



GED Study

Boosting Trade in Services in the Digitalisation Era

Potentials and Obstacles

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Executive Summary

A number of large European economies, such as Germany, France, Sweden and the Netherlands, have developed great potential for digital services trade. However, gross digital services trade over the internet in Germany and France does not fully live up to its potential. While both are performing well in exporting traditional communications and insurance services, exports of many modern digital-intensive businesses services which are set to shape future global trade patterns are lagging behind.

Looking at Germany alone, indirect digital services trade there is stuck below the international average and its full potential. Comparing the performance of digital sectors with Germany's overall economy, their average output growth has been smaller in key sectors, pointing to a loss in competitiveness. Germany would have to apply more technologies within these sectors to become more productive – and more tradable.

Germany's competitiveness in professional, scientific and technical activities, which employ a lot of data and digital tools, has been declining. This is in contrast to other countries which show an increase in productivity in these services over the years. Services, and in particular digital-intensive services, are important for the rest of the economy to upgrade and generate a higher level of productivity, enhancing competitiveness in the process. Indeed, modern manufacturing is itself increasingly based on new technologies and derives more value-added by including digital-intensive services in its production processes. Germany has the potential to become more productive in sectors such as advertising, market research and employment services and tapping into these unrealised gains would therefore not only increase Germany's exports in digital services, but also boost its manufacturing sector.

There is no clear divide between eastern and western Bundesländer (federal states) in digital services. Germany's 'new' states often perform well, in particular in information and communication services as well as in administrative and support services. Some services sectors that are important for manufacturing are lagging behind in those regions that are traditionally characterised as powerhouses for manufacturing. Professional, scientific and technical activities, as well as financial and insurance activities, lag behind in Bavaria. Furthermore, administrative and support service activities have fallen behind there, and even more so in North Rhine-Westphalia. This could further threaten Germany's trade performance within key manufacturing sectors that depend on digital-intensive sectors for export success.

Germany performs poorly when it comes to digital infrastructural issues such as mobile broadband subscriptions or international internet bandwidth. More important, however, is the fact that German businesses appear to be reluctant to embrace digital tools, processes and procedures or even digital management practices within their company structure. This has resulted in a fairly low impact of digitalisation on the economy – and one that has not improved in recent years, reflecting a loss in competitiveness.

Improving business usage of these endowments requires policy initiatives that address relevant factors aimed at increasing incentives and removing obstacles for the digital transformation of German companies. This is crucial for businesses to enhance their digital agility, preparing them also for future digital disruption. Companies across the entire range of the business services sector will have to embrace available digital technologies and skills to enable them to reach foreign markets more readily. Once Germany operates on a par with other high-performing European or OECD countries in this regard, it would realize its untapped trade potential and thereby boost its overall economy.

Introduction

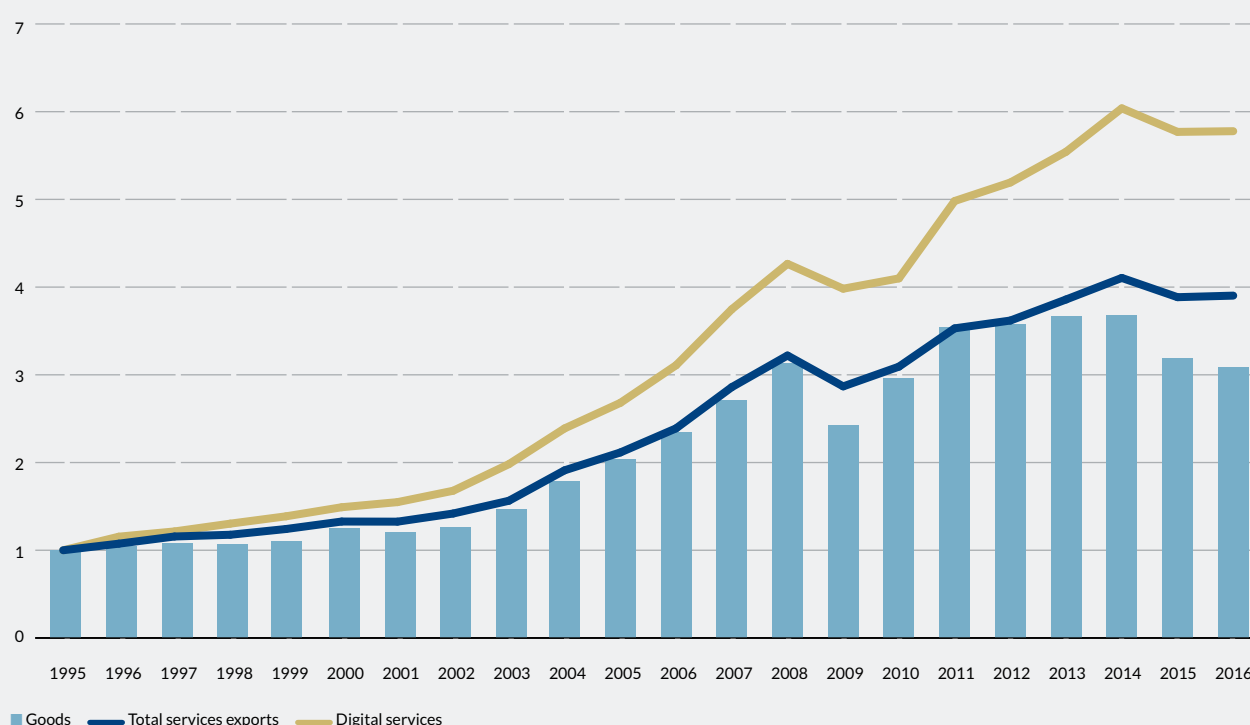
Economic history has shown that technological change radically affects the structure of production and trade. Technological change enabled the great structural shift in the 1800s that separated the production of goods from their consumption. Previously, a significant part of the West largely consumed what they produced but technological shifts rapidly boosted international trade – then mainly in goods – between countries.

For the past 40 years or so, developments in information and communication technology (ICT) have similarly transformed much of the way producers and consumers connect with each other. International trade has grown even faster

than before and this is because new technologies have reduced the costs of distance between producers – and producers and consumers. For instance, in the not too distant past, it was simply unimaginable to export services and not just goods. Thanks to new technologies and ICT, services have become tradable and this in turn has hugely expanded the scope of exports and imports. Nowadays, services represent around 23 percent of total trade and Figure 1 illustrates that now trade in services shows a growth rate substantially higher than that of trade in goods.

However, while digitalisation affects most forms of production and trade, we have long known that its strongest effect

FIGURE 1: Rapid growth rates of trade in services and ICT services (1995 – 2016), index growth rate



is in services trade. Indeed, a significantly more impressive growth rate in Figure 1 is observed for digital services. Since 1995, this type of digital flow grew with a factor of more than 5. With the current trend of digitalisation, it is likely that these changes in trade patterns will not just continue but accelerate, and that will ultimately change the way we perceive globalisation. In short, the digital economy is moving extremely swiftly and a large part of future trade flows resides in the digital sector. Furthermore, these digital and ICT services trade flows will feed into the wider economy.

However, one should bear in mind that digital technologies do not just enable a large part of the services economy to be tradable; services themselves are also becoming more and more digital-intense. The essence of this profound change is that the production and consumption of any type of service is increasingly being developed with the help of digital assets and instruments such as big data, internet-of-things and other ICTs. This digital process further feeds into the opportunity created by the fact that services have become tradable.

Moreover, whereas services trade can take place through other forms of supply such as direct investment or temporary migration, the fact that digital technologies can make many more services more easily traded over the internet means there is a far greater potential for services trade to grow more rapidly and play a greater role in national economies. The costs for enabling digital services trade are becoming more modest through expanding digital networks and that means – in trade parlance – that the classic form of cross-border supply, the movement across border of a product, is becoming more central to services trade.

Yet, as this report shows, developing an attractive digital infrastructure to make the cost of trading digital services is not a given. On the contrary, some countries are still lagging behind in some or many of these infrastructural “endowments” which enable digital services trade to happen in the first place. The purpose of this study is to generate a better understanding of what these endowments mean for countries’ trade potential in digital services and whether countries truly capitalize on digital developments so as to increase their digital services exports. In short, are countries boosting their trade in digital services to the extent that they could? A special focus is given to Germany as it forms the EU’s biggest economy.

It is likely that digital services and digital-enabled services trade – just like all forms of trade – will reflect the different endowments’ structures of economies, just as labour and capital traditionally have done for goods. The endowments specific to digital services trade will both relate to invested capital such as telecoms infrastructure, network-access capacity and the skills among the workforce that use digital technologies. These are the factors that will determine a country’s future success in digital services trade.

However, the question about how digitalisation affects the output and trade of services cannot be viewed in isolation from the endowments: to determine the performance and potential for services trade is not a “beauty contest” between countries but an exercise about *understanding the use of existing endowments* and whether economies perform well. In other words, the performance and potential of services trade in the digital era must come down to issues about the scale of endowments and how economies, and especially firms, use and absorb them in real terms.

It is important to recognize the role of endowment utilisation, especially in periods of technological change. It is all too often the case that observers and policymakers rate performance or potential as a factor of endowments alone. Consequently, countries are ranked in accordance with, for instance, their broadband capacity or the share of the population that subscribes to advanced mobile services. Furthermore, a typical policy prescription from observers of the digital economy is the expansion of networks and other ICT infrastructure. However, performance is not just a matter of the size of the input factors in an economy, and that is especially true in sectors where innovation is significant. Economic success and increased trade are equally determined by how various endowments and factors of production are combined in firms. It is therefore critical to grasp the industrial structures and capacities of an economy like Germany’s if we are to get an informed view about whether a country is performing well or not.

The utilisation of digital endowments is front and centre in this study. This report will start with a quantitative analysis about the performance of countries in digital services trade and whether they are truly tapping into their estimated potential for digital services exports. In so doing, the analysis compares the performance of European and OECD economies against their own predicted capacity. It therefore enables us to understand whether countries over- or under-perform in digital services trade. The analysis also sheds light on the potential for countries, specifically Germany, to trade digital services indirectly as an embodied

item in other industries and sectors using digital services, thereby even extending the scope of trade in these services.

One takeaway point from this analysis is that Germany underperforms in digital and digital-intensive services trade. Given the quality and scale of its endowments structure – its digital skills and all the capital that has been invested in its digital infrastructure – Germany should be trading more than it does. That begs the question: why is not Germany trading more in digital-intensive services? To get a better understanding of the factors holding back Germany, this report also performs a frontier analysis which takes us right to the issue of how digital factors and endowments are utilised.

The conclusion of this study is that while Germany has great potential to increase digital trade in services and, along with that, output and jobs connected to digitally and digital-intensive services, that potential can only be realised in the economy if firms get better at utilising existing endowments and capabilities, including digital services themselves.

Chapter 1 presents the result of our trade and frontier analysis, showing which countries in the EU and OECD over- or under-perform in digital services trade. Chapter 2 extends this analysis by looking at how digital services are embodied in other goods and services by these countries and therefore are indirectly exported. Here, too, it assesses whether countries are under- or over-performing as regards this indirect digital services trade. This section furthermore puts the results in a clearer German context, and anchors the trade analysis in the national economic development. Chapter 3 outlines the main conclusions and puts them in a policy context for Germany in particular.

1 Who is reaching or failing to reach its potential in digital services trade?

Although all countries trade in digital services over the internet, some perform better at exporting them than others. To analyse whether EU countries are doing well in exporting digital services, this paper performs an empirical assessment of which of these are over-performing and under-performing. With over-performing we mean that a country is exporting digital services beyond what one could reasonably expect based on its digital infrastructure, i.e. digital endowments structure. With under-performing we mean that a country is exporting fewer digital services than what one might expect given its digital infrastructure.

In order to do so, a gravity analysis of trade is applied. This analysis is the workhorse model of empirical trade analysis, in which trade flows are analysed against the benchmark of the most important trade costs that affect such flows, in our case the digital infrastructure and services trade policy. However, other cost factors also influence trade and are accounted for in the analysis. These cost factors are geographical distance, which still matters for trade in services over the internet (Head et al., 2008; Kimura and Lee, 2006; Ceglowski, 2006), as well as other widely known factors that affect how effectively we trade services, namely the legal framework for conducting businesses in a country, language barriers, sharing a border or not, or being member of the EU or the WTO. All these cost factors explain trade in services as well as digital services and are taken care of in our analysis, besides the digital infrastructure.

To assess this over- and under-performance, the gravity analysis employs gross trade data of services trade flows from the World Bank's Trade in Services Database (TIS) from 2011–2013 and follows the methodology by Sáez et al. (2015). This data records trade flows of all countries worldwide that trade services over the internet. This channel (or mode) of services trade is central to our analysis because

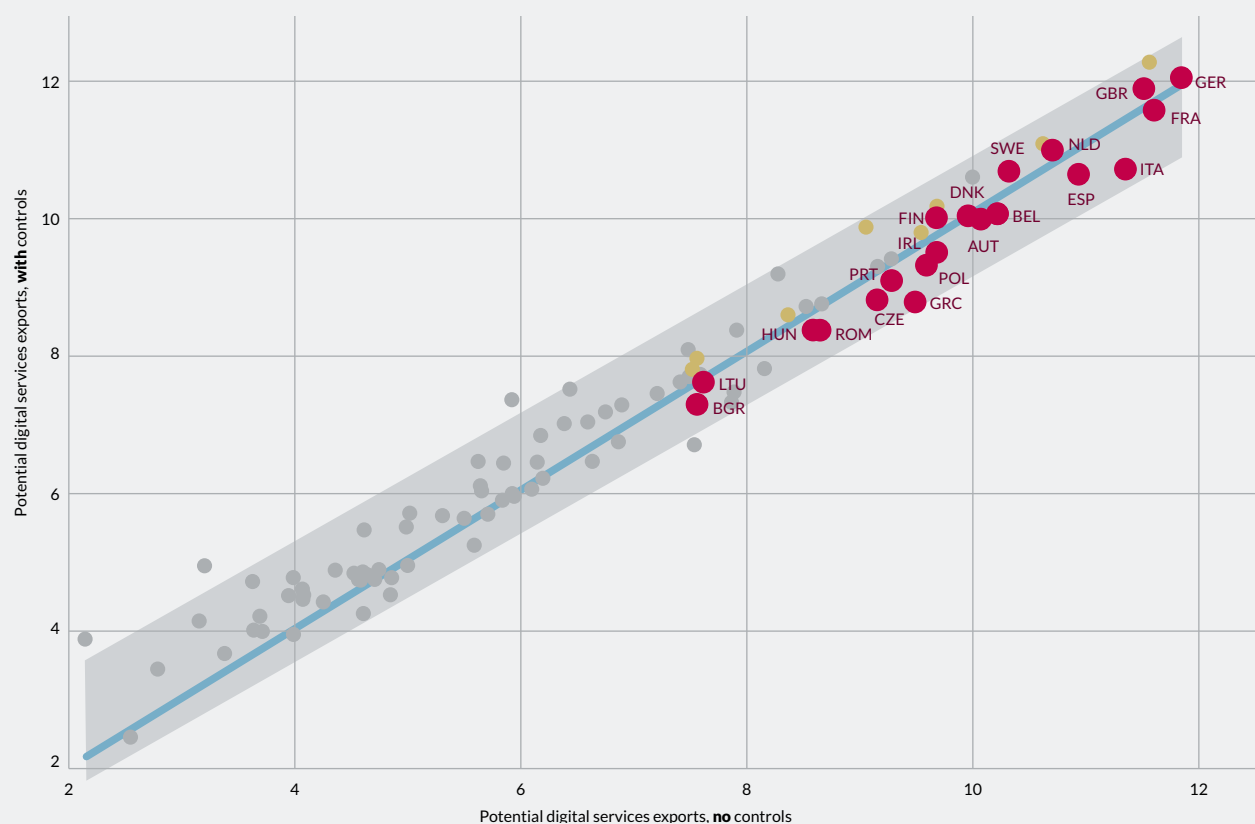
it covers cross-border trade in services delivered digitally.¹ However, to narrow down our scope further and to select the most relevant digital services alone, we focus on those services sectors from the TIS database which are most digital-intensive. The ranking and measurement of the most digital-intensive sectors is outlined in Table A1 in Annex I.

We focus on the following sectors: communication services, financial and insurance services, computer and information services, merchanting, as well as some other business services such as administrative services, business management services, advertising and market research and services between related enterprises, inter alia. These are precisely the services that appear in the Top 10 most digitally-intensive services sectors and are primarily also traded over the internet.² Although some other types of services that are less digitally-intensive are also recorded in this database and are therefore traded over the internet, they lie outside the scope of this analysis.³

The analysis of over- and under-performance in digital services trade for countries starts with assessing their expected trade potential in digital services. Figure 2 plots together the results of two estimated outcomes of the exports potential in digital services for each country. The first set of potential outcomes is plotted on the horizontal axis and is the result of an estimated model that only considers standard cost factors that influence this trade poten-

- 1 In WTO-speak this channel of services trade is called Mode 1 which applies when service suppliers' resident in one country provide services in another country, without either supplier or buyer/consumer moving to the physical location of the other. See for instance Francois and Hoekman (2010).
- 2 Other channels of services trade take place through Mode 2 (i.e. consumption abroad) which covers mostly tourism where consumers temporarily move to another country for consuming a foreign service, Mode 3 (i.e. foreign affiliate sales) which covers a multinational selling services abroad through its foreign presence, and finally Mode 4 (i.e. movement of workers) where the services providers move across borders to provide services abroad.
- 3 Examples include health services, travel services, transportation and construction services which are digitally less relevant.

FIGURE 2: Predicted digital services exports for EU countries – exports to the world



● Other countries ● EU member states ● Other OECD countries ■ 95-degree confidence intervals of the regressions — 45° line

Note: the grey-shaded area represents the 95-degree confidence intervals of the regressions. Digital services included only.

Source: World Bank TIS database, CEPII, WDI, WEF, author's calculations.

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BOX 1: Measuring a country's readiness for the digital economy and trade

The NRI is an encompassing index that measures how countries perform in digital capacity. It assesses more precisely the endowment structure of a country regarding ICT and shows the capacity of countries to produce digital goods, services and innovations by using information and communication technologies to boost competitiveness.

The overall index is composed of sub-indicators that each assess a different aspect of the digital economy and which all likely have an influence on digital services trade. These are items such as how well businesses and consumers are adopting and absorbing in the internet and ICT tools in their lives, but also aspects related to the sheer digital infrastructure and prices as well as aspects related to the economic and social impact ICT has in countries.

In the NRI, each of these aspects is in turn measures with specific variables and together they compose the overall indicator using a sophisticate aggregation procedure. As such, this index can be considered a summary indicator of a country's overall "digital infrastructure" or, in other words, a country's "digital endowments". In an economy, endowments are factors with which we produce and trade certain goods and services – in our case digital services.

Source: WEF; WEF (2016), author's input.

tial such as distance or being member of the EU or WTO. As a result, in this type of potential no other factors which otherwise could affect the performance (or the lack of performance) of digital services exports are taken into account in the model.

The second set of potential outcomes does however take into account the fact that additional factors have a separate impact on digital services exports. Besides the overall restrictiveness of a country's policy regime in services trade, for digital services trade the most important factors are the policies that determine a country's digital infrastructure, or put differently how well a country is prepared in terms of capitalising on the digital economy. To measure this, the World Economic Forum's (WEF) Network Readiness Index (NRI) is used in estimating this second potential. See Box 1 for further explanation of what is covered by the NRI. The results of this second augmented model are plotted on the vertical axis of Figure 2.

In Figure 2, each dot represents the estimation results by individual country. The maroon dots represent European Union countries, the yellow dots other OECD countries and the grey dots denote all other countries in the world for which data is available. The graph shows that there is a tight correlation between what the two potential outcomes for digital services exports show with a 45-degree line that separates the two models straight in the middle.

The results show that, because the second estimated potential properly controls for trade factors that affect digital services exports, observations below the 45-degree line indicate that there are other barriers (not picked up in the estimation) that prevent these countries from realising their full *potential* in digital exports to the rest of the world. Examples include Italy, Spain, Greece as well as Bulgaria and Romania; they could further increase their potential level of digital services trade. Other countries such as Finland and Sweden but also France and Germany have for the time being reached their current maximum *potential* capacity in digital services exports as they are placed on or above the 45-degree line. Germany however shows that it is on the line and therefore lags behind in potential capacity compared to other countries such as the UK and Sweden as well as most other OECD countries which are all above the line.

However, when plotting *actual* digital services exports of countries against their current potential, a different picture emerges. The analysis shows that, although some countries such as Germany and France do have good potential for

digital services exports, they nonetheless did not fully tap into this trade capacity. This can be seen in Figure 3, where the rightly predicted exports potential for digital services is plotted on the horizontal axis whilst each country's actual observed digital services exports are given on the vertical axis. Again, a 45-degree line separates the two variables in the middle so one can see the relative performance of countries.

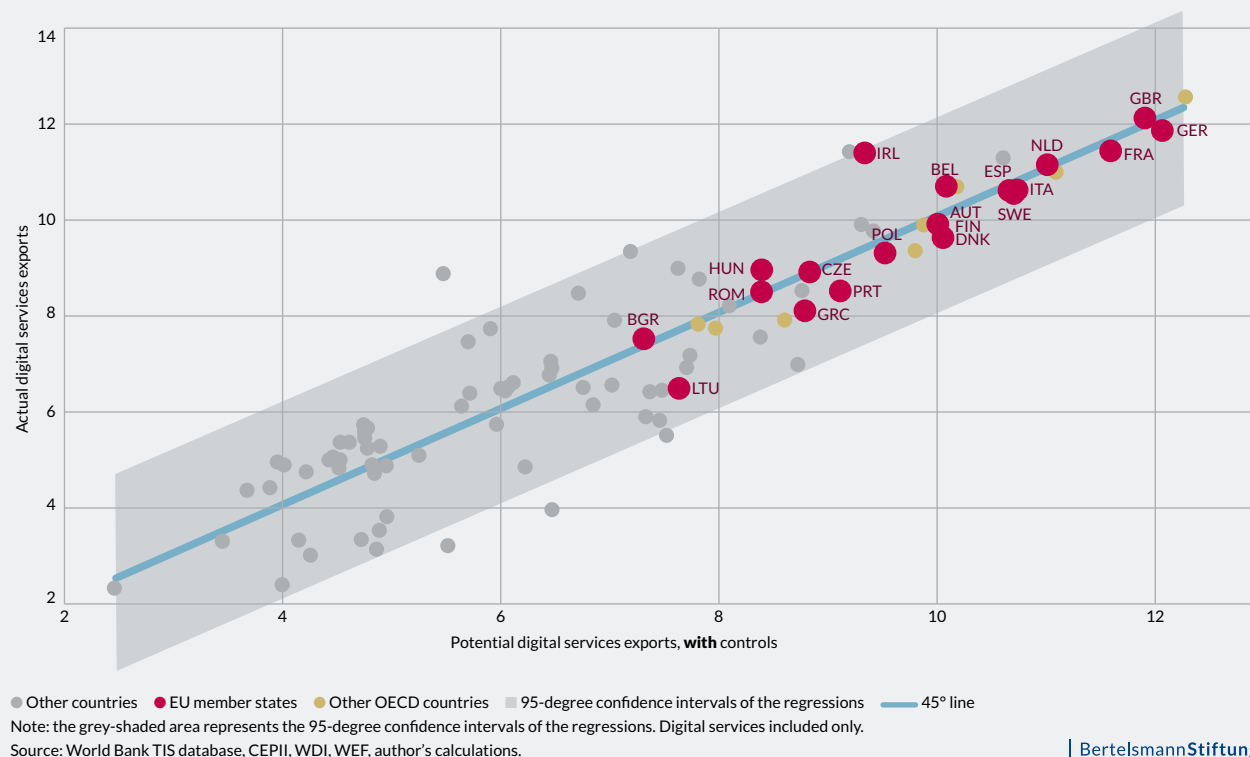
It becomes clear that some of the countries which in Figure 2 were placed *below* the line are in Figure 3 placed *above* the line. This indicates that these countries are *actually already performing better than their predicted potential*. Hence, they are "over-trading" with the rest of the world. Romania is a case in point. Ireland is also over-performing as it shows much larger digital services exports than its predicted potential. These countries are known for their strong digital services export performance and are likely to have comparative advantage in digital services. Ireland trades a lot of B2B services as it has many digital services headquarters and Romania is known for its success as an outsource destination of digital back-office services as well as other business processing services.

Other countries in Figure 3 are placed below the 45-degree line, and among them we find Italy and Greece, but also France and Germany. These countries are "under-trading" with regard to their predicted potential and therefore, in theory, should show greater digital services exports given the extent of their digital endowments. The results also show that other countries such as Lithuania, Portugal and Denmark could further exploit their export potential in digital services. Even though these countries have already reached their current maximum potential for digital services trade, their actual digital services exports nonetheless fall short of that predicted potential. In other words, there is still an amount of digital services exports left unexplored.

Table 1 lists those countries which according to our results over- and under-perform in digital services trade. The first column of Table 1 shows the results when taking all digital services sectors together as performed for Figures 2 and 3.

The ranking shows that many EU countries could improve their actual performance in digital services exports. Only a few European countries are performing above their potential. Smaller countries such as Ireland and Belgium appear to be strong over-performers. Great Britain, which has a strong position in services trade overall, is also a strong over-performer. Other countries that over-trade in digital

FIGURE 3: Predicted digital services exports compared to existing exports for EU countries – exports to the world



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services such as Romania or Bulgaria may come as more of a surprise, but these have most likely experienced greater exports of outsourced back-office services.

1.1 Over-performers and under-performers by sector

In a similar manner, using the same performance analysis, the results can be broken down into separate digital services sectors. An overview is given in Table 1 in which the entire group of digital-intense services sectors is split into six broad categories, namely merchanting services, business services, communication services, finance, computer and information services and finally insurance services. In Table 1, those countries that are over-trading are put in bold and ranked above the marking line in each column whilst the countries which under-perform in each services sector's exports are ranked below the line.

Overall, Germany, as well as France, appear as over-performers in exporting communication and insurance services. This does not come as a great surprise as both countries have large telecommunication companies which have

successfully exported their services abroad. Germany also has a strong position in the insurance market. France is an over-trader in merchanting services, which includes distribution such as retail and wholesale, but also leasing services. Traditionally, France has a strong distribution sector.

In all other services listed in Table 1, Germany performs below its potential and for some services such as business services as well as computer and related services it ranks extremely badly – at the bottom. This means that there is still room for Germany to enhance its exports over the internet in these digital-intense services. For France, a similar conclusion applies as it also under-performs in business services and computer services compared to its predicted potential.

One strong European over-performer is Ireland. It shows a strong over-performance in exports of financial services, computer services and insurance services. Furthermore, regarding merchanting services, Ireland also performs well.

In business services, the group of over-performers are in large part comprised of Central and Eastern European (CEE) countries such as Bulgaria, Hungary, Romania and Czech Republic. They are performing well compared to their pre-

TABLE 1: Over and under trading by digital services sector

Rank	Overall	Business	Merchanting	Communication	Finance	Computer	Insurance	
1	IRL	CHL	CHL	BEL	IRL	IRL	IRL	Overperforming
2	HUN	BGR	IRL	CAN	BEL	NZL	BGR	
3	BEL	HUN	HUN	NLD	NZL	CHL	GBR	
4	CAN	NZL	NZL	ITA	BGR	CAN	CHL	
5	BGR	ROM	KOR	USA	ITA	BGR	TUR	
6	USA	IRL	JPN	GBR	CAN	HUN	CAN	
7	GBR	CZE	TUR	IRL	GBR	CZE	USA	
8	ROM	CAN	BEL	FRA	TUR	AUS	GRC	
9	NLD	BEL	PRT	ROM	ESP	FIN	DEU	
10	CZE	KOR	AUT	DEU	ROM	BEL	ITA	
11	CHL	LTU	FIN	SWE	HUN	ROM	BEL	
12	KOR	POL	CAN	AUT	KOR	GRC	AUT	
13	ESP	AUS	DNK	AUS	CHL	AUT	FRA	
14	JPN	PRT	ITA	BGR	USA	DNK	CZE	Underperforming
15	AUT	AUT	CZE	ESP	GRC	ESP	ESP	
16	ITA	TUR	FRA	PRT	AUT	SWE	NLD	
17	FRA	NLD	GRC	TUR	PRT	ITA	SWE	
18	SWE	GRC	SWE	HUN	FRA	PRT	POL	
19	DEU	ESP	BGR	CZE	DEU	POL	KOR	
20	POL	DNK	DEU	KOR	AUS	USA	AUS	
21	FIN	SWE	ESP	GRC	LTU	NLD	JPN	
22	NZL	ITA	LTU	CHL	JPN	FRA	ROM	
23	DNK	FIN	AUS	NZL	DNK	DEU	DNK	
24	AUS	GBR	ROM	DNK	CZE	GBR	PRT	
25	PRT	FRA	POL	POL	POL	JPN	HUN	
26	GRC	USA	NLD	FIN	SWE	LTU	NZL	
27	TUR	DEU	GBR	LTU	FIN	TUR	LTU	
28	LTU	JPN	USA	JPN	NLD	KOR	FIN	

Source: World Bank TIS database, CEPII, WDI, WEF, author's calculations.

dicted potential and one important explanation is their position as destinations for information technology outsourcing (ITO) or businesses processing outsourcing (BPO) from other European countries.

Communications services are dominated by over-performers among many traditional EU members such as Netherlands, Italy, the UK or France, Germany and Sweden. These are also some of the countries that hold the largest and most successful telecommunications firms in revenue terms in Europe.

Looking at financial services, Spanish and the British firms are successful performers. Surprisingly, Germany and France are still under-performing in this area. Other over-performers in financial services are Ireland, Belgium, Italy and some Eastern European countries.

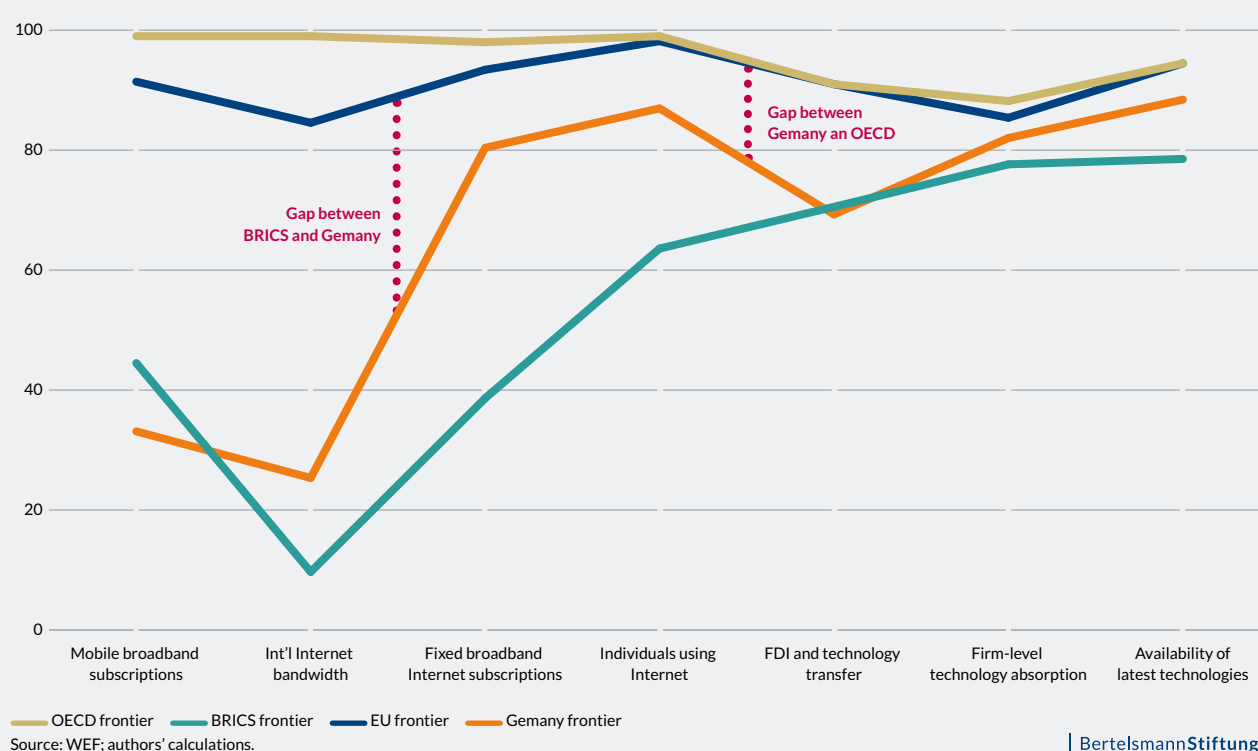
In computer services, some other countries appear as over-performers such as Finland, Belgium and Austria, but also Greece and the CEE economies. As already indicated, Germany together with France are performing below their potential in computer services. Finally, for insurance services similar countries perform relatively well, particularly the UK, Ireland plus Bulgaria and Italy.

1.2 Closing the digital gap with the frontier

To investigate more in depth how Germany and other EU and OECD countries could tap into their potential for digital services trade, we explore where they could improve their structural digital infrastructure or endowments.

Structural endowment factors were already used in the previous analysis for assessing the potential for digital services trade. They are proxied by the World Economic Forum's Network Readiness Index as explained in Box 1. However, this section will use this index to state in which digital sub-fields Germany and other countries show a gap between their position scoring and the scoring of the best performer, i.e. the frontier, within each group that has reached its maximum potential. The analysis thus compares Germany with the frontier country within each group as defined by the OECD, EU or BRICS. This is done for each digital sub-field of the index. This gap between Germany's score and that of the OECD, EU or BRICS frontier runner illustrates in which digital field of the economy there is policy scope for Germany to approach its predicted potential regarding digital services exports. If the digital gap is relatively wide, there is room for improvement for Germany to amend its policies in order to close its diffusion gap in digital indicators.

FIGURE 4: Closing the overall digital gap (Index rescaled from 0–100)



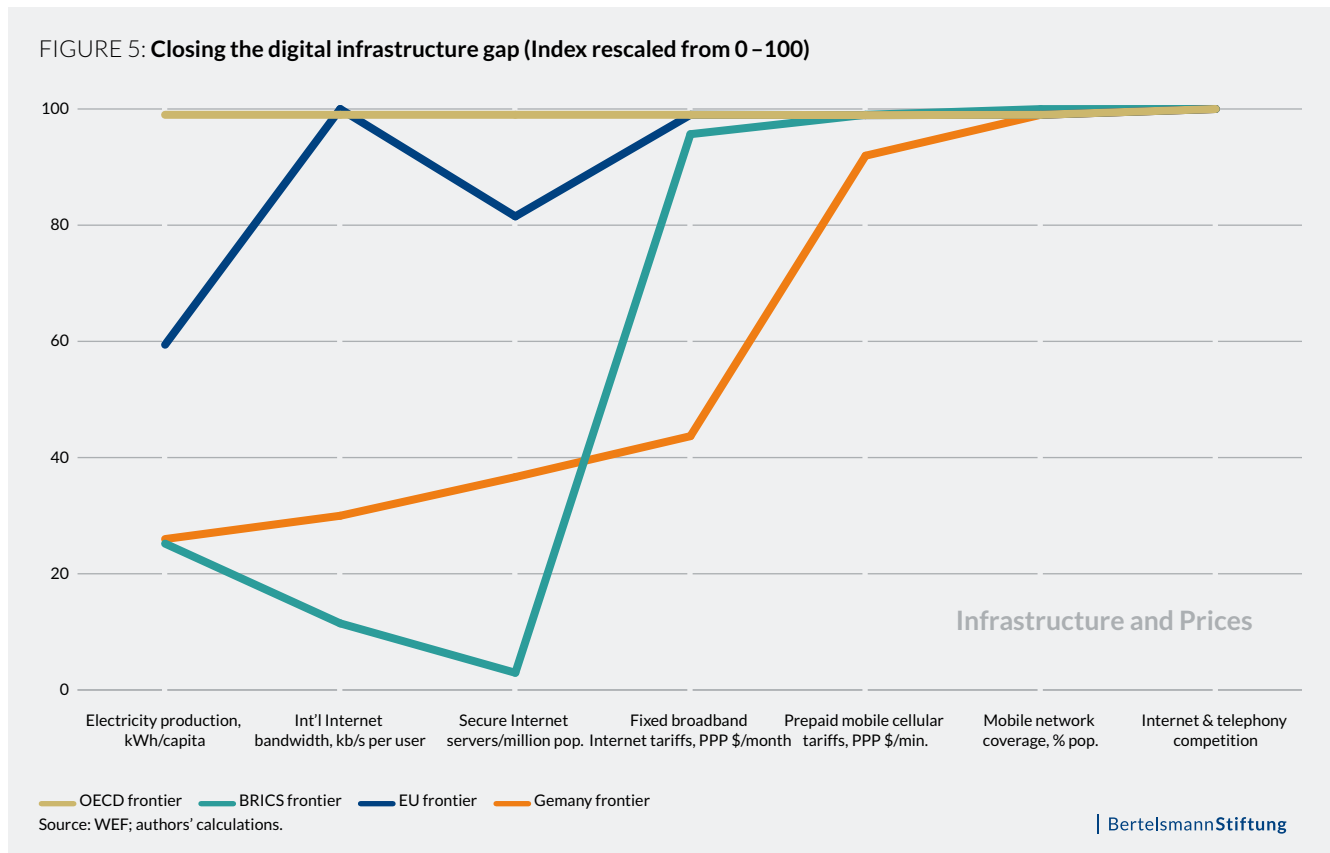


Figure 4 below shows a first illustration of this diffusion gap based on the seven aggregated sub-indicators of the World Economic Forum's NRI index, each representing a particular sub-area of the digital economy. The blue line shows the OECD frontier on each of the dimensions whereas the red line marks the country that represents the frontier in the EU. The purple line shows the BRICS frontier on these same dimensions and finally the green line represents the performance of Germany. Note that the more we shift to the right, the more we close the diffusion gap between Germany and other front-runners regarding these various dimensions of the digital economy. Dimensions on the left side of the figure shows that there is still a large diffusion gap between countries.

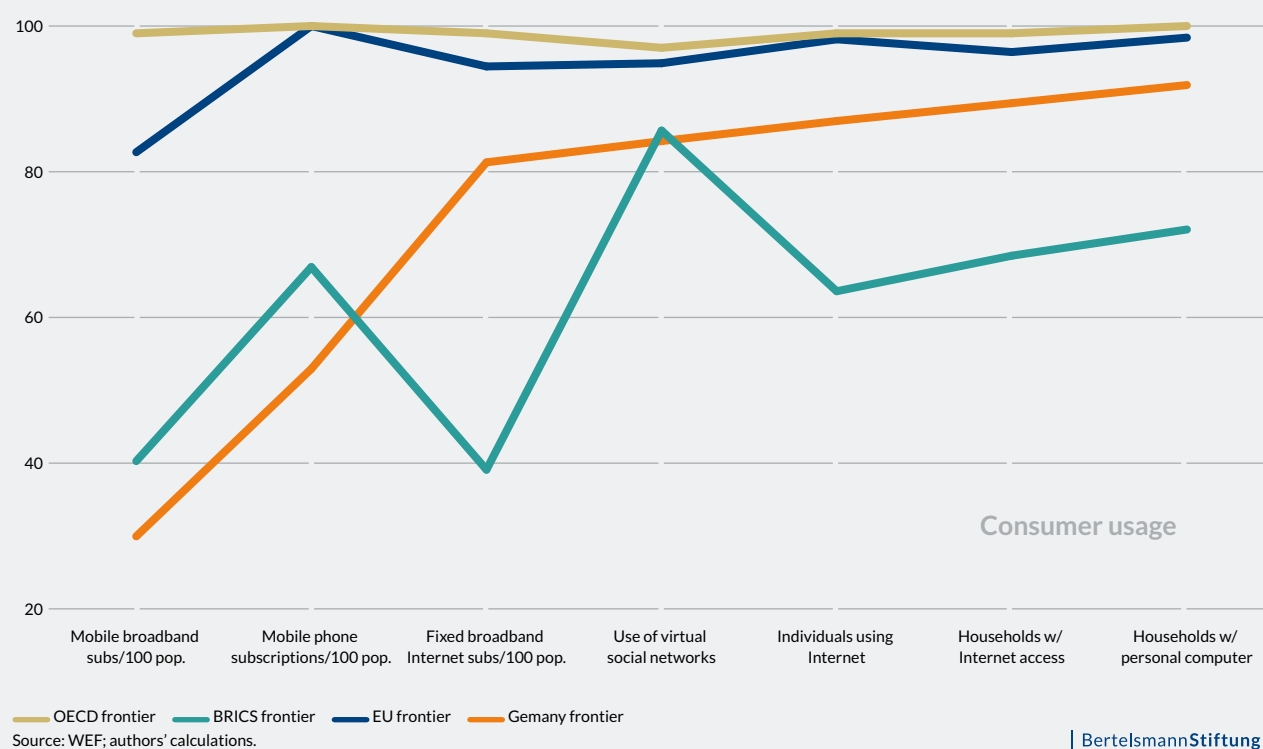
The figure shows that, in most cases, the OECD unsurprisingly constitutes the frontier. The graph also shows that there is a considerable gap between the OECD and BRICS frontiers, indicating that the BRICS countries lag behind the advanced economies. This comes as no surprise as these countries are also often lagging behind in many aspects of the digital economy, even though catching up fast. In addition, the gap between the OECD and Germany is particularly wide on some of the infrastructural dimensions such as international internet bandwidth and mobile

broadband subscriptions as well as FDI and technology transfer.

Figures 5–8 describe the various sub-areas of the overall NRI index. Figure 5 shows the diffusion gaps for physical digital infrastructure and prices across countries. Germany performs moderately with respect to international internet bandwidth (i.e. maximum quantity of data transmission from a country to the rest of the world) and the number of secure internet servers. In terms of prices and digital competition, Germany scores at the frontier. Note, however, that with fixed broadband tariffs, Germany scores much worse than the best performer within the BRICS group. This may be due to the limited broadband capacity and the low level of mobile broadband subscriptions in Germany (see Figure 3).

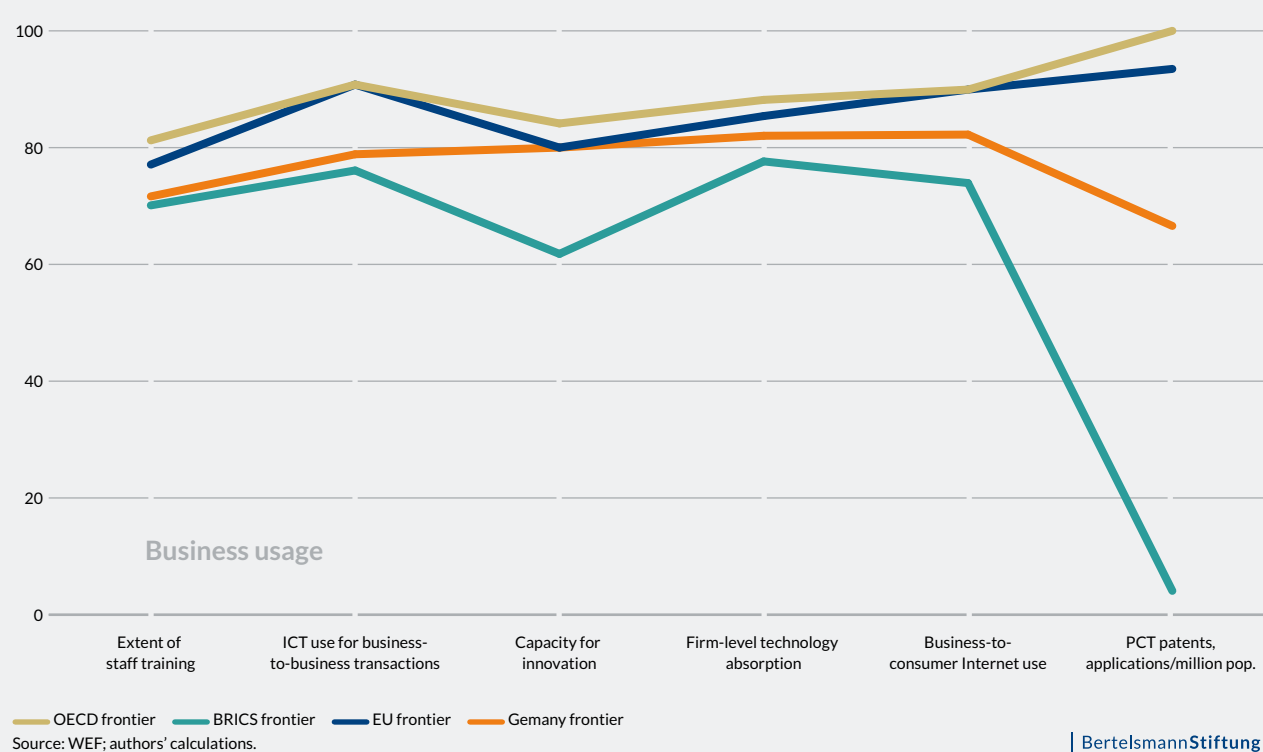
Figures 6 and 7 set out the consumer (i.e. individual) and business areas of the digital economy respectively. In Figure 6, it becomes clear that, although Germany overall preforms relatively close to the frontier, mobile broadband subscriptions are still falling behind. In fact, regarding both types of mobile subscriptions, the BRICS frontier

FIGURE 6: Closing the digital consumer gap (Index rescaled from 0 – 100)

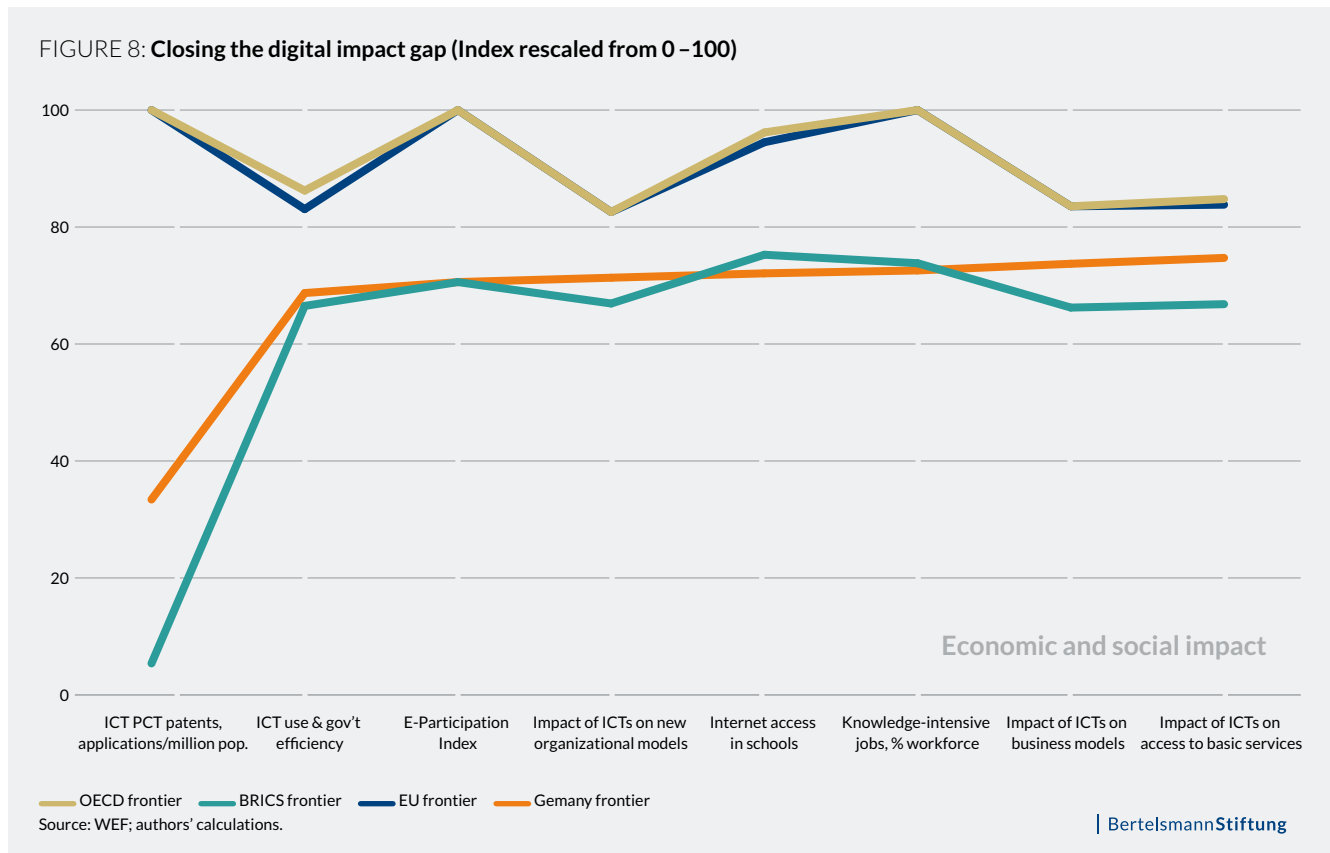


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FIGURE 7: Closing the digital business abilities gap (Index rescaled from 0 – 100)



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is performing better than Germany. For all other individual or household dimensions, Germany scores well and approaches the OECD and EU frontier.

The digital usage by businesses in Germany as shown in Figure 7 is also approaching the frontier and the diffusion gap between Germany and the EU or the OECD on the various dimensions shows a converging trend, except for patents applications where the gap increases. This latter variable measures the usage of the international patent application procedure. The BRICS frontier is on all dimensions lower than that of Germany. In both figures, countries from the OECD and EU form the frontier in digital usage by businesses and consumers.

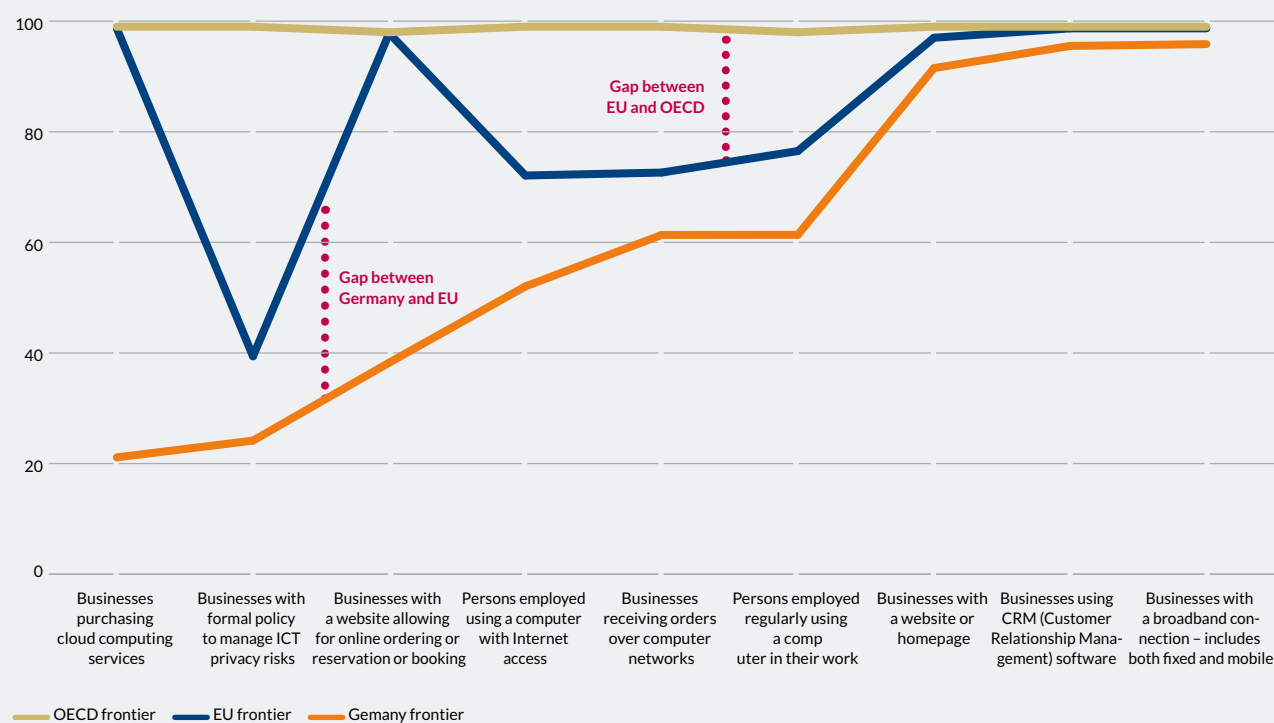
More interesting, however, is the fact that Germany's diffusion gap regarding the impact of digital tools and services is similar to that of the BRICS. Both, Germany and the BRICS, are lagging behind in this area in comparison to the OECD and the EU. This can be seen in Figure 8 in which the dimensions of economic and social impact of ICT are given. It shows that there is a distinct performance gap between, on the one hand, BRICS and Germany and, on the other hand, the EU and the OECD which is only closing to some degree.

Both Germany and the BRICS frontier score low on the number of ICT applications and the e-participation index as well as the share of knowledge-intensive jobs present in the economy, where the gaps on these additional dimensions are relatively wide. Yet for some other aspects the leading countries within the OECD and EU frontier also show some further potential to close the diffusion gap such as regarding the impact of ICT on organisational or business models. These frontier economies in the EU and OECD are often Finland, the Netherlands, Estonia or Singapore and Iceland.

The dimensions of individual usage and business usage can be further explored in more detail using additional information from the OECD, which assesses more extensively the various consumer and business angles of the digital economy. Two sets of information are employed, namely the business and individual performance in the digital economy, which are respectively shown in Figures 9 and 10.

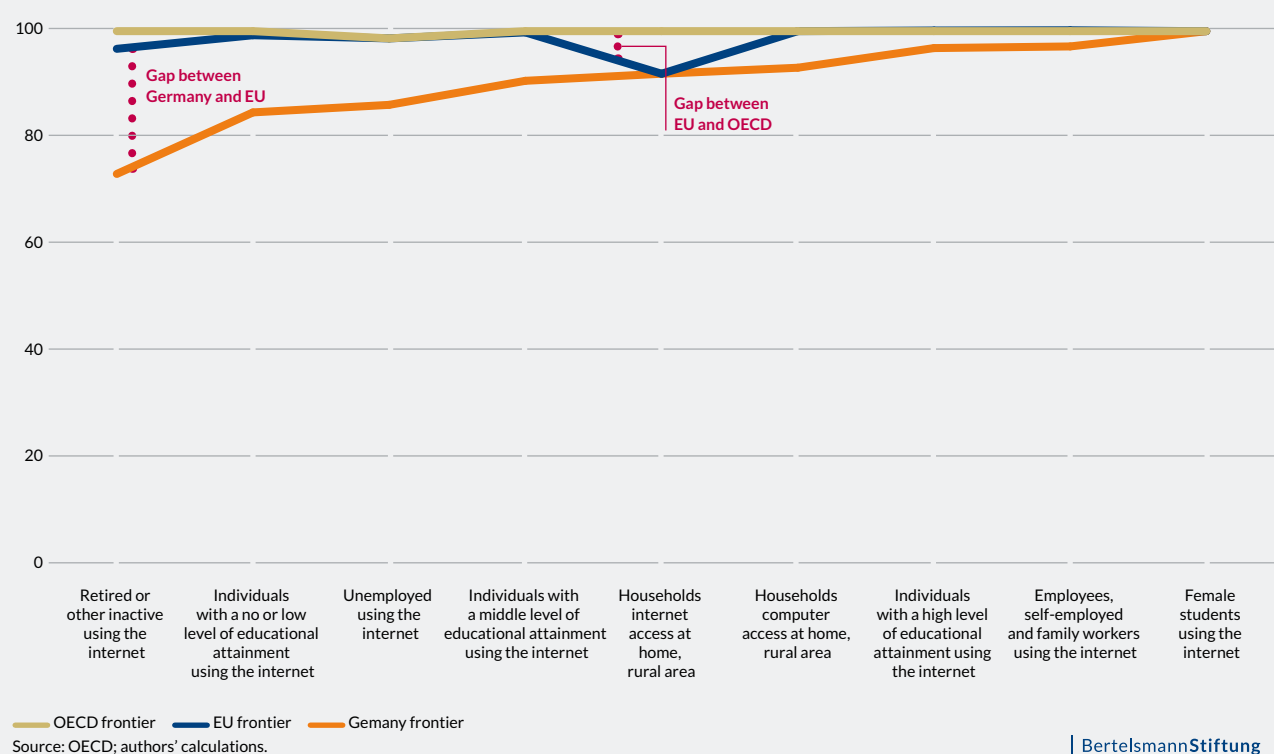
Figure 9 shows the OECD and EU frontier together with Germany. The BRICS frontier is not included as data for this group of countries is not available. The figure shows that, on none of the indicators, is Germany at the frontier

FIGURE 9: Closing the digital business absorbing gap (Index rescaled from 0 – 100)



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FIGURE 10: Closing the digital consumer absorbing gap (Index rescaled from 0 – 100)



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of the digital economy, although the diffusion gap between Germany and the frontier is relatively small on the final three – broadband connection, businesses using customer relation software and business with a website. Overall, however, the gap is relatively large on all other items, including areas of cloud computing, ICT privacy risks or businesses with a website for orderings. The front-runners in the EU tend to show a similar trend as Germany, although performing at the frontier and therefore much better than Germany regarding online ordering and cloud computing, and are respectively Finland and Sweden. The diffusion gap between Germany and these EU frontiers is therefore relatively big in these areas.

However, and as shown in Figure 10, the diffusion gap between Germany and the EU or the OECD frontier regarding the individual digital performance across the whole spectrum is a lot smaller. The various dimensions of personal employment of digital items are shown on the horizontal axis for Germany and the frontier countries in the EU and OECD. The figure indicates that Germany approaches the digital frontier to a very high extent by *closing the digital diffusion gap on many of the personal ICT usage dimensions*. For instance, although there is still a gap in the extent to which retired or other “inactive” persons use the internet, this gap is relatively small compared to the business performance of digital items as shown in Figure 9. In addition, the EU itself is on many dimensions also the frontier performer when compared with other OECD economies.

2 Extending the potential of Germany's digital services exports

The results from the previous chapter show that Germany, while performing well in some areas, significantly lags behind the EU and OECD frontier regarding its ICT endowments. As a consequence, neither Germany nor France is capturing its potential for trade in digital services.

Digital services like all services can be exported in different ways, thereby performing different roles in the economy. First, services can be exported directly across borders as the previous chapter has analysed. Second, services are also used as inputs into other industries and sectors in the economy. As such, services serve as links into value chains and are used as commodities for manufacturing activities. Third, services are also increasingly produced by manu-

facturing firms. This process is also known as “servicification” in which manufacturing firms supply services in-house for their manufacturing process or bundle and sell services along with the goods.

Recently developed data on exported value-added captures all these aspects regarding the role of services, that otherwise traditional trade data cannot account for. Value-added of trade therefore records not only the extent to which (digital) services are traded cross-border, but also how much they are employed and indirectly exported in the wider economy. The wider economy is defined as those industries and sectors in countries that use digital services in their production processes and export their goods in

FIGURE 11: Direct and indirect digital services value-added in gross exports (2011)

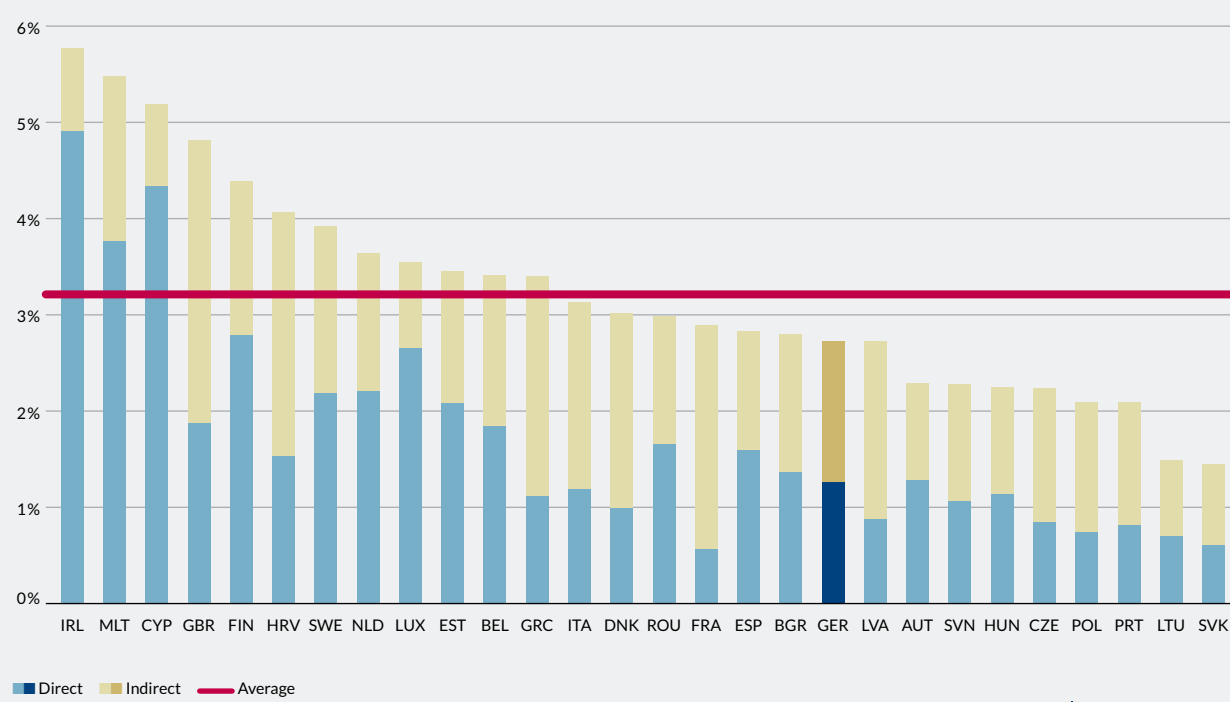
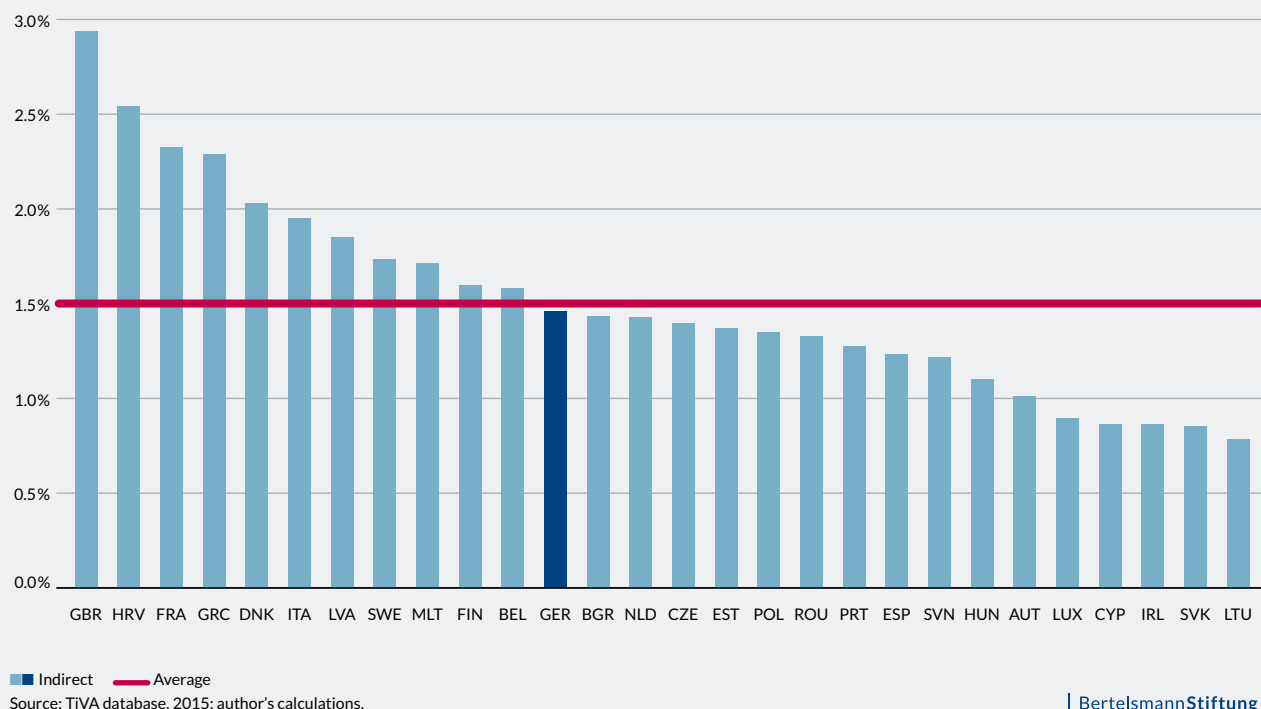


FIGURE 12: Indirect digital services value-added in gross exports (2011)



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which digital inputs are embodied to other countries. In this way, value-added exports data records what is indirectly exported in services.

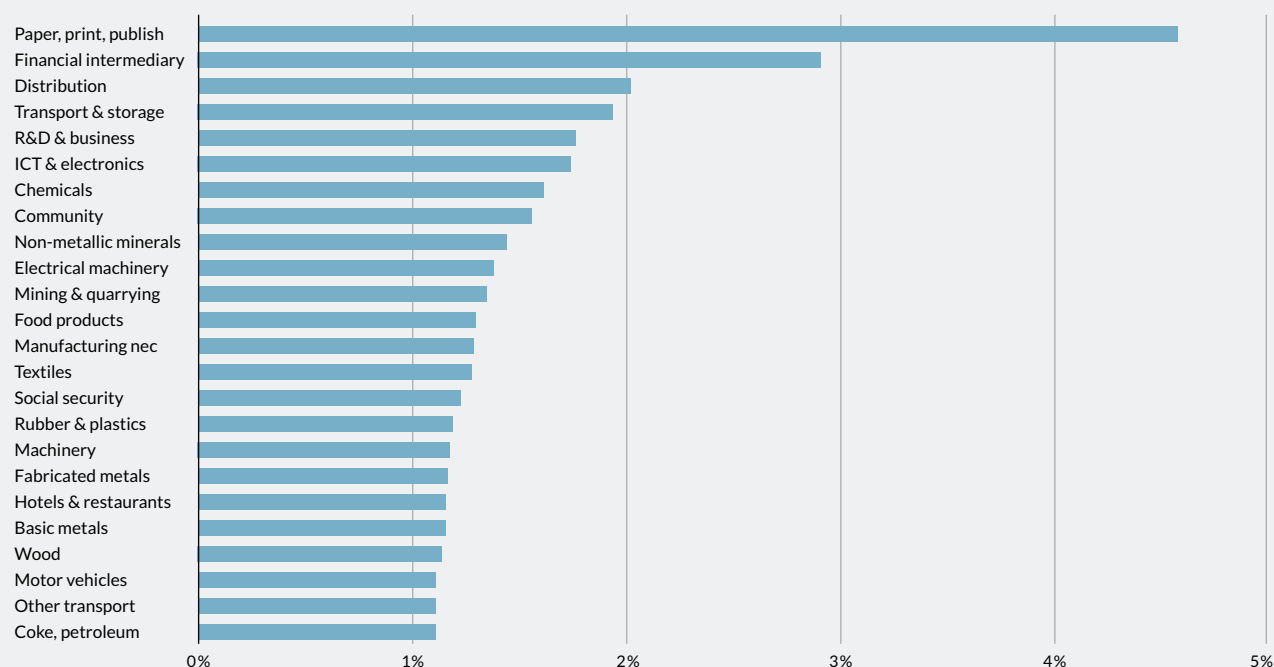
Figure 11 shows Germany's position with respect to digital services value-added exports compared to other European countries.⁴ It distinguishes between digital services which are directly exported by services firms, and those embodied in other downstream industries and sectors using digital service as inputs. Germany, together with France, shows a ranking position that is more placed on the right side of the bar chart and therefore has a lower than average level of total value-added exports of digital services, as both it and France fall under the EU average. This result reflects to some extent the specialisation pattern of Germany and France which is less focused on services and more on industries. Countries placed at the left side of the figure tend to be specialized in exports of services more generally.

⁴ Digital services are defined as ISIC Rev.3 sectors 64 and 72, which are respectively Telecommunications and Computer and related activities as defined in the TiVA database. No further breakdown of these services is provided that allows for assessing a disaggregated classification and selection following Table A1. This means that digital services here exclude the category of business services since ISIC Rev.3 category of Other business services is too broad to qualify as digital services unlike in the previous chapter where more detailed trade data was available and which only covered cross-border flows over the internet.

Yet, it is striking to see that Germany's indirect exported value-added for digital services is also relatively low, representing only 1.46 percent of total domestic value-added trade in gross exports. Germany therefore under-performs and is also in this case placed below the EU average as shown in Figure 12. Moreover, countries with a low direct share of value-added exports in many cases have high shares of indirect value-added exports. One clear case in point is France, which has a low direct share but compensates that with a high indirect share and is in fact placed third in Figure 12. The UK too shows a relatively lower direct share, but other sectors, such as the financial services sector, are using digital services a lot more in their exports. Overall, the figures illustrate that German industry does not appear to pick up domestic digital services as inputs in their exported goods.

Which industries in Germany do nonetheless use digital services? Figure 13 provides a breakdown of the industry users that embody digital services in their goods as well as services as digital services are not only used by industries, but also by services sectors. In fact, services are often the main users of digital services, particularly business services as Table A1 shows. In Germany, the main users of digital services are the paper and publishing industries (which comprise newspapers and books as well as recorded media),

FIGURE 13: Germany's indirect digital services value added in gross exports, by user (2011)



Source: TIVA database, 2015; author's calculations.

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BOX 2: Digitalisation of services themselves

The increased digitalisation of the economy is intertwined with servicification and as such can cover a wider set of sectors than telecommunications and computer services alone.

Services and manufacturing firms adapt and evolve their business strategies with the use of digital technologies so as to increase their productivity. In this process, some services such as business services or logistics services are becoming highly digitalised. When other industries use these services, this represents an additional channel through which industries indirectly export digital services.

Examples include marketing services or other back-office services such as business processing outsourcing which are highly digital-intense. Design and R&D services are another example, as they increasingly rely on computer techniques, big data or other ICT tools to adjust design for consumers. Marketing services employ a lot of big data and ICT techniques to retrieve information from consumers, and as such it makes this sector very digital-intense.

Even transportation and logistics services are becoming very digital-intense services. Standardizing and streamlining procedures in this sector are increasingly carried out with the help of ICT and digital items such as in traffic management. Lastly, many back-office and management services between companies are also becoming digitalised as head offices take on the function of controlling production processes with the help of data and computers.

All these digitalised services are input services for industries in their own right. When companies are using, producing and selling more and more of these digital-intense services, this digitalisation process forms another channel through which the economy becomes increasingly digitalised by the use of services.

followed by the financial and insurance sector and the distribution sector.⁵ These sectors are the most digital services-intensive sectors in Germany. The industrial sector in Germany that embodies most digital services is chemicals, followed by non-metallic minerals and electrical machinery. These are all relatively capital-intensive industries and they are to a high extent involved in global value chains.

2.1 National trends in Germany's digital-intensive services sectors

The success and efficiency of digital services and digital-intensive services is an important factor for the overall economic development and export competitiveness of a country. Productivity provides a first indication of both the potential of a sector to trade and of the general trade competitiveness of the sector in question. If services markets are competitive with healthy productivity growth, this will be positively felt throughout the whole economy employing

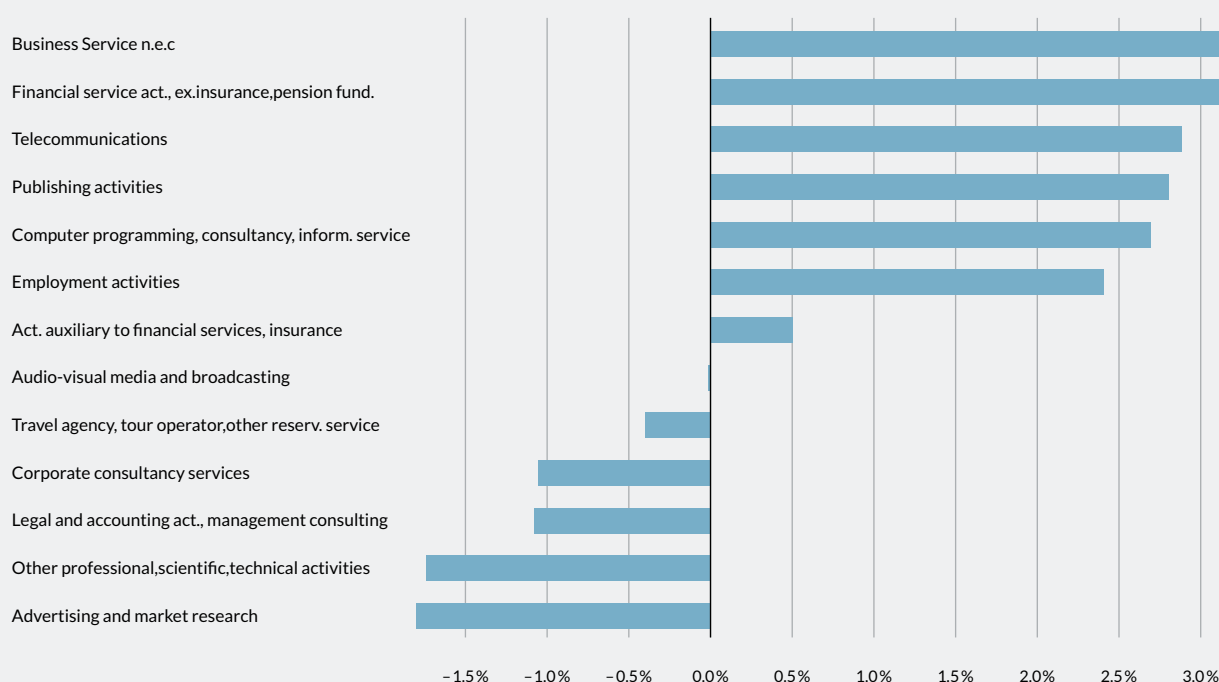
5 Telecommunications and computer services are actually the biggest users of digital services as well, but are excluded from this list as these are the two sectors which are selected as digital services producers as well.

them. (Van der Marel et al., 2016; Arnold et al., 2015; 2010). Since most of Germany's economy is composed of services, namely around 75 percent, and since digital services as well as digital-intensive services as defined in our previous chapter represent around 12–18 percent, the competitiveness of digital and digital-intensive services becomes critical to fulfilling Germany's digital trade potential.

Some digital services in Germany are, however, suffering from a lack of productivity. Figure 14 outlines sectoral data on productivity growth which is defined as output divided by the amount of people working in the respective sector. This represents a proxy for productivity. A negative growth rate is particularly likely to adversely affect trade performance and competitiveness in these sectors, ultimately impacting other sectors using them.

German business services as well as financial services show the highest productivity growth from 2000–2014. As pointed out above, financial services are very digital-intensive as are many business services. Interestingly, the previous chapter showed that Germany under-performs in terms of cross-border trade over the internet in these two sectors. Hence, given that these sectors are in fact very productive in Germany, tapping into their potential so as

FIGURE 14: Average annual growth rate of productivity (2000 – 2014)



Note: productivity is defined as output per worker. The annual average growth rate is computed.
Source: Federal Statistical Office of Germany; authors' calculations.

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to increase exports in both business and financial services should not be out of reach for German companies. Other high productivity growth sectors in Germany are the telecommunications sector, publishing services, computer and related services and employment services.

In contrast, Figure 14 also shows that many other business services such as consultancy services, professional services such as legal services and accounting, but also management services, scientific services and advertising and marketing services show low or negative productivity growth rates in Germany. As Box 2 outlines, these types of services are also increasingly digital-intense and increasing the productivity rate in these sectors would further expand Germany's cross-border trade potential in them. The only two sectors where Germany shows positive productivity growth and in which it is over-trading are telecommunications and insurance services.

It is important to keep in mind that these findings are not only relevant for Germany's ability to exploit its trade potential in digital and digital-intense services, but also for the future success and trade competitiveness of its manufacturing sector. Currently, industries are experiencing a massive transformation in which 3D printing, machine-to-

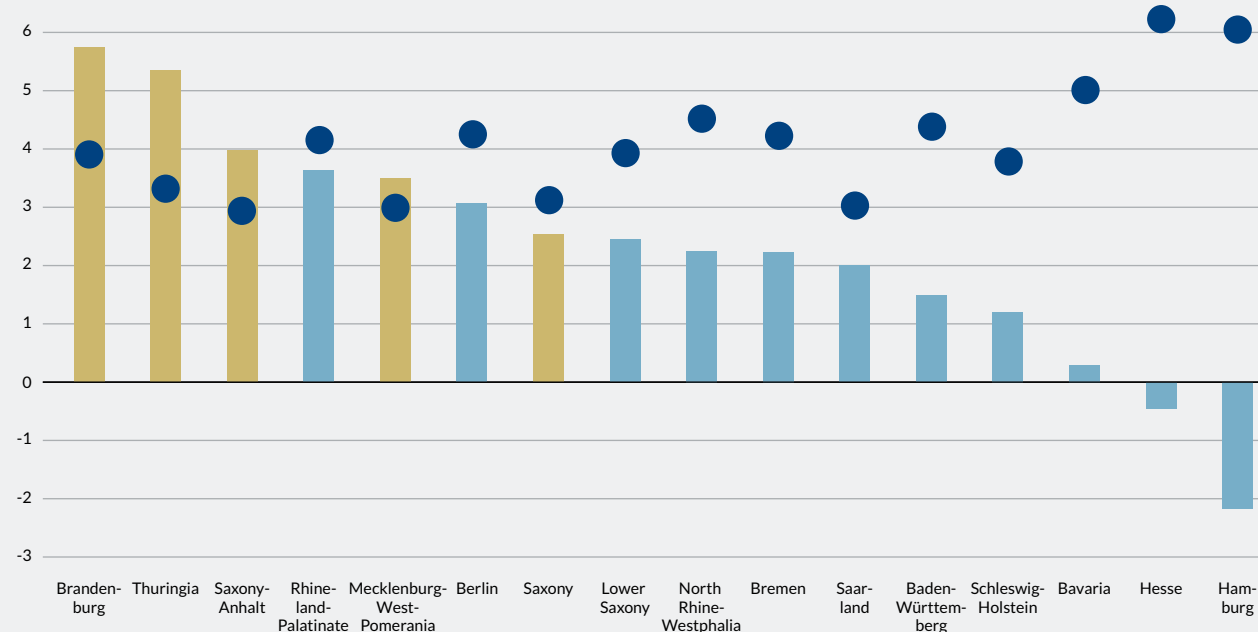
machine learning, cloud computing and the internet-of-things are going to be central elements. Digital services take up a special place in this process and, with the simultaneous development of the *servicification* of manufacturing, countries that capitalise on making digital and digital-intense sectors competitive are expected to benefit as services have a knock-on effect on industries.

2.2 Regional trends in Germany's digital-intense services sectors

This section aims at identifying and analysing the main trends of key digital-intense services among the different states and regions of Germany. The available data shows that there seems to be significant variations in productivity among the different German regions regarding these services. In order to analyse these trends, this section provides an overview of some of the most important digital-intense services sectors in German states for which data was available.

Figures 15–18 show the results for both growth and absolute levels of productivity. Since east German states are still catching up economically, their productivity growth

FIGURE 15: Productivity in Administrative and support service activities (2008 – 2014)



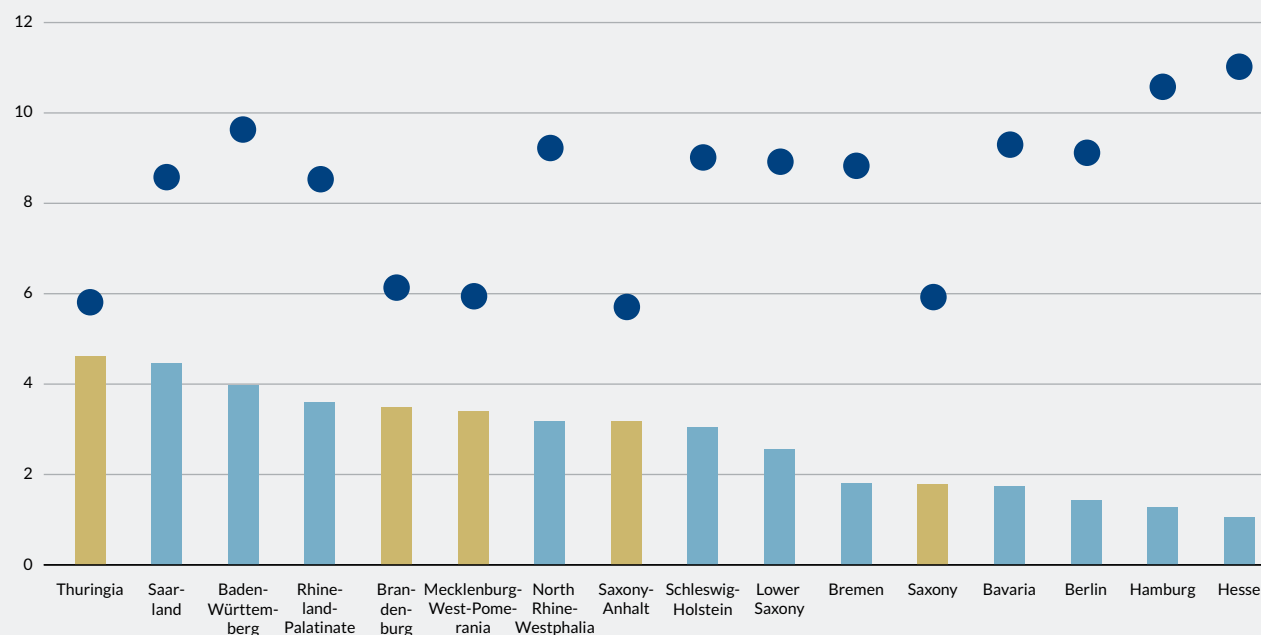
Professional, scientific and technical activities (in Percent): ■ Regions in former West Germany ■ Regions in former East Germany ● Level

Note: productivity is defined as output per worker. The annual average growth rate is computed.

Source: Federal Statistical Office of Germany; authors' calculations.

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FIGURE 16: Productivity in Financial and insurance activities (2008 – 2014)



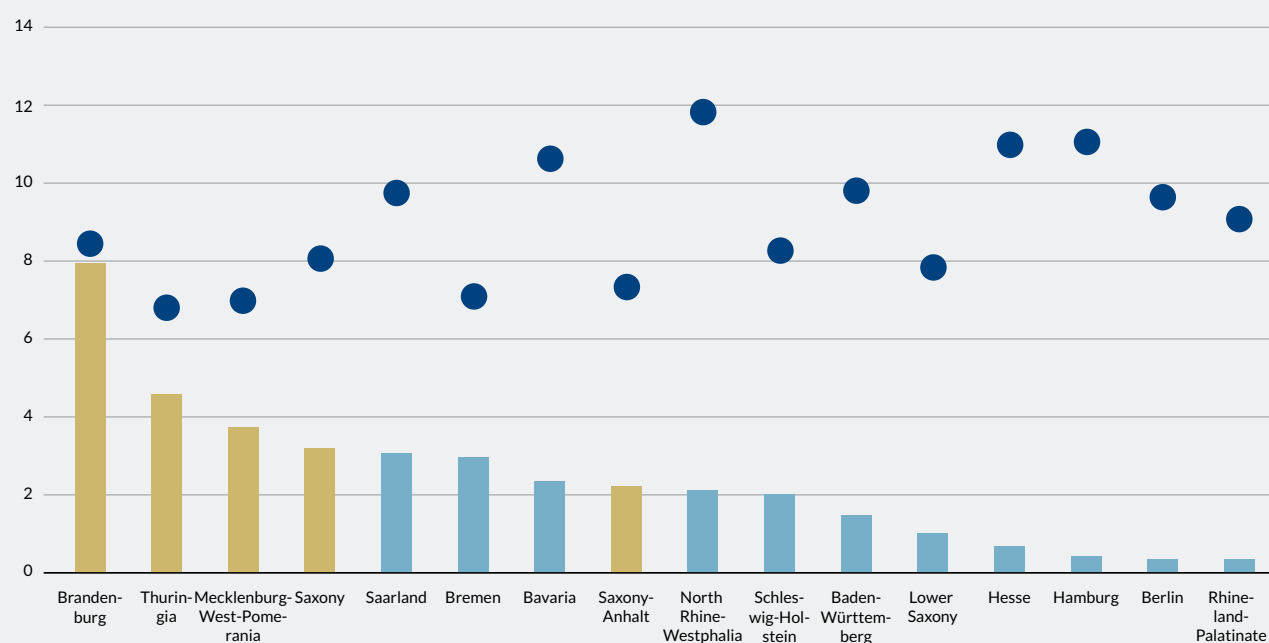
Professional, scientific and technical activities (in Percent): ■ Regions in former West Germany ■ Regions in former East Germany ● Level

Note: productivity is defined as output per worker. The annual average growth rate is computed.

Source: Federal Statistical Office of Germany; authors' calculations.

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FIGURE 17: Productivity in Information and communication (2008 – 2014)



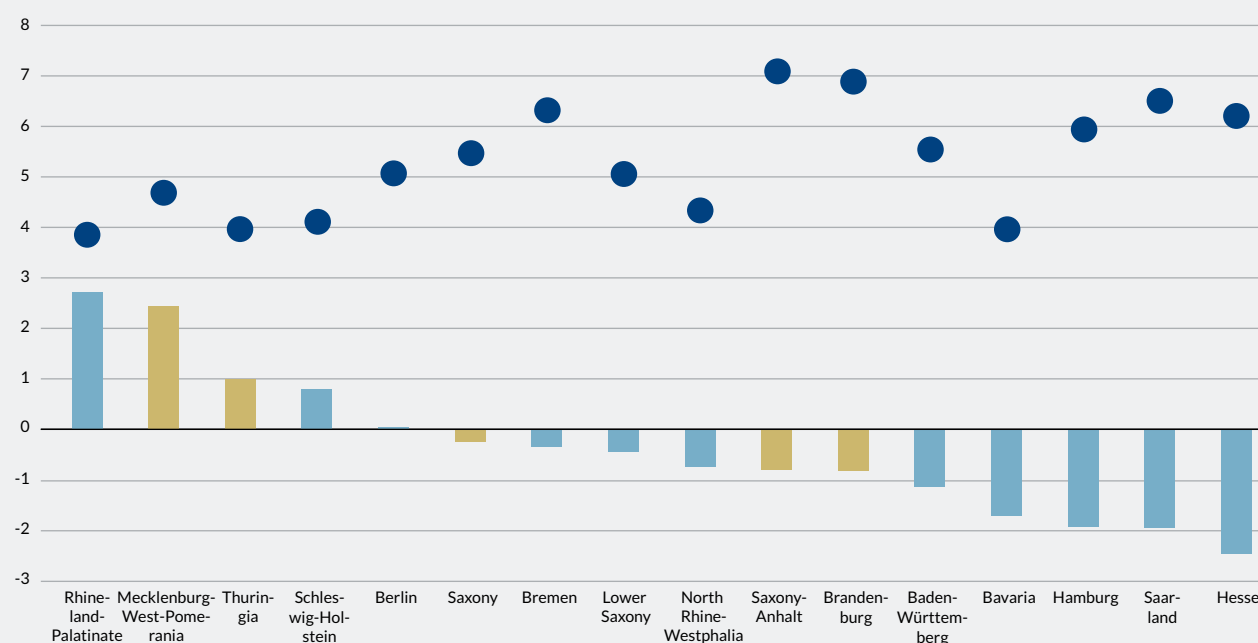
Professional, scientific and technical activities (in Percent): ■ Regions in former West Germany ■ Regions in former East Germany ● Level

Note: productivity is defined as output per worker. The annual average growth rate is computed.

Source: Federal Statistical Office of Germany; authors' calculations.

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FIGURE 18: Productivity in Professional, scientific and technical activities (2008 – 2014)



Professional, scientific and technical activities (in Percent): ■ Regions in former West Germany ■ Regions in former East Germany ● Level

Note: productivity is defined as output per worker. The annual average growth rate is computed.

Source: Federal Statistical Office of Germany; authors' calculations.

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levels may be higher because of their lower productivity base. On average, east German productivity levels are currently standing around 80 percent compared to west Germany. East German levels are highlighted in yellow in the figures below, while west German levels are shown in blue. The blue and yellow bars denote productivity growth rates and correspond to the left-hand axis, whereas the overlapping dots represent absolute levels of productivity and correspond to the right-hand axis.

The administrative support services sector shows high productivity growth rates for East German states, but their levels of productivity have overall been lower. Generally, there is an inverse relationship between low growth and high levels of productivity. One exception is Rhineland-Palatinate which has experienced both high growth rates and stands at a reasonably high level of productivity. Other regions which have low growth rates but already very high levels are Bavaria, Hessen and Hamburg. However, the latter two appear to have negative productivity growth, which could be a sign of their low levels of digitalisation in this sector.

Regarding financial and insurance services, Hamburg and Hessen show lower growth rates of productivity as they already have high levels. Both regions are known to have a

strong financial and insurance services sector. Some other regions, however, such as Saarland, Baden-Württemberg, Rhineland-Palatinate and North-Rhine-Westphalia have both high absolute levels and high growth rates of productivity. Most of the east German regions are catching up in financial services as their growth rates rank among the highest in Germany, though their absolute levels are still relatively low.

In information and communication services, which includes computer programming and related consultancy services, again some east German regions are catching up fast as illustrated by the high productivity growth rate. Brandenburg even has a productivity growth of almost 8 percent. However, their absolute levels are still fairly low. Nonetheless, it shows that these regions are moving upwards. Finally, professional, scientific and technical services overall show a negative productivity trend in which most regions have become less productive. The only regions which show positive growth rates in this sector are Rhineland-Palatinate, Mecklenburg-West-Pomerania, Thuringia, Schleswig-Holstein and to some extent Berlin.

Overall, these results allow for different conclusions at regional level. Firstly, even though east German regions are

still catching up with their richer western neighbours, their productivity growth rates are nonetheless strongly positive for some digital-intensive sectors such as computer services as well as administrative services. That should feed into Germany's trade potential as these regions are currently fast-growing in this area. Second, although there is a general trend in that regions with an already well-developed digital services sector are growing more slowly, this does not necessarily manifest itself in an east/west divide. Some west German regions in fact show low levels of efficiency in combination with low growth. This suggests that policy could have a significant role in the development of the digital services economy at regional level.

A final observation relates to the regions in west Germany which have well-developed manufacturing sectors. For some digital-intensive services such as administrative and business support services as well as professional and technical services, these regions show low growth rates which suggests that they may not be well-connected with industries. Figure 13 shows that at least some industries such as motor vehicles or the transport equipment industry have low levels of indirect value-added exports and therefore it would suggest that these regions are lagging behind in the take-up of digital services in their production and exports. If so, these trends outline a risk for Germany's trade performance not only for the digital-intensive services sectors mentioned, but also for key manufacturing sectors that depend upon them.

Finally, as an overall conclusion for Germany as whole, when combining these regional patterns with the results from the previous chapter, it is interesting to see that despite the positive growth levels of various digital-intensive business services and computer and related services across the regions, Germany does not yet seem to have turned this into fulfilling its trade potential. It is under-performing regarding these sectors compared to its trade potential and therefore there is still room for it to tap into greater exports of these digital-intensive services.⁶

2.3 The status of Germany's digital policies

This section focuses on an analysis of Germany's digital policy initiatives, in order to identify what the country can

do in public policy to benefit better from the increased tradability of services under digitalisation. It provides a screening of Germany's digital policy initiatives and maps out policy initiatives according to the degree that they address the different endowments analysed in the frontier analysis. By this screening and mapping, the frontier analysis and the policy framework at federal and regional level are put side by side and linked, indicating to what extent current policies address the most striking gaps of the frontier analysis.

However, policies that merely aim to increase digital policy endowments are not sufficient to help Germany reach its full trade potential and to exploit the benefits from the increasing tradability of services due to digitalisation. Indeed, Germany's policy framework should focus on public policy initiatives aimed at *increasing the incentives and removing obstacles for firms to make use of digital endowments to increase their services trade*. Here, it is crucial to keep in mind that the actors responsible for trade activity are firms in the sectors in question. Germany's policy framework should focus on incentivising and facilitating the use of digital endowments at their disposal, rather than simply on increasing the level of existent digital endowments. The crucial question for increased trade, and for Germany's economy and labour force to be able to benefit from it, is the extent to which the actors responsible for trade make use of digital endowments.

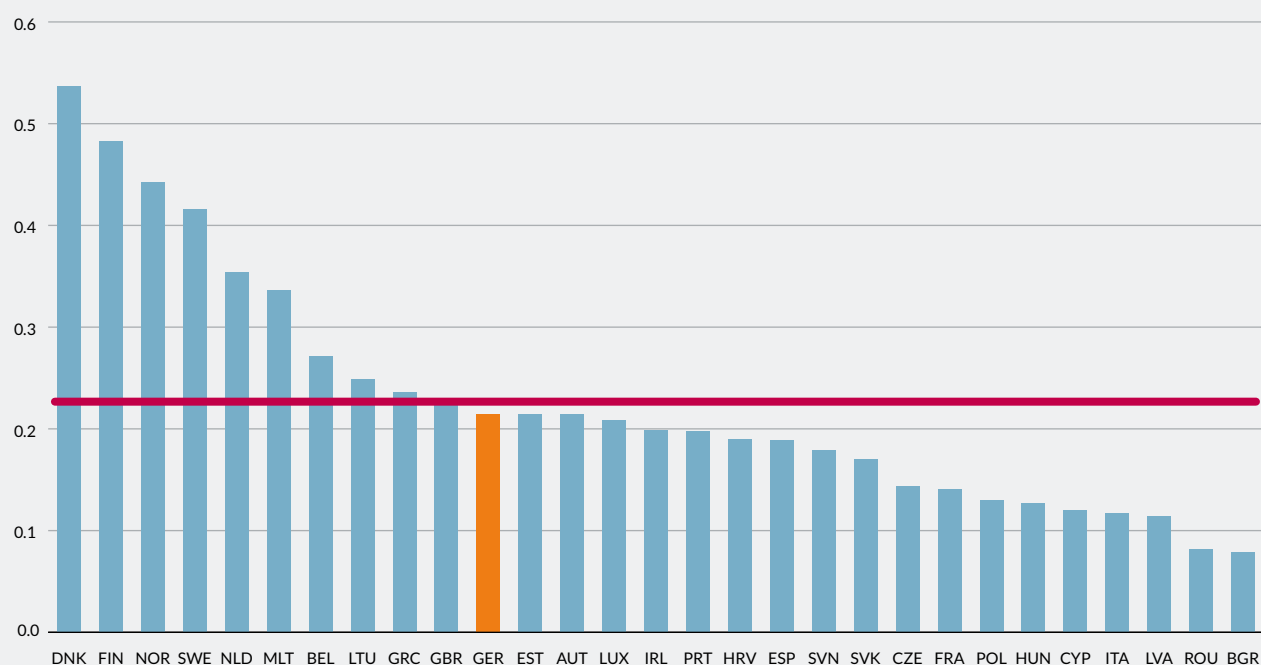
The process of businesses adopting increasingly modern types of operation is known as digital transformation or digital business transformation.⁷ It is important for firms to develop their digital business agility, which also increases their ability to respond to digital disruption, i.e. technological change that companies need to embrace in order to stay successful. Policy should aim to facilitate this process of digital business transformation by laying down the necessary environmental conditions. Digital business transformation is driven by a number of different factors, such as technology itself, consumer behaviour, markets, and also environmental factors (Forbes, 2017).

These environmental factors are where policy comes in. Recent research has identified a range of specific areas in which governments can facilitate the process of digital business transformation with concrete policy initiatives, which include: Developing skills to adjust to digital tech-

⁶ Germany also shows that it has not reached its export potential in financial services despite positive productivity growth rates in financial intermediation services across the regions. Note, however, that this latter sector is composed of financial as well as insurance services. Germany shows that is over-performing in trade in insurance services.

⁷ The concept of digital business transformation can be defined as "organizational change through the use of digital technologies and business models to improve performance" (See: IMD, 2015).

FIGURE 19: Enterprises with high levels of digital intensity (Index)



Average

Source: European Commission; authors' calculations

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nologies and to facilitate transition from job to job; helping firms invest in knowledge capital, and governments to invest in relevant research; facilitating competition in the digital-intense sectors; facilitating access to finance, especially for SMEs; removing inadequate regulation, for example regarding product market regulation, employment protection regulation and ICT regulation; and addressing relevant tax policy ramifications (OECD, 2017a, pp.15–17).

The results from the frontier analysis in chapter 1 have shown that Germany performs relatively poorly with regard to business usage (Figures 4 and 6) compared to the frontiers indicated by the EU and BRICS countries. Germany appears to have weaknesses and scores comparatively lowly in the following specific areas: Businesses purchasing cloud computing services; businesses with a website allowing for online ordering or reservation or booking; business with formal policy to manage ICT privacy risks; persons employed using a computer with internet access; use of PCT patents; ICT use for business-to-business transactions; extent of staff training; and B2C internet use.

The factors accounting for this include the environmental factors mentioned above. However, culture also plays a role, as the process of digital business transformation goes beyond mere absorption of new technologies. It also includes a change of “thought and organization culture” (Forbes, 2017). The cultural factor is relevant in the case of Germany, where the cultural attitude of many companies towards changing business models to meet digitalisation often remains one of caution.

The need for policy initiatives in Germany to specifically focus on increasing the degree to which firms make use of existing digital endowments is also illustrated by the low digital intensity of German firms. As outlined in Figure 19, Germany ranks below average when it comes to enterprises with high levels of digital intensity.

Accordingly, the following section will assess the digital policies directed at and benefiting businesses in Germany to see whether and how far these address the aforementioned constraints with a specific focus on incentivizing businesses in Germany to make increased use of digital endowments. A complete overview of Germany’s digital policy initiatives is provided in annex 3.

2.4 Overarching framework policies

In recent years, the Federal Government has taken action to actively foster and push for the development of digitalisation across Germany. It has issued the Digital Agenda 2014–2017 which sets out the key principles as well as key areas of action for its digital policy with the focus on economic and innovation policy (Federal Ministry for Economic Affairs and Energy, 2017a). The policies and initiatives implemented with the help of the Digital Agenda include amongst others the High-Speed Network Bill and Industry 4.0 initiative.

In addition, the Federal Ministry for Economic Affairs and Energy has issued the Digital Strategy 2025 to supplement the Digital Agenda 2014–2017. It aims to improve the economic, innovation and investment conditions with regard to digitalization and sets out additional initiatives and policy instruments to be deployed by the Government beyond the current election period. These include initiatives promoting digitalisation in SMEs, the public sector (eGovernance), the healthcare industry (eHealth), energy industry, digital mobility, the social sharing economy and promoting, expanding as well as investing in digitalisation (Ibid, 2017b). Complementing the strategy, the Federal Ministry for Economic Affairs and Energy has issued an action plan to turn the Digital Strategy 2025 into realistic measures that can be implemented (Ibid.). This Action Programme on digitalisation, for example, established the Digital Hub Initiative and the SME 4.0 Initiative, which both foster digital innovation and technological developments.

Within the framework of the overarching policies – the Digital Agenda 2014–2017 and the Digital Strategy 2025 – the Federal Government is thus pursuing several specific policy initiatives which aim to foster the digitalisation of the German economy. For the purpose of our analysis, which is focused on policies which matter for German businesses, we will describe policy initiatives falling within the following two areas: (i) IT infrastructure and general IT policies and (ii) policies promoting the digitalisation of the economy.

2.5 IT infrastructure and general IT policies

The Government aims to promote a market-driven expansion of broadband infrastructure and high-performance broadband networks also in rural areas (Ibid, 2017a). Major legislative developments that have resulted from the Digital Agenda 2014–2017 for the general IT infrastructure in Germany include critically the adoption of the High-Speed Network bill on January 27 2016. This bill aims at improv-

ing the digital infrastructure in Germany by facilitating the expansion of high-speed network coverage to a minimum of 50 megabits per second (Ibid).

A semi-public initiative to improve the infrastructure is the “*Netzallianz Digitales Deutschland*” (Federal Ministry of Transport and Digital Infrastructure, 2014), which is a forum initiated by the ministry. As well as embracing the Federal Ministry of the Interior and the Federal Network Agency it also includes large German telecommunication companies and associations from the telecommunications sector. It is an alliance of telecommunications and network companies that are willing to invest and innovate and with which the federal Government is determined to promote broadband expansion. The initiative serves as a forum to identify key issues, develop solutions and promote their shared implementation.

Furthermore, in 2015 the IT Security Act was adopted as a key goal of the Digital Agenda. The Act aims to increase and improve IT security in Germany for businesses and citizens, as well as protect IT infrastructure (Watson Farley & Williams, 2016). The IT Security Department of the Bundestag and the Federal Office for Information Security (BSI) pushed for this Act to gain control over cyber-attacks and increase the security requirements for companies in the sectors of telecommunications, IT, healthcare, energy, transport and traffic, food and water, and finance and insurance (Ibid.).

Overall, there have been recent initiatives which may address some of the constraints regarding Germany’s digital endowments. These initiatives may improve the digital infrastructure for businesses enabling them to better use digital technologies for their work processes and customer relations (improving, e.g. indicators on online sales, using computers at work etc., see Figure 6).

2.6 Policies promoting the digitalization of the economy

As part of the Digital Agenda, the German Federal Ministry for Economic Affairs and Energy has put forward several initiatives to foster the digitalisation of German society and economy focused on three priority areas: digital transformation, digital innovation, and digital sovereignty.

One main initiative is that the Federal Ministry for Economic Affairs and Energy has set up the so-called

“IT-Gipfel (summit)” which comprises the setting up of different platforms within three different key areas of the digital economy, i.e. the digital work area, innovative digitalisation of the economy and Industry 4.0. (*Die Bundesregierung*, 2017). These platforms aim to identify priority areas for action in each focus area, develop policy recommendations and provide practical examples of application. The Industry 4.0 platform is particularly important for the manufacturing and industrial sectors, as it combines communication technology with production methods in order to build digital network systems that coordinate and cooperate with each other and turn production lines into self-managing processes (Federal Ministry for Economic Affairs and Energy, 2017c). Its objective is to establish and publish recommendations and application examples for companies, especially SMEs, on how to develop and implement Industry 4.0. (*Die Bundesregierung*, 2017).

Although the Industry 4.0 initiative is oriented towards improving business opportunities and usage among German companies, a survey conducted in 2014 amongst 1,000 SMEs demonstrated the initiative’s shortcomings. Results demonstrated that 70 percent of companies with annual revenues lower than €500 million have not experienced positive results from the process of digitalisation (OECD, 2017b). This is due to the adoption gaps in digital technologies that mostly affect small firms, as well as the fact that the ICT products made available to SMEs do not take into account small firms’ needs (Ibid). More specifically, the research and projects generated by Industry 4.0 are not necessarily useful for SMEs due to the results, formatting and language used (Ibid).

The Federal Ministry for Economic Affairs and Energy proactively responded to the outcomes of these surveys by launching specific SME 4.0 digital production and work processes in June 2015 (Federal Ministry for Economic Affairs and Energy, 2017d). The initiative is designed to provide financial support for the digitalisation of SMEs by establishing five SME centres in Germany and funding them with up to €28 million over a three-year period (Ibid, 2017e). The initiative, furthermore, aims to provide SME-specific use cases and test SME specific Industry 4.0 applications, including the analysis of the specific needs of SMEs and the necessary build-up of organisational and personnel developments (Ibid, 2017f).

As a supplement to the SME 4.0 centres, the ‘Go Digital’ support programme was initiated to provide consulting services to companies with fewer than 100 employees. External services are available in a range of areas, from the

analysis of an SME’s IT capacities to the implementation of a feasible digitalisation process (Ibid, 2017b). Aiming to promote innovation in German SMEs the “Go Inno” programme supports consulting services for the professionalisation and innovation of management in companies with less than 100 employees (Ibid, 2017f). Through the SME Digitalisation Campaign, incentives for digital transformation, funding opportunities and consulting services are actively advertised to the SME community (Federal Ministry for Economic Affairs and Energy, 2017b).

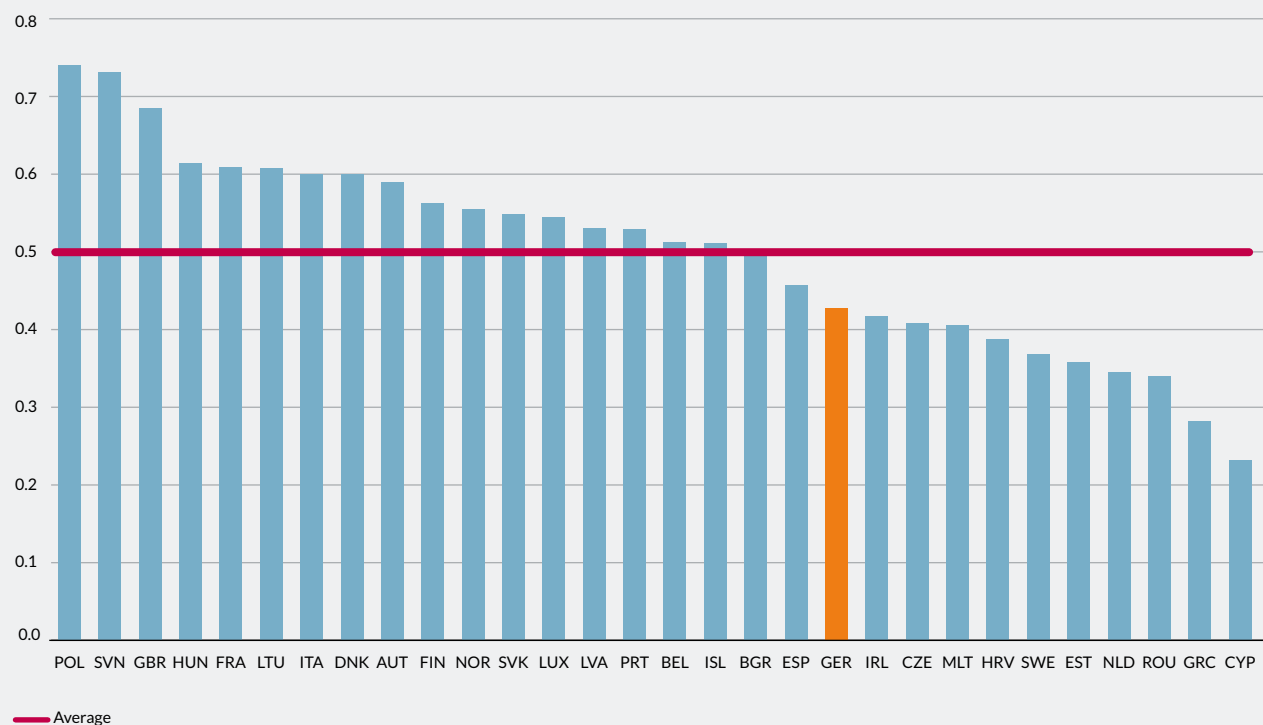
From a financial perspective, the *Kreditanstalt für Wiederaufbau* (KfW) (federal agency for reconstruction), extended its funding programme in July 2017 to SMEs. This aims to provide companies with financial support for digital transformations and innovation. The initiative was launched after a study by KfW Research demonstrated that most SMEs have not exploited the full benefits of digitalisation, and that Germany’s share of innovative companies has steadily decreased (Ibid, 2017g).

Another major policy initiative is the Digital Hub Initiative. Launched in November 2016 by the Federal Ministry for Economic Affairs and Energy, it aims to strengthen technological cooperation and innovation amongst the business community through the creation of digital hubs (Ibid, 2017h). Due to the range of strengths of Germany, each hub location will have a specific industrial focus, ranging from a manufacturing hub to innovative, logistical and mobility hubs (Ibid, 2017i). To speed up digital innovation, developments and transformations, the Digital Hub Initiative will establish strong networks both amongst and within the digital hubs (Ibid, 2017h).

The Federal Ministry for Economic Affairs and Energy has also started other smaller initiatives such as a series of events on digital services which will gather well-established firms, start-ups and research institutions together at sector and topical events in order to promote networks and highlight best practices for innovation and new developments (Ibid).

In order to monitor the progress made in the German economy regarding its digitalisation, an annual Digital Monitoring Report is issued by the Federal Ministry for Economic Affairs and Energy, which includes an index of digitalisation for German firms (Ibid, 2017h). According to the 2016 report, Germany achieved 55 out of 100 index points, which is a five-point improvement from 2015 and is expected to rise to 58 points in the upcoming five years (Ibid, 2017j). The survey results demonstrated that 40 per-

FIGURE 20: Enterprises exchanging business documents suitable for automatic processing (Index)



Source: European Commission; authors' calculations.

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cent of companies consider inadequate broadband coverage as the main obstacle to digitalisation in the commercial economy. This was closely followed by high costs of investments (38 % of respondents), too time-consuming (32 %) and a lack of reliable standards with regards to digitalization (28 %).

Apart from German state initiatives, business, politics and research representatives launched the Industrial Data Space initiative in late 2014 (Otto et al., 2016). The project aims to establish a trusted data network which can facilitate the exchange of data between different providers and users. The two-part project includes a research branch, which is funded by the Federal Ministry of Education and Research, and a non-profit user association branch (Ibid).

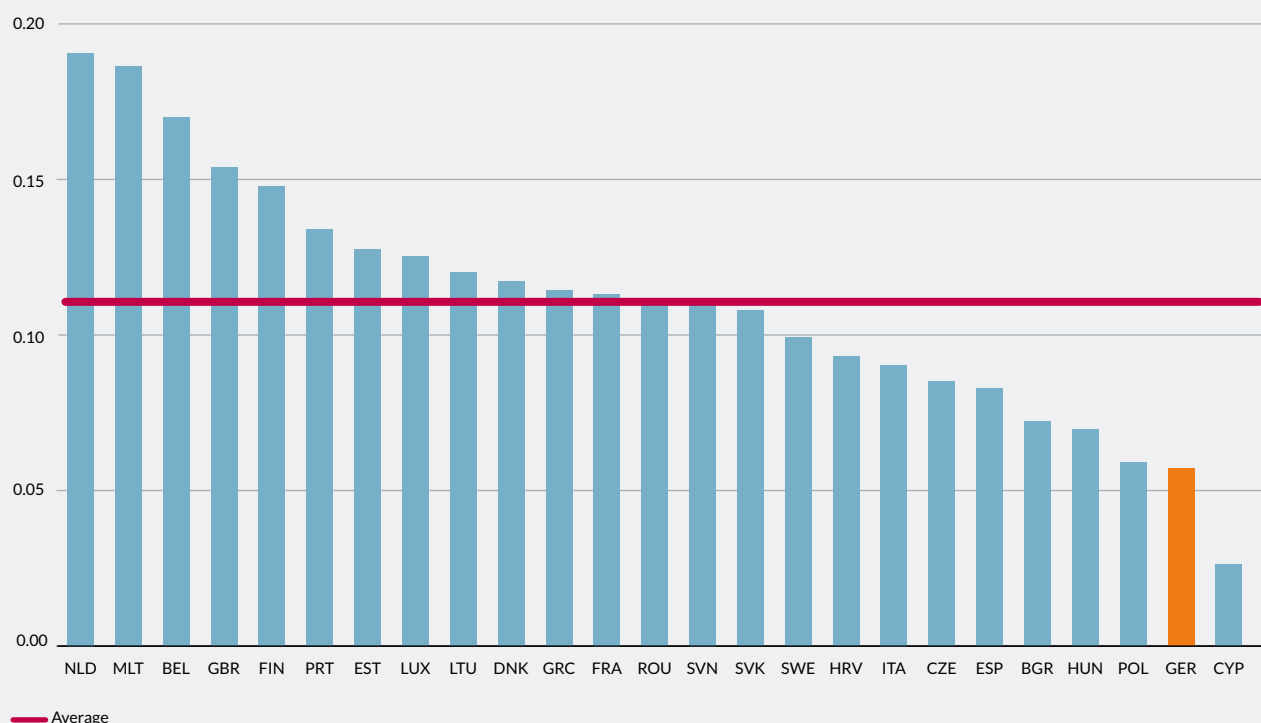
To sum up, at a policy level Germany has been advancing several initiatives in order to help its businesses make better use of the benefits arising from digitalised production processes. Several initiatives have been launched to foster innovation and the development and use of new technologies and business models. However, many of these initiatives have only recently started and may not yet have had an impact on increasing the use of digital solutions by German companies and the economy's digital competitiveness.

This may in part also explain the current under-performance of digital-intensive sectors.

In addition, as the policy analysis above has outlined, Germany does not specifically focus on public policy aimed at increasing the incentives and removing obstacles for firms to make use of digital endowments and increase their services trade. However, such initiatives are required to fully grasp Germany's trade potential in digital-intense services. This need for companies to increase their use of digital endowments is illustrated, for example, by German firms only scoring below average, in a European comparison, when it comes to exchanging business documents suitable for automatic processing.

Similarly, Germany scores below average when it comes to companies analysing big data from any data source. The need for companies to access and analyse big data is particularly strong when it comes to the digital-intensive sectors analysed in this study. This is especially significant considering the importance of such access for their trade performance. It is also important due to their link to the trade performance of complex manufacturing sectors in Germany.

FIGURE 21: Enterprises analysing big data from any data source (Index)



Source: European Commission; authors' calculations.

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Accordingly, Germany's policies should be increasingly targeted at initiatives that enhance two elements. Firstly, companies should understand better their requirements and ability to make use of such digital endowments. Many companies are still unaware of their needs or do not fully grasp the processes they could go through to make increased use of digital endowments. Secondly, companies should be more aware of the potential benefits of using such digital instruments for their ability to trade profitably. Such policy initiatives would help Germany raise its performance in trade within the digital-intense services sectors analysed, and help boost both output and employment in the relevant sectors. An extrapolation of those negative economic trends that have been identified could be averted, with positive trends reinforced, allowing Germany to reach its full estimated potential.

3 Concluding comments

Some of the biggest economies in the EU, such as Germany and France but also Sweden and the Netherlands, have developed great potential for digital services trade. In large part, this development is thanks to the friendly digital climate these countries have created in the past decade such as extended broadband networks, strong mobile network coverage and relatively competitive markets regarding telephony and internet. However, some of these countries – such as precisely Germany and France – appear not to capitalize on their potential as their trade patterns in digital services fall short of what they can achieve. As a first major finding, the study has shown that gross digital services trade over the internet in Germany and France does not fully live up to its potential.

This means that there is still plenty of scope to tap into unrealized gains from digital services trade: they can increase their digital services trade without expanding their endowments. The fact that this is notably the case for Germany and France is telling as these two countries will be by far the two biggest European economies post-Brexit and therefore largely determine the success of Europe's digital services trade. Given that future services trade is moving more and more online, it is important for these two European economies to realize that further policy changes would help them reach this digital trade potential. And although both are performing well in exporting traditional communication and insurance services, exports of many modern digital-intensive businesses services which are likely going to shape future trade patterns in the world are lagging behind.

Indirect digital services trade is an additional important area where Germany could further extend its potential. Currently, indirect digital services trade in Germany remains below the international average in a comparative analysis or is stuck below its full potential, restricting its overall trade potential in these sectors. Furthermore, a closer look into Germany's employment of digital services reveals the important role this plays. However, when looking at the

performance of digital sectors and comparing them with Germany's overall economy, the average output growth of digital sectors has in fact been smaller in key sectors. This points to a loss in competitiveness for key digital sectors. Germany would have to use and apply more technologies for these sectors to become more productive – and more tradable.

Within the basket of digital-intensive services there is a general pattern observable in that professional, scientific and technical activities have suffered a fall in productivity. These services use a lot of data and digital tools and their competitiveness has indeed been declining. Other countries show an increase in productivity in these services over the years. At first sight, one could argue that these patterns could indicate that Germany has comparative advantage in manufacturing and therefore services only play a secondary role in its economy.

However, such an assertion would be misleading. Services, and in particular digital-intensive services, have been shown to be an important vehicle for the rest of the economy to upgrade and generate a higher level of productivity, thereby becoming more competitive. Modern manufacturing, being itself increasingly based on new technologies, extracts more value-added by including digital-intensive services in its production processes. Given the potential for digital-intensive services in Germany to become more productive such as in advertising, market research and employment services, tapping into these unrealised gains would therefore not only increase Germany's exports in digital services, but at the same time would also boost its manufacturing sector in the future.

Within Germany, some regional trends also figure. There is no clear divide between the eastern and western states of the country. Germany's new states often perform well, in particular in information and communication services as well as administrative and support services activities. Another

interesting finding is that some of the regional services sectors that are important for manufacturing are lagging behind in those regions that are traditionally characterised as powerhouses for manufacturing. For example, professional, scientific and technical activities, as well as financial and insurance activities, lag behind in Bavaria. Furthermore, administrative and support service activities also lag behind there, and even more so in North Rhine-Westphalia. This could constitute a further risk for Germany's trade performance within key manufacturing sectors that depend on digital-intensive sectors for export success.

In short, the overall growth of Germany's digital sectors lags behind its economic growth and, instead of speeding up Germany's economic performance, it runs the risk in certain key sectors of being a slow-moving drag on the key manufacturing sector. Although employment in the digitally-intensive sectors has been growing, these numbers conceal that Germany has experienced a decline in digital competitiveness. If it wants to capitalize on its potential of digital-intensive business services exports, it would need to make the most of some of the factors that govern the digital sector. In particular, Germany still has room for improving its digital economic structure to bring it in line with countries performing at the frontier.

For instance, Germany shows poorer performance when it comes to some of the digital infrastructural issues such as mobile broadband subscriptions or international internet bandwidth. More important, however, is the fact that German businesses appear to be reluctant to embrace digital tools, processes and procedures or even digital management practices in their company structure. This has resulted in a fairly low impact from digitalisation on the economy, one that has not improved in recent years, reflecting a loss in competitiveness.

Improving business usage of these endowments requires policy initiatives that address relevant environmental factors aimed at increasing incentives and removing obstacles for the digital business transformation of German companies. This would also allow businesses to further enhance their digital business agility, thus enabling them to better prepare for digital disruption. Cultural factors, moreover, matter greatly. Digital business transformation is not merely about the absorption of new technologies, but also about adapting existing cultures of thought and business processes.

For Germany as well as for other European countries, these conclusions matter. Ultimately, long-term growth will be

secured by improved productivity performance of firms, enabling them to produce and trade more effectively. The digital take-up by all business services firms forms a major vehicle for achieving this trade boost. However, for this to happen, companies across the entire range of the business services sector will have to embrace the available digital technologies and skills to make it easier for them to reach foreign markets. Once Germany operates on a par with other high-performing European or OECD countries, it would realize its untapped trade potential and thereby boost its overall economy.

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Annex I: Most digital intensive sectors and their ranking

We have chosen digital sectors on the basis of detailed input-output tables from the US Bureau of Economic Analysis (BEA). This institute provides at 6-digit level the extent to which each and every sector uses a particular input commodity or service. In our process of calculations digital intensities, we compute how much each sector uses data producing services which are defined by eight sectors following Van der Marel et al. (2016).

When computing how much each sector uses these data services, we arrive at an indicator that tells us how much data services each downstream industry and services sector uses, i.e. how digital-intense these sectors are. Then one can perform a ranking of which sectors rank as most to least digital-intense. When doing so, business services together with telecommunications and other computer information services emerge as the most digital-intense sectors.

As a consequence, the Top 10 most digital-intensive sectors are therefore chosen to select the services analysed for the gravity model as these are the sectors that matter most in the digital sense. Table A1 provides the ranking of the overall Top 20 most digital-intensive sectors, while Table A2 outlines the sectoral concordance between different levels of aggregation following NACE.

TABLE 2: **Ranking of the most digital-intensive sectors**

Ranking	WZ-2008 Sector name (NACE Rev.2 sector name) ¹	Data Intensity based on Share
1	Telecommunications	0.2358405
2	Computer programming, consultancy, inform. Service (information service activities)	0.1408957
3	Publishing Activities	0.1403275
4	Business services n.e.c (security and investigation activities)	0.1243391
5	Travel agency, tour operator, other reserv. Service	0.1195686
6	Business services n.e.c (Office administrative, office support and other business support activities)	0.1074086
7	Public admin. and defence, compulsory social sec.	0.0959418
8	Legal and accounting act., management consulting	0.0945736
9	Computer programming, consultancy, inform. Service	0.0934905
10	Employment activities	0.0912173
11	Act. auxiliary to financial services, insurance	0.087397
12	Corporate consultancy services	0.0834998
13	Audio-visual media and broadcasting	0.079171
14	Other professional, scientific, technical activities	0.0762793
15	Education	0.0723397
16	Advertising and market research	0.0709871
17	Audio-visual media and broadcasting	0.0690728
18	Financial service act., ex. insurance, pension fund.	0.0578084
19	Activities of membership organisations	0.0539384
20	Repair of computers, personal and household goods	0.0506334

TABLE 3: **Sectoral concordance table**

One-digit sector name (WZ2008 and NACE Rev.2) ²	Two-digit WZ2008 sector names (NACE Rev.2)
J. Information and communication	» Telecommunications » Computer programming, consultancy, inform. Service (information service activities) » Publishing Activities » Computer programming, consultancy, inform. Service » Audio-visual media and broadcasting (Programming and broadcasting activities; Motion picture, video and television programme production, sound recording)
K. Finance and Insurance Activities	» Act. auxiliary to financial services, insurance » Financial service act., ex. insurance, pension fund.
M. Professional, Scientific and Technical Activities	» Legal and accounting act., management consulting (Legal and accounting activities) » Corporate consultancy services (Activities of head offices; management consultancy activities) » Other professional, scientific, technical activities » Advertising and market research
N. Administrative and Support Service Activities	» Renting and Leasing Activities (Leasing of intellectual property and similar products, except copyrighted works) » Travel agency, tour operator, other reserv. Service » Business services n.e.c (Security and investigation activities; Office administrative, office support and other business support activities) » Employment activities

Annex II: Overview of Germany's digital policy initiatives

TABLE 4: Overview of Germany's digital policy initiatives

Policy Initiative*	Involved Parties	Aim / Goal	Indicator classification	Timeline	Scope of influence
High-Speed Network Bill Digital Agenda 2014 – 2017	German Cabinet	High-speed coverage of at least 50 megabits per second	Infrastructure & Prices: » Internet bandwidth	Bill adopted on January 27 th 2016, aim to be achieved by 2018	Nationwide
IT Security Act Digital Agenda 2014 – 2017	IT Security Department of the Bundestag Federal Office for Information Security (BSI)	Improve IT security of individuals and companies with regards to availability, integrity, confidentiality and authenticity. Also aims to protect infrastructure that is essential for functioning of the community- prevent the loss of control of important IT systems.	Infrastructure & Prices: » Secure internet servers	Entered into effect on July 25 th 2015	Website operators and service providers Telecommunication companies Infrastructure operators in the energy, IT and telecommunication, transport and traffic, healthcare, food and water, finance and insurance sectors.
Digitale Gipfel	Federal Ministry for Economic Affairs and Energy	Framework for setting up platforms and forums to further implement the digital agenda- for example platforms for the digital work area, innovative digitalization and Industry 4.0	Business Usage: » Capacity for Innovation » Firm-level technology absorption Economic and Social Impact » Impact of ICTs on business models	From 2012 onwards	Business, research and scientific communities.
Industrie 4.0 and Platform Industrie 4.0 Digital Agenda 2014 – 2017	Federal Ministry for Economic Affairs and Energy (BMWi) Federal Ministry of Education and Research	Online security and protection in all fields for individuals and businesses- data protection, integrity and availability of digital infrastructures	Infrastructure & Prices: » Secure internet servers	Launched in April 2013, expanded in April 2015 Two funding programs: "Autonomics for Industry 4.0" and "Smart Service World" along with the Economic Affairs Ministry who has provided nearly 100 million euros to foster research and innovation	Industrial and manufacturing sector, business community.

Policy Initiative*	Involved Parties	Aim/Goal	Indicator classification	Timeline	Scope of influence
SME 4.0 » Go Digital Support Programme » Go Inno Programme Digital Strategy 2025, Action Programme on Digitalization	Federal Ministry for Economic Affairs and Energy	Providing financial, technical and consulting support for the digitalization of SME's	Business Usage: » Capacity for Innovation » Firm-level technology absorption	Launched in June 2015	SME's
KfW Loan	Kreditanstalt für Wiederaufbau	KfW loans will be extended to SME's for digital transformations and innovation	Business Usage: » Capacity for innovation » Firm-level technology absorption	July 1st 2017	SME's
Digital Hub Initiative Digital Strategy 2025, Action Programme on Digitalization	Federal Ministry for Economic Affairs and Energy (BMWi)	Support digital hubs in Germany- hubs that will permit companies, businesses, start-ups and the scientific community to cooperate, innovate, share expertise and exchange knowledge	Business usage: » Capacity for innovation » ICT use for business-to-business transactions » Firm-level technology absorption	Launched in November 2016	Start-up's, scientific institutions, SME's, large corporations
Digitalization Index-Digital Monitoring Report	Federal Ministry for Economic Affairs and Energy	Index of digitalization for German firms and Germany as a whole. Outlines the progress, strengths, weaknesses and challenges of digitalization. Provides future forecasts of expected digitization levels.	Infrastructure & Prices: » International internet bandwidth » Fixed broadband internet tariffs Business Usage: » Business-to-consumer internet use » ICT use for business-to-business transactions » Extent of staff training	Yearly analysis and report	Commercial economy
Industrial Data Space 2014	Initiative launched by business, politics and research representatives. Research funded by Federal Ministry of Education and Research	Establish trusted data network for data exchange	Business Usage: » ICT use business-to-business transactions » Capacity for innovation » Firm-level technology absorption	2014	Business community
Netzallianz Digitales Deutschland	Initiative launched by Federal Ministry of Transport and Digital Infrastructure Forum includes: Federal Ministry of Interior, federal Network Agency and companies as well as associations from the German telecommunications sector.	Forum to identify issues, solutions and promote the implementation broadband expansions and telecommunications	Infrastructure: » International internet bandwidth » fixed broadband internet tariffs Business Usage: Capacity for innovation	March 2014	Telecommunication sector

* The overview illustrates the policy initiatives analysed in chapter 2 which are considered most relevant for the scope of this analysis.

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