, 2017). Once a platform reaches a critical mass of users and establishes a dominant position in a market, it is hard for new potential entrants to challenge its market power.

Digitalization is also changing the scope of the activities that firms undertake. Digital retailers, traditionally connectors of international demand and supply through matching services, are increasingly providing complementary warehousing, logistic, e-payment, credit and insurance services. Meanwhile, some ICT hardware firms are moving away from manufacturing activities to provide cross-border network-based services linked to the manufactured products. For instance, IBM sold its hardware branch to focus on the provision of services such as its AI solution, Watson. Since its introduction, Watson has been applied to almost everything, from customer service to scientific and business modelling. It is an innovative breakthrough that is paving the way for applied AI (McGregor, 2019). Although AI is currently confined to relatively narrow tasks, its importance is expanding globally. It has already been incorporated into many services, from online searches and translation services to real-time traffic predictions and self-driving cars (UNCTAD, 2017a). This means it is expanding the scope of services that firms can offer and will eventually stimulate trade in services.

(ii) Digital technologies will affect the services component of global value chains

Services make up an important component of manufacturing. In addition to services bought as inputs, there are also services activities within manufacturing firms (Miroudot and Cadestin, 2017). The manufacturing sector is increasingly reliant on services, whether as inputs, as activities within firms or as output sold bundled with goods (see Figure D.15). Services are redefining the way manufacturing companies produce value. In the

Figure D.15: The manufacturing sector is increasingly reliant on services
Services in global value chains: from inputs to value-creating activities



Source: Miroudot and Cadestin (2017).

digital era, services are part of a business ecosystem in which collaboration with customers, partners and contractors is the key to innovation and productivity (Miroudot and Cadestin, 2017).

Digital technologies will play an important role in the future of global value chains (GVCs) and services trade. They are likely to affect the nature, complexity and length of value chains in the future. Two opposing forces may affect GVCs in the future.

On the one hand, digital technologies can generate longer value chains and increase foreign services value-added component of trade. This is because digital technologies can reduce costs that negatively affect GVCs and can increase the quality and availability of services which are enablers of value chains. For example, the Internet of Things, AI and blockchain technology can lead to more efficient delivery and logistics services (Lund et al., 2019).

On the other hand, AI, 3D printing and advanced robotics could reduce the role of labour as a source of comparative advantage, thus reducing international sourcing with intermediates and services increasingly sourced domestically in developed economies. Consequently, international trade in services might decrease. From a global perspective, this may lead to a stronger regionalization of production and shortened global value chains or reshoring (OECD, 2017a).

Despite speculation about automation and reshoring, there is no sign indicating a shortening of GVCs. Figure D.16 shows that overall share of foreign services value-added in world gross exports shows no significant decline and is slightly increasing. The results of the simulations conducted in WTO (2018a) go in the same direction. To the extent that services trade goes hand-in-hand with the evolution of GVCs, this result implies that we should not expect a negative impact from reshoring of manufacturing activity on services trade.

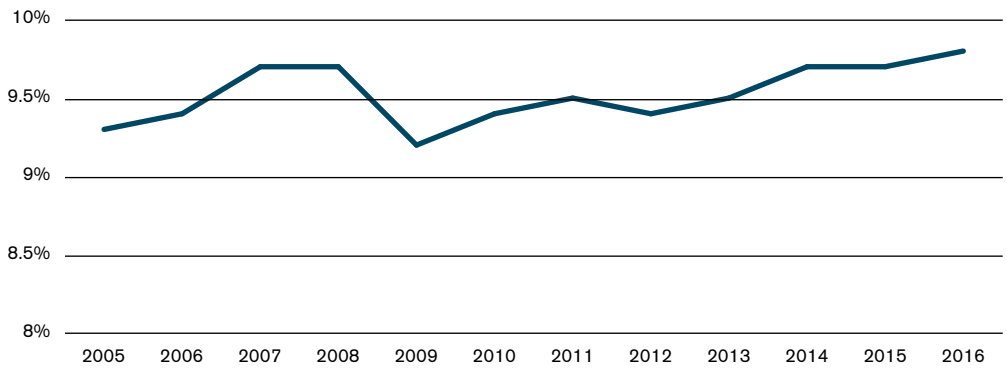
(iii) Digital technologies will create opportunities for inclusive trade

Digital technologies are helping countries to achieve inclusive growth by increasing services trade. Digitalization is an opportunity for many developing countries to overcome trade challenges with respect to their geographical, physical and locational conditions. New digital technologies have allowed some countries to overcome some traditional barriers. Landlocked developing countries are able to develop alternative areas of dynamic comparative advantage, such as modern business services, for which distance and physical conditions does not matter and which can bring economic growth, job creation and social development (UNCTAD, 2014). Border processes, geographical factors and physical infrastructure may become less relevant in the future, benefiting remote or landlocked countries aiming to enter new markets.

Ghani and O'Connell (2014) argue that, as services produced and traded across the world expand with advancements in technology and globalization, the possibility for low-income economies to grow faster increases. African countries can sustain service-led growth because there is enormous space for catching up and convergence (see Box D.7).

Figure D.16: The share of foreign services value-added in world gross exports is stable and is even slightly increasing

Share of foreign services value-added in world gross exports, 2005-16



Source: Trade in Value-Added (TiVA) database.

Box D.7: Fintech in sub-Saharan Africa

Financial intermediation and financial inclusion in sub-Saharan Africa remain low. However, mobile money has underpinned a radical change in the financial services delivery. Consequently, the region has become the global leader in mobile money innovation, adoption, and usage: around 40 out of 45 sub-Saharan African countries actively use this financial technology, or fintech (Lukonga, 2018). Mobile money account penetration in sub-Saharan African countries recorded a remarkable increase of almost 20 per cent between 2011 and 2014, largely driven by on-going financial innovation. Today, 12 per cent of adults (64 million people) in sub-Saharan Africa have mobile money accounts (compared to just 2 per cent worldwide), and 45 per cent of them have only a mobile money account. As the newly banked population becomes connected to mobile payments, it will become easier for them to participate in global trade, either as consumers or as businesses.

Today, Kenya is one of the economies with the highest use of mobile money, at 53 transactions per adult per year. This success is largely due to M-Pesa, a mobile phone-based money transfer system launched in 2007 by Safaricom and Vodacom. The service allows customers to deposit and withdraw money, transfer money to other users, or pay bills. The service quickly expanded to other countries in sub-Saharan Africa. As of end-2016, the service had almost 30 million users worldwide, of which 20.7 million are in Kenya. Several reasons contribute to the high success of this service. First, the low level of financial market infrastructure (branches, automatic teller machines, payment systems) generates a large unfulfilled demand for payment services in a market segment with a relatively large level of access to mobile devices. Second, an appropriate pricing strategy to attract customers and stores in tandem, and the deployment of a reliable and trustful network, are critical for success.

Digital technologies reduce information asymmetries, increase inclusiveness and encourage more services trade. Increasing the cross-border tradability of professional services and sectors such as healthcare, education and social work, where women are disproportionally employed (see section B.3), will allow more women to join the labour force (see Box D.8).

To conclude, digital technologies have the potential to benefit services trade in economies at all stages of development. Traditional factors such as geography and physical infrastructure, in which developing economies might lag behind, are likely to become less important for digitally enabled services. On the other hand, digital infrastructure, in particular a reliable and affordable high-speed broadband network will become a central factor for competitiveness, which can create opportunities for developing countries which invest in such digital infrastructure.

Regulations will also matter. Digitalization of trade can magnify the importance of institutions, in particular the regulation of data flows. Privacy, personal data protection and web content restriction policies will play an important role in this regard. The importance for intellectual property rights (IPRs) regulation for services trade is bound to increase in the digital age because many digital products are replicable at zero cost and are of a non-rival nature, i.e. they can be consumed by an indefinite amount of people at the same time without a loss of utility. The IPR regime is likely to be a key factor affecting countries' participation in the future of services trade.

(b) Demographics and new opportunities for services trade

The world's population is projected to reach 9.8 billion by 2050, concentrated mostly in developing countries (UNDESA, 2017). As shown in Figure D.18(a), low fertility rates and long life expectancy in developed countries will result in an ageing population (65 years and over) and shrinking labour force (20-64 years), while, as highlighted in Figure D.18(b), in developing countries, high fertility rates and low mortality rates will lead to growth in all population groups. In developed countries, the 65 years and older age group is set to constitute 27 per cent of the total population by 2050 compared to only 14 per cent for developing countries. These demographic changes will have a significant impact on global services consumption, production and trade patterns. A rapidly ageing population in developed countries is likely to require more healthcare services, while a growing young population in developing countries will require more education services. The change in global demographics will affect trade in services through two main channels: by changing the level and composition of import demand, and by changing comparative advantage.

Box D.8: Digital technologies provide new opportunities for women in services occupations

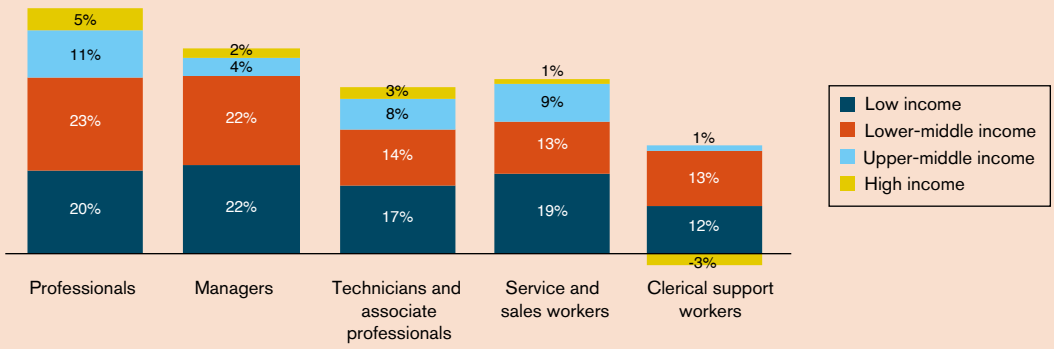
As women tend to work in the services sectors (see Section B), increasing women's participation in the formal labour force will increase services labour supply. Figure D.17, based on projection by the International Labour Organization (ILO), shows that increasing numbers of women will be working in high-skilled jobs in 2022 compared with today. In particular, more women will work in professional services such as accounting, law and medicine. On the other hand, the number of women working in low-skilled jobs, such as clerical support occupations, is likely to decrease in high-income countries, a decrease which could be attributed to the automation of clerical support occupations in high-income countries.

New technologies will also make the cross-border trade of professional services easier, which will bring more economic opportunities for women. In Upwork, an online marketplace for freelancers to provide services, 44 per cent of the workers are women, compared to an average of 25 per cent of the non-agricultural economy globally (World Bank, 2016). Airbnb, an online marketplace for hospitality service, estimates that more than 1 million women host on Airbnb, making up 55 per cent of the global Airbnb host community. In addition, women hosts on Airbnb rent out 20 per cent more lodgings than men, with a higher percentage of the women hosts reporting part-time employment and earning lower incomes outside of the hosting activity (Airbnb, 2017).

The kinds of services provided online extend to other areas such as medical and education services. In an analysis of online therapy services, Chester and Glass (2006) documented the rising number of female counsellors online relative to male counsellors. Female and male counsellors are now equally represented online. Such changing gender proportions may reflect the general increase in women's use of the internet over the years. Women are also discovering new opportunities in online teaching. Kim and Bonk's (2006) survey results showed that the number of female instructors online had increased dramatically over a few years. More than half of the respondents (53 per cent) were women, compared to a similar survey conducted a few years earlier, which was dominated by male instructors.

Figure D.17: The number of women in high-skilled jobs is increasing

Change in relative concentration of women, by services occupations and by income group, 2018-2022



Source: WTO calculations based on ILO (2019).

(i) Demographic structures and the composition of services demand

There is evidence that the contribution of a population's age structure on the aggregate preferences of households is nearly as important as income (Addessi, 2018). Given the significant changes predicted in demographic projections, we should expect demographic patterns to drive the composition of future demand for services, as per Figure D.19 which shows services expenditure by age group for the United States in 2017. The 65 and older age group, typically in retirement, spend more on real estate (29 per cent), insurance (22 per cent) and other services (17 per cent). Education expenditure decreases in the 65 and older age group (4 per cent) but is high for the under-25 age group (20 per cent).

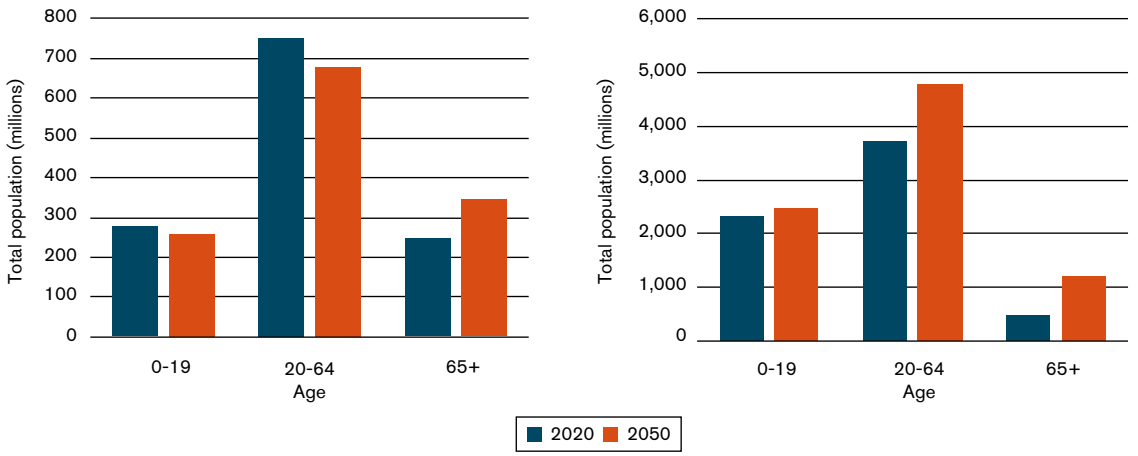
Although it does not show in Figure D.19, which is limited to private household expenditure in the United States, the impact of ageing on health expenditure is evident when private and public aggregate

Figure D.18(a): The population in developed countries is ageing

Population demographic projections in developed countries, 2020 and 2050

Figure D.18(b): The young population in developing countries is growing

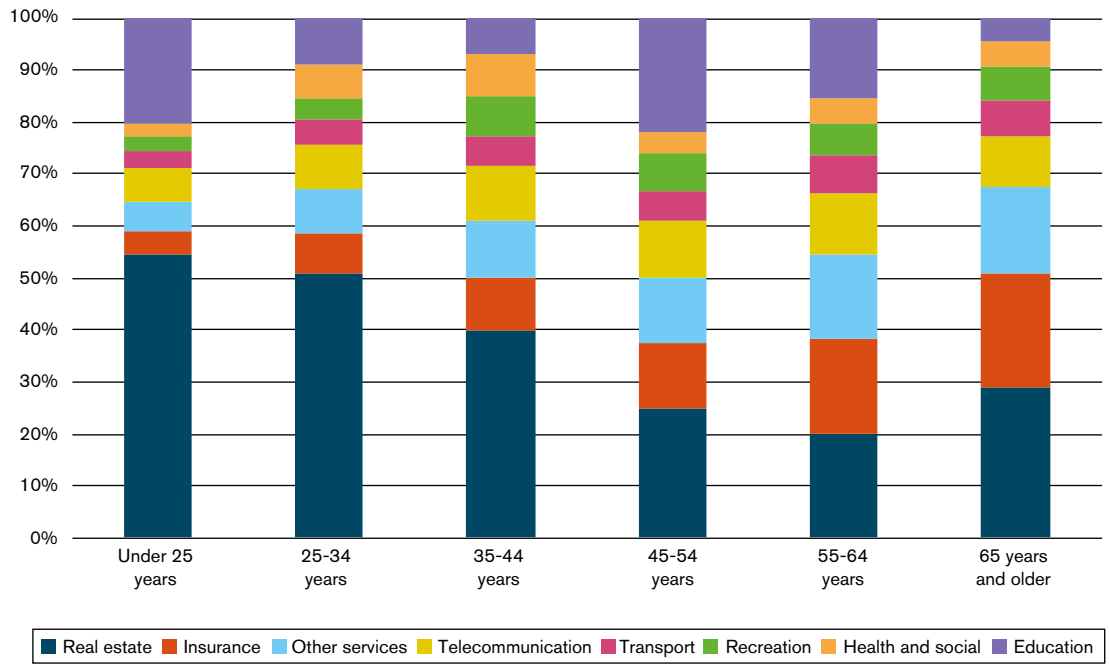
Population demographic projections in developing countries, 2020 and 2050



Source: WTO calculations based on United Nations Department of Economic and Social Affairs (UNDESA), Population Division data.

Figure D.19: Expenditure on services differs by age group

Share of overall household expenditure in the United States, 2017



Source: WTO calculations based on US consumer expenditure survey.

Note: "Other services" include financial and business services, hotels, restaurants, renting, motor vehicle maintenance and repair, construction and insurance services.

expenditure are taken into account. Figure D.20 shows the positive correlation between the old age dependency ratio[26] and the share of aggregate expenditure on health services for 40 economies between 2000 and 2014. As the old age dependency ratio increases, the share for aggregate health expenditure also increases. Colombier and Braendle (2018) provide robust evidence that population ageing is an important determinant of total healthcare services for Switzerland, but only when both private and social care are taken into account (Colombier and Braendle, 2018). Regression results presented in Table D.2 also highlight the impact of old age on aggregate health expenditure. The regression results show the impact of the old age dependency ratio on health and education expenditure. The regression was run on an aggregate share of health and education expenditure data collected from the World Input Output Database (WIOD) for 40 economies. The regression equation included population, GDP per capita, child dependency ratio and old age dependency ratio. The results suggest that, as the number of people aged 65 and above increases by 1 per cent, both the public and private share of health expenditure increases by 0.29 per cent.

Figure D.20: The correlation between the old age dependency ratio and aggregate health expenditure is positive

Relationship between old age dependency ratio and aggregate health expenditure for 40 economies between 2000 and 2014

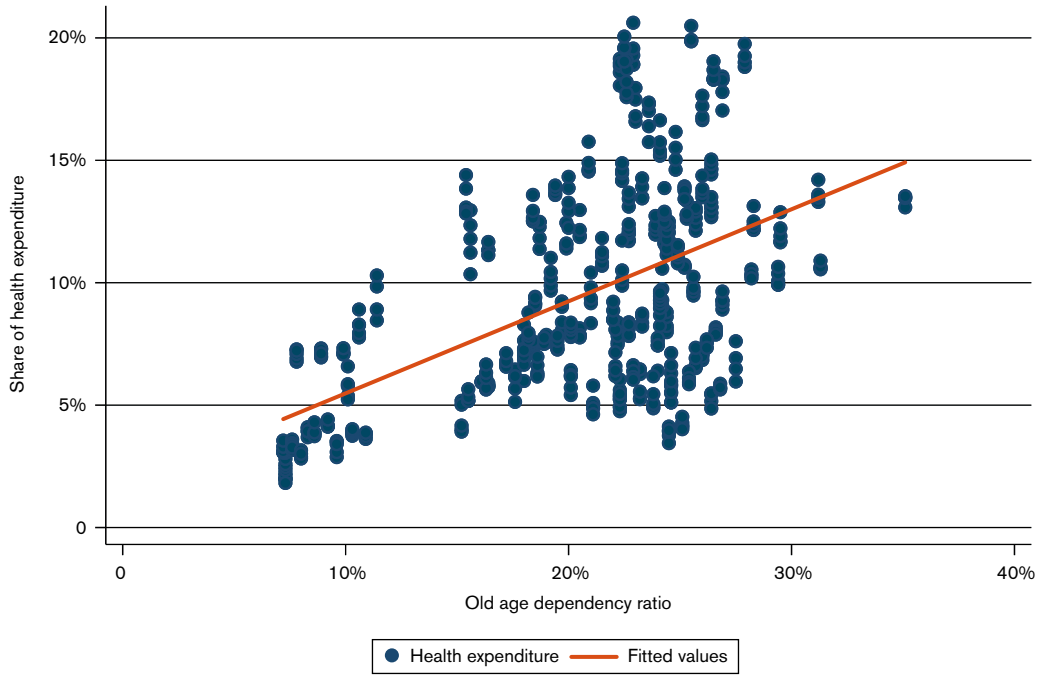


Table D.2: The old age dependency ratio increases the share of aggregate expenditure for health and education

Regression results

	Health	Education
ln GDP per capita	0.240*** (6.08)	0.124*** (3.97)
ln population	0.691*** (8.28)	0.585*** (8.90)
ln old age dependency ratio	0.289*** (3.87)	-0.0850 (-1.45)
R^2	0.500	0.244
N	560	560

t statistics in parentheses - * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source: WTO calculations based on the World Input Output Database (WIOD), 40 economies between 2000 and 2014.

The growing demand for healthcare services is also reflected by the growth of health services occupations in developed countries. In the United States alone, five of the top ten fastest growing occupations are related to healthcare, and these occupations include home health aides, personal care aides, physicians' assistants and nursing practitioners (US Bureau of Labor Statistics, 2019), as highlighted in Figure D.21. A similar trend is also observed in the European Union, where employment of health associate professionals is expected to increase by 10.38 per cent between 2016 and 2030 (Cedefop and Skills Panorama, 2019).

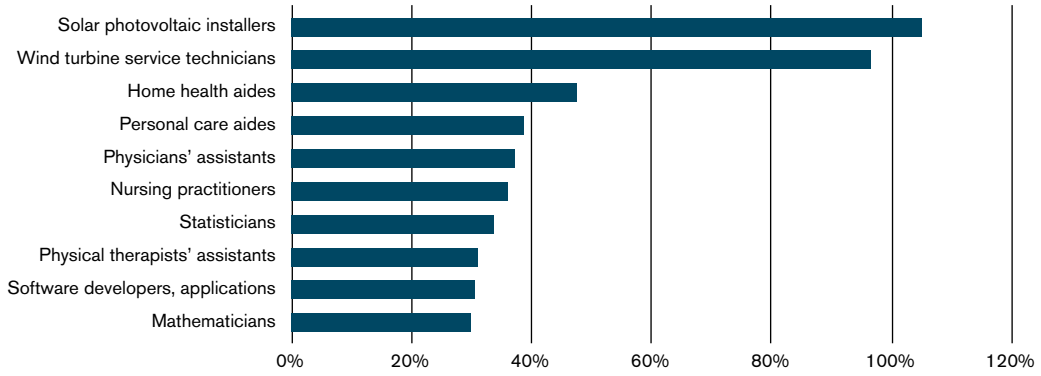
As healthcare demand outpaces healthcare supply in developed countries, supply of these services is likely also to come from developing countries where there is a large working-age population. Mobility of people and the increasing remote delivery of health services through digital technologies are likely to satisfy this demand. Currently, the mobility of health workers is satisfying this demand. Between 2010 and 2011, the Germany, the United Kingdom and the United States had a significant proportion of foreign-born nurses (over 10 per cent) (OECD, 2015). Asian economies were the world's top suppliers of emigrant doctors and nurses. Among these economies, small and island economies show the highest outflows of health services providers. Between 2010 and 2011, doctors and nurses who had emigrated to the OECD area accounted for 20 per cent of the estimated healthcare workforce needs in their countries of origin (OECD, 2015). This mobility trend for health workers is likely to continue and increase as ageing increases in developing countries and the movement of healthcare workers will depend on other factors such as immigration policies, which are further outlined in Section E (Box E.5).

While developed countries are experiencing rapid ageing, developing countries have a large young population and fast-growing working-age population. Demographics of developing countries are largely divided between countries in the first demographic transition stage (when mortality starts declining while fertility remain high, thus population increases and becomes relatively younger), mostly LDCs, and countries in the second stage (characterized by a declining fertility and an increase in the working-age population), that are now benefitting from the demographic dividend.[27] The population of LDCs is projected to increase from 1 billion in 2017 to 1.9 billion in 2050, with their populations largely skewed towards the younger age group. Developing countries in the second demographic stage have a growing working-age population and some of them are now benefitting from the demographic dividend.

Developing Asia has the largest working-age population. For example, China's consumer working-age group (15-59) is set to increase by 100 million people and will be one of the largest services consumer markets by 2030 (Dobbs et al., 2016). This age group in the wealthier category is already spending one-quarter of their consumption on dining out, recreation and education (Dobbs et al., 2016). Education expenditure is also increasing as this age group includes people who start having families and sending their children to school. Typically, in this age group, there are individuals who are starting families and moving away from their parents' homes, leading to an increase in the demand for housing and for the basic utilities that come with housing. As individuals find employment, demand for transport also increases as individuals commute to and from work and travel for other activities. Figure D.22 shows the household services consumption composition

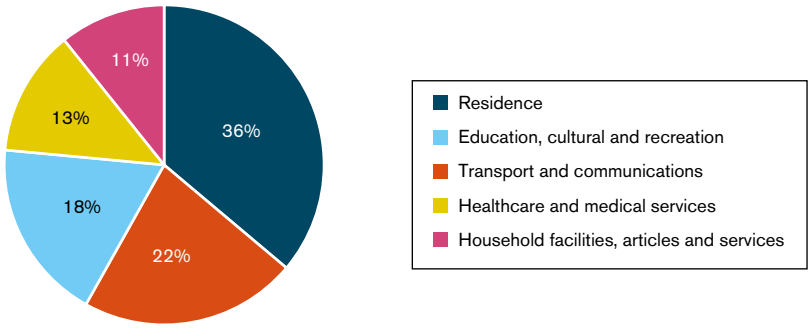
Figure D.21: Five of the top 10 fastest growing occupations in the United States are related to healthcare

Top 10 fastest growing occupations in the United States 2016-26, projected occupation growth



Source: WTO calculations based on 2019 data from the US Bureau of Labour Statistics.

Figure D.22: The most consumed services in China are housing, transport and communication
China's aggregate household services consumption, 2017



Source: WTO calculations based on data from National Bureau of Statistics of China.

for China in 2017, with the largest services consumption being housing, transport and communication.

Education expenditure is also increasing for some Asian economies. There is an increase in Asian students obtaining higher education in OECD countries, and one of the factors driving this demand from Asia is changes in export markets demographics. Most Asian students tend to study in the United States, which is the highest tertiary education exporter, but Australia, Canada, the Republic of Korea and New Zealand are also becoming common tertiary education exporters (Beghin and Park, 2019). In the future, as new technologies allow easier delivery of online education services across borders (see Box D.9), we should expect an increase in education services trade.

Box D.9: Trade in online education services will increase with more interactive digital technologies and a growing young population in developing countries

Education services have been affected by a reduction in trade costs and new technologies. Developing countries have a large young population and the demand for education services is higher in these countries. The low trade costs and new technologies will likely increase education services trade between developed and developing countries.

Online courses ensure open access and unlimited participation via the internet. In addition to traditional course materials, such as recorded lectures, readings and problem sets, many online course platforms provide interactive courses with user forums to support community interactions among students, professors and teaching assistants, as well as immediate feedback to quick quizzes and assignments. New technologies to improve broadband transmission and enhance personalized learning experiences will usher in a new wave of online education in the future. Students from developing countries and remote areas have the opportunity to learn from top university professors through online videos and interactive assignments, often at a fraction of the normal university tuition. The global online course market is projected to grow from US$ 3.9 billion in 2018 to US$ 20.8 billion by 2023, with an annual growth rate of 40.1 per cent (Docebo, 2016). Chuang and Ho (2016) report that 71 per cent of the students taking courses on Harvard's and MIT's online course facilities are from outside the United States.

Delivery of education services has already been heavily influenced by 4G networks, which has improved download speeds sufficiently to allow teachers to deliver online learning material, such as videos, and digital platforms. Broadband, mobile and internet services and the next generation of mobile broadband (5G) permit personalized online lessons to suit students' different learning styles. The addition of virtual reality and augmented reality technologies have the potential to engage and motivate learners to explore material from a variety of differing perspectives and could prove a key component in future learning environments (Kerawalla et al., 2006; Wu et al., 2013). As the quality of online education continues to improve, more individuals will enrol in online education, offering new opportunities for cross-border trade in education services. These new opportunities for cross-border trade in education service are likely to benefit developing countries through knowledge diffusion at low costs, and thus contribute to human capital development in developing countries.

(ii) Generational preferences and the Generation Z demand for online services

Along with changes in demographics, generational preferences will also play a significant role in shaping services consumption. Millennials (born between 1980 and 1996), Generation Z (born between 1997 and 2012) and the New Generation (born after 2012), having lived in a mostly digital world, are likely to increase the demand for online and on-demand services. By 2030, Generation Z and the New Generation will constitute more than 50 per cent of global population (see Figure D.23) and their consumption of social media and on-demand services will increase services trade through digital platforms.

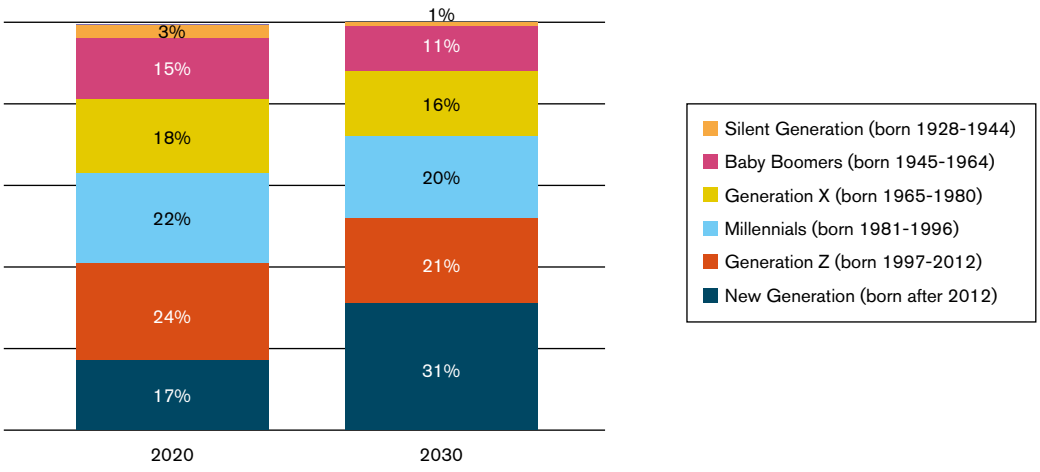
Past consumption trends show that Millennials and Generation Z tend to be the greatest consumers of digital services, in particular sharing applications, social media and on-demand services. According to a global survey by Nielsen (2014), 42 per cent of Millennial and Generation Z respondents are likely to rent products in shared communities compared to 17 per cent of global Generation X respondents (those born between 1965 and 1980) and 7 per cent of global Baby Boomers (i.e. those born between 1945 and 1964). The use of digital platforms will facilitate services trade, particularly in entertainment and renting services, allowing users to rent out their products and services on various platforms to consumers in different markets. If current generational trends persist, the consumption of social media services is likely to increase in the future. Currently nearly 98 per cent of digital consumers are social media users, which makes social media platforms influential in the consumption of services such as video- and music-streaming (GlobalWebIndex, 2018).

Figure D.24 shows the average number of social media accounts per internet user by age group. Millennials and Generation Z constitute, on average, have more than 9 social media accounts. They also represent more than 50 per cent of the users of major social media platforms and spend, on average, more than 2 and half hours per day on social media, compared to one hour for Baby Boomers (GlobalWebIndex, 2018).

As demand for these online services increases, cross-border services trade is also likely to increase in the future. Online video content streaming is a growing trend, largely among Millennials and Generation Z, but also in the other generational groups. There is an increased preference for streaming videos rather than using traditional video mediums such as DVDs. Netflix and YouTube are the largest video streaming services providers globally. Netflix offers its services to subscribers that pay a set monthly fee for their streaming content, while YouTube offers free access to its streaming service. Both streaming platforms have a wide global reach and are fast becoming the main exporters of creative content for various artists in both developed and developing countries. These streaming services are an opportunity for artists in developing countries, in particular, to export their creative content to international markets at low costs (see Box D.10).

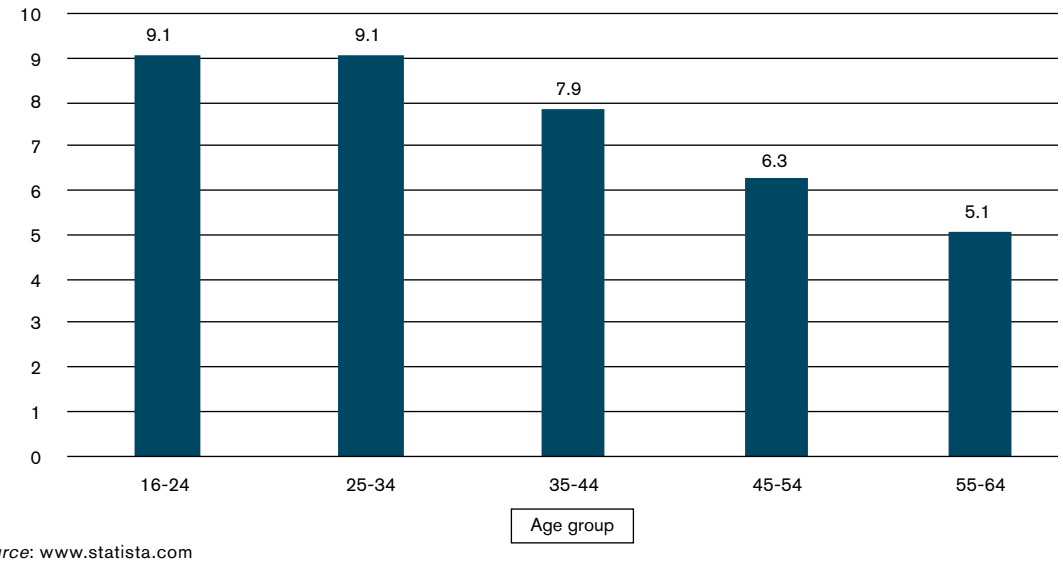
Figure D.23: By 2030, Generation Z and the New Generation will constitute more than 50 per cent of the global population

Population composition by age group in 2020 and 2030



Source: WTO calculations based on data from UNDESA.

Figure D.24: The New Generation and Generation Z are the most active users of social media accounts
Average number of social media accounts per internet user by age group, 2019



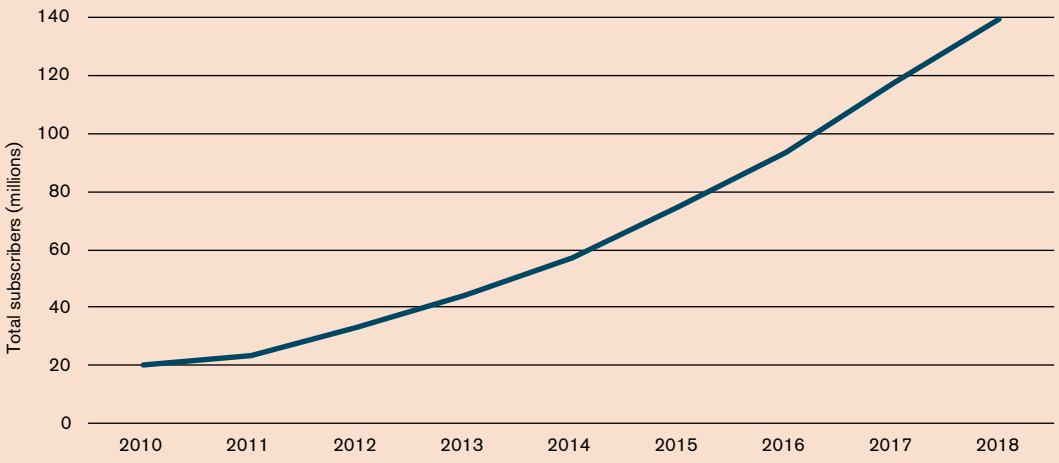
Source: www.statista.com

Box D.10: Online video content streaming

Netflix

Netflix is the largest global subscription internet television network. The streaming platform offers video entertainment streaming for a monthly subscription fee. Since Netflix launched in international markets in 2010, its subscriptions have continued to grow, from 20 million subscribers in 2010 to 139 million subscribers in 2018 (see Figure D.25). In contrast, traditional Netflix DVD rental services have declined over time as the number of online streamers increases.

Figure D.25: Total Netflix subscriptions have been increasing
Total Netflix subscriptions, 2010-18



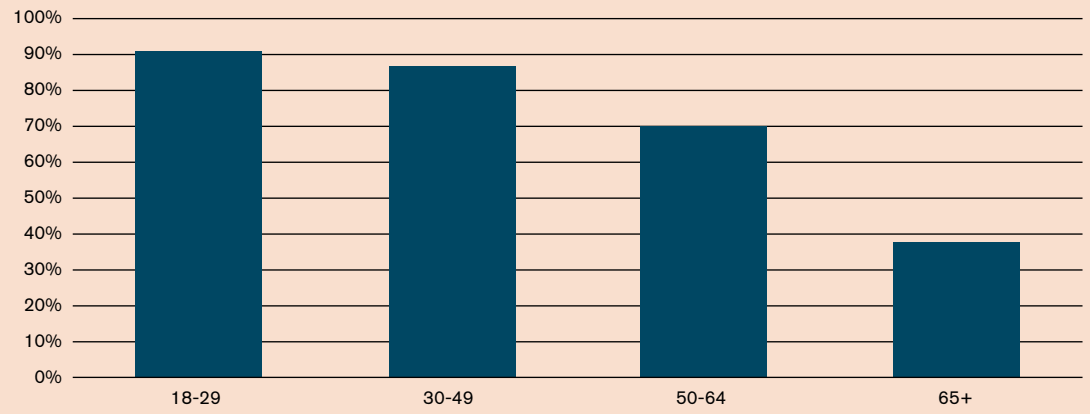
Source: WTO calculations based on data from Netflix.

Box D.10: Online video content streaming *(continued)*

YouTube

YouTube has over 1.9 billion logged viewers every month, viewing over a billion videos every day in 91 economies and 80 languages.[28] As per Figure D.26, younger age groups are the main users of YouTube video streaming services in the United States, with 91 per cent of the population between 18 and 29 years using YouTube compared to 38 per cent for the 65 and over age group. YouTube also offers content creation opportunities for individuals in both developed and developing countries. Artists in developing countries have been able to use YouTube as a platform to export their creative content to different countries. The platform is now offering streaming services for artists through its Official Artist Channels. YouTube also started the "YouTube Music Foundry" programme in 2016 to provide workshops to artists from various economies on content creation. This service has benefitted artists from various countries, including Belgium, Ghana, Japan, the Republic of Korea, Mexico, Nigeria, Puerto Rico and the United Kingdom.

Figure D.26: Younger generations make the most use of YouTube in the United States
Percentage of people in the United States that use YouTube by age, 2019



Source: WTO calculations based on data from the Pew Research Center.

(c) Rising incomes favour a shift towards services activities

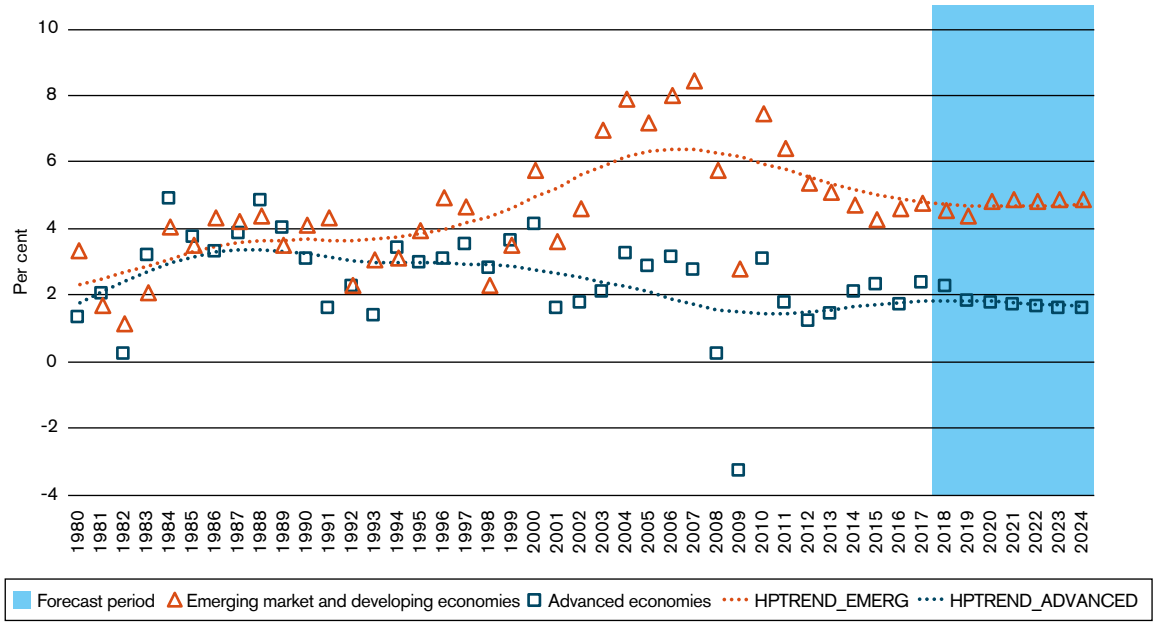
While an important income gap between high-income and low-income countries remains, a key pattern that has emerged since the beginning of the millennium is that of income convergence. Figure D.27 shows the GDP growth in advanced economies and emerging market and developing economies since 1980. Since 2000, developing economies have been growing at a much faster rate than developed economies, thus reducing the income disparities. Although the speed of convergence has been slowing in recent years, predictions suggest that this process of convergence will continue over the next five years, further closing the income gap.

Income level determines the composition of demand for goods and services as well as the demand for different types of services. Furthermore, the economic transformation that is behind growing incomes brings about changes in the production structure. Improvements in institutions, appropriate regulations and the development of human capital favour shifts towards services activities (Hoekman and Mattoo, 2008). As a result, rising incomes go hand-in-hand with changes in demand composition and countries' patterns of specialization.

(i) The growing demand for skill-intensive services

One general fact of economic development is that the share of services in GDP and employment rises as per capita income increases. Accordingly, research shows that the average income elasticity of the demand for services is higher than one, meaning that, as income per capita increases, services consumption grows more than proportionally. In contrast, the average income elasticity for goods is lower than one (Caron et al., 2014).

Figure D.27: Countries' GDP is predicted to converge
GDP growth by level of development, 1980-2024

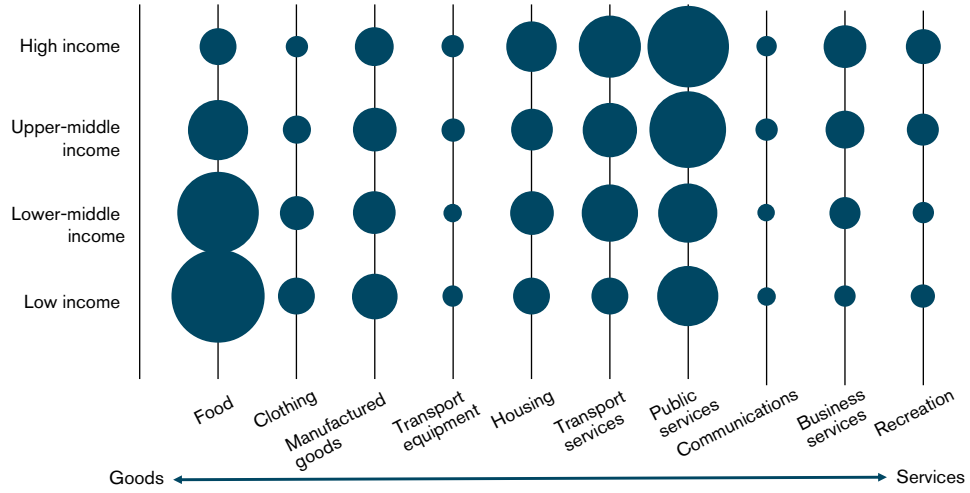


Source: IMF World Economic Outlook and WTO Secretariat calculations

Notes: Smoothed trends are estimated by applying the Hoderick-Prescott (HP) filter to annual growth rates at constant prices (percentage change). We denoted these trends as HPTREND in the figure, for advanced economies (in blue) and emerging economies (in orange).

Changes in the expenditure share of households at increasing levels of income is one explanatory factor behind this pattern. It is well known from the early work of Engel (1857) that, as income grows, the share of income spent on necessities such as food decreases. Figure D.28 shows the composition of consumption at different levels of income. The most evident trend is that food becomes a smaller share of consumption as income increases, and so does clothing. Conversely, spending on recreational services and business services increases with income.

Figure D.28: The composition of expenditure changes according to income
The composition of expenditure by country income level, 2014



Source: Authors' calculation based on GTAP data for 2014.

Notes: Income categories are based on World Bank country classifications in 2017.

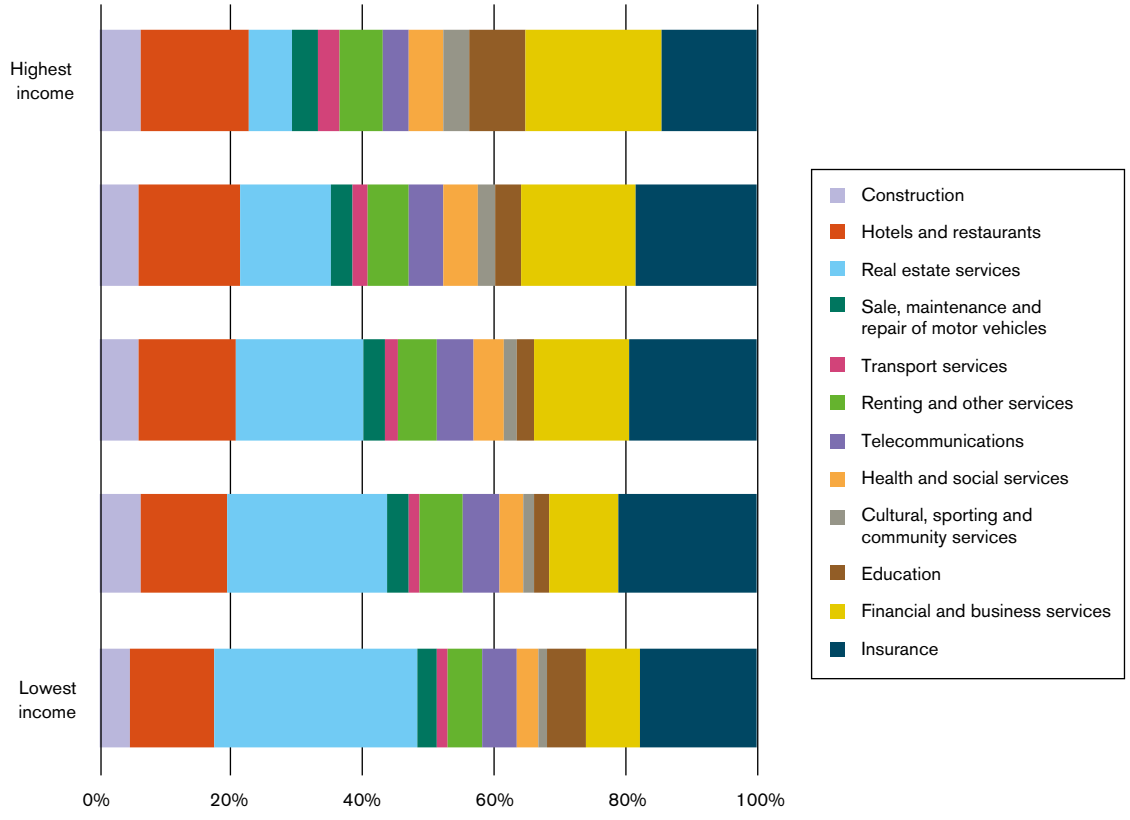
Looking specifically at services consumption by household income level, Figure D.29 clearly shows that the share of spending on hotels and restaurants, health and social, recreational, financial and professional services increases as the level of income increases. Conversely, the share of spending on construction services remains constant across income groups, while the share of real estate services, represented by expenditures on rent, steeply declines with income.

Overall, as income grows, countries increasingly consume services, especially skills-intensive services. Not only do services industries have a higher income elasticity than goods, but services that have higher income elasticity are also the most skills-intensive (Caron et al., 2014). This is illustrated in Figure D.30, which shows estimated income elasticities and skill intensities in the different services sectors, based on Caron et al. (2014).

(ii) Potential for the growing internationalization of services trade

On the supply side, economic development allows specialization in complex products that tend to be not only skills-intensive but also services-intensive. Firms in high-income economies tend to rely more on various ICT, business and professional services. In fact, the share of those services as inputs in total output is twice as high in high-income economies than in lower-income economies.[29] The skills content of occupations is not constant over time and across countries. As countries become richer, production

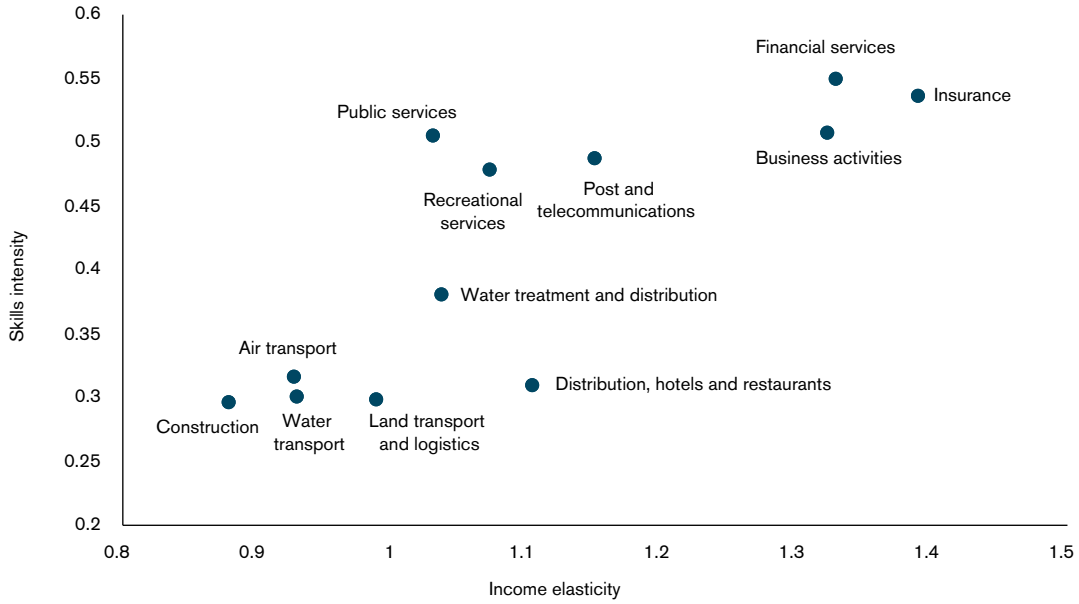
Figure D.29: The composition of services consumption changes according to income
Composition of services consumption in percentage by quintiles of household income



Source: Data from the US Bureau of Labor Statistics (2017), Table 1101.

Notes: Quintiles denote the five equal groups into which a population is divided according to the distribution of income. "Construction" also includes household insurance and expenses of materials for owner-performed repairs and maintenance. "Other services" include housekeeping services, gardening, laundry and dry-cleaning (non-clothing), termite and pest control products and services, and home security systems. "Education" includes school supplies. "Business services" include legal fees, accounting fees, funerals, cemetery lots, union dues, occupational expenses, expenses for other properties. "Insurance" includes vehicle, private health, and life and other personal insurance.

Figure D.30: As income grows, countries increasingly consume skills-intensive services
Positive relationship between income elasticity and skill intensity



Source: Caron et al. (2014)

Notes: Skills intensity is measured by the ratio of skilled labour to total labour input. It is computed including the factor usage embedded in the intermediate sectors used in each sector's production. "Distribution, hotels and restaurants" includes wholesale, retail and repair services. "Recreational activities" include cultural and sporting activities. "Public services" include public administration, education, health and social work, and sanitation activities.

and trade patterns change, causing a shift in economic production structures and consequently a variation of the type of skills required (Aedo et al., 2013). Countries display heterogenous skills content for similar occupations, which depends on the technologies available (Dicarlo et al., 2016).

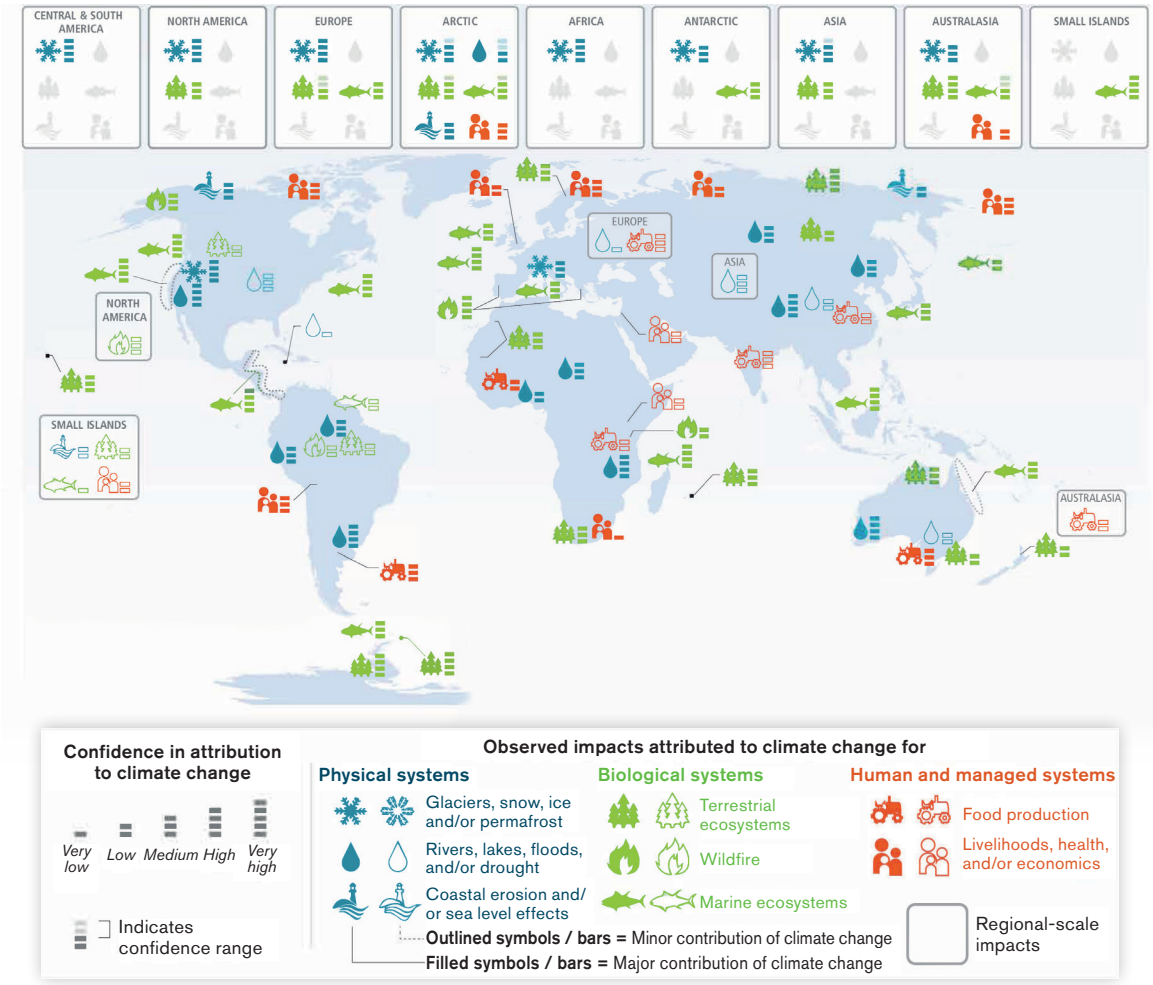
In addition, many services sectors are characterized by a pervasiveness of regulations and licensing, they are infrastructure-intensive, and many are knowledge-intensive. Comparative advantage in services trade is thus determined by factor endowments, infrastructure, but also an economy's governance, institutions and regulations, as discussed in Section C. Indeed, Amin and Mattoo (2006) affirm that regulatory and contract-enforcing institutions play a key role in the development of services sectors because these sectors enter into a more complex web of transactions with the rest of the economy and are more prone to market failure due to asymmetric information. Hence, better institutions are positively correlated with a higher size of the services sector relative to GDP.

Since rich countries consume relatively more of the skill-intensive goods and services that they are specialized in producing, they also trade more with one another than with low-income countries. It follows from above that increasing convergence in GDP is likely to drive up global demand for services, especially skills-intensive and institutional-intensive services. Since income growth is associated with better institutions and regulation, trade in services among growing economies is expected to increase. As countries converge in GDP, they will also trade more services.

(d) Climate change

According to the Intergovernmental Panel on Climate Change (IPCC) (2014), climate change refers to any change in the state of the climate, whether due to natural variability or as a result of human activity, that persists for an extended period, typically decades or longer patterns. These changes include increased temperatures, often referred to as global warming, as well as changes in atmospheric conditions, including humidity and rainfall patterns. Global climate change has already had observable effects on the environment, including a rise in sea levels, a loss of ice mass and increased frequency, duration and intensity of extreme weather-related events, such as floods, droughts, fires and pest outbreaks (see Figure D.31).

Figure D.31: Global climate change has already had observable effects on the environment
Observed impacts attributed to climate change



Source: IPCC (2014).

These events also affect the economy, including services trade. For instance, in January 2018, hundreds of flights from Toronto's Pearson International Airport in Canada were cancelled because of extreme wintry conditions and high winds (Global News, 2018). As the climate continues to change, the structure, composition and functioning of the global economy, including services trade, will have to change and adjust to new climate conditions (IPCC, 2014). In particular, climate change is expected to affect international trade through two main channels: countries' comparative advantages and trade costs, in particular transport and distribution costs (WTO and UNEP, 2009).

Despite improvements in data availability and models, there is to date no complete and comprehensive quantitative assessment of the impact of climate change on international trade, including services trade. The impact of climate change on services may have indirect effects on other economic sectors, which in turn may affect the supply and demand for services trade. One of the greatest challenges is to identify and assess the impacts of climate change in an integrated way so as to take fully into account the many complex interactions.

The literature has mainly identified and assessed channels through which climate change can affect specific economic activities, such as the agricultural sector (Moore et al., 2017; Nelson et al., 2013). Very few studies have systematically examined the effects of climate change on services trade, except for the tourism and transport sectors. In fact, many services are often viewed as less vulnerable to climate change than other economic activities, such as agriculture.

This is in part because of their lower sensitivity to climatic variability and change, and higher capacity to adapt to changes in climate (IPCC, 2014).[30]

Yet the services sector is not only expected to be affected directly by climate change through alterations in the supply and demand for goods and services, but also indirectly through the impacts of climate change on labour productivity and inputs, including energy and water supply (van der Mensbrugghe and Roson, 2010). In addition, the supply and demand of services may be affected by some climate change policies. Overall, the impact of climate change on trade in services is likely to be region- and industry-specific, depending on countries' vulnerabilities and sensitivities to climate-related events. The following sub-sections review some of the services sectors identified in the literature as likely to be affected by climate change.

(i) Tourism and recreation services: many destinations at risk, and a rise in ecotourism

Many types of tourism activities are weather-dependent and by extension, climate-dependent. Weather, including temperature, hours of sunshine and precipitation, is an intrinsic component of the tourist's experience. Rising temperatures and extreme weather events will have important impacts on many services of the tourism industry. Changes in the length and quality of seasons will affect the tourist offer and, in turn competitive relationships between touristic destinations, as well as inter- and intra-regional tourism flows. Coastal, island and mountain destinations are considered particularly sensitive to climate change. For instance, the rise in temperatures and rainfalls in certain areas, along with a reduction of snowfall and the melting of glaciers, will have a direct impact on winter tourism involving snow sports.

Climate change can also hinder the development of some tourist activities by increasing damage to infrastructure, business interruptions and operating costs, such as insurance, backup power systems and evacuation systems (Cashman et al., 2012; Uchegbu and Kanu, 2011). The profitability and attractiveness of nature-based tourism will also be affected by climate-induced environmental changes, such as water scarcity, the loss of biodiversity, higher sea levels, coastal erosion, an increased risk of flooding and natural hazards, degraded habitats, a reduced landscape aesthetic and an increased incidence of infectious diseases.

Tourists may be discouraged from visiting some destinations if their attractiveness or affordability decreases (WMO et al., 2008). Climate change mitigation policies aimed at reducing greenhouse gases could also impact travelling costs, which in turn could lead tourists to change their travel habits, including modes of transportation and destination. It is however, unclear how exactly tourists will respond to the effects of climate change. Some projections suggest that tourism from North to South, especially during the hotter seasons, could decrease while tourism from South to North may increase (Hamilton et al., 2005). At the same time, tourism in the South could become more attractive during cooler seasons (Amelung and Viner, 2006).

Some tourism services may, in some cases, be able to adjust to new climate and environmental conditions at a cost, for instance by investing in snow-making equipment, beach enhancement, additional air-conditioning or back-up water systems.[31] Diversifying the available recreational activities can also create new markets, for instance by developing trekking-related activities all year around in mountain destinations to compensate for a lack of snow.

In parallel, increased awareness of social, economic and environmental sustainability has given rise to a new type of tourist, characterized by environmental and cultural sensitivities, willing to pay between 2 and 40 per cent more on ecotourism or sustainable tourism (UNEP and UNWTO, 2012). Ecotourism encompasses all nature-based forms of tourism in which the main motivation of the tourists is the observation and appreciation of nature and traditional cultures, while sustainable tourism refers to tourism that takes full account of its current and future economic, social and environmental impacts.

Although still a developing industry in some parts of the world, ecotourism and sustainable tourism are one of the fastest growing segments of the travel and tourism industry, particularly popular among Baby Boomer and Millennial generations (Orbis Research, 2019). The ecotourism and sustainable tourism markets are expected to keep increasing to meet ever more demand, including by complying with voluntary ecotourism and sustainability certification programmes. In many developing countries, these new market opportunities (that also represent employment and entrepreneurship opportunities) are often considered as a means to promote natural resources conservation, while improving the living conditions of local communities in terms of education, the empowerment of women, and health and income (ILO, 2018).

(ii) Transportation services: disruption of traditional routes

The transportation sector is already experiencing weather-related services disruptions, but with increases

in temperature and precipitations, the rise of sea levels and extreme climactic events, the frequency of damage to transportation infrastructures, including roads, airports and ports, will increase (Dellink et al., 2017; IPCC, 2014). Transport infrastructures are, however, vulnerable to climate change in different ways and to different degrees, depending on their state of development, resilience and adaptability to new weather conditions. In general, floods tend to induce more physical damage, while drought and heat waves tend to have more indirect impacts on infrastructure systems (Mills and Andrey, 2002).

Maritime shipping may experience more frequent port closures. Similarly, land-based transportation, including trucks and trains, and air transport may be impacted by climate change, through faster degradation of road and bridge infrastructure and impairment of the operation of airports (Dellink et al., 2017). This damage to transport infrastructure will result in an increase in maintenance, operation, rehabilitation and repair costs, as well as accelerated infrastructure replacement costs. In addition, climate change may indirectly cause losses of infrastructure service and activity disruption such as delays, detours and cancellations (Gelete and Gokcekus, 2018). For instance, climate change could have severe consequences for aircraft take-off performances, including regarding the number of passengers and volume of fuel airplanes are able to carry (ICAO, 2016). These climate-related impacts could ultimately impact the profitability, competitiveness and affordability of the different modes of transportation.

Similarly, climate change mitigation policies promoting the development and adoption of energy-efficient fuels and alternative fuel sources may have an impact on transportation costs. Such policies could lead economic operators to modify, if necessary, the choice of mode(s) of transportation to deliver goods and services in a timely manner and at the lowest cost. In fact, changes in transportation services are expected to have an important impact on other transportation-dependent services sectors, such as energy, tourism and wholesale and retail trade.[32] All other things being equal, higher transportation and shipping services costs drive a wedge between origin and destination prices, which results in a lower demand for transportation services, and ultimately changes in the direction and composition of trade (Koetse and Rietveld, 2009). In that context, some operators in the transportation industry have already invested in new, more resilient, transportation infrastructure and engines.

Although most climate impacts on transportation are expected to be negative, climate change could positively affect the supply and demand of some regional transportation industries. For instance, land-based transportation services may improve in regions experiencing milder winter conditions, because reduced snowfall and less frequent winter storms may lead to a lesser necessity to remove snow and ice, and less cold-weather damage to vehicles. Similarly, warmer winters could reduce the amount of sea ice in many important shipping lanes, extending the shipping season. In the Arctic, the loss of the ice cap caused by warmer temperatures could also open up the possibility of a northwest passage during portions of the year, which could reduce maritime shipping times and distances by up to 40 per cent between Asia and Europe (Rojas-Romagosa et al., 2015).

(iii) Energy services: distribution infrastructures at risk but rise in alternative energy services

Energy services can be particularly exposed to climate change, with risks of disruption of geological exploration and energy production, as well as risks of damage to energy transmission and transfer infrastructure (Hewer, 2006; Schaeffer et al., 2012). Power distribution infrastructures are vulnerable to climate change in different ways and to different degrees, depending on their resilience and adaptability to new weather conditions. Suspended overhead cables and transmission masts are particularly vulnerable to high winds and their effects, such as falling trees, ice storms, lightning strikes, avalanches, landslides and flooding, while transmission cables buried underground tend to be more resilient but significantly more expensive to install.[33] Gas transmission systems can also be affected by mud flows, floods, landslides and permafrost thawing.

Disruption and damage of this type to energy production and infrastructure will increase the operating costs of managing and maintaining energy facilities and networks, including the transportation, transmission and distribution of energy. Extreme weather events could further affect the wholesale marketing of energy and its retail and supply, causing greater price volatility due to sudden shorter or longer spikes in energy demand during cold waves (for heating) and heatwaves (for cooling), as well as shortages, production disruption, and storage and distribution difficulties.

The energy sector can increase its resilience to climate change by diversifying energy supply sources, including renewable energies, expanding its linkages with other regions and countries exposed to different

climate risks, and investing in new technologies to design and construct climate-resilient facilities to produce, transform, supply, transport and distribute energy. Climate change mitigation and adaptation policies can further impact the development and diffusions of alternative energies, which can in turn affect a broad range of energy services, including the distribution and retail supply of energy.

(iv) Environment-related services: new opportunities and emerging technologies

Efforts to mitigate and adapt to the effects of climate change, along with changing consumer preferences, have created new environment-related services, and stimulated existing ones (WTO and UN Environment, 2018; WTO and UNEP, 2009). Environmental services cover a wide range of activities related to infrastructure services, such as solid and hazardous waste management and water and wastewater treatment, and activities related to non-infrastructure services, such as engineering design, environmental consultancy services, environmental technology equipment installations and environmental remediation (Kommerskollegium, 2014; Steenblik and Grosso, 2011; USITC, 2013).[34]

The market for environmental goods and services is substantial (UNEP, 2018). Environmental services have been estimated to represent more than 65 per cent of the market value of environmental industry (EBI, 2017). It is however, often difficult to discuss environmental goods and services separately (Bucher et al., 2014). The provision of many environmental services often requires some environmental goods. Similarly, environmental goods often embed environmental services content or involve installation, maintenance service or monitoring. For example, the construction of wind power systems requires project consultancy services, transportation and the installation of wind turbines and towers, but also the construction of wind turbine foundations, control systems, access roads and other related infrastructure (IRENA, 2018).

The diversity and severity of impacts resulting from climate change will also create a need to develop new environment-related technologies, including goods and services, to address pressing environmental and climate concerns. The market for environmental goods and services is therefore expected to grow significantly in the near future. Although initially the development and diffusion of environment-related services technologies has been occurring in high-income countries, a number of emerging and developing economies are likely to experience a fast-growing market for environment-related services thanks to more investment in environmental infrastructure and stronger environmental and climate change policies.

New market opportunities and new technologies could change the structure of the market for certain environmental services, some of which are still largely concentrated in a single public company or a couple of large companies. For instance, although the water sector in many economies continues to be largely concentrated in a few multinationals, it could become more competitive as it becomes more responsive to innovative technologies (Le Vernoy, 2017). In that context, lower services trade restrictions on environment-related services could further facilitate the adoption and diffusion of more affordable environmental technologies and practices (Kim, 2011; Sauvage and Timiliotis, 2017).

(v) Insurance services: growing demand for insurance against climate risks

With rising socio-economic costs associated with more frequent extreme weather events, preventive risk management play an import role to build socio-economic resilience. The economic cost of natural disasters in 2018 reached almost US$ 160 billion, most of which was related to extreme weather such as blizzards, droughts, floods, heatwaves, hurricanes, and tornadoes (Munich Re, 2019).[35] This is particularly important in many developing economies, because they are likely to be most impacted by climate change (Stern, 2007). Insurance systems have been found to be an effective tool to reduce climate-related economic vulnerability (Golnaraghi, 2018; IPCC, 2014). In that context, the demand for insurance against the risk of extreme weather events will become increasingly important as the global economic cost of weather damage could reach US$ 1 trillion in a single year by 2040 (Dlugoleck, 2008).

Although many climate risk categories, such as windstorms and flooding, are already covered by private or public insurance companies, at least in many developed and emerging economies, other extreme climate risks, such as storm surges, are not subject to a risk-sharing arrangement. The supply of insurance for currently non-existing insurance markets could therefore increase in the future with the rise in economic losses caused by weather risks (Botzen et al., 2010).

However, the development of climate insurance markets could be hindered if weather risks become too high and economic losses too uncertain. Faced with increased climate risks, insurers could manage their exposure to natural hazards by limiting their risk and

excluding the coverage of specific weather events, but also by adjusting premiums, controlling the damage with lower economic compensations, or transferring the risks. Because of these difficulties, public initiatives and public-private partnerships have been developed and could be promising solutions for meeting the demands to compensate weather-related damage that is currently not covered by private insurances.

3. Quantifying services trade in the future

In this section, the analysis on changes in the patterns of services trade is complemented with quantitative projections on changes in the size and patterns of international trade in services. To this end, the Global Trade Model (GTM)[36] is employed, featuring multiple sectors and production factors, intermediate linkages, capital accumulation, a global transport sector and a host of taxes. Affiliate sales of services by multinationals (GATS mode 3) are not included in the model, and so the results reported below only refer to services trade through GATS modes 1, 2, and 4.

Three trends related to the earlier analysis on changes in the pattern of services trade are analysed quantitatively with the GTM: (i) changes in technology, (ii) the reduced importance of face-to-face interaction, and (iii) changes in trade policies. Changes in technology consist of three sub-trends, partially based on the analysis in WTO (2018a). First, tasks are reallocated from labour to capital because of digitalization, robotization and the development of AI. Second, changes in the production process will lead to a more intensive use of ICT services by other sectors in the economy. Third, digitalization will lead to a reduction in trade costs. These trends were introduced in WTO (2018a) and have been extended in this year's report.

The reduced importance of face-to-face interaction for economic transactions is inspired by the recent book *The Globotics Upheaval* (Baldwin, 2019),[37] which argues that with new technologies, many more services can be delivered remotely. To model changes in trade policies, estimates of the ad valorem equivalent (AVE) trade cost level of the recently released World Bank Services Trade Restrictiveness Index (STRI) are combined with scenarios on their expected reduction.

To analyse the three trends outlined above, a baseline scenario for the global economy is developed up until 2040 based on macroeconomic projections from the International Monetary Fund (IMF), the OECD and the United Nations (UN), starting from baseline data for 2014, and the baseline scenario is presented in the next section, with technical details delegated to Appendix D.2.

Three other phenomena relevant for the future pattern of services trade were discussed earlier in this section: demographics, income growth and changing preferences, and climate change. A quantitative analysis of climate change is beyond the scope of this report and would have to be studied separately. The other trends are part of the baseline scenario. In particular, three trends related to demographic changes described earlier in this section are included in the baseline scenario. First, changes in labour supply related to ageing are modelled based on demographic projections by the IMF and the World Bank. Second, changes in the savings rate imposed on the model are based on an empirically estimated model of the savings rate as a function of GDP levels, GDP growth rates and demographic factors. Third, changes in the number of skilled workers are modelled based on projections by the International Institute for Applied Systems Analysis (IIASA) (KC and Lutz, 2017).[38]

Changes in demand related to ageing are not incorporated in the model. Ageing is expected to affect mainly expenditures on education and healthcare, which are not recorded separately in the baseline database employed for our work. Finally, the role of income and changing spending patterns are also part of the baseline.

(a) Baseline of the global economy

The baseline development of the global economy is determined by macroeconomic projections, combined with four types of structural change.

First, based on empirical estimates with EU KLEMS (a statistical and analytical research project financed by the European Commission) and OECD-STAN (i.e. OECD Structural Analysis) data, differential productivity growth is imposed on the model. The estimates show that agriculture displays the fastest productivity growth, followed by manufacturing and services, although some of the services sectors such as telecommunications and ICT services display above average productivity growth as well.[39] These assumptions are in line with the findings in Box C.1, comparing productivity growth in selected services sectors with those in manufacturing.

Differential productivity growth is highly relevant for projections on the role of services in the economy. Given the limited scope for substitution between goods from different sectors, both for consumers demanding final goods and firms demanding

intermediate goods, above-average productivity growth of agriculture and manufacturing leads to a falling value share of these sectors in the economy. Correspondingly the value share of services tends to rise. Lower than average productivity growth of services raises the relative price of services, thus raising the importance of this sector in the economy, given the limited scope for substitution.

A second phenomenon also leads to a rising share of services in the economy: non-unitary income elasticities. As mentioned earlier in this section, services tend to display income elasticities above one, whereas particular goods, such as food, display income elasticities lower than one.[40] As countries grow, this tends to lead to a rising share of services in the economy.

The third and fourth types of structural change are both related to demographic change. Third, the savings rate adjusts in response the changes in GDP and demographics;[41] as populations age they tend to reduce the savings rate. Fourth, projections for changes in the number of skilled and unskilled workers are imposed on the model.[42] Emerging countries tend to display the strongest growth in the supply of skilled labour.

Besides these structural changes, an important policy change in the realm of international trade is also included in the baseline. Trade costs are projected to fall in the baseline as a result of the implementation of the WTO Trade Facilitation Agreement (TFA), which entered into force in February 2017.[43]

Table D.3 displays the baseline projections imposed on the model. The table shows that demographic changes are affecting the baseline and contains three main takeaways. First, the emerging regions are projected to grow more in terms of GDP than the developed regions. This reflects the assumption of convergence in income levels in the OECD GDP projections. Second, the projections on both population and employment growth show that ageing will affect some regions substantially. Population and labour force growth are projected to turn negative in China, Japan and Russia. Labour force growth is also projected to become negative in the European Union and the Republic of Korea. Although population growth does not become negative in these regions, the changing age structure is projected to turn labour force growth negative. Third, the projections on education indicate that there will be a large increase in the number of skilled workers. Whereas the number of unskilled workers is projected to fall in many regions, the number of skilled workers is expected to rise in all regions. Furthermore, the largest growth is projected to occur in the emerging regions, with the strongest projected GDP growth in the Asian LDCs, India and sub-Saharan Africa.

(b) Capturing three future trends

Three trends influencing the size and pattern of services trade are included in the simulations. Each of them will be discussed in turn in a non-technical manner in this sub-section, with technical details delegated to Appendix D.2 Since technological developments are highly uncertain, the trends modelled are an indication of the direction global trade is projected to take.

(i) Changes in technology because of digitalization

To model changes in technology we largely follow WTO (2018a). Three trends are included, all related to the digitalization of the economy: a reallocation of tasks from labour to capital raising productivity growth and the capital income share; a more intensive use of ICT services by other sectors; and falling trade costs. Digitalization (and robotization) are assumed to lead to a more intensive use of capital in the production process, leading both to higher productivity growth and to a higher capital intensity of production.

Second, the more intensive use of ICT services as intermediate input by other sectors was also part of the report last year. However, the modelling of this trend has been refined in two ways.

Third, trade costs are projected to fall because of the introduction of new technologies related to digitalization. Following the same approach as earlier in this section, in a first step, inferred trade costs are regressed on variables expected to change with new technologies and on a host of control variables for three broad sectors, primary (agriculture and extraction), secondary (manufacturing), and tertiary (services). In a second step, a scenario is formulated for the change in the variables related to new technologies, like that in WTO (2018a), based on the assumption that values converge to the level of the highest quartile (the 25 per cent highest value). For services trade, three variables drive the reduction in trade costs: common language (people speaking the same language), broadband coverage, and the credit and contract environment. First, the trade-fostering impact of common language on trade is assumed to fall because of new technologies.[44] Second, rising broadband coverage will reduce trade costs. Third, the development of blockchain will reduce the trade costs associated with bad credit and contract environments.[45]

(ii) Reduced importance of face-to-face interactions

Trade in many services sectors is hindered at present by the necessity for face-to-face interactions. Baldwin

Table D.3: Projected macroeconomic growth rates vary across economies
Projected cumulative growth rates of population, GDP, labour force and number of skilled and unskilled workers, 2018-40

	Population	GDP per capita	GDP	Labour force	Unskilled labour	Skilled labour
Asian LDCs	17	161	204	20	13	109
Australia	32	27	67	28	10	64
Brazil	11	41	56	9	-1	53
Canada	20	25	51	13	-7	31
China	-1	144	141	-14	-22	65
European Union (28)	4	40	45	-4	-16	37
European Free Trade Association (EFTA)	18	21	43	8	-8	44
India	23	166	226	23	14	106
Japan	-8	30	19	-14	-36	14
Republic of Korea	0	65	65	-17	-51	26
Latin America	16	58	83	16	3	71
Mexico	17	57	83	15	5	82
Middle East and North Africa	31	59	108	35	19	121
Russian Federation	-3	65	61	-8	-13	14
Southeast Asia	17	118	154	16	3	93
Sub-Saharan African LDCs	56	111	229	78	75	214
United States	15	28	47	10	0	35
Other Asian economies	31	52	99	31	26	73
Other sub-Saharan Africa	50	72	158	66	48	186
Rest of world	4	94	101	5	-3	35
Average	**19**	**51**	**80**	**17**	**8**	**71**

Source: Population numbers reproduced with permission from the UN (Medium Scenario), GDP per capita reproduced with permission from IMF (up until 2023) and OECD (shared socio-economic pathways (SSP) 2, a middle-of-the-road scenario for the future). Employment reproduced with permission from IMF (until 2023) and UN (Medium Scenario). Skilled and unskilled workers based on UN employment data, and shares of tertiary educated workers from KG and Lutz (2018).

Notes: The table displays cumulative growth rates from 2018 until 2040. The number of skilled and unskilled workers is calculated as employment times the share of tertiary educated workers in all workers. Global averages are calculated based on shares in 2018.

(2019) argues that new technologies are expected to lead to a strong reduction of trade costs in services, as they make it possible to circumvent the need for face-to-face interaction. We determine the potential reduction in trade costs because of new technologies by estimating the impact of the importance of face-to-face interaction on trade costs.

Employing data on the task intensity of occupations mapped to sectors and trade costs inferred from international relative to intra-national trade, provides support for the hypothesis that sectors with a large share of tasks requiring face-to-face interaction display higher trade costs.[46] Furthermore, we show that the face-to-face intensity can explain the difference in trade costs between goods and services. Phrased differently, although the data show that trade costs are significantly higher in services trade, this difference becomes insignificant after controlling for measures of face-to-face intensity.

With technological progress, it is likely that face-to-face interactions will become less important over time, which is likely to reduce trade costs. Furthermore, this reduction will be strongest for services, since face-to-face interactions matter more for services sectors. To determine the expected reduction in trade costs, we assume that the face-to-face task intensity of the different sectors will fall to the sector with the lowest face-to-face task intensity, motor vehicles. The intuitive idea is that new technologies will make production less face-to-face-intensive. As a result, trade costs in the different sectors fall.[47] This scenario is admittedly somewhat speculative and thus mainly serves to show

the potential impact of the scenarios described in Baldwin (2019) on the reduced importance of face-to-face interaction (see also the opinion piece by Richard Baldwin on page 126).

(iii) Changes in trade policies (STRI)

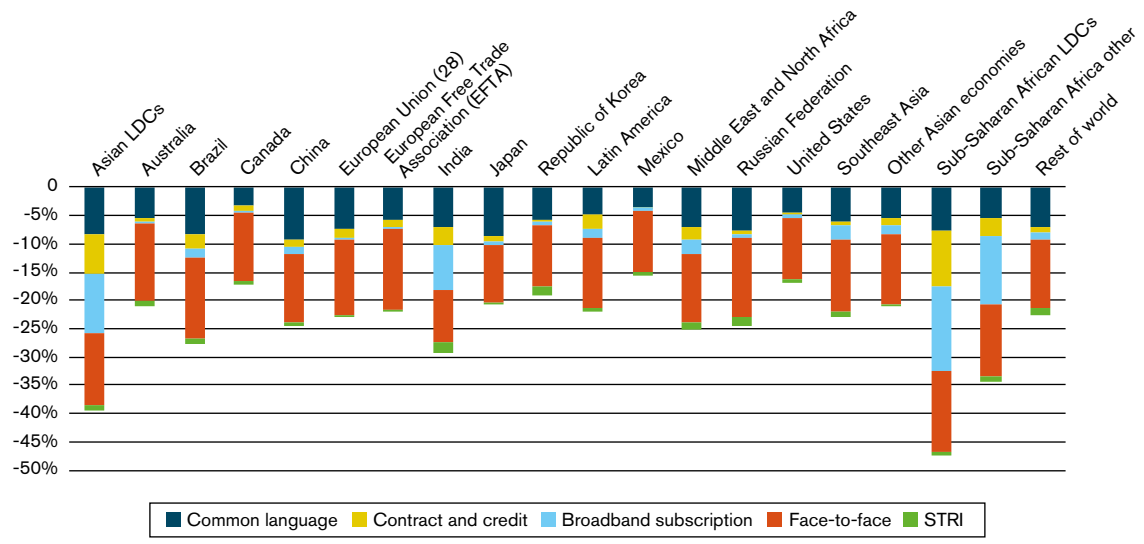
As described earlier in this section, the World Bank has developed a new services trade restrictiveness index (STRI). Gravity estimates on the impact of the STRI on trade flows are combined with a scenario for the reduction in the STRI to determine possible reductions in trade costs because of changes in economies' regulation of services trade.[48] To determine the impact of the STRI (a most-favoured-nation variable applying to all importers) on trade flows, an interaction term of the STRI is included with a trade-with-self dummy (technically a border dummy). This means that the impact of the STRI on trade flows is identified based on how much the STRI reduces international trade relative to domestic trade. Technical details are in Borchert et al. (2019b) and estimation results are in Appendix D.2.

Gravity equations are estimated for five sectors: telecommunications, transport, insurance, banking and professional services. For the other services sectors the STRI is not available or there is no good match between the sector on which STRI data are available and services trade data. The STRI interaction with the trade-with-self dummy is significantly associated with trade only for the first three sectors. This means that only in three sectors a lower level of STRI is associated with a significantly larger amount of international trade. For the other two sectors, services trade data do not align well with the STRI in terms of sectoral classification because sectoral definitions differ. The estimated STRI coefficients are mapped into ad valorem equivalent trade cost reductions based on the following scenario for the reduction in trade costs.[49] It is assumed that the STRI is reduced to the median economy of the quartile with the lowest level of STRI, which is considered to be a reasonable liberalization scenario.[50] This means that the STRI is assumed to fall to the economy with approximately the 12.5 per cent lowest level.

The fact that the impact of the STRI on trade costs is only estimated for five sectors and that the estimates generate significant effects only for three sectors, implies that the impact of the simulated changes in services trade regulations will be limited.

Figures D.32 and D.33 display the trade-weighted average reductions in trade costs. The figures show that the largest reductions in trade costs are expected

Figure D.32: New technologies are projected to reduce trade costs in least-developed economies
Ad valorem equivalent trade cost reductions 2018-40 – different trends (averages across economies)



Source: WTO calculations based on various methodologies as described in the text.

Notes: The figure displays the contribution of different variables to the reduction in trade costs in the different scenarios. Common language, credit and contract, and broadband subscription measure the reduction in trade costs because of a reduced impact of the absence of a common language, poor credit and contract environment, and a low number of broadband subscriptions, respectively. Face-to-face measures the reduction in trade costs due to a reduced importance of face-to-face contact for trade costs. STRI measures the reduction in trade costs due to an improvement in services trade regulation. The methodology is described in the text. Note that percentage reductions are not additive. The corresponding numbers are in Appendix Table D.5.

OPINION PIECE

By Richard Baldwin,

Professor of International Economics and Co-Director of the Centre of Trade and Economic Integration, Graduate Institute for International and Development Studies and Centre for Economic Policy Research

Digital technology and telemigration

Globalization is simple. Arbitrage drives globalization. When the cost difference across countries is larger than the trade cost, companies exploit the cost gap by buying low and selling high. Traditionally, this arbitrage mostly concerns trade in goods because it is easy to ship "things-that-we-make" across borders. It was much harder to ship across borders the "things-that-we-do" – what economists call "services". But why is that? Why is it easier to ship goods than services across borders?

The answer lies in the reality of services. For many services, the service-provider and service-buyer have to be in the same place at the same time. The technical difficulty of getting service-providers from one nation into a room with service-buyers from another nation is the reason why globalization, up until now, has mostly been about goods, not services.

Digital technology, however, is changing that reality. In a whole host of ways, digital technologies, or digitech, are making remote people seem less remote, making it easier for people sitting in one country to work in another country. But looking at how digitech is doing this, consider the international cost differences that make this profitable.

A professor of economics in Zurich, for instance, earns about 20 times what an economics professor earns in Manila. If we lived in a Star Trek world, where professors could teleport from Manila to Zurich and back, it is likely that the University of Zurich would engage in at least some arbitrage of professors. Of course, teleportation is not real thing, but digitech is moving reality in that direction. It is enabling what I call "telemigration" in my 2019 book, *The Globotics Upheaval: Globalization, Robotics, and the Future of Work*, namely people sitting in one nation and working in offices in another nation.

Putting it plainly, the incentives for telemigration are enormous, but so too are the technological barriers. I believe that emerging market exports of services will explode in coming years, since digitech is tearing down the barriers at an eruptive pace. I would focus on four aspects of this technological lowering of barriers to telemigration. First is domestic telecommuting.

Many have switched to telecommuting, and our companies are reorganizing things to make this domestic telecommuting easy. They are investing in new collaborative, cloud-based software packages as well as in in telecommunications hardware and services that make remote workers seem less remote. Having arranged things to make telecommuting possible, companies will find it profitable to use foreigner freelancers, at least for some tasks. Of course, using remote foreign talent might not be as good as using in-person domestic talent, but the foreign labour will be a whole lot cheaper.

The second is online freelancing platforms. These are like eBay, but for services, not goods. Just as eBay made it easy to buy and sell goods online, these platforms are making it easy to buy and sell services online in the form of freelancing. They will be like the "container ships" of telemigration. They are how companies in rich nations will find, hire, pay, manage and fire telemigrants from poorer nations.

The third factor is machine translation. It has improved radically. The key breakthrough was when, from 2016, the United Nations, the Canadian Parliament, and the European Parliament and European Commission posted online millions of human-translated sentences. This allowed the artificial intelligence geniuses at Google, Twitter, Facebook, Amazon and Microsoft to train AI models to translate text contextually, instead of word by word. That made a huge difference.

This is revolutionary. Hundreds of millions of talented, low-cost freelancers who have been excluded from telemigration by their lack of language skills will soon be able to communicate, via translation

technology, in "good-enough" English, or French, or any other widely spoken language. And some of them will be able to do at least part of many service jobs for a whole lot less than the people doing them today. It will even have a big impact on goods trade, since standard estimates suggest that a common language boosts trade by more than 50 per cent.

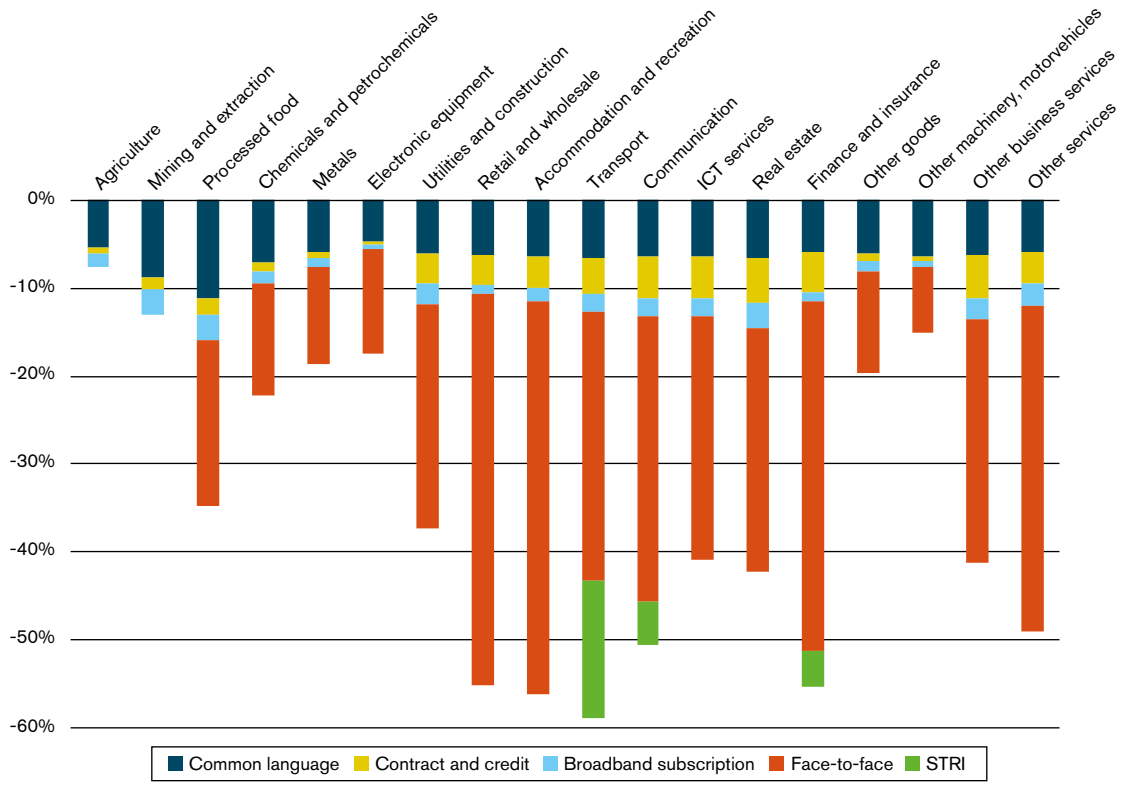
The fourth factor is technologies creating ways to make it seem as if you are in the same room with colleagues or clients in a different country. One of the new technologies is called telepresence rooms. These are common in large banks, some large companies and in some government departments.

Another is "telepresence robots". These are like a Skype screen on a simple robot body, where the robot is driven by the person on the screen. They are often used in US hospitals so that doctors can talk to patients without driving to the hospital. Some companies use them to allow managers to visit field offices without travelling. The telepresence robot remains in the field office and when the manager wants to interact with people in the field office, he or she fires up the telepresence robot and drives it around the field office. People say that the physicality of the robot really changes the quality of the communication. It boosts trust, understanding, and the authority of the telemigrant.

The progress to date is impressive, but it will accelerate radically in the next few years as 5G is implemented and raises transmission speeds by two orders of magnitude.

This development will be disruptive in advanced economies, where service workers have been mostly shielded from globalization, but it is a huge export opportunity for emerging market workers. In a nutshell, telemigration allows developing nations to exploit their comparative advantage directly based on low labour costs, without having to build a good with the labour and then export the good.

Figure D.33: New technologies are projected to reduce trade costs in different services sectors
Ad valorem equivalent trade cost reductions 2018-40 – different trends (sector averages)



Source: WTO calculations based on various methodologies as described in the text.

Notes: Figure D.33 displays the contribution of different variables to the reduction in trade costs in the different scenarios. Common language, credit and contract, and broadband subscription measure the reduction in trade costs because of a reduced impact of the absence of a common language, poor credit and contract environment, and a low number broadband subscriptions, respectively. Face-to-face measures the reduction in trade costs, because of a reduced importance of face-to-face contact for trade costs. STRI measures the reduction in trade costs because of an improvement in services trade regulation. The methodology is described in the text. Note that percentage reductions are not additive. The corresponding numbers are in Appendix Table D.6

in the transport sector and in the developing countries, which tend to start from a higher initial level of trade restrictiveness.

(iv) Comparison of trade cost reductions

Figures D.32 and D.33 contain an overview of the average ad valorem equivalent trade cost reductions associated with new technologies. The figures display the trade-weighted averages per importer and per sector and contain an overview of the contribution of the different variables to the total reduction in trade costs associated with the introduction of new technologies.

Inspecting the projected trade-weighted average trade cost reductions in the different scenarios in Figure D.32 and D.33 shows that the scenario on the reduced importance of face-to-face interaction for trade costs and the presence of a common language are expected to have the largest impact on trade cost reductions. The scenario on the reduced importance of face-to-face interaction is treated as a speculative scenario, showing what would happen if technological developments did indeed drastically reduce the importance of face-to-face interaction. Figure D.33 makes clear that the trade cost reductions associated with the face-to-face scenario are largest in the services sectors.

In comparison to the impact of new technologies, reduced trade policy barriers are projected to have a more limited impact. However, regulatory barriers are likely to affect the scope for trade cost reductions, because of new technologies. If countries impose policy barriers related to data localization, for example, the projected trade cost reductions are not expected to take place.

(c) Results of the simulations

This section presents the impact of the described trends on the global economy, focusing on changes in services trade. As the baseline contains important trends for services trade, such as demographic change, differential productivity growth and changing preferences, the baseline results are also discussed in detail where relevant. To summarize, the results of three scenarios are presented:

1. Technological changes because of digitalization, including reductions in trade costs
2. Reduction in trade costs because of a reduced need for face-to-face interaction
3. Lower trade policy barriers modelled through a lower services trade restrictiveness index (STRI).

The three scenarios are introduced cumulatively in the simulations in the order presented here. Hence, the third scenario (STRI) also contains the trade cost and technology changes of the other two scenarios.

(i) The role of services in output and trade

Table D.4 displays the share of services output in total output in 2018 and the projected values in 2040 in the baseline and in the digitalization scenario. The table shows that the share of services in the economy tends to increase in all regions. Whereas the share stays relatively low in sub-Saharan Africa (increasing from 55 per cent to 64 per cent in the baseline), it is projected to rise from 62 per cent to 75 per cent in China and increase from an already high 81 per cent to 87 per cent in the European Union.

Two mechanisms drive the rising share of services in the model. First, productivity growth is smaller in most services sectors (based on econometric estimates introduced above), making them more expensive and given the limited scope for substitution this raises their value share in the economy. Second, spending patterns of private households change as their incomes grow. Income elasticities for services tend to be above one, whereas they are below one in other sectors, especially food. As a result, the services share in output tends to increase. It is difficult to disentangle the importance of the two channels in the model. Additional simulation results show that the shares spent on services rise more sharply for private expenditures than for intermediate demand. This seems to indicate that both mechanisms are important. For intermediates demand, only differential productivity growth plays a role, whereas for private expenditures both mechanisms are at play.

The rising share of services in the economy has two important implications for services trade.[51] First, the fact that services are much less tradable than goods implies that a rising share of services in the economy tends to lead to a fall in the trade-to-output ratio through a composition effect. If relatively less tradable sectors in the economy become more important, the role of trade in the economy tends to decline through a composition effect through a changing sectoral composition of the economy. Lewis et al. (2018) use this insight to argue that trade growth would have been much stronger without differential productivity growth since the 1970s, since the relatively non-tradable sectors have become more important in the economy. Second, the shift towards services in the domestic economy implies that there should also be scope to augment the share of services in trade from its baseline level of about 21 per cent.[52] However, as will be discussed now, although the share of services

Table D.4: The share of services output in total output is projected to rise
Value share of services output in total value of output in 2018 and 2040 in the baseline and in 2040 under the digitalization scenarios

Region	2018 baseline	2040 baseline	2040 digitalization
Asian LDCs	64%	83%	86%
Australia	80%	85%	86%
Brazil	76%	84%	84%
Canada	80%	86%	88%
China	62%	75%	79%
European Union (28)	81%	87%	89%
EFTA	75%	82%	84%
India	71%	83%	86%
Japan	81%	86%	88%
Republic of Korea	69%	79%	81%
Latin America	69%	79%	80%
Mexico	72%	80%	82%
Middle East and North Africa	54%	64%	69%
Russian Federation	64%	71%	74%
United States	83%	88%	90%
Southeast Asia	61%	73%	76%
Other Asian economies	73%	80%	82%
Sub-Saharan African LDCs	55%	64%	70%
Sub-Saharan Africa other	49%	63%	65%
Rest of world	68%	78%	81%
Global average	**74%**	**82%**	**84%**

Source: Simulations with WTO Global Trade Model.
Notes: The table displays the share of services (net) output in total value (net) output.

trade in total trade is projected to increase, it will not come close to the share of services output in total output.

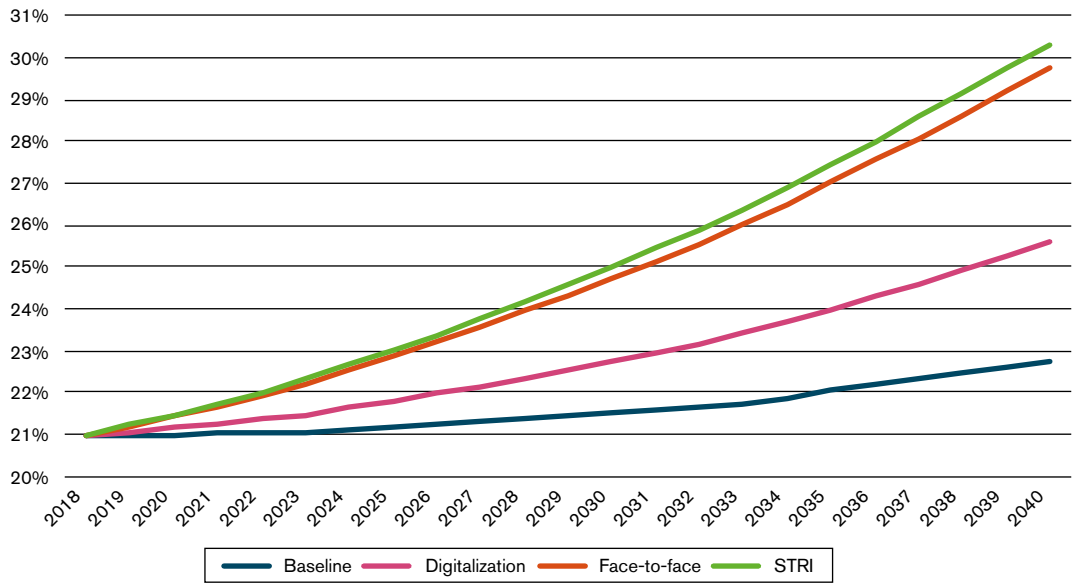
Figure D.34 displays the development of the share of services trade in total trade under the different scenarios. Services trade in the WTO Global Trade Model only contains trade through GATS modes 1, 2 and 4 and excludes mode 3 (i.e. sales by foreign affiliates). Therefore, services trade shares are smaller than in Section B. Figure D.34 shows that, in the baseline, the share of services trade is projected to increase only very modestly, from 21 per cent to 22 per cent. In the digitalization scenario, the share increases to about 26 cent. Adding the face-to-face scenario leads to an increase in the share of services trade of close to 30 per cent. This share is projected to exceed 30 per cent when trade policy barriers decline as well. This shows that the rising share of services in the domestic economy projected in Table D.4 does not trigger a corresponding rise in the share of services trade (see Figure D.34). The reason for this is that the services sectors whose shares in the domestic economy increase most (business services and health and education services) are relatively harder to trade across borders. Only a reduction in trade costs, as in the different scenarios, leads to an increase in services trade.

(ii) Macroeconomic effects on trade and GDP

In this section, we will present the projected changes in trade and GDP under the different scenarios. Figure D.35 displays the average annual percentage increase in real trade for goods and services and for the individual services sectors.[53] The scenario on change in services trade regulations (STRI scenario) is not displayed in this figure on sectoral changes, but is presented in a separate figure, as

Figure D.34: The share of services trade in total trade is projected to rise above 30 per cent in the scenario where all trade costs decline

Share of services trade in total trade in four cumulative scenarios, 2018-40

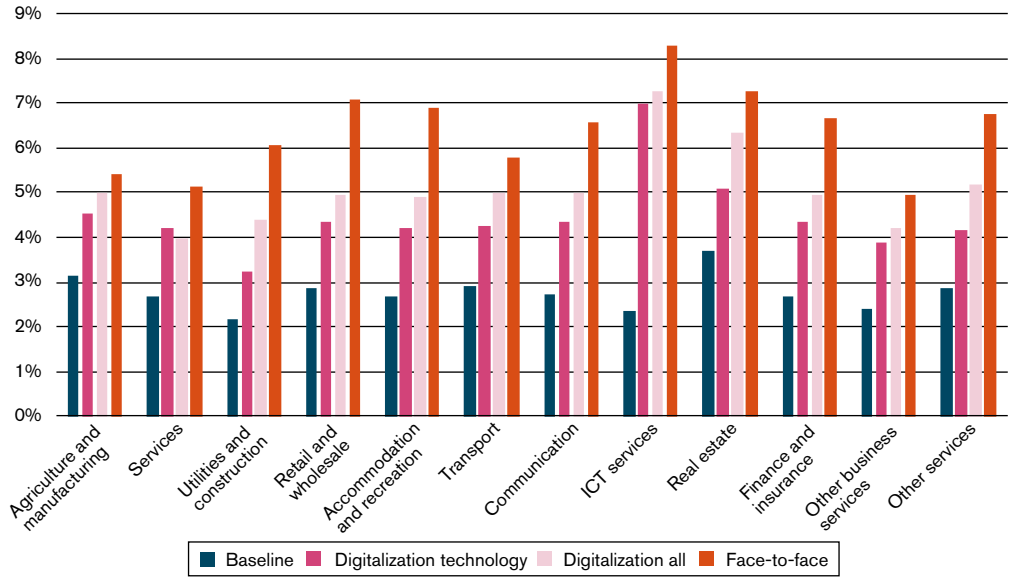


Source: WTO calculation with the WTO Global Trade Model.

Notes: The figure displays the share of exports in services (at free-on-board prices), inclusive of transport services sold to the global transport sector. The digitalization scenario contains additional productivity growth, a more intensive use of ICT services in production, and reductions in trade costs associated with the digitalization such as an extension of broadband coverage. The face-to-face scenario, which is cumulative to the first scenario, includes trade cost reductions because of the reduced importance of face-to-face interaction. The STRI scenario adds reductions in trade policy related trade costs.

Figure D.35: Projected trade growth is highest in ICT services

Annual real trade growth in different services sectors, 2018-40



Source: Simulations with WTO Global Trade Model.

Notes: The figure displays the average yearly real trade growth from 2018 until 2040 under the different scenarios in the different sectors. "Agriculture and manufacturing" and "Services" are calculated based on trade-weighted averages. The digitalization scenario has been split into two in this figure. The "digitalization technology" scenario contains additional productivity growth and a more intensive use of ICT services in production. The "digitalization all" scenario adds reductions in trade costs associated with digitalization, such as an extension of broadband coverage. The face-to-face scenario, cumulative to the digitalization scenario, includes trade cost reductions because of the reduced importance of face-to-face interaction.

it only plays a role in three of the services sectors. The digitalization scenario has been split into two in this figure. "Digitalization technology" includes only additional productivity growth and a more intensive use of ICT services, whereas "digitalization all" also includes reductions in trade costs.

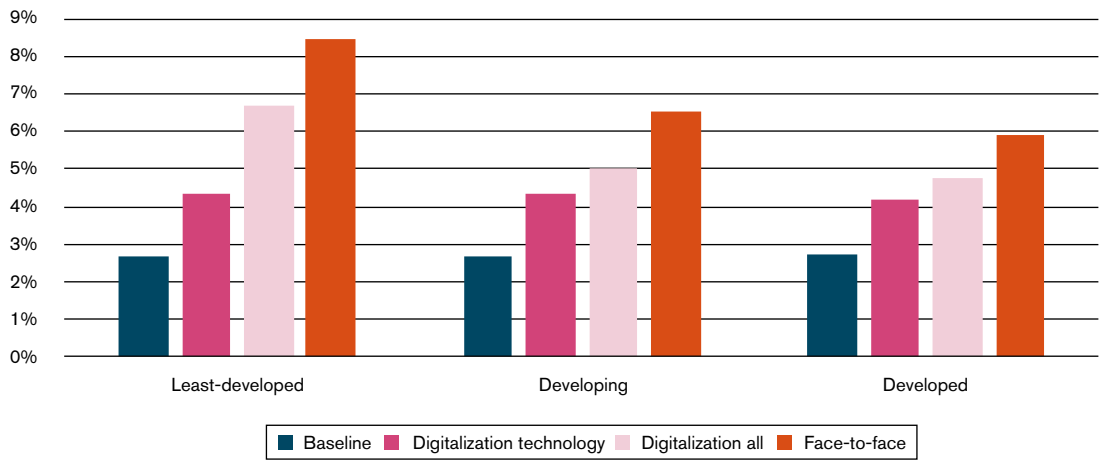
Although projected trade growth is higher in the baseline for agriculture and manufacturing, growth in services trade is almost identical to trade growth in agriculture and manufacturing in the digitalization and face-to-face scenarios. The figure also shows that the impact of reductions in trade costs because of the reduced importance of face-to-face interaction is much stronger for services than for commodities. In particular in the retail and wholesale, communications, and finance and insurance sectors, trade growth would be much higher.

Figure D.36 shows projected annual real trade growth for services in the three aggregate regions – least-developed, developing, and developed – for the different scenarios. The figure makes it clear that projected trade growth is comparable in the three regions in the baseline, whereas it is substantially higher in least-developed and developing countries in the "digitalization all" scenario. Higher assumed GDP growth in least-developed and developing countries is not translated into higher trade growth, because countries are also dependent on trading partners for their trade growth.[54] Least-developed countries in particular are projected to benefit from reductions in trade costs in the digitalization scenario, because reductions in trade costs associated with better broadband and the reduced impact of the credit and contract environment are larger for lower-income countries. The projected increase in trade growth in the face-to-face scenario is more equal across the different regions.

The additional trade growth in the different scenarios also leads to higher GDP growth. The developing and least-developed countries are projected to benefit more from reductions in trade costs associated with new technologies and from the reduction in trade costs in the face-to-face scenario. Annual growth of real GDP is projected to increase from 5 per cent to 5.3 per cent and from 6.4 per cent to 7.5 per cent in respectively the developing and least-developed countries with the trade cost reductions associated with new technologies, whereas real GDP growth in the developed countries would only increase from 3.3 per cent to 3.4 per cent. In the face-to-face scenario the different regions would benefit more proportionally with real GDP growth increasing further to 3.7 per cent, 7.9 per cent, and 3.7 per cent in respectively the developing, least-developed, and developed countries.

Finally, Figure D.37 shows the impact of the STRI scenarios on services export growth in the three sectors, with projected reductions in trade costs. The largest increase in trade is projected to take place in transport services in the least-developed

Figure D.36: Projected services trade growth is highest in least-developed countries
Annual real trade growth of services in different regions, 2018-40

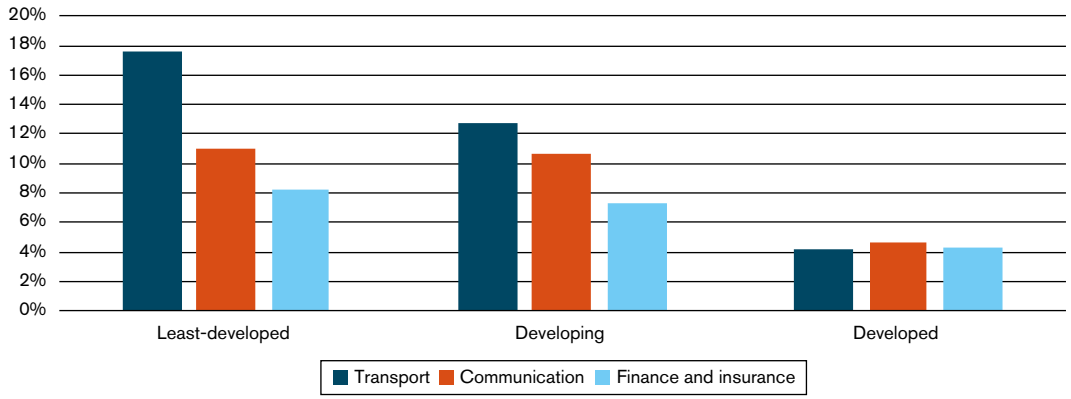


Source: Simulations with WTO Global Trade Model.

Notes: The figure displays the average yearly real trade growth of services from 2018 until 2040 under the different scenarios in the different regions. Region averages are calculated based on trade-weighted averages. See also the note to Figure D.35.

Figure D.37: Projected services trade growth associated with reductions in services trade barriers is highest in least-developed countries

Additional real growth of exports in three services sectors (cumulative) as a result of the reduction in STRI, 2018-40



Source: Simulations with WTO Global Trade Model.

Notes: The figure displays the cumulative additional growth in real exports from 2018 until 2040 under the scenario of a reduction in the STRI towards the median of the lowest quartile of STRI scores across economies. Regional averages are calculated based on trade-weighted averages. See also the note to Figure D.34.

countries. This pattern is driven by the scenario and the estimated impact of the STRI. Least-developed countries start with the highest levels of trade restrictions and thus will display the highest additional trade growth, and ad valorem equivalents of services restrictions are highest in the transport sector. However, Appendix Table D.12 shows that the additional growth in services exports of the United States in the three sectors with reductions in the STRI is above the average despite the fact that the reduction in the STRI is far below the average. The reason is that the United States tends to benefit from reductions in barriers of its trading partners.

(iii) Services trade by sector

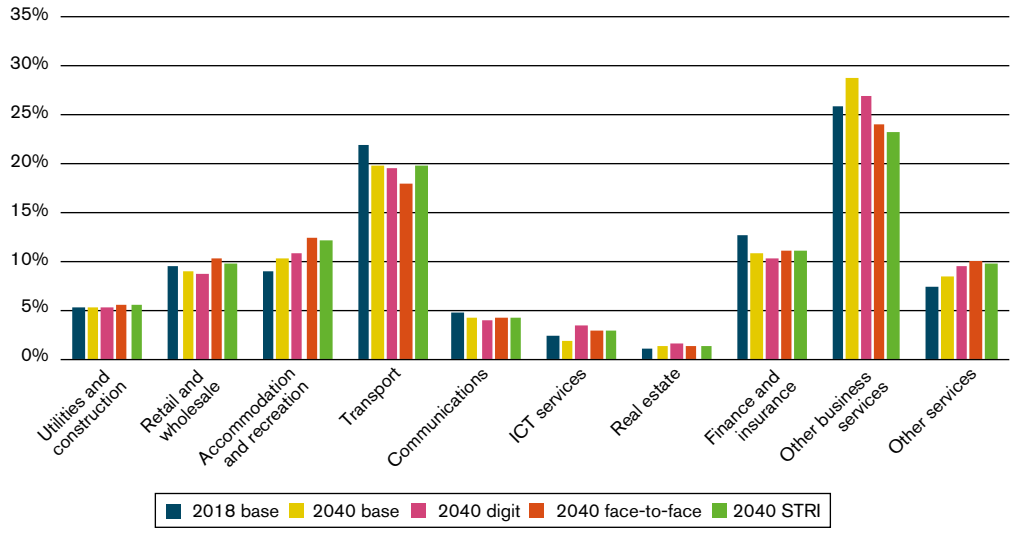
Figure D.38 displays the share of different services sectors in total services trade at a global level. The figure shows that the different scenarios generate considerable variation in the importance of different sectors in total services trade. In the baseline, the share of services sectors displaying lower productivity growth tends to increase ("Other business services" and "Other services"), whereas the share of sectors with high productivity growth ("Communications", "ICT services", and "Finance and insurance") tends to fall. In the digitalization scenario the share of ICT services is projected to return to its old level, because of the more intensive use of ICT services as intermediates in the other sectors) included in the model. In the face-to-face scenario, the relative importance of the transport sector tends to decrease, whereas the shares of "Finance and insurance" and "Other services" are projected to increase. In the face-to-face scenario, the share of transport falls, because of stronger reductions in trade costs in the other sectors. In the STRI scenario the share of transport returns to the 2040 baseline level because of the projected reduction of trade barriers in this sector.

(iv) Services trade by level of development

Figure D.39 displays the development of the share of developing and least-developed countries in total trade (upper panel) and services trade (lower panel). The upper panels of the figure show that the share of developing and least-developed countries in total trade is projected to increase in the baseline and more so in the different scenarios with only small differences between the different scenarios. The share of developing countries is projected to increase from 46 per cent to about 53 per cent in the baseline and about 55 per cent in the different policy scenarios, whereas the share of least-developed countries is projected to increase from about 1.3 per cent to respectively 2 per cent and 2.5 per cent in the baseline and the different policy scenarios. The main reason for a higher share of developing and least-developed countries in global trade in the different scenarios is the projection that less technologically advanced economies are expected to reduce trade costs more significantly (related to an improvement in internet coverage and a smaller negative impact of a low level of the credit and contract environment on trade costs). This convergence scenario is discussed

Figure D.38: The importance of different services sectors in services trade varies with different scenarios

Value share of services sectors in total services trade, 2018-40

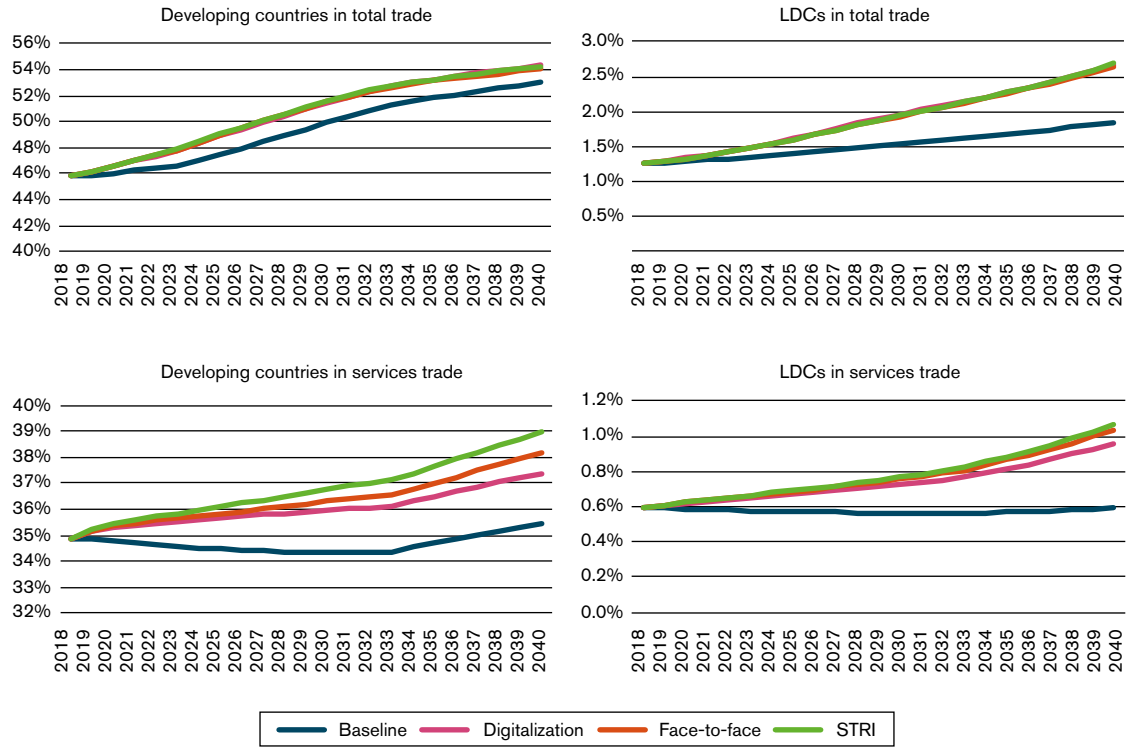


Source: Simulations with WTO Global Trade Model.

Notes: The figure displays the value share of global trade in different services sector in total global services trade. The scenarios are cumulative.

Figure D.39: The share of developing and least-developed countries in services trade rises in scenarios with trade cost reductions

Share of developing countries (left panels) and least-developed countries (right panels) in total trade (upper panels) and services trade (lower panels), 2018-40



Source: Author's calculation with the WTO Global Trade Model.

into more detail in WTO (2018a) and compared there with a scenario in which countries' technologies and trade cost reductions do not display convergence.

The share of developing countries in services trade displays much more variation across the different scenarios. Whereas the share is projected to stay roughly constant in the baseline scenario, at around 35 per cent, it is expected to increase to almost 40 per cent in the face-to-face scenario. The share of developing countries is projected to increase in the digitalization scenario for the same reason as described above for total trade: developing countries are expected to catch up in technologies impacting trade costs. However, both additional scenarios raise the share of developing countries in services trade more.

First, developing economies are expected to benefit more from the reductions in trade costs in the face-to-face scenario, despite the fact that the modelled reduction in trade costs in this scenario does not vary by country. The reason that developing economies benefit disproportionally from trade cost reductions is related to the fact that trade cost reductions are concentrated in the skills-intensive services sectors. And, as may be seen in Table D.4, the supply of skilled labour is expanding rapidly in developing economies. Hence, the demographic changes in the supply of skilled labour and the reductions in face-to-face related trade costs reinforce each other in their impact on a rising share of developing economies in services trade.

Second, the STRI-scenario of convergence contains a stronger reduction of trade policy barriers in developing economies, which tend to start with a higher initial level of trade restrictiveness.

(d) Overview of the simulation results

Bearing in mind that our model does not capture trade growth on the extensive margin (that is, growth generated by new trading relationships or new sectoral flows) and trade in services through foreign affiliates, our simulations give rise to three main conclusions:

1. The share of services output in total output is projected to increase substantially from 74 per cent to 82 per cent in the baseline scenario, whereas the share of services trade is projected to increase only marginally (from 21 per cent to 22 per cent based on GTAP data) in the baseline scenario. Digitalization will increase the share of services in trade to about 26 per cent. If the need for face-to-face contact becomes less of a barrier for trade and trade policy barriers are reduced, the share of services trade could increase further, to more than 30 per cent. This represents a 50 per cent increase in the share of services trade in global trade. Hence, new technologies and changes in policy are projected to bring the share of services trade closer to the share of services output in total output.

2. Whereas trade growth is projected to be higher in goods than in services in the baseline, services trade growth is projected to outpace trade growth in agriculture and manufacturing in the digitalization scenario. Trade growth is highest in least-developed countries, because of higher projected GDP growth and stronger reductions in trade costs in both the baseline and the digitalization scenario. Although reductions in trade barriers are modelled to occur mostly in lower-income countries, export growth in developed countries would also be promoted by it.

3. The share of developing countries in services exports is projected to stay around 35 per cent in the baseline scenario, although the share of developing countries in total trade is projected to become more than 50 per cent. Hence, the simulations do not provide support for the hypothesis that changes to demography and education incorporated in the baseline, such as the increasing supply of skilled labour in developing countries, raise the strength of developing countries in services trade. However, the interaction of demographic changes and technological changes will expand the role of developing countries in services trade. In the scenario in which all trade costs decline, the share of developing countries in services trade would rise substantially from 35 per cent to almost 40 per cent, representing an increase of about 15 per cent. Developing countries would benefit disproportionally from lower trade costs in services, because of the strong projected growth in the number of skilled workers in these countries.

4. Concluding observations

The future is going to change the quantity of services we trade, what services we trade, the ways we trade services, and who trades them. The evolution of barriers to services trade, technological developments, trends in demography and income growth, and climate change are some of the key factors that will drive future patterns of trade in services. This report looks at these trends and highlights some of the key channels through which the effects on trade in services may play out in the future.

Measuring trade costs using a novel approach, this report estimates that overall trade cost in services are

higher than in trade in goods, but that they have gone down over time. Regulatory barriers have fallen. Digital platforms and new technologies are likely to reduce the cost of services trade even further in the future. These trends are likely to boost trade and to increase the variety of services traded in the future. There is a potential for services to favour inclusiveness, as lower barriers to trade allow more small businesses and women to participate in services trade.

The future development of regulation in digital services trade and investment in digital infrastructures will be key in determining countries' comparative advantages in digitally enabled services sectors. On average, reforms have reduced policy barriers in some sectors over time, yet new trade restrictions in some sectors, especially in digitally-enabled services have emerged. Regulatory differences between economies can pose high compliance costs for firms, especially small enterprises. Without more cooperation in the area of services trade-restrictiveness, there is the risk that, while macroeconomic trends and technologies may provide for more inclusive services trade, policies may impede these gains.

Digital technologies will affect trade in services not only through their effects on trade costs. This report highlights three more channels. First, technological developments affect trade in services because they affect the productivity of the services sectors. ICT technologies are the main drivers of this phenomenon, and patterns of R&D and innovation suggest that they will continue to play a key role in the future. ICT-intensive sectors are likely to dominate the future of trade in services. Second, new technologies blur the difference between goods and services activities. Third, digital technologies affect trade in services through their effects on global value chains. The largest share of services trade is currently represented by the demand for services inputs by firms operating within a global value chain. Since there is no evidence of reshoring, we expect demand for services trade through this channel to be sustained.

Another global trend that will have a major impact on trade in services relates to demographic changes. A population's age structure plays a key role in affecting the composition of future services import demand and patterns of specialization. An ageing population in developed countries will demand more health services. A growing young population in developing countries will demand education and digital services. Trade in services will be key to satisfying these demands. Digital technologies may facilitate imports of educational services in developing countries, with potential positive development effects.

Millennials and Generation Z will represent an increasing share of the population. On average, they constitute more than 50 per cent of major social media platforms users and spend more than two and half hours per day on social media, compared to one hour for Baby Boomers. Demand for online services is therefore likely to increase in the future, providing new opportunities. For example, streaming services provide opportunities for artists in developing countries, for example, to export their creative content to international markets at low costs.

One of the most striking features of the global economy since the start of the millennium is the increasingly significant role played in it by developing countries. Developing economies have increased their rate of convergence with developed economies, and predictions are that this trend is going to persist in the future – although at a slower pace – with some developing countries converging toward the GDP of developed countries. As their income grows, consumers devote a larger share of it to services, especially skills-intensive services. And, in parallel, as their income grows, countries increasingly specialize in the production of skill-intensive services. We should expect increasing trade in services as economies converge.

Finally, the report turns to the phenomenon of climate change and the likelihood that it will disrupt some services and their trade. In tourism and recreation services, climate change is putting some destinations at risk. In transportation, climate change will disruption some of the traditional routes, and probably open new ones. But, pushed by the changing demand from consumers and government regulation, services industries are adapting to become more environmentally friendly. This is the case, for example, of the growing demand for ecotourism, especially from the Millennial generation. The market for environmental goods and related environmental services (such as project consultancy services, transportation and installation of wind turbines and towers required for the construction of wind power systems) is expected to grow significantly in the future. Trade in these environment-related services is likely to grow and provide helpful in adapting to and mitigating climate change.

In order to get a sense of the potential quantitative impact of these major trends on services trade, the report uses the WTO CGE model to run a number of simulations. The model does not capture trade in services through foreign affiliates and it can only partially account for the creation of new services trade relationships, therefore it cannot account for all the dynamics the Report discusses in relation

to major trends. Nevertheless, it provides some interesting insights. First, looking at the patterns of trade in services between 2019 and 2040, our simulation shows that the future expected patterns of demographic changes and income growth alone will only marginally increase the share of services trade in the global economy unless the effects take place through FDI or new trade relationships.

Then, having established this baseline scenario, we examine the impact of three trends: (i) general lower services trade costs due to technological innovation; (ii) reduced need for face-to-face interaction; and (iii) reduction of the policy barriers to services trade. Our simulations project that, under this scenario (where future technological changes are accompanied by a reduction of services trade barriers), the services sector's share of global trade will grow by 50 per cent. If developing countries adopt new technologies, their share in global services trade will increase by about 15 per cent.

While the discussion in this section about the future of trade in services tended to focus on the opportunities that future trade in services may provide, it also foreshadows issues related to social disruption, competition issues and security concerns, which the major trends may bring about and which may become important for the WTO and for international cooperation in the future.

Appendix D.1: Trade costs and their decomposition

Trade cost are estimated using a sector-level gravity model specification proposed in Egger et al. (2018). First, we obtain the coefficients on country-pair dummies $(\widehat{d_{ij}})$ from a fully saturated gravity model using a Pseudo Poisson Maximum Likelihood (PPML) estimator. The underlying international and domestic trade data come from the World Input-Output Database (WIOD) for 2000 to 2014, and from experimental multiregional input-output tables by the Asian Development Bank (ADB-MRIO) for 2015 to 2017.[55] We concorded the two datasets to ensure their consistency.

Second, to obtain trade costs (T_{ij}) we transform these estimates using a sectoral elasticity of substitution θ:

$$T_{ij} = (\widehat{d_{ij}})^{-1/\theta}$$

The parameter θ is estimated for each sector in Egger et al. (2018). A higher θ means a more elastic reaction of demand to prices, and hence a higher responsiveness of import demand to trade frictions. Generally, θ takes on a lower value for services than for manufactures, implying that trade in services reacts less to changes in trade costs. The use of sector-specific elasticities also means that the estimated size of trade costs differs from conventional estimates that typically use one uniform elasticity of substitution for all sectors.

In the subsequent analysis we identify the factors which explain T_{ij}, run a regression analysis with importer and exporter fixed effects, and use the results to decompose the bilateral variation in T_{ij} into different components.

The use of importer and exporter fixed effects precludes identification of factors that have the same impact on trade across all partners. However, we are still able to include several country-specific variables which are likely to drive bilateral trade costs. For instance, both partners need to a have good broadband coverage. Having fast internet access in the exporting economy does not help if nobody is connected in the importing economy. Hence bilateral trade costs will be determined by the minimum of the two partners.

The estimated equation is

$$\begin{aligned}\ln(T_{ij}) = \alpha + \boldsymbol{\beta} \cdot Transport\ and\ travel_{ij} + \boldsymbol{\gamma} \cdot Information\ and\ transaction\ costs_{ij} \\ + \boldsymbol{\delta} \cdot ICT\ penetration_{ij} + \boldsymbol{\varphi} \\ \cdot Trade\ policy\ and\ regulatory\ differences_{ij} + \boldsymbol{\rho} \\ \cdot Governance\ quality_{ij} + \varphi_i + \theta_j + \epsilon_{ij}.\end{aligned}$$

- To capture the impact of transportation and travel costs on total bilateral trade frictions, the set of variables in $Transport\ and\ travel_{ij}$ includes the log of population-weighted distance, a binary variable indicating whether the trading partners share a border and a binary variable indicating whether either of the trading partners is landlocked.[56] Additionally, it includes the minimum between the exporter's and the importer's quality of port infrastructure[57] and the minimum of trade- and transport-related infrastructure.[58]
- To capture the impact of information and transaction costs, the set of variables in $Information\ and\ transaction\ costs_{ij}$ includes having a common ethnic language, having a common religion, having a common legal origin, previously being in a colonial relationship, previously being the same country[59] and the historical stock of migrants (in 1970) from the exporting in the importing country and from the importing in the exporting country.[60]
- $ICT\ penetration_{ij}$ consists of the minimum of the exporter's and the importer's broadband coverage per capita, mobile phone subscriptions per capita and fixed line subscriptions per capita.[61]
- To capture trade policy barriers and regulatory differences, the set of variables in $Trade\ policy\ and\ regulatory\ differences_{ij}$ includes being in a free trade agreement, being part of the European Union and being part of the Eurozone.[62] It also includes the OECD's Services Trade Restrictiveness Index (STRI) heterogeneity, applied bilateral tariffs[63] and the burden of customs procedures.[64] Note that in services regressions, the STRI heterogeneity is at a sectoral level, while in goods regressions, we include the simple average of STRI heterogeneity across all services sectors. Similarly, tariffs are sector-specific in goods regressions, while in services regressions we use the simple average bilateral tariff.
- $Governance\ quality_{ij}$ includes differences in the rule of law, regulatory quality and corruption, as well as the minimums of these variables between the importer and the exporter.[65]

While trade cost trend figures are based on 43 economies, the regressions for the decomposition of trade costs are run on data from 2016 and include 30 economies (870 country pairs), as this is the latest year and the largest sample for which all variables are available.[66] The estimation is run separately for each two-digit sector. The R-squared decomposition is computed using the Shapley and Owen values.

Appendix D.2: Simulations

This appendix contains technical details about the different trends included in the quantitative simulation exercise. The size of the effects of different trends is based on econometric work, together with scenario-building (for falling trade costs as a result of new technologies, the rising share of e-commerce, falling trade policy barriers, and the reduced importance of face-to-face interaction), on predictions from the literature (for the productivity part of digitalization and robotization) and on trends in the past (for rising capital income shares and a more intensive use of ICT services).[67]

To construct the baseline, the GTAP10 (Global Trade Analysis Project) database (Version 3) for 2014 is aggregated to 20 regions, 16 sectors, and five factors of production (see Appendix Tables D.1 and D.2 for an overview of the aggregation).[68] Based on the 2014 baseline data, the development of the global economy is projected to 2023 using medium-run macroeconomic projections from the IMF on GDP per capita growth, population growth, employment growth and changes in the savings rate. From 2023 to 2040 the projections are disciplined by long-run projections from the OECD (shared socio-economic pathways, SSP2)[69] (Dellink et al., 2017) on GDP per capita growth and complemented by UN projections on population and labour force growth.

(a) Aggregation of regions and sectors

Appendix Tables D.1 and D.2 display the aggregation of regions and of sectors, respectively.

Appendix Table D.1: Aggregation of regions

Code	Region	Comprising
asl	Asian LDCs	Cambodia; Bangladesh; Lao People's Democratic Republic; Myanmar; Nepal; Rest of Southeast Asia
aus	Australia	
bra	Brazil	
can	Canada	
chn	China	
e28	European Union (28)	
eft	EFTA	
ind	India	
jpn	Japan	
kor	Republic of Korea	
lac	Latin America and the Caribbean	
mex	Mexico	
min	Middle East and North Africa	
oas	Other Asian economies	Hong Kong (China); Mongolia; New Zealand; Pakistan; Sri Lanka; Chinese Taipei; Rest of Oceania; Rest of East Asia; Rest of South Asia.
row	Rest of world	Albania; Armenia; Azerbaijan; Belarus; Georgia; Kazakhstan; Kyrgyz Republic; Tajikistan; Ukraine; Rest of Eastern Europe; Rest of Europe; Rest of Former Soviet Union; Rest of the world.
rus	Russian Federation	
sea	Southeast Asia	Brunei Darussalam; Indonesia; Malaysia; Philippines; Singapore; Thailand; Viet Nam.
ssl	Sub-Saharan African LDCs	Benin; Burkina Faso; Ethiopia; Guinea; Madagascar; Malawi; Mozambique; Rwanda; South Central Africa; Tanzania; Togo; Uganda; Zambia; Zimbabwe; Rest of Eastern Africa; Rest of Western Africa.
sso	Sub-Saharan Africa other	Botswana; Cameroon; Central Africa; Côte d'Ivoire; Ghana; Kenya; Mauritius; Namibia; Nigeria; Senegal; South Africa; Rest of South African Customs Union.
usa	United States	

Notes: 141 GTAP regions are aggregated to 20 regions. Only details for regions not unambiguously defined are included.

Appendix Table D.2: Aggregation of sectors

Code	Region	Comprising
agr	Agriculture	
ext	Mining and extraction	
prf	Processed food	
che	Chemicals and petrochemicals	
otg	Other goods	Leather products; manufactures nec; paper products, publishing; textiles; wearing apparel; wood products.
met	Metals	
elm	Electronic equipment	
otm	Other machinery, motor vehicles	Machinery and equipment nec; mineral products nec; motor vehicles and parts; transport equipment nec.
utc	Utilities and construction	
trd	Wholesale and retail	
acr	Accommodation and recreation	Accommodation, food and services; recreational and other services.
tra	Transport	
com	Communications	
ict	ICT services	
rsa	Real estate activities	
obs	Business services	
fin	Finance and insurance	
ots	Other services	Public administration and defence, education, healthcare and dwellings.

Notes: 65 GTAP regions are aggregated to 16 sectors. Only details for sectors not unambiguously defined are included. "nec" is "not elsewhere classified".

(b) Changes in technology because of digitalization

Three types of technological change because of digitalization are included in the simulations and the technical details of each of the three is discussed in turn.

(i) Reallocation of tasks from labour to capital

We follow the approach in WTO (2018a) to model the reallocation of tasks from labour to capital and thus refer for the technical details to Appendix C.3 of last year's report. The trend is modelled within the theoretical framework developed by Acomoglu and Restrepo (2018) of an optimal allocation of capital and labour to different tasks. Following Acemoglu and Restrepo we assume that the initial allocation of tasks is suboptimal. Therefore, reallocation leads to both higher productivity growth and a change in the capital share of production. Projections on higher productivity growth varying by sector are based on studies of the impact of digitalization on productivity growth. The rising capital income share is based on historical trends, and variation across economies in the reallocation of tasks towards capital is determined by variation in the Digital Readiness Index of the World Economic Forum (WEF). Based on the different studies, productivity growth is projected to increase by 1.25 per cent on average, and the labour income share is projected to fall by 0.02 (2 percentage points) per decade. However, these trends differ per sector and per economy, with the former determined by the studies on productivity growth, and the latter by the digital readiness index from WEF. The scaling factors of both the additional productivity growth and changes in the capital income share are displayed in Appendix Table D.3.

(ii) More intensive use of ICT services

To project the change in the share of ICT services, we combine empirical estimates using historical data from the WIOD between 2000 and 2014 and projections on the tendency for the share of ICT services to fall over time, given the above average productivity growth of ICT services in our model. More specifically, suppose the initial share of supplying sector k to using sector l in the data is s_{kl}^{in} in and the final share is s_{kl}^{in}. Based on the model without a more intensive use of ICT services, the share of sector k is projected to change from $\widetilde{s_{kl}^{in}}$ to $\widetilde{s_{kl}^{fin}}$ because of differential productivity growth. Then the projected change in the share of sector k is given by:

Appendix Table D.3: Scaling factors of regions and sectors for the calculation of productivity growth and capital income share changes due to new technologies

Regions	Scaling factor	Sectors	Scaling factor
Sub-Saharan African LDCs	0.64	Metals	0.64
Asian LDCs	0.69	Processed food	0.65
Sub-Saharan Africa other	0.77	Agriculture	0.65
Latin America and Caribbean	0.83	Other services	0.66
India	0.83	Transport	0.73
Mexico	0.88	Mining and extraction	0.86
Brazil	0.88	Other goods	0.87
China	0.92	Utilities and construction	0.87
Rest of world	0.95	Chemicals and petrochemicals	0.99
Middle East and North Africa	0.97	Real estate activities	1.05
Southeast Asia	0.97	Other business services	1.05
Russian Federation	0.99	Wholesale and retail	1.07
Other Asian economies	1.09	Accommodation and recreation	1.07
European Union (28)	1.15	ICT services	1.22
Australia	1.21	Communications	1.23
Canada	1.23	Finance and insurance	1.30
Republic of Korea	1.23	Other machinery and motor vehicles	1.56
Japan	1.23	Electronic equipment	1.64
EFTA	1.27		
United States	1.27		

Source: Own calculations based on empirical regressions and studies on productivity effects of digitalization.

Notes: Scaling factors determine both the additional productivity growth relative to the average (1.25 per cent per year) and the change in the capital income share relative to the average (0.02 per decade).

$$\Delta sh_{kl}^{proj} = sh_{kl}^{fin} - sh_{kl}^{in}\frac{\widetilde{s_{kl}^{fin}}}{\widetilde{s_{kl}^{in}}} = \Delta sh_{kl}^{emp} - sh_{kl}^{in}\frac{\widetilde{s_{kl}^{fin}} - \widetilde{s_{kl}^{in}}}{\widetilde{s_{kl}^{in}}} \quad \text{(D.1)}$$

For example, if the share of sector k in sector l has changed historically from 2 per cent to 2.5 per cent in the data, whereas it is projected to fall from 3 per cent to 2.5 per cent in the simulations, then the trend in the share of sector k, net of the influence of differential productivity growth, is:

$$\Delta sh_{kl}^{proj} = 2.5\% - 2\%\frac{2\%}{3\%} = 0.5\% - 2\%\frac{2\%-3\%}{3\%} = 1\tfrac{1}{6}\% \quad \text{(D.2)}$$

Table Appendix D.4 contains the observed change in the share of ICT services used in other sectors from 2000 to 2014 (over 15 years), the simulated change in the share of ICT services from 2018 to 2032 in the data, and the projected changes based on equation (D.1).

(iii) Trade cost reductions associated with technological change

Projected trade cost reductions associated with technological change are modelled in two steps following the same approach as in WTO (2018a). First, trade costs inferred from international relative

Appendix Table D.4: Estimation results share of ICT services used by different sectors as intermediate input in historical data and simulated data

	Agriculture	Business services	Chemicals and petrochemicals	Communications	Electronic equipment	Mining and extraction	Finance and insurance	ICT services
Historical data								
Average normal change in shares								
Coefficient	0.00987***	0.00382	0.00951**	0.08254***	0.00996	0.01684***	0.11100***	0.50010***
Standard error	-0.00325	-0.00571	-0.00374	-0.01579	-0.00779	-0.00467	-0.02634	-0.09197
Number of observations	600	586	600	600	600	600	600	586
Simulated data								
Average percentage change in shares								
Coefficient	-0.0829***	-0.9728***	-0.1617***	-0.7185***	0.0386	-0.6344***	-0.8842***	-0.7724***
Standard error	(0.0222)	(0.0184)	(0.0223)	(0.0160)	(0.0285)	(0.0165)	(0.0158)	(0.0156)
Number of observations	420	420	420	420	420	420	420	420
	Met	otg	othm	ots	Prf	tra	trd	Utc
Historical data								
Average normal change in shares								
Coefficient	0.01175***	0.01916***	0.01500***	0.02679***	0.01359***	0.01841	0.03498***	0.00614
Standard error	-0.00344	-0.00412	-0.00396	-0.0054	-0.00436	-0.0125	-0.00959	-0.0042
Number of observations	600	600	600	600	600	600	600	600
Simulated data								
Average percentage change in shares								
Coefficient	-0.4876***	-0.3112***	-0.3703***	-0.8699***	-0.1329***	-0.4800***	-0.7543***	-0.5618***
Standard error	(0.0205)	(0.0213)	(0.0183)	(0.0152)	(0.0225)	(0.0173)	(0.0163)	(0.0188)
Number of observations	420	420	420	420	420	420	420	420

Source: Own regressions using data from WIOD and simulation results with Global Trade Model.

Notes: Upper panel estimates report average yearly normal changes in shares of ICT services in different sectors with historical data from WIOD, and lower panel estimates report average yearly percentage changes in shares of ICT services with simulated data with the WTO Global Trade Model. *** p<0.01, ** p<0.05, * p<0.1

to intra-national trade, using the GTAP10 data also used in the simulations, are regressed on a host of determinants of trade costs. This is done for the three aggregate sectors: primary, secondary and tertiary. Second, a scenario is formulated for the change in the variables related to new technologies, as in WTO (2018a), based on the assumption that values converge to the level of the highest quartile (i.e. the 25 per cent highest value). Appendix Table D.5 contains the results of the regressions of inferred trade costs.

There are three changes compared to WTO (2018a). First, trade costs are calculated using GTAP data, in order to generate consistency between the data used for the simulations and for the estimation. Second, in line with the trade cost decomposition presented earlier in this section, more control variables are included in the regression of inferred trade costs on its determinants, in particular the World Bank measures Rule of Law and Quality of Regulation introduced in Appendix D.1. This reduces the risk of omitted variable bias and thus the risk that projected trade cost reductions may be overestimated.[70] Third, the variables included to capture the influence of digital technologies are changed. Five variables are included. To capture the influence of digital technologies on customs procedures, the lead time to export is included. This variable only affects trade costs for manufacturing sectors in the simulations and does not play a role for services in the scenario for changes in trade costs. Measures of the quality

Appendix Table D.5: Regression of inferred trade costs on measures of trade costs

Variables	Primary sector	Secondary sector	Tertiary sector
Dummy for FTA	-0.0880***	-0.0846***	-0.0167
	(0.0101)	(0.0118)	(0.0165)
Dummy for common colony	0.00935	-0.0831***	-0.0493**
	(0.0172)	(0.0205)	(0.0241)
Dummy for colonial relation	-0.176***	-0.225***	-0.258***
	(0.0274)	(0.0314)	(0.0527)
Log (distance)	0.0865***	0.144***	0.153***
	(0.00495)	(0.00586)	(0.00809)
Dummy for landlocked	0.181***	0.181***	0.164***
	(0.00661)	(0.00877)	(0.0120)
Dummy for common border	-0.237***	-0.266***	-0.332***
	(0.0207)	(0.0273)	(0.0361)
Log(credit environment)	-0.0697***	-0.110***	-0.0868***
	(0.00687)	(0.00831)	(0.0118)
Log(contract environment)	0.000986	-0.0251*	0.231***
	(0.0112)	(0.0133)	(0.0196)
Dummy for common language	-0.0677***	-0.141***	-0.0680***
	(0.0114)	(0.0119)	(0.0181)
Log(lead time to export)	-0.0100	0.0301***	0.0367***
	(0.00730)	(0.00907)	(0.0116)
Log(broadband connectivity)	-0.0493***	-0.0809***	-0.0988***
	(0.00370)	(0.00448)	(0.00646)
Log(rule of law)	-0.374***	-0.580***	-0.790***
	(0.0285)	(0.0344)	(0.0477)
Difference rule of law	-0.00353	-0.00755*	-0.00832
	(0.00326)	(0.00413)	(0.00614)
Log(regulatory quality)	0.280***	0.295***	0.439***
	(0.0270)	(0.0331)	(0.0442)
Difference regulatory quality	-0.00527	-0.00214	-0.0141**
	(0.00333)	(0.00411)	(0.00594)
Constant	0.538***	0.789***	0.921***
	(0.0908)	(0.110)	(0.156)
Observations	5,565	5,565	5,565
R-squared	0.426	0.568	0.455

Source: Dependent variable constructed based on GTAP-data. Explanatory variables from the Centre d'études prospectives et d'informations internationales (CEPII) and the World Bank, as described in Appendix D.1.

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table D.6: Ad valorem equivalent trade cost reductions different trends (averages across economies)

Regions	Common language	Credit and contract	Broadband subscription	Digitalization total	Face-to-face	STRI	Total
Asian LDCs	-8.15	-7.15	-10.55	-23.72	-12.74	-0.85	-34.00
Australia	-5.37	-0.59	-0.41	-6.31	-13.56	-0.99	-19.82
Brazil	-8.43	-2.52	-1.46	-12.04	-14.31	-1.04	-25.41
Canada	-3.11	-1.18	-0.24	-4.49	-12.19	-0.45	-16.51
China	-9.27	-1.27	-1.36	-11.63	-11.86	-0.74	-22.69
European Union (28)	-7.21	-1.59	-0.39	-9.04	-13.27	-0.37	-21.41
EFTA	-5.60	-1.30	-0.30	-7.10	-14.35	-0.58	-20.89
India	-7.05	-3.12	-8.00	-17.15	-9.15	-1.98	-26.22
Japan	-8.74	-0.87	-0.51	-9.98	-10.39	-0.01	-19.34
Republic of Korea	-5.89	-0.25	-0.41	-6.51	-10.90	-1.57	-18.01
Latin America	-4.86	-2.38	-1.65	-8.65	-12.40	-0.72	-20.55
Mexico	-3.54	-0.11	-0.45	-4.08	-10.87	-0.54	-14.97
Middle East and North Africa	-7.12	-2.18	-2.44	-11.36	-12.12	-1.43	-23.21
Russian Federation	-7.79	-0.55	-0.48	-8.73	-13.98	-1.76	-22.88
Southeast Asia	-5.98	-0.84	-2.47	-9.07	-12.73	-0.91	-21.37
Sub-Saharan African LDCs	-7.78	-9.89	-14.93	-29.31	-14.12	-0.80	-39.77
United States	-4.34	-0.52	-0.45	-5.27	-10.89	-0.57	-16.07
Other Asian economies	-5.46	-1.18	-1.71	-8.17	-12.24	-0.41	-19.74
Sub-Saharan Africa other	-5.50	-3.07	-12.13	-19.51	-12.67	-1.07	-30.46
Rest of world	-7.02	-0.86	-1.50	-9.20	-11.97	-1.37	-21.16
Average	**-6.62**	**-1.45**	**-1.47**	**-9.33**	**-12.29**	**-0.70**	**-21.03**

Source: WTO calculations based on various methodologies as described in the text.

Notes: The table displays the contribution of different variables to the reduction in trade costs in the different scenarios. "Common language", "Credit and contract" and "Broadband subscription" measure the reduction in trade costs because of a reduced impact of the absence of a common language, a poor credit and contract environment, and a low number of broadband subscriptions, respectively. "Face-to-face" measures the reduction in trade costs because of the reduced importance of face-to-face contact for trade costs. "STRI" measures the reduction in trade costs because of an improvement in services trade regulation. The methodology is described in the text. Note that percentage reductions are not additive.

of contracts and credit institutions are included, based on the assumption that their influence will be reduced if blockchain technologies are developed, which will make market participants less dependent on poor credit and contract institutions. Next, it is argued that the negative impact of common language on trade costs will fall because of the introduction of new technologies. Finally, regressions show that the number of broadband subscriptions has a negative influence on trade costs and it is assumed that lagging economies in terms of broadband subscriptions will catch up with the 75 per cent best-performing regions.[71]

(c) Reductions in trade policy barriers

Reductions in trade policy barriers are obtained in two steps. First, services trade flows inclusive of domestic flows in five sectors are regressed on an interaction term of the World Bank STRI with a trade-with-self (border) dummy and a host of control variables. Since the STRI is a most-favoured-nation measure applying to imports from all trading partners, the impact of the STRI is identified based on the difference between domestic purchases and imports, technically by including an interaction term of the STRI with a border dummy. Although the trade data consist only of balance-of-payments data (GATS modes 1, 2 and 4), for trade restrictiveness, the total STRI (a weighted average of the STRIs for all four modes) was included. The reason to do so is that restrictions to mode 3 trade will also affect trade through the other modes, both if the different modes are complementary or if they are substitutable.

Appendix Table D.8 contains the results of the regressions (using a Pseudo Poisson Maximum Likelihood) for the five sectors on which the STRI is available (see also Borchert et al., 2019b). The table shows that the STRI has a negative and significant

Appendix Table D.7: Ad valorem equivalent trade cost reductions different trends (sector averages)

Regions	Common language	Credit and contract	Broadband subscription	Digitalization total	Face-to-face	STRI	Total
Agriculture	-5.33	-0.82	-1.48	-7.49	0.00	0.00	-7.49
Mining and extraction	-8.82	-1.40	-2.84	-12.65	0.00	0.00	-12.65
Processed food	-11.21	-1.87	-2.79	-15.31	-18.95	0.00	-31.36
Chemicals and petrochemicals	-7.15	-0.95	-1.45	-9.36	-12.61	0.00	-20.79
Metals	-5.85	-0.70	-1.10	-7.55	-11.01	0.00	-17.73
Electronic equipment	-4.78	-0.35	-0.45	-5.54	-11.91	0.00	-16.78
Utilities and construction	-6.07	-3.47	-2.27	-11.38	-25.49	0.00	-33.97
Retail and wholesale	-6.20	-3.41	-0.99	-10.29	-44.53	0.00	-50.24
Accommodation and recreation	-6.49	-3.53	-1.54	-11.18	-44.53	0.00	-50.73
Transport	-6.61	-4.09	-1.94	-12.18	-30.55	-15.63	-48.54
Communications	-6.48	-4.63	-2.10	-12.68	-32.38	-5.03	-43.93
ICT services	-6.48	-4.63	-2.10	-12.68	-27.59	0.00	-36.77
Real estate	-6.59	-5.09	-2.90	-13.92	-27.59	0.00	-37.66
Finance and insurance	-5.97	-4.55	-0.92	-11.07	-39.78	-4.05	-48.62
Other goods	-6.09	-0.83	-1.15	-7.93	-11.65	0.00	-18.66
Other machinery, motor vehicles	-6.33	-0.58	-0.67	-7.51	-7.49	0.00	-14.43
Other business services	-6.30	-4.84	-2.44	-13.01	-27.59	0.00	-37.01
Other services	-5.96	-3.43	-2.59	-11.54	-37.11	0.00	-44.37
Average	**-6.62**	**-1.45**	**-1.47**	**-9.33**	**-12.29**	**-0.70**	**-21.03**

Source: WTO calculations based on various methodologies as described in the text.

Notes: The table displays the contribution of different variables to the reduction in trade costs in the different scenarios. "Common language", "Credit and contract" and "Broadband subscription" measure the reduction in trade costs because of a reduced impact of respectively the absence of a common language, poor credit and contract environment and a low number of broadband subscriptions. "Face-to-face" measures the reduction in trade costs, because of a reduced importance of face-to-face contact for trade costs. "STRI" measures the reduction in trade costs because of an improvement in services trade regulation. The methodology is described in the text. Note that percentage reductions are not additive.

Appendix Table D.8 Regression of services trade, measures of trade costs, and the interaction between STRI and a border dummy

	Transport	Insurance	Banking	Information and communications	Professional services
Ln(distance)	-0.2047***	-0.5427***	-0.1771*	-0.5160***	-0.0826
	(0.057)	(0.179)	(0.094)	(0.096)	(0.053)
Contiguity	0.5921***	-0.2377	-0.2016	-0.0171	0.4353***
	(0.138)	(0.394)	(0.225)	(0.206)	(0.127)
Common language	0.8739***	1.4100***	1.4235***	0.9552***	0.9797***
	(0.119)	(0.322)	(0.166)	(0.184)	(0.106)
Common religion	-0.3841*	-0.4881	-0.7664**	-0.0518	-0.2764
	(0.214)	(0.594)	(0.338)	(0.283)	(0.188)
Common legal origin	-0.0365	-0.2325	-0.0499	-0.2780*	-0.0174
	(0.095)	(0.273)	(0.144)	(0.154)	(0.088)
FTA dummy (WTO)	0.2605**	0.1392	0.1287	0.3104*	0.2482**
	(0.110)	(0.351)	(0.184)	(0.170)	(0.100)
Dummy both EU	0.8654***	1.2343***	1.0964***	1.0291***	1.1226***
	(0.126)	(0.355)	(0.226)	(0.183)	(0.111)
Border dummy	6.7516***	-0.8487	-4.0299*	-0.3701	-3.4687***
	(1.366)	(2.789)	(2.326)	(2.223)	(0.938)
Border dummy* STRI	-2.9917***	-1.3762*	-0.2896	-1.1997**	-0.3157
	(0.367)	(0.737)	(0.609)	(0.608)	(0.253)
Observations	2555	2358	2353	2524	2595

Source: Borchert et al. (2019b).

Notes: Standard errors in parentheses. Dependent variable: services imports in 2016. Estimation method: Pseudo Poisson Maximum Likelihood. Full sets of exporter-year and importer-year fixed effects included but not reported. * p <0.10, ** p<0.05, *** p<0.01.

impact on international trade flows in three of the five sectors: transport, telecommunication and insurance. In the other two sectors, business services and banking, the STRI is insignificant.

In the second step, a scenario is built for reduction of services trade restrictiveness in the different economies. In particular, it is assumed that the STRI falls to the median of the quartile with the lowest STRI. This implies that economies with the highest level of restrictiveness will display the largest trade cost reductions, whereas economies with the lowest level of restrictiveness will not display any trade cost reduction.

To map the changes in STRI in the described convergence scenario into reductions in trade costs, the ad valorem equivalent of the scenario is calculated based on the following formula with $STRI_k^{BM}$, the benchmark level of the STRI in sector k, β_k the coefficient on the interaction term of STRI and the border dummy, and σ_k the substitution elasticity used in the simulations and:[72]

$$AVE_{ik} = \left[exp\left(\frac{\beta_k \left(ln\left(STRI_k^{BM}\right) - ln\left(STRI_{ik}\right) \right)}{\sigma_k - 1} \right) - 1 \right] * 100$$

The trade-weighted average STRIs for the different economies and sectors are in Appendix Table D.9. It is assumed that the trade costs associated with restrictive trade policies are cost-increasing and changes are thus modelled as changes in (cost-increasing) iceberg trade costs. Although some modellers assume that trade restrictions are partially rent-increasing instead of cost-increasing, the fact that rents lead mostly to rent-seeking implies that also rent-increasing trade costs are resource-dissipating and thus cost-increasing.[73]

Appendix Table D.9: Ad valorem trade cost reductions in three services sectors associated with reductions in STRI

STRI	Transport	Communication	Finance and insurance
Asian LDCs	2.83	0.60	0.43
Australia	0.71	0.25	0.11
Brazil	0.75	0.59	0.27
Canada	0.42	0.88	0.09
China	1.47	1.30	0.79
European Union (28)	0.75	0.22	0.09
EFTA	1.16	0.51	0.13
India	3.09	0.74	0.46
Japan	0.00	0.10	0.02
Republic of Korea	1.85	0.33	0.00
Latin America	0.65	0.33	0.20
Mexico	1.94	0.39	0.77
Middle East and North Africa	1.97	0.68	0.57
Russian Federation	1.75	0.53	0.27
Southeast Asia	1.35	0.26	0.19
Sub-Saharan African LDCs	1.15	0.23	0.44
United States	0.62	0.00	0.22
Other Asian economies	0.44	0.23	0.05
Sub-Saharan Africa other	1.15	0.23	0.44
Rest of world	2.50	0.49	0.06
Average	**1.33**	**0.44**	**0.28**

Source: Borchert et al. (2019b).

Notes: The table displays the reduction in ad valorem trade costs associated with the reduction in STRI according to convergence of the STRI to the level of the median economy of the lowest quartile of the STRI.

(d) The influence of face-to-face interactions on trade costs

In our setting, trade costs are inferred from the amount of international relative to intra-national trade, following Head and Ries (2001) as well as Chen and Novy (2011). We refer to our measure of trade costs as the Head-Ries-Meissner or the HRM Index. To this end, we employ data from the most recent GTAP10 database, for the year 2014. Furthermore, for easier comparability, we set the substitution elasticity equal across sectors.[74]

We further calculate the importance of face-to-face interactions for different sectors using the US O*NET database.[75] This dataset contains measures indicating the importance of certain tasks for different occupations on a scale from 0-100. Following Blinder (2009), we make use of four task indicators, which are likely to capture the importance of face-to-face interactions. These are "Establishing and maintaining personal relationships", "Assisting and caring for others", "Performing for or working directly with the public" and "Selling or influencing others".[76] These variables are available at the occupational level and therefore must be mapped to the industry level. In doing so, we follow the methodology in Oldenski (2012) by using data on the shares of occupations used in each industry from the US Bureau of Labor Statistics Occupational Employment Statistics (2007, 2010). Unfortunately, it was impossible to match the task-based occupation data to certain agricultural and natural resource sectors, which fall out of the sample. We further omit all natural resource sectors, as face-to-face interactions are unlikely to play a role in their context. Lastly, we construct a composite measure, referred to as the face-to-face index, by taking the average of the four task related variables at the sectoral level. A larger value of the index indicates a stronger importance of face-to-face interactions for a certain sector.

We use two samples in the analysis. First, we construct the measure of trade costs for pairs of importer and exporter economies for each industry. This setting allows for variation across sectors that is specific to each bilateral country pair and we therefore refer to this case as the bilateral sample. Nevertheless, our face-to-face index varies only at the sectoral level, with no variation across economies. Therefore, we also conduct the analysis with data averaged across country pairs, which only contains sectoral variation.[77] This sample is referred to as the collapsed or sector-level sample. However, both our samples yield very similar results.

The first insights can already be inferred from Appendix Figure D.1, which plots our measure of trade costs, the HRM Index, against the importance of face-to-face interactions. We see that a stronger importance of face-to-face meetings is associated with larger trade costs in general.

Furthermore, compared to goods sectors, the face-to-face index seems to be more important for services sectors, which tend to appear on the upper right part of the figure.

To further explore this relationship, we also estimate OLS (i.e. ordinary least squares) regressions with three specifications. The results for the sample using bilateral data are reported in Appendix Table D.10.[78] In the larger sample, we include several controls at the level of individual economies, such as standard gravity variables, the credit and contract environments, a dummy for a common language, logistics efficiency, customs procedures and broadband subscriptions.[79] Since our controls do not vary at the sectoral level, they are excluded from the regressions using only sectoral variation.

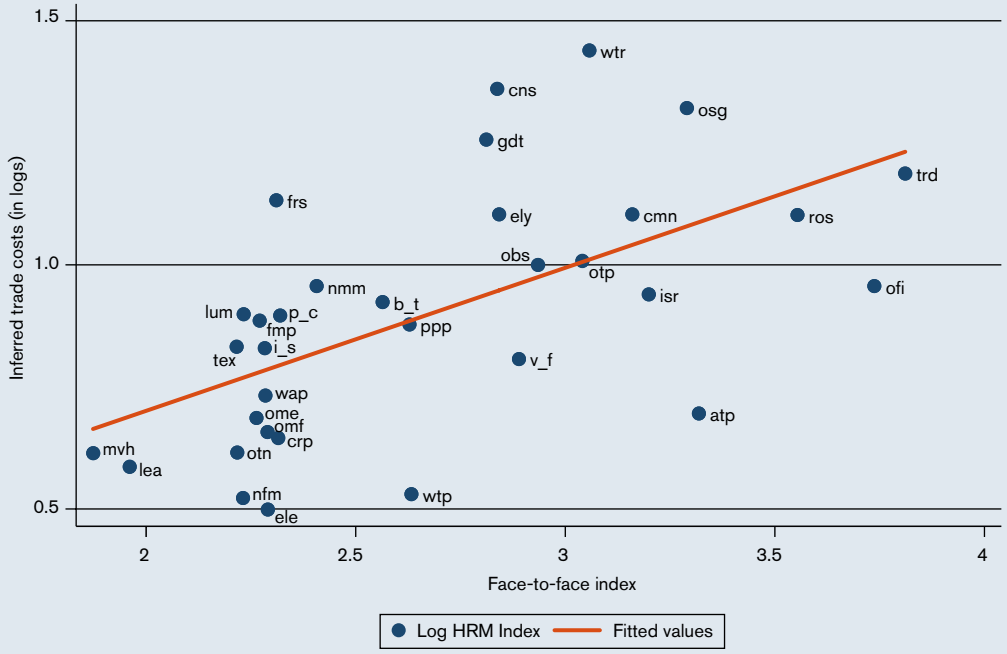
In the first columns, we focus on the effect of an indicator variable for services sectors on trade costs. Our second specification examines the effect of face-to-face interactions, while our last specification includes both the services dummy and the face-to-face index. Reassuringly, both samples yield fairly similar results.

On their own, both the services variable as well as the face-to-face index are highly significant and are associated with larger trade costs in both samples. Nevertheless, as specification (3) shows, once both variables are included in the regressions, the effect of being in a services sector is strongly reduced. In the bilateral sample, the coefficient for services sectors becomes very small, slightly negative and highly insignificant when the face-to-face index is included. In this case, the coefficient for the importance of face-to-face interactions remains significant at the 1 per cent level, with a similar magnitude to before. In the sector-level sample, however, the coefficients for services and the face-to-face index are insignificant, when both are included. Nevertheless, this is probably due to the low number of observations, resulting in a loss of statistical power. Importantly, the coefficient for the services dummy is strongly reduced when accounting for face-to-face interactions.

Therefore, these results indicate that face-to-face interactions are strong drivers of trade costs and that the channel driving the higher trade costs for services sectors seems to go through the importance face-to-face meetings. As technological progress reduces the need for face-to-face interactions, we can expect trade costs to fall in the future, especially for services.

Appendix Figure D.1: Greater importance of face-to-face communication is associated with larger trade costs in general

The importance of face-to-face interactions and trade costs



Note: The abbreviations used in this figure can be consulted at https://www.gtap.agecon.purdue.edu/databases/contribute/detailedsector.asp

Appendix Table D.10: Face-to-face interactions and trade costs – bilateral sample

	(1) Log HRM Index	(2) Log HRM Index	(3) Log HRM Index
Services	0.270***		-0.00164
	(0.0126)		(0.0228)
Face-to-face index		0.304***	0.305***
		(0.0102)	(0.0204)
Log Credit Environment	-0.0931***	-0.0868***	-0.0867***
	(0.0207)	(0.0198)	(0.0198)
Log Contract Environment	0.0575***	0.0573***	0.0573***
	(0.0219)	(0.0204)	(0.0203)
Common Language	-0.0596***	-0.0683***	-0.0683***
	(0.0181)	(0.0169)	(0.0169)
Log Logistics Efficiency	-0.146***	-0.149***	-0.149***
	(0.0143)	(0.0145)	(0.0143)
Log Customs Procedures	0.0494***	0.0488***	0.0488***
	(0.0180)	(0.0177)	(0.0177)
Log Broadband Subscriptions	-0.0498***	-0.0480***	-0.0479***
	(0.00861)	(0.00814)	(0.00814)
Constant	0.620***	-0.0849	-0.0880
	(0.216)	(0.211)	(0.211)
Gravity Controls	yes	yes	yes
Observations	135135	135135	135135
R^2	0.467	0.510	0.510

Source: Dependent variable: GTAP inferred trade costs. Explanatory variables from CEPII, World Bank and O*NET. The face-to-face index is based on the approach in Blinder (2009).

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Appendix Table D.11 Face-to-face interactions and trade costs – sector-level sample

	(1) Log HRM Index	(2) Log HRM Index	(3) Log HRM Index
Services	0.303***		0.180
	(0.0767)		(0.161)
Face-to-face index		0.293***	0.145
		(0.0646)	(0.137)
Constant	0.768***	0.115	0.434
	(0.0387)	(0.165)	(0.319)
Observations	33	33	33
R^2	0.361	0.348	0.386

Source: Dependent variable: GTAP inferred trade costs. Explanatory variables from CEPII, World Bank and O*NET. The face-to-face index is based on the approach in Blinder (2009).

Notes: Robust standard errors in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

(e) Additional simulation results

Appendix Table D.12 Additional real growth of exports (cumulative) in three services sectors as a result of reductions in the STRI

Region	Transport	Communications	Finance and insurance
Asian LDCs	19.21	15.05	15.27
Australia	18.11	10.05	6.36
Brazil	14.26	9.59	7.92
Canada	11.5	8.27	7.78
China	6.65	9.54	6.8
European Union (28)	1.53	2.75	3.47
EFTA	1.84	3.4	2.82
India	11.5	14.12	9.93
Japan	3.82	9.74	6.36
Republic of Korea	6.4	7.22	5.1
Latin America	16.52	9	6.52
Mexico	16.37	9.49	8.89
Middle East and North Africa	18.31	11.88	8.86
Russian Federation	14.21	10.41	7.89
Southeast Asia	13.25	9.91	7.06
Sub-Saharan African LDCs	17.21	10.16	7.19
United States	14.52	10.29	5.86
Other Asian economies	13.21	7.71	4.47
Sub-Saharan Africa other	17.01	10.33	7.62
Rest of world	9.14	9.75	7.99

Source: Simulations with the WTO Global Trade Model.

Notes: The figure displays the cumulative additional growth in real exports from 2018 until 2040 under the scenario of a reduction in the STRI towards the median of the lowest quartile of STRI scores across economies. Region averages are calculated based on trade-weighted averages.

Endnotes

1 See Anderson and van Wincoop (2004); Novy (2013). Roughly speaking, the inferred trade costs can be considered as an equivalent of ad valorem tariff duties. An estimated trade cost of 3, for example, can be interpreted as an ad valorem tariff duty of (3-1) * 100%=200%.

2 The experimental WTO Trade in Services Dataset by Mode of Supply (TISMoS) dataset is not available at the bilateral level necessary for the inference of trade costs.

3 For instance, in the case of distribution and transport services or bundled products that have both a good and a service component (such as computers with after-sale services).

4 Roughly speaking, the inferred trade costs can be considered as an equivalent of ad valorem tariff duties. An estimated trade cost of 4.3 can be interpreted as an ad valorem tariff duty of 330 per cent. The formula is: ad valorem equivalent = (trade cost – 1) *100.

5 Conventional estimates of bilateral trade costs typically use one uniform elasticity of substitution. By contrast, our estimation is based on a new set of elasticities, estimated in Egger et al. (2018), which varies with each sector and thus provides a more precise measure of bilateral trade costs. A higher elasticity of substitution means more competition through the more elastic reaction of demand to higher prices on output. The elasticity of substitution tends to take on lower values for services than for manufactures, implying that services are more differentiated and face less competition.

6 Emerging economies are those classified by the World Bank in the year 2000 as low- and middle-income; developed economies are those classified as high-income. In our sample, emerging economies are represented by Brazil, Bulgaria, China, Croatia, Cyprus, the Czech Republic, Estonia, Hungary, India, Indonesia, Latvia, Lithuania, the Republic of Korea, Malta, Mexico, the Russian Federation, Turkey, Romania, Poland, Slovak Republic and Slovenia. Developed economies are Australia, Canada, EU15, Japan, Norway, Switzerland, Chinese Taipei and the United States.

7 See Appendix D.1 for a technical explanation of the trade cost decomposition.

8 More precisely, the governance quality index captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development; perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests; and perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police and the courts, as well as the likelihood of crime and violence.

9 According to UNCTAD (2015), potentially ICT-enabled services include financial and insurance services, telecommunications, computer and information services, charges for the use of intellectual property, business services and personal, cultural and recreational services.

10 Also see Section B.

11 https://gocatalant.com/

12 https://www.comatch.com/de/

13 https://www.worksome.dk/

14 https://outsizedgroup.com/

15 https://www.flexport.com/

16 https://www.uship.com/

17 https://freighthub.com/en/

18 https://www.saloodo.com/

19 https://www.dbschenker.com/global/drive4schenker

20 https://www.twill.net/

21 https://www.tradelens.com/

22 In 2013, the World Bank and the WTO signed a Memorandum of Understanding concerning the establishment a unique database on services policies, covering commitments taken by WTO members in various agreements, applied regimes and services statistics. The memorandum focused in particular on the increased cooperation of both agencies for the collection and dissemination of information on applied services trade policies in WTO members. I-TIP Services, the services component of the Integrated Trade Intelligence Portal (I-TIP) was released in 2013. The main objective of the integrated database is to make it easier for WTO members and other stakeholders to access the various types of information relevant for services trade policy-making. I-TIP Services can be consulted at http://i-tip.wto.org/services/

23 The OECD has also been producing a STRI and an accompanying regulatory database since 2014 (http://www.oecd.org/trade/topics/services-trade/). Regulatory information for 43 economies in the World Bank STRI is sourced from the OECD database to avoid any duplication of data collection efforts.

24 Maritime covers maritime freight transport and auxiliary services (agency, freight forwarding, cargo handling, storage and warehousing).

25 In addition to corporate tax and customs duties, governments are also exploring ways to equalize and apply value-added and general sales taxes.

26 The old age dependency ratio used in this report is defined by UNDESA as the number of persons aged 65 years or over in a population relative to the number of persons aged 15-64 years.

27 According to the United Nations Population Fund, demographic dividend is the economic growth potential resulting from the share of the working-age population being larger than the old and young age groups.

28 https://www.brandwatch.com/blog/youtube-stats/

29 Calculations based on the WIOD database for the year 2014. The measure is calculated as the sum of intermediate input sourcing from sectors 39-50 of the ISIC Rev. 4 classification as a share of total output. High-income economies are Australia, Canada, EU15, Japan, the Republic of Korea, New Zealand, Norway, Switzerland and the United States. Lower-income developing economies are Brazil, China, Indonesia, India, Mexico, Russia and Turkey.

30 Overall, the impacts of changes in population, age structure, income, technology and public policy on most economic sectors, including many services industries, will be large relative to the impacts of climate change (IPCC, 2014).

31 Such responses will also increase the demand for different services, including installation- and safety-related services.

32 Wholesale and retail trade is likely to adapt to climate change by changing storage and distribution systems to reduce vulnerabilities, and by changing the consumer goods and services offered in particular locations. Some of these adaptations could increase prices of goods and services to consumers.

33 Although the impact of climate change on the telecommunication sector is not discussed in detail here, communication infrastructures can also be exposed to climate change. For instance, overhead cables and cell phone transmission masts are vulnerable to high winds and ice storms.

34 There is no widely accepted definition of environment-related goods and services. According to the General Agreement on Trade in Services (GATS), environmental services include sewage services, refuse disposal, sanitation and similar services, reducing vehicle emissions, noise abatement services, nature and landscape protection services and "other" environmental services. In this section, environment-related services include services used for climate change adaptation or mitigation.

35 Natural disasters also include non-weather events such as earthquakes, tsunamis, mudslides, volcanoes and wildfires.

36 The GTM is a recursive dynamic computable general equilibrium (CGE) model.

37 See the opinion piece by Richard Baldwin on page 126.

38 The impact of ageing on sector-specific skills, as identified by Gu and Stoyanov (2019), are not included in the model by lack of estimates on differences in sector-specific labour productivity growth related to ageing.

39 This ordering of productivity growth across the three broad sectors (highest productivity growth in agriculture, followed by manufacturing, and then services) is in line with the literature on structural change (Herrendorf et al., 2014).

40 Technically, non-unitary elasticities are modelled through non-homothetic preferences in which spending shares change with income. In the model we work with the constant distance elasticity (CDE) utility function, adjusting the parameter determining the income elasticity as a function of GDP per capita.

41 Based on an empirically estimated equation following the approach in Foure et al. (2013).

42 The projections are based on KG and Lutz (2018).

43 Based on the approach in Moise and Sorescu (2013) and WTO (2015), the country-specific OECD trade facilitation indicators are converted into ad valorem trade cost reductions, leading to trade cost reductions of about 15 per cent globally. These trade cost reductions are phased in over a period of 15 years, starting in 2019. The reductions are phased in over a longer period, as countries will need time to implement the TFA.

44 Empirical research shows that the presence of a common language in two countries makes it easier for countries to trade with each other.

45 In economies with bad credit and contract environments, it is more difficult to obtain loans and to enforce contracts.

46 The task intensity of face-to-face interaction is measured following the approaches in Blinder (2009) and Oldenski (2012). We map these measures of task intensity to Global Trade Analysis Project (GTAP) sectors using occupation data.

47 Further details about the modelled reduction in trade costs are in Appendix D.2.

48 In a gravity estimation, trade between two economies is explained by the forces of gravity, trade costs, economic size and the attractiveness to trade with other regions.

49 The ad valorem equivalent trade cost reduction is the trade cost reduction expressed in ad valorem terms which is equivalent to a certain change in the STRI.

50 This liberalization scenario is proposed by the authors of this World Trade Report and should not be attributed to Borchert et al. (2019b).

51 As emphasized before, we do not include services trade in the form of commercial presence in another country (GATS mode 3), as this is not part of our model. Furthermore, a proper evaluation of the share of services trade in total trade would require us to include affiliate sales in both services and manufacturing.

52 As discussed in Section B, the share of services trade in total trade would be larger if GATS mode 3 were taken into account.

53 The reason, as mentioned when the STRI was introduced, is that data on services trade restrictions do not exist for some of the services sectors and that for other services sectors the STRI is not significant in gravity regressions because of the lack of good correspondence between the coverage of services trade data with that of the STRI.

54 Total trade does display higher growth in the baseline in least-developed and developing countries because of the stronger reduction in manufacturing trade costs associated with the introduction of the WTO Trade Facilitation Agreement (results not displayed).

55 The authors of this report remain responsible for the use of these experimental data for the estimation of trade cost.

56 Source: Head and Mayer (2014).

57 Source: World Economic Forum, Global Competitiveness Report and data files, retrieved from https://data.worldbank.org/indicator/IQ.WEF.PORT.XQ.

58 Source: World Bank, Logistics Performance Index, retrieved from https://data.worldbank.org/indicator/LP.LPI.INFR.XQ.

59 Source: Head and Mayer (2014).

60 Source: World Bank (2019), Global Bilateral Migration Database.

61 Source: International Telecommunications Union (ITU), ICT Statistics, retrieved from https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

62 Source: Mario Larch's Regional Trade Agreements Database from Egger and Larch (2008), 2018 update.

63 Source: World Bank, World Integrated Trade Solution (WITS).

64 Source: World Economic Forum, Global Competitiveness Report and data files, retrieved from https://data.worldbank.org/indicator/IQ.WEF.CUST.XQ.

65 Source: World Bank, Worldwide Governance Indicators (WGI).

66 Cyprus, Estonia, Latvia, Lithuania, Luxembourg and Malta are not included due to their small size. Belgium, Hong Kong (China), Ireland, the Netherlands and Chinese Taipei are not included due to their high share of re-exports.

67 Basing trends on the past is a conservative approach for rising capital income shares, given that technological changes leading to rising capital shares such as robotization and AI are expected to accelerate. Also, for the more intensive use of ICT services, the use of trends in the past is probably a conservative approach, given the trends described earlier in this report, such as digitalization and AI.

68 Two sectors, "ICT services" and "Other business services" emerge from splitting up the sector "Business services", employing SPLITCOM (a program to split up sectors) and information about spending and cost shares from WIOD.

69 SSP2 is a middle-of-the-road scenario. The projections for GDP are based on this scenario.

70 The methodology to infer trade costs earlier in the chapter deviates from the approach in WTO (2018a) and the approach followed here. Differences are discussed in Egger et al. (2019).

71 The variable Logistics Performance Index, included in WTO (2018a) is omitted from the scenario this year because of endogeneity with the size of trade flows and thus inferred trade costs.

72 This formula follows Benz (2017) and Bekkers and Rojas-Romagosa (2018).

73 Rent-increasing trade costs raise the costs of trading goods by generating excess profits (rents) for various economic agents, such as importers or exporters. Iceberg trade costs raise the costs of trading goods by dissipating scarce resources.

74 We employ the trade-weighted average substitution elasticity in the GTAP database, which is equal to 6.88.

75 O*NET Resource Center (2012).

76 Blinder (2009) additionally includes an indicator referred to as "Social perceptiveness", which we omit due to its apparent absence in our database.

77 We construct averages weighted by bilateral trade flows.

78 For the bilateral sample, we employ a weighted regression, with bilateral trade flows serving as importance weights. This mirrors the weighted averages constructed for our smaller, collapsed sample.

79 The included gravity variables are distance as well as dummies for the presence of a free trade agreement, for having a common colony, for having had a colonial relationship since 1945, for landlocked countries, and for contiguity.