

Trends in Global ICT Trade

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Abstract: The Asian continent, the EU28 and the US account for 90% of the world exports of ICT goods and services. Asia, notably China and the Four Tigers, dominate world trade in ICT equipment, and their export competitiveness has increased in the past few years. The EU28 has only gained competitiveness in ICT services. Asia and China have a strong comparative advantage in equipment, while the EU28 has an advantage in services, however China is catching-up rapidly. The distribution of value in world ICT markets stresses the dominance of the US in IT and software services, as well as intermediation and media, and the dominance of Asia in hardware and electronics. Overall, the strength of the US relies on the global reach of its world leading providers, while Asian dominance relates to a strong specialisation in equipment exports. The EU28 main asset lies in ICT services exports, while telecommunications services is the only segment where it has a significant share of world revenue, however its growth rate is the lowest of the three main regions.

Key words: ICT trade, comparative advantage, export competitiveness, global ICT ecosystem.

Assessing trade in digital goods and services along with the geographical distribution of related revenues provides an overview of world digital leaders' main assets, and relative strengths and weaknesses. Basic trade indicators are used to assess their export competitiveness, export and trade structure, trade balances, comparative advantage, trade openness and intensity in the markets for digital equipment and services¹. These indicators provide estimates of value flows across the globalised digital ecosystem. In addition, assessing the distribution of digital sectors' revenues across the leading regions provides information on the concentration of value in the digital ecosystem.

^{*} Disclaimer: opinions expressed in this article are those of the author and do not necessarily represent the opinions of Orange.

¹ The term "intensity" refers to the relative importance of exports and trade in the GDP of a country or a region, and does not relate to the trade intensity index, which consists in the ratio of export shares.

The analysis of trade in digital goods and services builds upon the World Trade Organisation's data on exports and imports of countries and continents by sector of activity. The analysis of value distribution across domestic markets builds upon an aggregation of listed firms' revenues, grouped according to their core production activity in their domestic market, and follows the approach developed in PERIN & POUILLOT (2013). It measures the shares of regions in value produced in each of the layers of the digital industry, as well as their share in world market capitalisation.

Combining supply-side analyses of value, in terms of both flows and location, builds a map of the global digital value chain. The recent evolutions in trade indicators highlight the enduring dominance of the Asian continent (and of China in particular) in the trade of digital equipment. While the EU28 still accounts for the bulk of world exports of digital services, its competitiveness is decreasing as China is catching up rapidly. China and Asia have a comparative advantage in digital equipment while the EU28 has a comparative advantage in digital services. Overall, world trade in digital equipment and digital services remains dominated by the Asian continent.

In terms of domestic location of value, the US are the world leaders in IT and software, as well as in intermediation and information services, while the dominance of the Asian continent in digital equipment is supported by its relatively high share in the digital equipment world revenue. The EU28 only accounts for a limited share of the global digital value, despite its export competitiveness in services. This indicates a need for a policy that is supportive of investment in all digital services, in order to increase specialisation and develop competitive advantage in ICT industries.

■ Assessing the world digital economy on the basis of value location and flows

The economics of ICT industries has been widely analysed in the economic literature. Over the last two decades, significant attention has been given to assessing their contribution to the global economy, in terms of fixed asset investment, innovation, aggregate value added and labour productivity. An extensive literature has highlighted the role of ICT in economic growth, notably the effects of ICT adoption on productivity gains (CETTE *et al.*, 2010; JORGENSEN *et al.*, 2016; OLINER & SICHEL, 2000). Most of these empirical studies have focused on the effects of ICT capital

accumulation and on the adoption of ICT services on aggregate labour productivity and on total factor productivity growth, in a range of domestic markets, most often the USA (BIAGI, 2013). Recent research has shown the direct causal effect of the penetration of ICT goods and services (computers, mobiles phones and Internet) on economic growth (VU, 2011). Public policy recommendations drawn from these estimations point out the need to encourage investment in ICT assets, innovation in ICT industries, and the adoption of ICT services in order to foster sustainable long run growth.

These empirical contributions, often based upon growth accounting methodologies, relied in general on a basic definition of ICT, namely, IT hardware and telecommunications equipment, and software, treated as capital goods and intermediate inputs, the accumulation of which induce a decrease in production prices, and thus foster gains in labour and multifactor productivity. With the globalisation of the ICT value chain and the increasing adoption of ICT in most sectors of the production system on a worldwide basis, a new stream of literature has relied on a more refined description of ICT industries, considered as an ecosystem of interrelated layers of industry (FRANSMAN, 2010). This approach has led to evidence the reallocation of production value between layers of ICT industry and geographical areas, notably the shift of revenues from the EU to the US through the rise of Internet intermediaries building on the investment in European ICT infrastructures and services (ARLANDIS & CIRIANI, 2010). Extending these supply-side approaches by considering the value of final consumption in the markets for digital products leads to a comprehensive assessment of the worldwide digital ecosystem, where the EU appears to have been losing ground in all layers of industry, while its domestic demand has been declining, contrary to the Asian continent and the US (PERIN & POUILLOT, 2013; 2015). The approach that consists of assessing the value of production by layers of industry in a range of domestic markets has been used to highlight insufficient European specialisation in the rapidly developing markets for intermediation services providers (VEUGELERS, 2011).

A complementary approach to assessing the distribution of revenues in ICT layers across the main domestic markets is to examine empirically the trade in ICT goods and services. This provides additional information on their export competitiveness, on the weight of ICT in their structure of exports, and on the comparative advantage of countries in ICT products. A range of empirical estimations has also identified the major trends and the leading countries in ICT trade in the OECD from 1996 to 2008, and has identified, in particular, the importance of the US, Korea and Japan

(BOURASSA, 2011). The main trend in ICT trade over 2000-2011 has been the rise of China, whose exports of ICT goods have increased tenfold, making China the top worldwide exporter. During this period, the exports of the other main countries have increased by less than a factor of 1.5. In 2011, China's exports in ICT goods were more than three times that of the US in value. In the markets for ICT services, India has been the world top exporter during the 2000-2012 period (OECD, 2013).

The Asian continent has become a major supplier of intermediate inputs in the global ICT industry (DE PRATO & NEPELSKI, 2013). China and India are the two largest Internet markets and the fastest growing mobile data markets in the world. Their industry has increasingly specialised in ICT manufacturing, and software and telecommunications services respectively during the last ten years (SIMON, 2017a). In addition, China also relies on a fast growing IT service sector, notably in the cloud computing market segments, where domestic providers have become global players (KSHETRI, 2015). During the last fifteen years, China has developed a comprehensive industrial strategy for the telecommunications sector, as well as IT and Internet services, which led its companies to compete on a global scale, and to challenge the dominance of the US in the Internet industry (FABRE & GRUMBACH, 2011). Developing a comprehensive description of the economics of ICT industries requires both an understanding of the location of value and its distribution across domestic markets in addition to the patterns of trade.

■ A measure of export competitiveness: dynamics of regions in the world exports of digital equipment and services

The export competitiveness of a region in global markets for digital products is assessed by the evolution of the region's share in the world exports of digital goods and services². The Asian continent represents the bulk of worldwide digital equipment exports. The increase in China's exports of digital equipment between 2009 and 2015 (+9.3%) has been faster than

² Digital equipment according to the World Trade Organisation (WTO) is composed of "electronic data processing and office equipment", "telecommunications equipment", and "integrated circuits and electronic components", and digital services consist in "telecommunications, computer and information services".

the overall increase in world exports (4.8%), while European exports decreased slightly (-0.7%) and US exports increased slower than the world exports (3.7%)³. The Asian continent had the largest share of world exports of digital equipment over the 2009-2015 period, and thus represents the largest world market share⁴. China alone accounted for 33.7% of the world exports of digital equipment, the Four East Asian Tigers (Taiwan, Hong-Kong, Singapore and South Korea) accounted for 19% and Asia accounted for 66.2% of world exports in 2015. China's share had the highest growth rate over 2009-2015 (+4.3%), along with Asia (+1.8%). China's economy had also the largest share in Asian exports of digital equipment, (51% in 2015), and this share has been increasing by 2.4% over 2009-2015. The EU28 still accounted for 18% of world digital equipment exports despite a sharp decrease (-5.2%), while the share of the US has declined slightly (-1.1%), accounting for only 8% of world exports in 2015.

In terms of digital equipment exports, China and, more generally, the Asian continent, have been the most competitive regions and have strengthened their position. The EU28 and the US have been losing competitiveness, as well as Japan (-8.7%). The combined share of the EU28, US and China in the world exports of digital equipment reached 60% in 2015, and the EU28, US, China, Four East Asian Tigers, and Japan together accounted for 82% of world digital equipment exports in 2015. These aggregate shares have generally remained stable.

The Asian continent had a 7.2% share of digital equipment exports in the world exports of total merchandise in 2015 (+2% over the 2009-2015 period), and China had a 3.7% share (+4.5%). China's share of digital equipment exports in world exports of total merchandises was significantly higher than the EU28 and US shares, (respectively 2% and 0.9% in 2015). The EU28 share decreased sharply, (-5.0%), while the US share has only slightly decreased (-0.8%)⁵. The dynamics of regions' shares of digital equipment exports in the world exports of merchandises provide evidence of

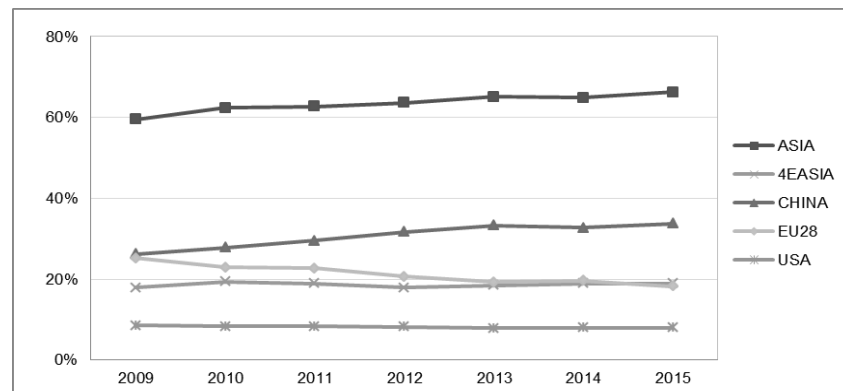
³ Exports in value are obtained from the World Trade Organisation (WTO) database and are expressed in current US dollars.

⁴ Region to world exports of ICT equipment and services ratio relates to the region's world market share and provides insights on export competitiveness. Our estimates are consistent with the OECD (2013) estimates:
http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2013_sti_scoreboard-2013-en

⁵ The table of digital equipment export to world exports of total merchandises ratio are presented in the appendix.

the strong momentum of the Asian continent and the weakening of the position of the EU28.

Figure 1 - Region to world digital equipment exports ratio



Source: authors' calculation from WTO database

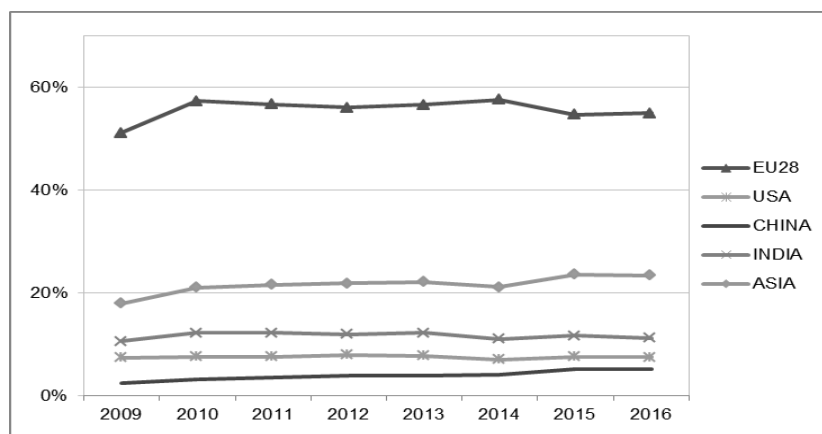
Ranking and trends are different in the worldwide market for digital services⁶. The exports of digital services by the EU28 increased by 7.5% over the 2009-2016 period, which is comparable to the dynamics of India (+7.2%), while the world exports increased by only 6.4%, and China has gained significant momentum (+18.6%), along with Japan (+13.8%), and the Asian continent (+10.5%). China still had, however, only a limited share of the world exports of digital services in 2016 (5.2%). The EU28, by contrast, had the largest share (55%) in 2016, while the share of China and Asia (23.5%), was significantly lower than their share in the world exports of equipment over 2009-2015. The US share of the world exports of digital services is comparable to their share of digital equipment exports (7.6% in 2016), while India gained significant weight, accounting for 11.2% of world exports in 2016, and 48% of Asian continent's exports in 2016 (while China accounted for only 22% of Asia's exports).

⁶ Digital services relate to telecommunications, and computer and information services. In the WTO database, the "Computer and information services" aggregate is subdivided into "computer services" (hardware and software related services and data processing services), media, or "news agency services", which relate to "provision of news, photographs, and feature articles to the media", and other information provision services, which relate to "database services and web search portals". See the description at: http://stat.wto.org/StatisticalProgram/WSDbStatProgramTechNotes.aspx?Language=E#Def_Meth_Services.

China and Japan have experienced strong growth in their respective shares of world exports, (+11.5%) and (+7.0%) over the 2009-2016 period. While the world exports of digital services in 2016 were still dominated by the EU28, the European share has only increased slowly (+1.0%) in comparison to the momentum of Asian countries. The US does not show any specific edge over the other two leading regions (Asia in equipment and EU28 in services). The combined share of the EU28, US and China in the world exports of digital services amounted to 68% in 2016, while the EU28, US, China, and India accounted together for 79% of the world exports, and the EU28, US, and Asia together represented 86% of the world exports of digital services.

Moreover, the digital services exported by the EU28 accounted for 5.4% of commercial services exported worldwide. The EU28 had the highest share of digital services in the world exports of commercial services, above the US (0.7%), China (0.5%), and Asia (2.4%), although China's share has increased sharply over the 2009-2015 period (+15.3%), which is notably faster than the increase in the European share (+2.5%), the US share (1.7%) and even the Asian continent share (+5.9%)⁷. These trends provide further evidence of the increase in the export competitiveness of Asia in world markets for digital services. In particular, China is catching-up with the EU28 at a rapid pace.

Figure 2 - Region to world digital services exports ratio



⁷ The table of digital services exports to world exports ratio for commercial services are presented in the appendix.

Combining digital equipment and services, China and the EU28 represent the bulk of world digital exports. The Asian countries' exports of digital equipment and services have increased faster than the world exports over the 2009-2015 period: +9.6% for China, +6.3% for India, +7.1% for Asia, while the EU28 and the US exports have increased at a lower rate than the world exports (2.6% and 4.3% respectively, compared to 5.2%). China and the EU28 had a 27.7% and a 26% share in world exports of digital products in 2015, while the Asian continent alone accounted for 57.2% of these exports. China's share in total digital exports has increased by 4.2% and Asia's share has increased by 2%, while the European share has decreased by 2.5%, and the US share has decreased slightly (-0.8%). These recent trends also provide evidence of the strong dynamics of Asian exports in digital goods and services and a decrease in European export competitiveness in digital services, despite a high share of world exports in 2016. The EU28, the US and China together accounted for 62% of world exports of digital goods and services, while the EU28, the US and Asia accounted together for 91%⁸.

Ratios of region to world exports of digital equipment by subsectors

The shares of regions in world exports of digital equipment are decomposed by sub-sectors⁹. The Asian continent accounted for the largest part in world exports of digital equipment in 2015: 60% of IT equipment, 60% of telecommunications equipment, and 80% of electronic components exported worldwide in 2015 were exported by Asia. Similarly, 39% of IT equipment, 40% of telecommunications equipment and 20% of electronic components exported worldwide were exported by China. The EU28 accounted for 23% of the world IT equipment exports, and 22% of telecommunications equipment and 9% of electronic components exported worldwide were exported by the EU28 in 2015. The shares of European exports in the world exports of digital equipment have been decreasing over the 2009-2015 period, particularly in electronic components (-6.7%), and also in telecommunications equipment (-5.3%), and IT equipment (-3.5%). The dynamics of China's exports were reinforced: +9.8% in electronic

⁸ The table of digital equipment and digital services exports to world exports of digital equipment and services ratio is presented in the appendix.

⁹ "IT equipment" relates to "electronic data processing and office equipment" and "Electronic equipment" relates to "integrated circuits and electronic components" in the WTO categorisation of digital equipment production sectors.

components, +5.4% in telecommunications equipment, and +2.2% in IT equipment. Overall, the Asian continent's most notable increase in export competitiveness has been registered in telecommunications equipment (+2.7%). The shares of the US in the world exports of telecommunications remained stable (+0.4), increased in IT equipment (+1.7%), and decreased notably in electronic components (-5.2%). The US shares in all three subsectors accounted for less than 10% of the world exports of digital equipment in 2015.

Table 1 - Region to world digital equipment export ratio by digital sector in 2015

	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
IT hardware / Equipment	22.9%	9.5%	38.8%	60.2%
Telecommunications Equipment	21.7%	7.2%	40.4%	59.9%
Electronic Components	9.2%	7.7%	19.9%	80.5%

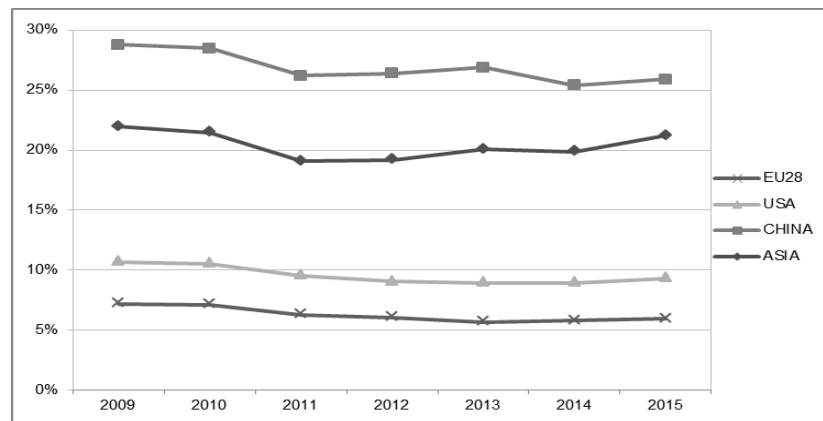
Source: authors' calculation from WTO database

■ Export and trade structure: regions' shares of ICT exports (trade) in their total exports (trade)

The ratios of digital equipment and services exports to total merchandises and commercial services exports of regions provide insight regarding the importance of digital products in their total exports. The structure of China's exports is more concentrated on digital manufactured goods when compared to that of the EU28, the US, and the world economy. China's share of exports of digital equipment in its exports of merchandises was 25.9% in 2015, while the shares of the other two main regions were both under 10%: digital equipment exports accounted for 5.9% of the EU28 and for 9.3% of the US exports of merchandises, while they accounted for 10.9% of the exports of the world economy. China's exports structure is more intensive in equipment than the Asian continent's, its export share has been higher over the 2009-2015 period (27% on average against 20%). The Four East Asian Tigers have the highest share of digital equipment in merchandises exports (28%) compared to other regions, while Japan had a lower share (10%), although it was still above that of the US. By contrast, the EU28 had the lowest export share of the three main regions and a lower export share than the world economy. The share of digital equipment in the exports of total merchandise of the EU28 has decreased by 3.2%, while the

trend has remained stable for the world economy (+0.2%) and has declined for the US (-2.2%), China (-1.7%), and Asia (-0.6%)¹⁰.

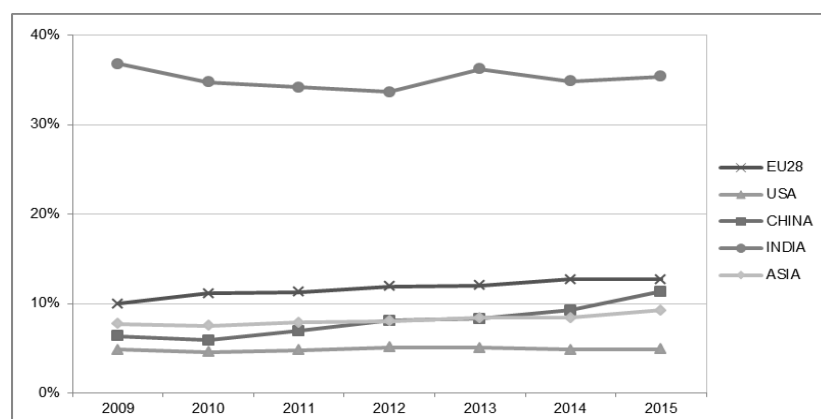
Figure 3 - Digital equipment to total merchandises export ratio of regions



Source: authors' calculation from WTO database

Despite its relative weakness in the world market for digital equipment compared to China and the Asian continent, the EU28 has an higher share of digital services in its exports of commercial services (12.7% in 2015) than the US (4.9%), China (11.4%), Japan (2.1%), Asia (9.3%), and the world economy as well (9.8%). India had the highest ratio of digital services to commercial services exports (35.4%). China had the strongest increase in the ratio of digital services to commercial services export over the 2009-2015 period (+10.2%), ahead of Japan (+8%), the EU28 (+4.1%), the Asian continent (+3.0%), the world economy (+1.4%), and the US (+0.3%). The share of digital services' exports for India has actually decreased slightly (-0.7%).

¹⁰ The table of digital services exports as a percentage of commercial services exports of regions is presented in the appendix.

Figure 4 - Digital services to total commercial services export ratio of regions

Digital export structure: ratios of digital equipment to total merchandise exports by subsectors

The shares of digital equipment in regions' exports of total merchandise can be decomposed by sub-sectors. This decomposition provides information on the structure of exports of digital equipment of the main countries. The structure of China's exports shows a relative concentration on telecommunications equipment, which accounted for 13% of its total merchandise exports, while IT equipment accounted for 8.5%, and electronic components accounted for 4.6% in 2015. The Asian digital export structure was more evenly distributed across the three layers (IT equipment accounted for 5% of the Asian continent's exports of total merchandise, while telecommunications equipment and electronic components accounted for 8% each). The US export structure was also more balanced (around 3% of US total merchandise exports each). The European exports are less intensive in electronic components (accounting for only 0.9% of European exports of total merchandise), while the European profile in IT equipment and telecommunications exports is comparable to the US profile (2% and 3% respectively of exports of total merchandise). The Asian shares of telecommunications equipment and electronic components increased (+1.6% and +1.4%), while they also increased for China's electronic components (+5.4%). European exports of IT equipment, telecommunications equipment and electronic components fell as a percentage of total merchandise (-4.8%, -2% and -2.8% respectively). Overall, digital equipment has been losing ground as a percentage of total

European exports, and the European digital industry has been losing ground in the world export of total merchandise.

Table 2 - Digital equipment to total merchandises export ratio by country and sector in 2015

	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
IT hardware / Equipment	2.1%	3.1%	8.5%	5.5%
Telecommunications Equipment	2.9%	3.4%	12.9%	7.9%
Electronic Components	0.9%	2.7%	4.6%	7.8%

Source: authors' calculation from WTO database

The digital trade balances of the main regions

The export to import ratio of digital equipment and services is an indication of digital trade balances¹¹. The EU28 has a trade deficit in digital equipment (an export to import ratio of 0.7 in 2015), along with the US (0.4) and Japan (0.7), while China and South Korea both have a significant trade surplus (1.5 and 1.8 respectively). By contrast, the EU28 had a large trade surplus in digital services in 2016 (a 1.8 ratio), as was the case for China (a 1.9 ratio in 2016). On the other hand, Japan has a large trade deficit in digital services (a 0.3 ratio in 2016), and the US are close to equilibrium (a 0.99 ratio in 2016). Overall, the US economy relies more on imports than the EU28 and Asia, in both digital equipment and services.

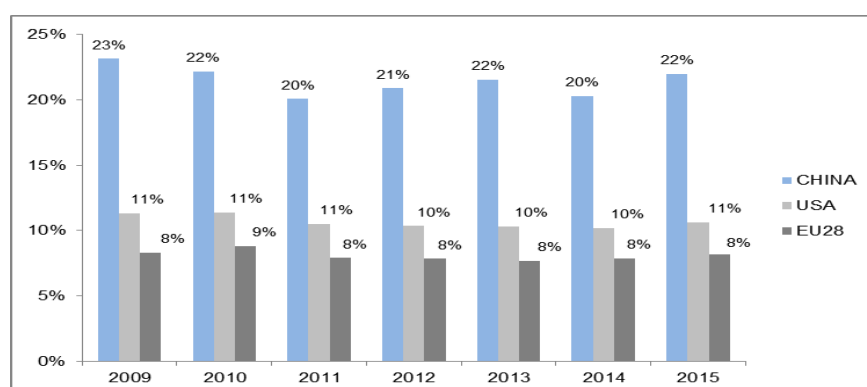
Ratio of trade in digital products to total trade in goods and services

The share of digital trade in total trade of a country, (the ratio of the sum of exports and imports of digital equipment and services to the sum of exports and imports of all goods and services), was higher for China (22% of all traded goods and services were digital equipment and services in 2015), while the US share was 10.6% (-1.1%) and the EU28's was only 8.2% (-0.3%). China's trade in goods and services relies more on digital products compared to the other two main regions, although the share has declined slightly (-0.9%). The ratio of exports of digital equipment and services to total goods and services exports for China (25% in 2015) was significantly higher

¹¹ Tables of ratios of exports to imports for digital equipment and digital services are presented in the appendix.

than EU28 and US ratios (8% in 2015), which indicates that China's export competitiveness relies more on digital products¹².

Figure 5 - Share of trade in digital goods and services in total trade of regions



Source: authors' calculation from WTO database

Trade in equipment represents the bulk of world trade in digital products

Apart from the European Union, trade in digital goods and services essentially consists of trade in equipment. Exports of equipment represent the largest part of US and Chinese digital exports. The EU28 has a more balanced profile, as in 2015, European exports of digital equipment and European exports of digital services amounted to \$318 billion and \$262 billion respectively, while US exports of digital equipment reached \$142 billion and North America exports of digital services only amounted to \$45 billion. Similarly, China's exports of digital equipment amounted to \$591 billion, while exports of digital services only accounted for \$112 billion for the entire Asian continent.

As a result, the shares of trade in digital equipment and in digital equipment and services in overall trade in goods and services and in GDP were relatively similar in 2015 for the US (9.2% compared 10.6% of US total trade and 2.6% compared to 3% of US GDP) and China (21.2% compared to 22% of total trade and 8.8% compared to 9.1% of GDP). By contrast, the

¹² The table of digital exports (equipment and services) as a percentage of total merchandise and commercial services exports by region is presented in the appendix.

share of digital equipment was significantly lower than the share of digital equipment and services in total trade and in GDP for the EU28 (5.4% compared to 8.1% of total trade and 4.8% compared to 7.2% of GDP). This is explained by the fact that European exports of digital services are relatively significant in comparison to exports of digital equipment¹³. This indicates that the EU28 has an important activity in terms of trade in digital services.

Revealed Comparative Advantages in digital products

The Revealed Comparative advantage (RCA) indexes are computed for each of the leading regions¹⁴. China had the highest RCA value in digital equipment in 2009 (3.12) and 2015 (2.81), and these are higher than the RCA values for the Asian continent. The advantage in equipment has weakened, however. The EU28 and the US have no advantage in the equipment industry, while the EU28 does have an advantage in digital services (1.29 in 2009 and 1.53 in 2015). Europe is the only region to have an advantage in digital services and it has increased over the period. Overall, RCA index values indicate that China has the strongest advantage, while the EU28, due to its weakness in equipment, does not present any advantage in digital products¹⁵. An alternative RCA index based on the ratio of exports to imports notably indicates an increasing comparative advantage of China in services, and an increasing disadvantage of the EU28 and the US in equipment¹⁶. Overall, RCA indexes by manufacturing sector highlight the comparative advantage of the Asian continent and, in particular, China in all segments (especially in the IT and telecommunications industries).

¹³ The table of ratios of digital equipment trade to total trade by regions and the table of digital equipment trade as a percentage of GDP by regions are presented in the appendix.

¹⁴ The RCA index, (Balassa Index), is the product's share in a country's exports divided by the product's share in world exports. The critical value is unity, RCA value above unity indicates a comparative advantage in the product.

¹⁵ When calculated on the basis of goods and services separately instead of on the basis of total exports, RCA ratios indicate that China has a comparative advantage in services in 2015 (with a 1.15 RCA value). Other values do not change the results from the standard RCA calculation. See Tables 8 and 9 in the appendix.

¹⁶ The alternative RCA index (RCA 2) is the logarithm of export to import ratio of a product divided by the ratio of export to import of all products for a given country. The critical value is zero, positive values of RCA indicate a comparative advantage.

Table 3 - Revealed Comparative Advantage (RCA) in digital equipment and services

<i>ICT Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.63	0.87	3.12	2.17
2015	0.51	0.74	2.81	2.06
<i>ICT Services</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	1.29	0.76	0.29	0.66
2015	1.53	0.71	0.43	0.74
<i>Total ICT</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.76	0.85	2.57	1.88
2015	0.73	0.74	2.31	1.78

Source: authors' calculation from WTO database

Table 4 – Revealed Comparative Advantage (RCA 2) in digital equipment and services

<i>ICT equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	-24.6	-31.9	30.4
2010	-30.8	-31.7	35.8
2011	-27.7	-32.0	40.2
2012	-27.9	-36.5	32.3
2013	-31.8	-38.8	28.8
2014	-30.9	-37.4	27.7
2015	-37.1	-39.9	12.3
<i>ICT services</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	35.4	-40.5	72.8
2010	23.3	-51.2	101.8
2011	28.7	-52.0	122.5
2012	30.6	-41.0	141.9
2013	28.7	-46.1	127.8
2014	38.7	-49.4	131.0
2015	42.1	-46.2	146.1

Source: authors' calculation from WTO database

Table 5 - Revealed Comparative Advantage (RCA) in digital equipment by sector

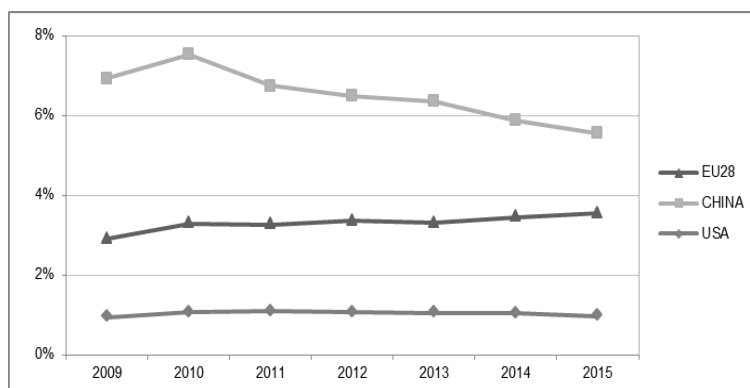
<i>IT Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.75	1.00	3.47	2.01
2015	0.68	1.01	2.73	1.76
<i>Telecoms Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.80	0.81	3.0	1.75
2015	0.65	0.76	2.84	1.75
<i>Electronic components</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.37	1.23	1.16	2.47
2015	0.27	0.82	1.40	2.36

Source: authors' calculation from WTO database

■ Digital trade intensity and digital openness: shares of digital exports and trade in GDP

The exports of digital goods and services to GDP ratio and the trade in digital goods and services to GDP ratio provide information on the importance of trade in a domestic economy. Both ratios reflect the "intensity" of digital exports and trade measured as a share of domestic GDP¹⁷. In 2015, China had the largest share of digital exports in GDP (5.6%), ahead of the EU28 (3.5%) and the US (1.0%). Over the 2009-2015 period, the ratio of exports of digital equipment and services to GDP increased by 3.4% for the EU28. It has decreased for China (-3.6%), which has lost ground in digital trade intensity but remains well ahead of the other two main regions. The ratio of digital exports to GDP has remained stable for the US (+0.5%), while the EU28 had higher export "intensity" than the US.

¹⁷ The term "intensity" refers to the relative importance of exports and trade in GDP, and does not relate to the trade intensity index, which consists in the ratio of two export shares.

Figure 6 - Digital equipment and services exports to GDP ratio

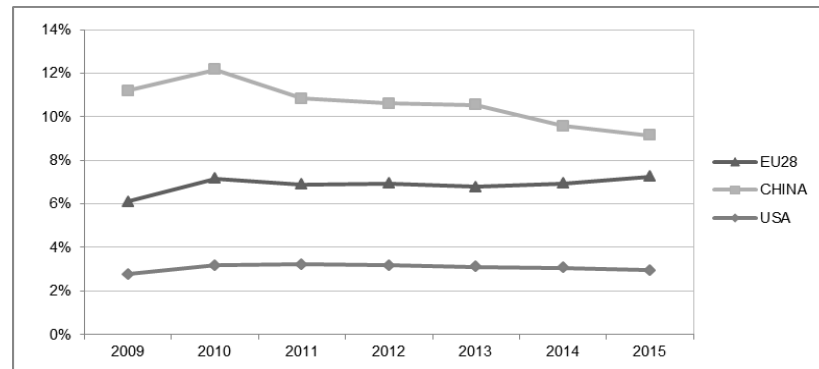
Source: authors' calculation from WTO database

In 2015, the digital openness index, defined as the ratio of trade in digital equipment and services to GDP was also higher for China (9.1%), compared to the EU28 (7.2%), and the US (3%). The ratio of trade in digital equipment and services to GDP increased for the EU28 (+2.9%), declined for China (-3.3%) and slightly increased for the US (+1.1%)¹⁸. China's digital trade still accounted for a larger share of GDP compared to the other two leading regions in 2015. Overall, countries' profiles in terms of digital trade and of total trade are comparable. The digital trade openness index has increased by 2.9% and 1.1% for the EU28 and the US, while their total trade index has increased by 3.4% and 2.1% respectively over the period 2009-2015¹⁹. The relative decline for China's indexes is slower in total goods and services trade than in digital trade: -1.6% for the total trade index, compared to -3.3% for the digital index²⁰.

¹⁸ The openness index, or the trade to GDP ratio is obtained by dividing the sum of exports and imports of a region (to the rest of the world) by the GDP of the same country or region.

¹⁹ The average annual growth rate of total trade to GDP ratios are calculated on data from the World Bank. They are similar to authors' own calculation based on WTO data: the EU28 and US openness index increased by 3.3% and 2.3% respectively.

²⁰ According to World Bank database and own calculation based on WTO database sources, the openness index for the EU28 was 83.4% (88% according to own calculation based on WTO data) for the EU28, 40.5% (41.6% according to own calculation based on WTO data) for China and 28% (28% according to own calculation based on WTO data) for the US in 2015. The openness index has increased in the EU28 between 2010 and 2015 (+2%), by contrast it has remained stable in the US (-0.13%) over the period 2010-2015, and has decreased in China (-4%).

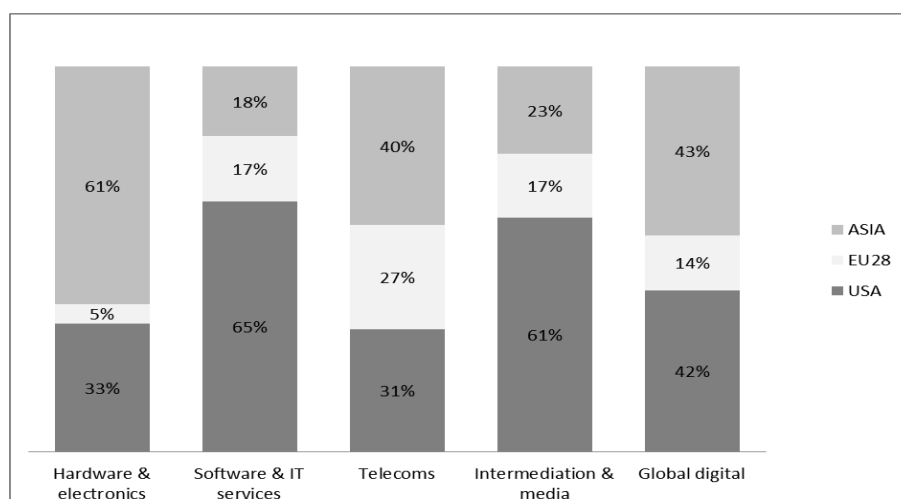
Figure 7 - Digital openness Index: Digital equipment and services trade to GDP ratio

Source: authors' calculation from WTO database

■ The distribution of digital economy value across geographical areas

In addition to the assessment of trade in digital equipment and services, it is possible to assess the value of production from all sectors of the world digital economy by main geographical areas of the EU28, USA, and Asia. These areas have been identified from trade analysis as the most important regions in international trade for digital equipment and services at global level. The supply-side approach developed by PERIN & POUILLOT (2015) consists of calculating revenues using data from the published accounts of 503 publicly-listed firms which represent over 92% of the revenues from all firms listed in the digital sector. This group of firms is split into four sectors: hardware & electronics, software and IT services, telecommunications services, intermediation & media (e-commerce, intermediation services and content production)²¹. The combined 2015 revenue of USA, EU28 and Asia accounted for 95% of revenue in the global digital ecosystem.

²¹ The ICT industry classification is presented in the first table of the Appendix.

Figure 8 - Digital sectors revenues distribution by geographical revenues 2015

Source: Authors' calculations from Thomson Reuters' data

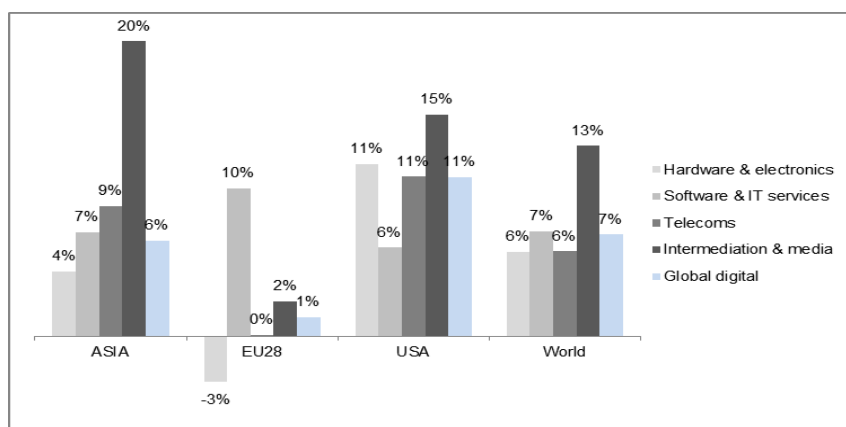
Asia dominates the hardware and electronics sector (61% of global revenues in 2015), while the US dominates the software and IT sector (65% of revenues), and the intermediation and media sector (61% of revenues). Telecommunications services are more balanced in terms of revenue distribution. Asia has the largest share (40%), while the EU28 also accounts for a significant share (27%). With the exception of telecommunications services, the European share in aggregate revenues is significantly below US and Asian shares. In terms of the aggregate digital sector, the EU28 is overshadowed by the US (42% of revenues) and Asia (43%).

The European decline in IT hardware and electronics is also confirmed as the EU28 revenues have decreased by 3% over the 2010-2015 period, while European revenues in software and IT services have increased sharply (+10%), and the growth rate of global digital sector revenues has been increasing weakly (+1%). Apart from the exception of software and IT services, however, the European digital revenue growth is weak compared to other regions.

The growth of US and Asia has been significant in the telecommunications services, with an 11% and a 9% annual average growth rate respectively over the 2010-2015 period. For intermediation and media, growth has also been strong for these two regions (15% and 20% respectively). The US is also growing fast in software and IT services, with an 11% annual revenue growth, and its global digital revenues are

increasing at an 11% annual rate, which is the highest growth rate of the sample. By contrast, the EU28 has the lowest growth rate for revenue for the global digital sector (only 1% compared to 7% for the world, 11% for the US, and 6% for Asia). The high growth rate of European software and IT services seems consistent with the competitiveness of the EU28 in IT and computer services that can be seen from the high European share in world exports of digital services and the positive trade balance in digital services (1.8 export-import ratio in 2016).

Figure 9 - Revenue growth of sectors by region (CAGR 2010-2015)



Source: Authors' calculations from Thomson Reuters' data

Additional indicators confirm that the US and Asia account for the greater share of economic value generated in the world digital economy. The EU28 is absent from the 20 leading firms in terms of market capitalisation in 2017, while 12 are US firms, and 7 are Chinese firms²². Moreover, Asian and US firms also dominate the world digital economy in terms of revenues, as among the 20 world Internet leaders, 12 are US firms, 4 are Chinese firms and only 2 are from European Member States²³. Financial information on the 503 publicly-listed firms show that the US alone (with 174 listed firms) accounted for 53% of world market capitalisation for the digital sector in 2015, while the Asian continent (with 204 listed firms) accounted for 29%

²² See

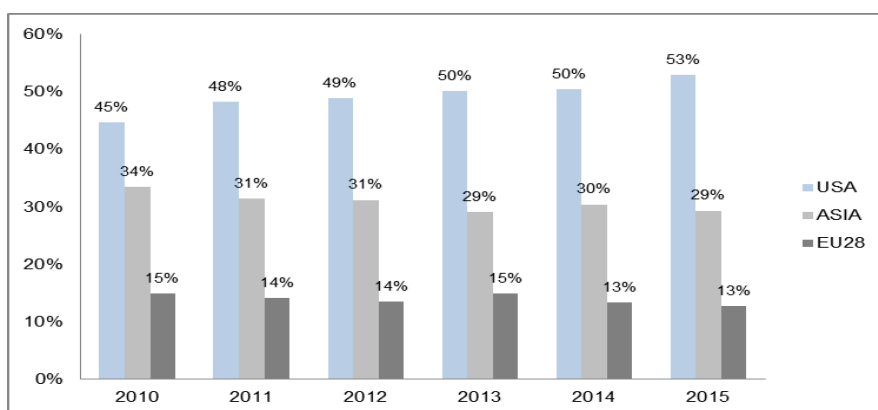
<https://www.statista.com/statistics/277483/market-value-of-the-largest-internet-companies-worldwide/>

²³ See

https://en.wikipedia.org/wiki/List_of_largest_Internet_companies; the revenues are reported between 2014 and 2016.

and the EU28 (with 84 firms) accounted for only 13%. Over the 2009-2015 period, the momentum has been strengthening for the US-listed firms (+3%), while it has been weakening for the Asian (-2.2%), and the EU28 (-2.6%) firms.

Figure 10 - Share of continents in world market capitalization



Source: Authors' calculations from Thomson Reuters' data

In addition, the world's Internet leaders are the firms that contribute the most to the global effort of R&D in the software and IT services sectors (SIMON, 2017b). The lack of a European presence in the leading group of Internet and IT services suppliers could therefore deprive digital service providers from the EU28 from the competitive gains that result from investment in innovation.

■ Conclusion

The Asian continent and, in particular China, along with the EU28 and the US are the leading regions in the global digital economy, in terms of both trade and domestic value of production. Asia, the EU28 and the US together accounted for more than 80% of the world exports of digital goods and for more than 90% of the world exports of digital goods and services in 2015. Digital equipment represents the bulk of world exports in digital products from the US and Asia. In contrast, European exports of digital services are relatively important in comparison to its exports of digital equipment. Asia accounted for more than three fifths of the world exports of digital equipment and the EU28 accounted for more than half of the world exports in digital

services in 2015. In the telecommunications equipment sector, 60% of worldwide exports were from Asia, while only 20% were from Europe and the gap has increased.

China and Asia exports of digital products have increased faster than the world economy's exports of digital products, and their shares of world exports increased faster than EU28 and US shares. The export competitiveness of the EU28 and US has declined, while that of the Asian region has increased. The EU28 only gained export competitiveness in services but the Asian countries are catching up. China and Asia have a comparative advantage in digital equipment and services, while the EU28 has only a comparative advantage in digital services.

The US dominates software and IT services, and intermediation and information sectors (accounting for 65% and 61% of global revenues), while Asia dominates digital hardware and electronics (61% of global revenues). While the EU28 is less present in all sectors, the gap with leaders is lower in telecommunications services. The US is a leader of the global digital economy: it accounts for more than half of world market capitalisation and has the highest revenue growth rate (+11%), while the global revenue of all digital markets only increased by 7%.

The US strength in world markets for digital products relies on the global reach and dominance of its leading domestic firms which are globalised. Asian countries dominance in world trade of digital products relies on their strong potential for exports. The EU28's only significant asset relates to exports of digital services. In this respect, European policies should consider reinforcing the dynamics of digital services export specialisation and competitiveness and promoting the growth of telecommunications services, the only sector where the EU28 has a significant share in world revenue.

Appendix

This appendix presents the tables that are discussed in the text, in order of their appearance. All results presented in the tables are authors' own calculations from World Trade Organisation data. The first table presents the ICT industry classification used in the analysis of domestic market value.

ICT market / industry classification

<i>Hardware & Electronics</i>	<i>Software & IT services</i>	<i>Telecom services</i>	<i>Intermediation & Media</i>
<i>IT hardware</i> - Computer hardware - Peripherals <i>Telecommunications</i> - Network equipment - Mobile devices <i>Consumer Electronics</i> - Connected devices	<i>Software</i> - B2B software - B2C/package software <i>IT services</i> - Network Services - IT Services & Consulting	- Wireless telecommunications - Fixed telecommunications - Integrated telecommunications - Satellite & Cable - Internet & Broadband	<i>Intermediation</i> - e-commerce & Internet - Intermediation services <i>Media</i> - Gaming - Content Production - Broadcasting (TV audio) - Advertising Publishing

Table 1 - Region digital equipment / services exports to world total merchandise / services export ratio

<i>ICT EQUIPMENT</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	2.72%	0.92%	2.83%	6.42%
2010	2.48%	0.90%	3.01%	6.75%
2011	2.13%	0.79%	2.78%	5.90%
2012	1.95%	0.78%	3.00%	6.01%
2013	1.87%	0.76%	3.22%	6.29%
2014	1.93%	0.78%	3.22%	6.38%
2015	2.0%	0.88%	3.69%	7.25%
<i>ICT SERVICES</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	4.64%	0.68%	0.2%	1.70%
2010	4.93%	0.65%	0.27%	1.88%
2011	5.03%	0.67%	0.32%	2.00%
2012	5.14%	0.73%	0.36%	2.06%
2013	5.27%	0.73%	0.36%	2.13%
2014	5.59%	0.69%	0.40%	2.11%
2015	5.38%	0.75%	0.51%	2.40%

Table 2 - Region to world digital equipment & services exports ratio

	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>	<i>EU28+US+CHINA</i>	<i>EU28+US+ASIA</i>
2009	30.2%	8.3%	21.6%	51.4%	60.1%	89.9%
2010	28.8%	8.2%	23.7%	55.4%	60.7%	92.4%
2011	29.0%	8.2%	24.7%	55.1%	62.0%	92.4%
2012	27.5%	8.2%	26.3%	55.5%	62.0%	91.2%
2013	26.8%	7.9%	27.5%	56.6%	62.2%	91.3%
2014	27.7%	7.8%	26.6%	55.6%	62.2%	91.1%
2015	26.0%	7.9%	27.7%	57.2%	61.6%	91.1%

Table 3 - Digital equipment/services to merchandise/commercial services exports ratio of regions

<i>ICT EQUIPMENT</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>	<i>JAPAN</i>	<i>4EASIA</i>	<i>WORLD</i>
2009	7.2%	10.7%	28.8%	22.0%	15.5%	27.8%	10.8%
2010	7.1%	10.5%	28.5%	21.5%	13.6%	28.2%	10.8%
2011	6.3%	9.5%	26.2%	19.1%	12.0%	24.7%	9.4%
2012	6.0%	9.1%	26.4%	19.2%	11.6%	23.8%	9.4%
2013	5.7%	8.9%	26.9%	20.1%	11.2%	25.2%	9.7%
2014	5.8%	9.0%	25.4%	19.9%	10.8%	26.1%	9.8%
2015	5.9%	9.3%	25.9%	21.2%	11.1%	28.2%	10.9%
<i>ICT SERVICES</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>	<i>JAPAN</i>	<i>INDIA</i>	<i>WORLD</i>
2009	10.0%	4.8%	6.3%	7.7%	1.3%	36.8%	9.1%
2010	11.1%	4.6%	5.9%	7.5%	1.4%	34.7%	8.6%
2011	11.3%	4.8%	6.9%	7.9%	1.4%	34.2%	8.9%
2012	11.9%	5.1%	8.1%	8.0%	1.7%	33.6%	9.2%
2013	12.0%	5.1%	8.3%	8.4%	2.0%	36.2%	9.3%
2014	12.7%	4.8%	9.2%	8.4%	2.0%	34.8%	9.7%
2015	12.7%	4.9%	11.4%	9.3%	2.1%	35.4%	9.8%

Table 4 - Export to import of digital equipment/services ratio

<i>ICT EQUIPEMENT</i>	<i>EU28</i>	<i>CHINA</i>	<i>JAPAN</i>	<i>KOREA</i>	<i>US</i>
2009	0.75	1.62	1.28	1.91	0.48
2010	0.70	1.62	1.12	2.01	0.47
2011	0.73	1.63	1.00	1.85	0.48
2012	0.74	1.56	0.92	1.86	0.46
2013	0.74	1.51	0.78	1.99	0.46
2014	0.74	1.58	0.72	1.88	0.46
2015	0.70	1.53	0.75	1.77	0.44
<i>ICT SERVICES</i>	<i>EU28</i>	<i>CHINA</i>	<i>JAPAN</i>	<i>INDIA</i>	<i>US</i>
2009	1.58	1.74	0.31	10.50	0.92
2010	1.45	2.55	0.39	11.20	0.86
2011	1.56	2.76	0.38	14.74	0.89
2012	1.60	2.96	0.41	14.02	0.99
2013	1.57	2.24	0.43	14.37	0.98
2014	1.74	1.88	0.28	12.63	0.97
2015	1.75	2.15	0.24	14.49	0.99
2016	1.78	1.99	0.27	11.60	0.99

Table 5 - Digital products exports on total exports ratio

<i>Digital Equipment & Services exports / total exports</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	7.9%	8.8%	26.8%
2010	8.1%	8.8%	26.2%
2011	7.5%	8.2%	24.3%
2012	7.5%	7.9%	24.7%
2013	7.3%	7.8%	25.3%
2014	7.6%	7.7%	24.0%
2015	7.8%	7.9%	24.7%

Table 6 - Digital equipment trade on total trade & GDP ratios

<i>Digital Equipment trade / total trade</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	6.2%	9.9%	22.7%
2010	6.5%	10.1%	21.8%
2011	5.7%	9.2%	19.6%
2012	5.4%	9.0%	20.4%
2013	5.1%	8.9%	21.0%
2014	5.1%	8.8%	19.7%
2015	5.4%	9.2%	21.2%
<i>Digital Equipment trade / GDP</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	4.5%	2.4%	11.0%
2010	5.3%	2.8%	11.9%
2011	4.9%	2.8%	10.6%
2012	4.8%	2.8%	10.4%
2013	4.5%	2.7%	10.3%
2014	4.5%	2.6%	9.3%
2015	4.8%	2.6%	8.8%

Table 7 - Digital equipment & services trade on total trade & GDP

<i>Digital Equipment & services trade / total trade</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	8.3%	11.3%	23.1%
2010	8.8%	11.4%	22.2%
2011	7.9%	10.5%	20.1%
2012	7.8%	10.3%	20.9%
2013	7.7%	10.3%	21.6%
2014	7.8%	10.2%	20.3%
2015	8.2%	10.6%	22.0%
<i>Digital Equipment & Services trade / GDP</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>
2009	6.1%	2.8%	11.2%
2010	7.2%	3.2%	12.2%
2011	6.9%	3.2%	10.8%
2012	6.9%	3.2%	10.6%
2013	6.8%	3.1%	10.5%
2014	6.9%	3.1%	9.6%
2015	7.2%	3.0%	9.1%

**Table 8 - Revealed comparative advantage (RCA) in ICT goods and services
(relative to total exports)**

<i>ICT Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.63	0.87	3.12	2.17
2010	0.62	0.86	2.98	2.08
2011	0.63	0.89	3.13	2.12
2012	0.60	0.85	3.17	2.11
2013	0.55	0.81	3.20	2.17
2014	0.55	0.80	3.02	2.13
2015	0.51	0.74	2.81	2.06
<i>ICT Services</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	1.29	0.76	0.29	0.66
2010	1.56	0.78	0.34	0.70
2011	1.57	0.81	0.38	0.73
2012	1.63	0.82	0.40	0.73
2013	1.61	0.80	0.37	0.74
2014	1.62	0.71	0.38	0.69
2015	1.53	0.71	0.43	0.74
<i>Total ICT</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.76	0.85	2.57	1.88
2010	0.78	0.85	2.53	1.85
2011	0.80	0.88	2.62	1.86
2012	0.80	0.84	2.63	1.85
2013	0.76	0.81	2.64	1.89
2014	0.78	0.78	2.45	1.82
2015	0.73	0.74	2.31	1.78

**Table 9 - Revealed comparative advantage (RCA) in ICT goods and services
(relative to merchandise and services exports)**

<i>ICT Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.67	0.99	2.67	2.04
2010	0.66	0.97	2.63	1.98
2011	0.67	1.01	2.78	2.03
2012	0.64	0.96	2.79	2.03
2013	0.59	0.92	2.78	2.08
2014	0.59	0.91	2.59	2.02
2015	0.54	0.85	2.37	1.94
<i>ICT Services</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	1.10	0.53	0.70	0.85
2010	1.29	0.54	0.69	0.88
2011	1.28	0.54	0.78	0.89
2012	1.30	0.56	0.88	0.88
2013	1.29	0.55	0.89	0.91
2014	1.31	0.50	0.95	0.86
2015	1.29	0.50	1.15	0.94
<i>Total ICT</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.76	0.85	2.57	1.88
2010	0.78	0.85	2.53	1.85
2011	0.80	0.88	2.62	1.86
2012	0.80	0.84	2.63	1.85
2013	0.76	0.81	2.64	1.89
2014	0.78	0.78	2.45	1.82
2015	0.73	0.74	2.31	1.78

Table 10 - Revealed comparative advantage (RCA) in ICT equipment by sector

<i>IT Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.75	1.00	3.47	2.01
2010	0.70	0.98	3.57	1.99
2011	0.71	1.09	3.72	1.99
2012	0.71	1.06	3.58	1.96
2013	0.71	1.06	3.40	1.95
2014	0.71	1.03	3.19	1.88
2015	0.68	1.01	2.73	1.76
<i>Telecoms Equipment</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.80	0.81	3.00	1.75
2010	0.85	0.83	2.93	1.66
2011	0.84	0.89	3.10	1.75
2012	0.79	0.86	3.08	1.76
2013	0.72	0.84	3.05	1.81
2014	0.72	0.83	3.02	1.79
2015	0.65	0.76	2.84	1.75
<i>Electronic components</i>	<i>EU28</i>	<i>US</i>	<i>CHINA</i>	<i>ASIA</i>
2009	0.37	1.23	1.16	2.47
2010	0.39	1.14	1.23	2.36
2011	0.40	1.08	1.33	2.43
2012	0.36	0.98	1.48	2.47
2013	0.29	0.90	1.82	2.55
2014	0.29	0.90	1.38	2.49
2015	0.27	0.82	1.40	2.36

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