Development Informatics

Working Paper Series

The Development Informatics working paper series discusses the broad issues surrounding digital data, information, knowledge, information systems, and information and communication technologies in the process of socio-economic development

Paper No. 68

Defining, Conceptualising and Measuring the Digital Economy

RUMANA BUKHT & RICHARD HEEKS

2017

Developed as part of DIODE: the "Development Implications of Digital Economies" strategic research network, funded by the UK's Economic and Social Research Council as part of the Global Challenges Research Fund initiative

ISBN: 978-1-905469-62-8

Published by: ***Centre for Development Informatics***
Global Development Institute, SEED
University of Manchester, Arthur Lewis Building, Manchester, M13 9PL, UK
Email: cdi@manchester.ac.uk Web: http://www.cdi.manchester.ac.uk

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Defining, Conceptualising and Measuring the Digital Economy

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2017

Abstract

The digital economy is growing fast, especially in developing countries. Yet the meaning and metrics of the digital economy are both limited and divergent. The aim of this paper is to review what is currently known in order to develop a definition of the digital economy, and an estimate of its size. The paper argues there are three scopes of relevance. The core of the digital economy is the '*digital sector*': the IT/ICT sector producing foundational digital goods and services. The true '*digital economy*' – defined as "that part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services" – consists of the digital sector plus emerging digital and platform services. The widest scope – use of ICTs in all economic fields – is here referred to as the '*digitalised economy*'. Following a review of measurement challenges, the paper estimates the digital economy as defined here to make up around 5% of global GDP and 3% of global employment. Behind this lies significant unevenness: the global North has had the lion's share of the digital economy to date, but growth rates are fastest in the global South. Yet potential growth could be much higher: further research to understand more about the barriers to and impacts of the digital economy in developing countries is therefore a priority.

A. Introduction

The digital economy is a recently-emerging phenomenon of increasing importance given estimates of double-digit annual growth around the world, with particularly strong growth in the global South (WEF 2015). The driving forces behind this emergence are economic and political, but they of course also have roots in technological innovation (itself shaped by wider forces). In the 1990s, economic changes were associated mainly with emergence of the Internet, and this remains a foundation for growth of the digital economy. But during the 2000s and 2010s a succession of new information and communication technologies (ICTs) has diffused and underpinned economic change. This includes the embedding of connected sensors into more and more objects (the Internet of things); new end-user devices (mobile phones, smartphones, tablets, netbooks, laptops, 3D printers); new digital models (cloud computing, digital platforms, digital services); growing intensity of data usage through spread of big data, data analytics and algorithmic decision-making; and new automation and robotics technologies (OECD 2015).

Arising from these technologies is a set of digital affordances: potential actions an individual or organisation with a purpose can undertake with a digital system within the context of the environment within which they function (Heeks 2017). These include datafication (an expansion of the phenomena about which data are held), digitisation (conversion of all parts of the information value chain from analogue to digital), virtualisation (physical disembedding of processes), and generativity (use of data and technologies in ways not planned at their origination through reprogramming and recombination) (Heeks 2016). The impact of any technology can be understood as the product of its scale of diffusion and depth of effect (Handel 2015). With rapid diffusion – including in developing countries – and increasing depth of effect with ever-stronger affordances, the impact of digital technologies on the economy is growing fast.

That impact can be understood as a disruption of existing economic processes, systems and sectors, re-shaping existing consumer behaviour, business interactions and business models (Dahlman et al. 2016). It can also be understood as the emergence of new economic processes, systems and sectors. Within individual sectors, we see this readily reflected in dominance of new firms: Uber (world's largest "taxi" company), Facebook (world's most popular media company), Alibaba (world's biggest and most valuable retailer) and Airbnb (world's largest "hotelier"). And new business models come to dominate the discourse even if not yet the economic realities: the notion of "Industry 4.0" (see Figure 1), for example.

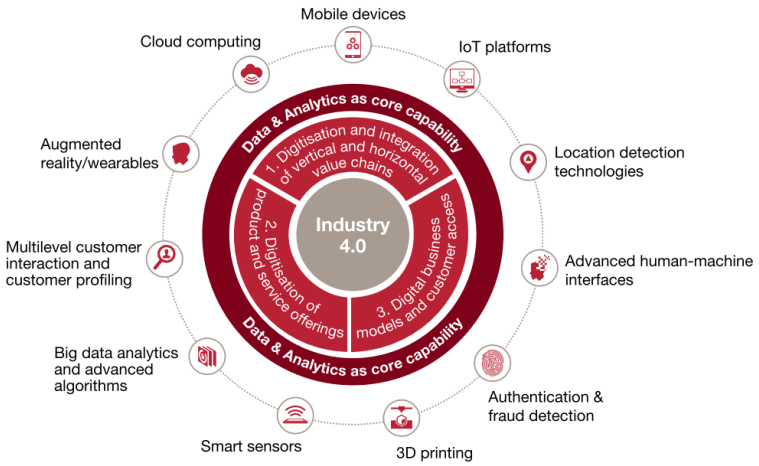


Figure 1: Industry 4.0 framework and contributing digital technologies
Source: Geissbauer et al. (2016)

One model that emerges from a mix of discourse and reality is the notion of the digital economy, argued by some to be the leading driver of economic growth and to lead to "life-changing economic upheavals" and "profound regional implications on businesses, jobs and people" (Brynjolfsson & Kahin 2000, Bahl 2016). For developing countries, there is significant promise that the digital economy will boost economic growth, raise productivity of capital and labour, lower transaction costs and facilitate access to global markets (Dahlman et al. 2016). These are not just empty words: the digital economy is growing 15-25% per year in emerging markets (WEF 2015). There are specific digital dividends already observed that may counter-act economic inequalities: above-local-average wages for digital labour in the global South potentially leading to global convergence of incomes (Beerepoot & Lambregts 2015); new and unique local markets for digital start-ups within developing countries (Quinones et al. 2015); and digital platforms in the global South providing an escape route from ineffective, corrupt market and labour institutions (Lehdonvirta 2016).

Alongside these opportunities, though, are various challenges. There are dangers of exclusion from opportunities, for example due to low levels of digital skill and technology penetration both within and between countries (Dahlman et al. 2016). There are dangers of adverse incorporation into the digital economy due to liminality (lack of resources, capabilities, institutions, relations) (Murphy & Carmody 2015); specific volatility of developing country digital enterprises (Foster & Heeks 2010); and marginalisation of developing country workers within any strengthening of digital labour driven from and for the global North (Martin 2016). There are dangers of digital economy disbenefits, both specifically within developing countries, e.g. growth in vulnerabilities around digital security and privacy (Manyika et al. 2013) and between global North and South, e.g. risks that digital technologies will contribute to the "re-shoring of production" and thus augment "premature deindustrialisation" across the developing world (Dahlman et al. 2016, Rodrik 2016).

Yet, despite these huge opportunities and threats relating developing countries and the digital economy, most research and policy advice has focused on high-income countries. The implications for low- and middle-income countries in the global South, at the level of government, firms and workers, are under-researched. Hence, the formation in 2017 of the "Development Implications of

Digital Economies" (DIODE) strategic research network, funded by the UK's Economic and Social Research Council as part of the Global Challenges Research Fund initiative.

A first recognition within the network was that the notion of the digital economy itself needed – and lacked – clarification as the digital economy has become "increasingly blurred ... and intertwined with the traditional economy" (EC 2013). The purpose of this paper is therefore to undertake a review of literature on the digital economy in order to understand definition, conceptualisation and measurement of this phenomenon. The paper begins with definitions, introducing a three-scope approach to understanding the digital economy. Following a graphical and analytical conceptualisation, it then discusses ways in which the digital economy has been measured.

B. Defining and Conceptualising the Digital Economy

B1. Defining the Digital Economy

Table 1 lists a whole series of definitions of "digital economy" that have arisen over time since the typically-cited origin of the term: Don Tapscott's *The Digital Economy: Promise and Peril in the Age of Networked Intelligence* (Tapscott 1996). A few sources dodge a specific definition; for example identifying the digital economy instead as a "complex structure" (European Parliament 2015), or as being understood "less as a concept and more as a way of doing things" (Elmasry et al. 2016).[1] But most do provide a specific definition with a number of recent definitions being simple and straightforward variants of, "an economy based on digital technologies" (EC 2013).[2]

Definitions are always a reflection of the times and trends from which they emerge. One can see this in the technologies encompassed. Early definitions (Tapscott 1996, Lane 1999, Mesenbourg 2001) focus specifically on the Internet; reflecting its emergence during the 1990s as a mainstream technology, at least in the global North. Later definitions add new technologies such as mobile and sensor networks (DBCDE 2009), and cloud computing and big data (G20 DETF 2016). Or they opt for the more generic notion of "digital technologies" as per the simple definitions.

One can also see historical specificity in the scope of the definition. Early definitions sought to justify their differentiation from earlier ideas such as the information economy[3] (and the related but

[1] Including Haltiwanger & Jarmin (2000) who state, "We must start, however, by defining what we mean by the digital economy", and then do not provide a definition; and OECD (2015) which contains nearly 300 pages of discussion specifically about the digital economy without providing a definition.

[2] Very similar definitions are offered by British Computer Society (2014), Charoen (2015), Rouse (2016) as well as the Oxford Dictionary (OUP 2017).

[3] Though not explored in detail here, we recognise other terms used to represent concepts similar to "digital economy" (Brynjolfsson & Kahin 2000b, Srinivas & Yasmeen 2017). "Internet economy" (and its lesser twin, "web economy") arose in the 1990s and will be discussed further in the section on measurement. "New economy" flared for a while around the turn of the century but did not gain sufficient momentum to last. "Network economy" has had more longevity but is even harder to define and delimit than digital economy as its focus is structural rather than technological.

broader idea of the information society). Tapscott (1996), for example, argued the digital economy to encompass two generations of economic activity. The first was informational and compromised of basic tasks such as putting up static information on websites, but the second related to communication, reflecting the more interactional activities enabled by the Internet. Similarly, Brynjolfsson & Kahin (2000b) state:

> The term "information economy" has come to mean the broad, long-term trend toward the expansion of information- and knowledge- based assets and value relative to the tangible assets and products associated with agriculture, mining, and manufacturing. The term "digital economy" refers specifically to the recent and still largely unrealized transformation of all sectors of the economy by the computer-enabled digitization of information.

These authors were therefore seeking to demonstrate that something beyond earlier informational ideas was underway.

Simultaneously, the ability of the Internet to facilitate commercial transactions was being recognised and incorporated into digital economy definitions. At the turn of the century, the US Commerce Department's report, *The Emerging Digital Economy*, placed IT-enabled business activities into its definition (Margherio et al. 1999). This was made more explicit in 2000 in the edited volume, *Understanding the Digital Economy* (Brynjolfsson & Kahin 2000a) in which both editors and contributors (Brynjolfsson & Kahin 2000b, Kling & Lamb 2000) incorporated e-commerce into the scope of the digital economy; this being the period of the dot.com bubble.

These definitions also marked the initial appearance of two important features found in some digital economy definitions. First, a differentiation into components. For example, Kling & Lamb (*ibid.*) built on Margherio et al. (1999) to identify four parts to the digital economy:

> *"Highly digital goods and services:* These are goods that are delivered digitally and services of which substantial portions are delivered digitally [*e.g. online information services, software sales, online education*]. …
> *Mixed digital goods and services:* … the retail sale of tangible goods [*e.g. books, flowers, hotel rooms plus associated sales and marketing*] …
> *IT-intensive services or goods production:* services that depend critically on IT for their provision [*e.g. accounting services or complex engineering design*] … manufacture of tangible goods in whose production IT is critical (such as precision machining that uses computerized numerical control or chemical process plants that are controlled by computer) …
> *The segments of the IT industry that support these three segments of the digital economy:* The goods and services of the IT industry that most directly support the foregoing three segments of the digital economy include a large fraction of the computer networking subindustry, PC manufacturing, and some IT consulting firms. (Some analysts characterize the IT industries in more expansive terms and add communications equipment—including broadcast—and communications services"

This segmentation includes one of relatively few explicit recognitions that production of ICT goods and services including telecommunications is part of the digital economy.

The second feature is an implicit acknowledgement of the fuzzy boundaries of the digital economy. Through use of terms like "highly", "substantial", "intensive", "most directly" and even "critically", the Kling & Lamb definition introduces subjectivity and a recognition that there is no rigid boundary that enables all economic activity to be rigorously placed either inside or outside the scope of "digital economy".

Mesenbourg (2001) similarly segments the digital economy into the production of ICT infrastructure and the use of ICTs for other economic processes. But in the latter category he starts to look beyond the spotlighting of e-commerce to also add use of ICTs to conduct other business processes. As to some degree with Kling & Lamb, this prefigures later and broader definitions that widen out to include all digitally-enabled economic activity in their definition. These include the simple definitions noted at the start of this section and others such as DBCDE (2013), Dahlman et al. (2016) and G20 DETF (2016).

One challenge of the latter wide and simple definitions has been the breadth of economic activities that currently involve digital technology. Some have therefore followed the lead of Kling & Lamb (2000) and Mesenbourg (2001) to sub-divide the domain. For instance, Cognizant seeks to distinguish between just "doing digital" vs. actually "being digital": simply using digital technologies vs. placing them at the core of all business processes (Asen & Blechschmidt 2016, Bahl 2016). As with earlier definitions, though, the dividing line remains subjective.

Table 1: Evolving definitions and concepts of the digital economy

SOURCE	DEFINITION	FOCUS
Tapscott 1996: *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*	No direct definition but called it the "*Age of Networked Intelligence*" where it is "not only about the networking of technology… smart machines… but about the networking of humans through technology" that "combine intelligence, knowledge, and creativity for breakthroughs in the creation of wealth and social development".	Said to have first coined the term "digital economy". Emphasised that the digital economy explains the relationship between the new economy, new business and new technology, and how they enable one another.
Lane 1999: *Advancing the Digital Economy into the 21st Century* (Assistant to the US President for Science and Technology)	"…the convergence of computing and communication technologies in the Internet and the resulting flow of information and technology that is stimulating all of electronic commerce and vast organisational changes".	Focused on e-commerce and the wider ramifications of the digital economy around issues such as privacy, innovation, standards, and the digital divide.
Margherio et al. 1999: *The Emerging Digital Economy* (US Commerce Department)	No explicit definition but identified four drivers: "Building out the Internet ... Electronic commerce among businesses ... Digital delivery of goods and services ... Retail sale of tangible goods".	First clear segmentation of the digital economy. Emphasised foundations of digital economy more than economy itself.
Brynjolfsson & Kahin 2000b: *Understanding the Digital Economy: Data, Tools, and Research*	"...the recent and still largely unrealized transformation of all sectors of the economy by the computer-enabled digitization of information".	Emphasised understanding the digital economy from various angles: macroeconomics, competition, labour, organisational change.

SOURCE	DEFINITION	FOCUS
Kling & Lamb 2000: in Brynjolfsson & Kahin 2000a	"...includes goods or services whose development, production, sale, or provision is critically dependent upon digital technologies".	Segmented the digital economy into four parts: "Highly digital goods and services ... Mixed digital goods and services ... IT-intensive services of goods production" and the IT industry.
Mesenbourg 2001: *Measuring the Digital Economy* (US Bureau of the Census)	Defined the digital economy as "having three primary components": - "E-business infrastructure is the share of total economic infrastructure used to support electronic business processes and conduct electronic commerce" - "Electronic business (e-business) is any process that a business organization conducts over computer-mediated networks" - "Electronic commerce (e-commerce) is the value of goods and services sold over computer-mediated networks".	Focused on how to measure the emerging phenomena of e-business and e-commerce.
Economist Intelligence Unit 2010: *Digital Economy Rankings 2010*	No explicit definition but ranking of digital economy is based on: "The quality of a country's ICT infrastructure and the ability of its consumers, businesses and governments to use ICT to their benefit".	Emphasis on the foundations for a digital economy rather than the digital economy itself with measures of: connectivity and technology infrastructure, business environment, social and cultural environment, legal environment, government policy and vision, and consumer and business adoption.
OECD 2013: *The Digital Economy*	"The digital economy enables and executes the trade of goods and services through electronic commerce on the Internet".	Main content relates to competition and regulation in digital markets, with additional discussion of network effects, interoperability, and open vs. closed platforms.
Department of Broadband Communications and the Digital Economy (DBCDE), Australia 2013: *Advancing Australia as a Digital Economy: An Update to the National Digital Economy Strategy*	"The global network of economic and social activities that are enabled by digital technology, such as the internet and mobile networks".	Key elements seen as readiness, environment and usage, and focus on policy measures to enhance the digital economy.

SOURCE	DEFINITION	FOCUS
European Commission 2013: *Expert Group on Taxation of the Digital Economy*	"...an economy based on digital technologies (sometimes called the internet economy)".	Identifies characteristics of digital economy companies: • innovation through new sources of finance (venture capital) • importance of intangible assets • new business models based on network effects • cross-border e-commerce
British Computer Society 2014: *The Digital Economy*	"The digital economy refers to an economy based on digital technologies, although we increasingly perceive this as conducting business through markets based on the internet and the World Wide Web".	Key digital economy issues seen as innovation, rights, cyber-security and digital literacy.
European Parliament 2015: *Challenges for Competition Policy in a Digitalised Economy*	"A complex structure of several levels/layers connected with each other by an almost endless and always growing number of nodes. Platforms are stacked on each other allowing for multiple routes to reach end-users and making it difficult to exclude certain players, i.e. competitors".	Focus on competition and regulation of the digital economy.
House of Commons 2016: *The Digital Economy*	"The digital economy refers to both the digital access of goods and services, and the use of digital technology to help businesses".	Focus on policies for regulation and support of the digital economy.
G20 DETF 2016: *G20 Digital Economy Development and Cooperation Initiative*	"...a broad range of economic activities that include using digitized information and knowledge as the key factor of production, modern information networks as an important activity space, and the effective use of information and communication technology (ICT) as an important driver of productivity growth and economic structural optimization".	Emphasis on networked and intelligent ICTs that enable economic activities. Focus on policy, including cross-national policy, priorities for the digital economy.
Elmasry et al. 2016: *Digital Middle East: Transforming the Region into a Leading Digital Economy* (Digital McKinsey)	No explicit definition: "less as a concept and more as a way of doing things", but with three attributes: "creating value at the new frontiers of the business world, optimizing the processes that execute a vision of customer experiences, and building foundational capabilities that support the entire structure".	Covers measurement of digitisation, under-performance of the region, and strategies for government and business to accelerate progress towards a digital economy.

SOURCE	DEFINITION	FOCUS
Bahl 2016: *The Work Ahead: The Future of Businesses and Jobs in Asia Pacific's Digital Economy* (Cognizant)	No explicit definition; instead differentiation between "doing" and "being" digital (see also Asen & Blechschmidt 2016).	Focus on business value and profitability with advice to move from doing to being digital: "Businesses need to inject digital into the very core of what they do and how they interact and transact with customers, partners and employees. This means digitizing processes to super-charge profitability."
Knickrehm et al. 2016: *Digital Disruption* (Accenture)	"The digital economy is the share of total economic output derived from a number of broad "digital" inputs. These digital inputs include digital skills, digital equipment (hardware, software and communications equipment) and the intermediate digital goods and services used in production. Such broad measures reflect the foundations of the digital economy".	Covers how to improve micro- and macro-economic growth through better use of digital economy foundations.
Rouse 2016: *Digital Economy*	"The digital economy is the worldwide network of economic activities enabled by information and communication technologies (ICT). It can also be defined more simply as an economy based on digital technologies".	Brief review of definitions.
Dahlman et al. 2016: *Harnessing the Digital Economy for Developing Countries* (OECD)	"The digital economy is the amalgamation of several general purpose technologies (GPTs) and the range of economic and social activities carried out by people over the Internet and related technologies. It encompasses the physical infrastructure that digital technologies are based on (broadband lines, routers), the devices that are used for access (computers, smartphones), the applications they power (Google, Salesforce) and the functionality they provide (IoT, data analytics, cloud computing)".	Emphasises the potential of digital economies to deliver inclusive and sustainable growth, but only if key enablers are put in place.
OUP 2017: *Digital Economy*	"An economy which functions primarily by means of digital technology, especially electronic transactions made using the Internet".	Definition only.

SOURCE	DEFINITION	FOCUS
Deloitte n.d.: *What is Digital Economy?*	"...the economic activity that results from billions of everyday online connections among people, businesses, devices, data, and processes. The backbone of the digital economy is hyperconnectivity which means growing interconnectedness of people, organisations, and machines that results from the Internet, mobile technology and the internet of things (IoT)".	Sees four main areas of digital transformation: future of work, customer experience, digital supply networks, and Internet of things.

B2. Conceptualising the Digital Economy

Building from the prior analysis, we can identify three elements relating to conceptualisation of the digital economy. All definitions give some acknowledgement that digital technologies of some kind are the foundation for the digital economy. But only a few, in their explanations, identify the production of these technologies and related foundational services as part of – indeed as the core of – the digital economy. We can refer to this core as the *digital sector*: more often called the "IT sector" or the "ICT sector". Though long in the tooth, it is still common to define this using the OECD definition of the ICT sector first agreed in 1998: "a combination of manufacturing and services industries that capture, transmit and display data and information electronically" (OECD 2002). This currently covers ISIC industrial codes (revision 4) 26 (manufacture of computer, electronic and optical products), 582 (software publishing), 61 (telecommunications), 62 (computer programming, consultancy and related activities), and 63 (information service activities). This was described and illustrated (see Figure 2) in more detail by Heeks (2008); albeit the higher-level components go beyond the OECD definition and overlap into the wider digital economy (see below):

- *"Goods*: production of ICT consumer goods such as computer hardware and digital telecommunications, plus ICT producer goods: both capital goods (e.g. automated machinery for manufacturing PCs) and intermediate goods (chips, motherboards, hard disk drives, DVD drives, etc used in computer manufacture).
- *Software*: design, production, marketing, etc. of packaged and customised software.
- *Infrastructure*: "development and operation of enabling network infrastructure" (Wong 1998:325); both foundational telecommunications plus value-added networking services.
- *Services*: professional services not covered in other categories such as consulting, training and technical services.
- *Retail*: sale, re-sale and distribution of ICT goods, software and infrastructure and related services.
- *Content*: production and distribution of data content, including back-office processing and digitisation."

None of the definitions restricts itself solely to the digital sector but always adds some component of the "ICT consumption/application" category noted in Figure 2. Thus, the digital economy must be defined as being broader than simply the digital sector. At their broadest, overall definitions of the digital economy cover all digitally-enabled economic activity. But this raises a problem: "Increasingly the digital economy has become intertwined with the traditional economy making differences between them less clear" (OECD 2013); "The digital economy is increasingly interwoven with the physical or offline economy making it more and more difficult to clearly delineate the digital economy" (European Parliament 2015). Not only is there a problem of clarity, there is also a problem of scope: as more and more services, manufacturing and even primary production activities rely on ICTs, the digital economy under these definitions increasingly becomes just "the economy".

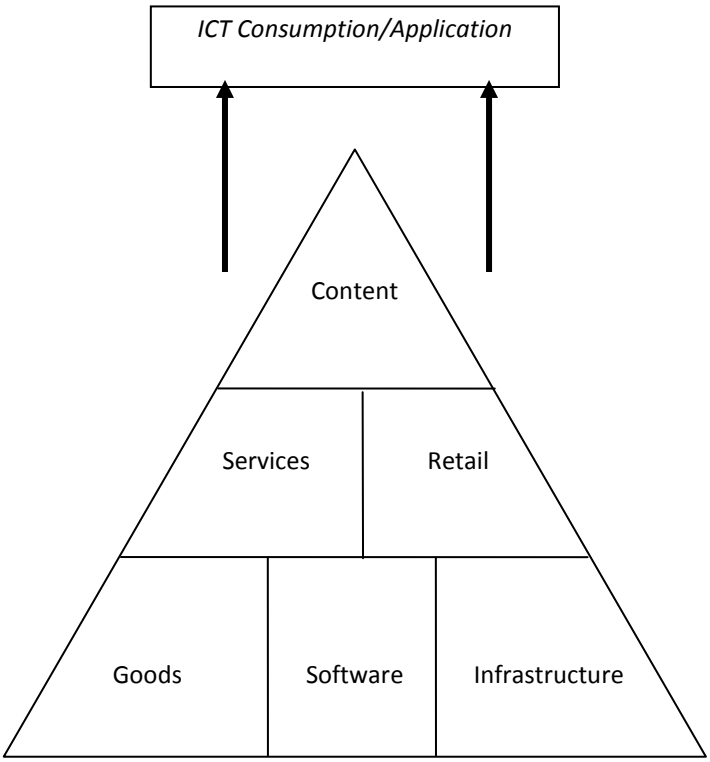


Figure 2: Typology of ICT sub-sectors
Source: Heeks (2008)

To partly skirt this problem, we will not refer to this broad scope – covering all economic activity based on digital technologies – as the digital economy but, instead, as the *digitalised economy*. This arises from the differentiation between "digitisation": conversion of data from analogue to digital form; and "digitalisation": application of digitisation to organisational and social processes (including economic activity) (Brennen & Kreiss 2014). This broad-scope definition therefore covers e-business (ICT-enabled business transactions) and its sub-set, e-commerce (ICT-enabled external business transactions), algorithmic decision-making in business, use of digitally-automated technologies in manufacturing and agriculture including Industry 4.0 and precision agriculture, etc.

Here, though, we will seek a narrower-scope definition of the *digital economy*, based on the notion of intensive and extensive applications of ICTs (Narasimhan 1983). Intensive applications intensify – that is, improve in some way – an existing economic activity. Extensive applications extend the boundaries of economic activity:

> A simple way to understand extensive economic activity is to ask: "has this activity only arisen due to ICTs?". If the answer is no – the activity already existed before ICTs – then any use of ICTs is intensive. If the answer is yes – the activity only exists because of ICTs – then this is extensive (Heeks 2017).

Via this approach, the digital economy would represent all extensive applications of digital technologies plus the production of those digital technologies. It would include the OECD definition digital sector, and the broader elements represented in Figure 2 above: digital services, retail and content activities not covered by the OECD definition and codes. And it would cover some parts of emergent phenomena – the platform economy, the gig economy, the sharing economy – where those could be seen to be new economic activities that did not pre-exist digital technology. For example, platform-based companies would be included. This is easy to see with firms like Facebook

and Google that are solely digital; a bit less clear with platforms trading tangible goods like Amazon, eBay or Alibaba; and reaching the blurred edge with firms like Airbnb and Uber. But we would define the latter as lying within our digital economy definition because they are not accommodation firms or taxi firms; they are digital platforms and they are built on digital innovations and digital business models (Accenture 2016).

Based on this and the central notion of extensivity, we therefore define the digital economy as "that part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services". The definition has a blurred boundary but it is also flexible enough to incorporate digital and digital business model innovation over time. As Figure 3 summarises, it encompasses both the core digital sector and also the broader range of extensive digital activity, without claiming that all digitised activity is part of the digital economy.

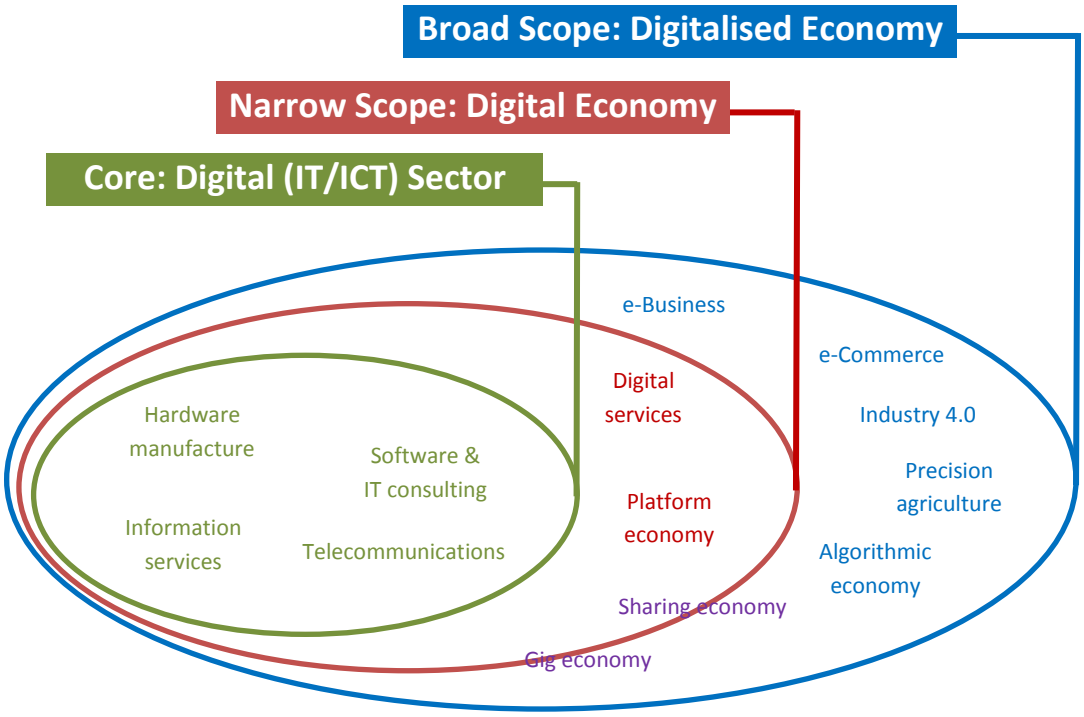
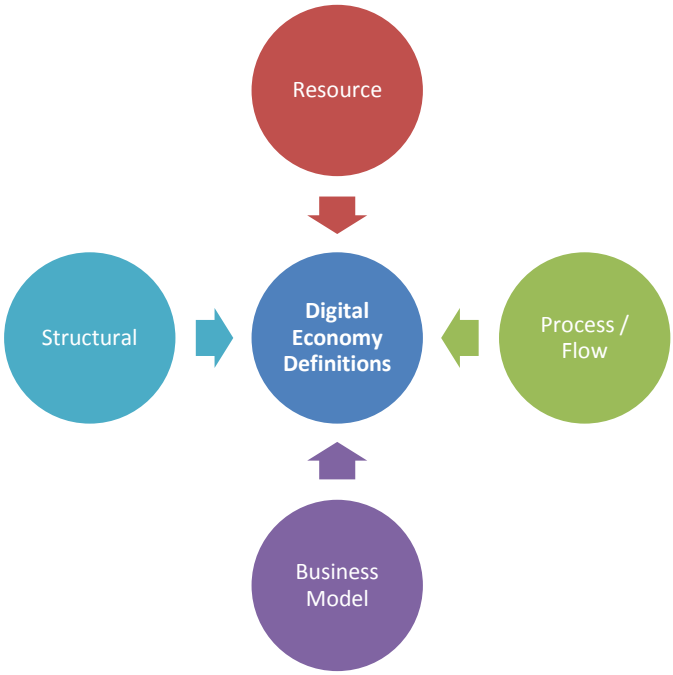


Figure 3: Scoping the digital economy
Source: Authors

Box 1: Perspectives on the Digital Economy

Analysing the digital economy definitions in Table 1, one can identify a number of different perspectives reflected:

- **Resource Perspective**: most obviously this rests on a ***technology perspective*** with many definitions identifying the technologies on which the digital economy is founded; but some include a ***content perspective*** that typically relates to the handling of data or information (e.g. Brynjolfsson & Kahin 2000b), and a ***human resource perspective*** that goes further to incorporate human knowledge or creativity or skills that are enabled by ICTs (e.g. Tapscott 1996).
- **Process/Flow Perspective**: many definitions cover the use of technologies to support particular business processes such as transactions/commerce (e.g. Kling & Lamb 2000, Mesenbourg 2001), while a few acknowledge the new flows of data or information that are enabled by ICTs (e.g. Lane 1999). This would include talking about the changes to processes that are occurring (e.g. Bahl 2016).
- **Structural Perspective**: may be rather generic in talking about economic transformation (e.g. Brynjolfsson & Kahin 2000b, G20 DETF 2016) or more specific in identifying the new web-/network-based structures that emerge as part of the digital economy (e.g. DBCDE 2013, European Parliament 2015).
- **Business Model Perspective**: lying between the process and structural perspectives, are the few definitions that bring in the idea of the new business models that are being enabled e.g. those that mention e-business or e-commerce (e.g. Mesenbourg 2001, European Commission 2013) or digital platforms (e.g. European Parliament 2015).



Alongside these direct components of definitions, we can identify:

- **Discourse of Novelty, Urgency, Inevitability**: "Don't blink: the future is rushing straight at us" (Dean et al. 2012). Within the definitions and their surrounding discussion there is a continuous sense of novelty and change in relation to the digital economy: new technologies, new organisational forms (from processes through business models to structures), and implicit within this new values and norms. Particularly by consulting firms, but also by others, there is a sense of urgency; of action being needed now to put in place new business strategies and new government policies. And there is no questioning of the importance and inevitability of the digital economy's emergence. The questions are not whether the digital economy will grow or should be allowed to grow or in what ways it should grow; it is going to grow – especially in your competitor firms and nations – and the devil take the hindmost.

C. Measuring the Digital Economy

Given the increase in digitally-enabled economic activity and hence its growing economic importance, measuring the digital economy is an essential process. But it is a flawed process:

> Good policy making, tax policy and the allocation of resources require high-quality data. This does not exist at present in the digital economy, and policy making cannot therefore be reliably expected to support as much as possible the digital economy" (House of Commons 2016)

There are a number of challenges:

- Definition/boundaries: as discussed above, the definitions of "digital economy" are various and differing. This does not *per se* make measurement difficult but it makes comparisons difficult. And definitions with a blurred boundary between the digital economy and the rest of the economy make measurement difficult (OECD 2014).
- Data quality problems: at present, particularly in developing countries, foundational data problems exist – data is absent or of poor quality. This is exacerbated by continuous innovation, which means data gathering is always behind the curve of technological change (*ibid.*).
- Problems with price: Moore's Law and its ilk – "my watch has more computing power than the Apollo 11 moon mission" – mean constantly falling prices for the same amount of ICT power, storage, etc. And the same may be true for ICT-enabled services, which also see qualitative changes that price may not reflect, and the availability of free items (think Wikipedia) that nonetheless add economic value (House of Commons 2016, OECD 2016). Corrections have to be made to account for this but these are not an exact science (Moulton 2000, OECD 2014, OECD 2016).
- Digital economy invisibility: many digitally-enabled economic activities do not readily appear as output. They may be intermediate services between business or between consumers; it may be difficult to price inputs so making it hard to calculate value-added; and being often virtual, they are hard to track no least in relation to cross-border digital trade[4] and digital consumers-as-producers (WEF 2015, House of Commons 2016, OECD 2016).

Some argue that as a result of these challenges, the metrics of the digital economy using conventional economic analysis are "not just unknown, but unknowable" (Sheehy 2016). The assumed impact of these challenges is that the size of the digital economy is currently "grossly underestimated" (*ibid.*). For example, use of Standard Industrial Classification codes showed there to be 167,000 digital sector companies in the UK in 2012; but direct investigation estimated the true number to be 60% higher at just under 270,000 (House of Commons 2016; see also ONS 2015). Sheehy (2016) estimates that if the contribution of the digital economy were to be calculated differently – based on the *absolute* value delivered, rather than by using GDP-related economic measures – then the digital economy would be a far more important part of the overall economy: delivering 20% of the total value of the global economy, rather than the current value of around 5% of global GDP[5].

[4] Cross-border data flows are >200 terabits per second, and "data flows now exert a larger impact on global GDP than the flow of goods" (Manyika et al. 2016).

[5] As discussed next, this looks similar to the size differentiation between digitalised and digital economies.

Notwithstanding these challenges, we will review what measurement data has been made available.

C1. Overall Size of the Digital Economy

The bad news is that there are no specific measures of the digital economy as just defined, but the measures that are available give some sense of overall size. The foundational minimum is set by measures of the digital (IT/ICT) sector; for example that it represented c.6% of OECD value added in 2012 and 2013 (OECD 2014, OECD 2015) or that it represented c.US$3.5tn or c.4.5% of global GDP in 2015 (Selvan & Kalyanasundaram 2015, Gartner 2016). GDP percentages for developing countries are likely to be around one-third to one-half of OECD/global figures, based on other data such as that given below[6].

There are cross-cutting measures, which cut across the scopes defined above. One used by various McKinsey reports is the idea of the "Internet economy": the contribution to GDP of Internet-enabled economic activity (e.g. du Rausas et al. 2011)[7]. This represents a slice across the three economic scopes represented in Figure 3, excluding some of the digital sector, and excluding non-Internet-related (e.g. some mobile-related) elements of the digital and digitalised economy. Estimated size of the Internet economy for 2010 was US$1.7tn or just under 3% of global GDP. A different slice arises from estimates of the mobile sector, which in Figure 3 terms looks to largely be confined as a sub-set of the digital sector but with perhaps some inroad into the digital economy. This was estimated by McKinsey to represent just under 1.5% of global GDP in 2011 (Manyika et al. 2013) and at US$1.1tn – again 1.5% of global GDP – in 2015 by GSMA (2016)[8]. Given the presence of smartphones/mobile Internet, this will overlap to some extent with the Internet economy estimates.

There are additive measures; for example, adding the size of the platform economy to that of the digital sector. One estimate gives the "collaborative economy" as US$15bn in 2013: around 0.002% of global GDP (Petropoulos 2017). An alternative sums the turnover of the top 25 platform firms worldwide, which gives a total of US$391bn in 2016: around 0.5% of global GDP (WP 2017).

Finally, there are much higher estimates which encompass the digitalised economy. For example, those suggesting the value of e-commerce in 2013 was US$16.2tn; just over 21% of global GDP (UNCTAD 2015). And those suggesting the size of the "digital economy" (but defined as per the digitalised economy above) represented US$19tn or 22.5% of the global economy in 2015 (Knickrehm et al. 2016).

[6] See also UNCTAD (2012) which estimates computer software and services to comprise around 1.5% of GDP in industrialised economies and around 0.5% of GDP in developing countries.

[7] Calculated via an expenditure-based approach using a proportion of cost for end-user equipment like PCs (% time spent online / % all time used); all e-commerce figures; all Internet subscription expenditure; trade balance based on proportion of trade that is Web-enabled (for OECD estimated at 70% of software and services plus 40% of hardware/telecom expenditure, but much lower in some developing countries e.g. for India).

[8] Consisting of mobile operators, mobile infrastructure providers, device manufacturing, distributors and retailers, and content, applications and other services. Note GSMA (2016) claims a further US$2tn impact on global GDP via improvements in the general economy and productivity improvements.

Steering between these, we can estimate that the digital economy as defined above represents around 5% of global GDP, though this will likely grow with growth in platform firms and digital services[9]. So the digital economy is huge but still dwarfed by the non-digital economy.

C2. Features of the Digital Economy

Notwithstanding the lack of direct digital economy measures, one can draw other conclusions about the digital economy from the available data:

i. ***The digital economy is unevenly distributed***. There is uneven distribution between global North and global South. For example, McKinsey figures estimate the Internet economy in 2010 contributing 3.4% of developed country GDP but only 1.9% of "aspiring country"[10] GDP, with the former contributing 78% and the latter 22% of the overall Internet economy (Manyika & Roxburgh 2011, Gnanasambandam et al. 2012). Figure 4 shows the data for 2012, with the GDP share of the Internet economy in Africa well below that of other country groupings at just 1.1% (Manyika et al. 2013). Likewise, three-quarters of global e-commerce was accounted for by the US, UK, Japan and China (UNCTAD 2015).

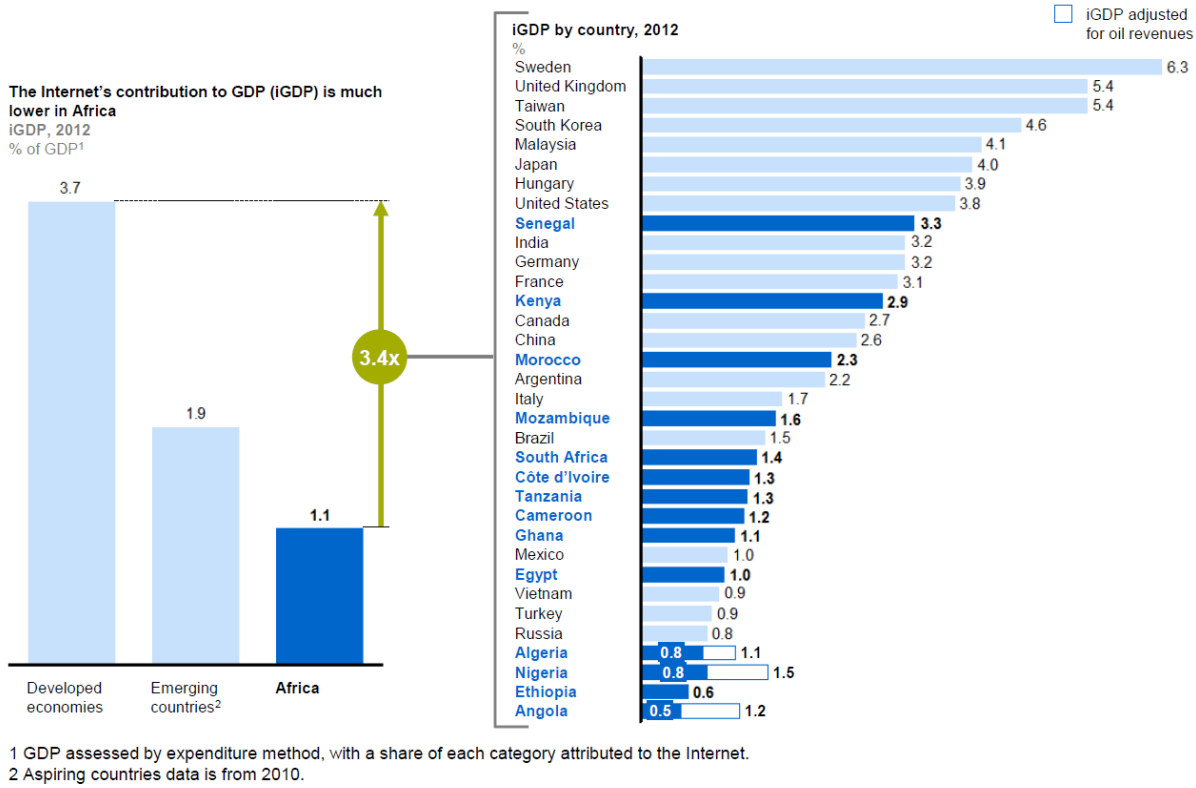


Figure 4: Size of the Internet economy in Africa
Source: Manyika et al. (2013)

[9] For example, the estimate that by 2025 online talent platforms alone will turn over US$2.7tn: some 2% of global GDP (Manyika et al. 2015).

[10] "Aspiring country" does not equate to the typical understanding of global South/developing country since it includes Russia and some relatively high-income Central/Eastern European and West Asian nations as well as some higher-income countries of Africa, Asia and Latin America; and it excludes almost all of Africa and much of Asia.

There is also uneven inter-regional distribution. For example, the US dominates the global North's digital (IT/ICT) sector, taking around one quarter of the global total (ITA 2017). Within the US, this contributes 7.1% of GDP[11] which is well above the OECD average (*ibid.*). The same applies in the global South. Using McKinsey's figures (du Rausas et al. 2011), two-thirds of Internet economy GDP in aspiring countries came from the four BRICs (see also Figure 4). Digital economy leaders include India (with more than 7% of GDP estimated to come from the IT sector alone (Nasscom 2016)) and the Philippines (with more than 7% of GDP estimated to come from the BPO sector alone (Chang et al. 2016)).

ii. ***The digital economy is growing faster than overall economies, especially in the global South***. The greater size of the digital economy in the global North means its past impact on overall economic growth has been larger there. For instance, McKinsey data estimates that the Internet contributed more than 20% of GDP growth in developed economies during the five years to 2011, more than 10% in the large emerging BRICs economies, and more than 5% in other aspiring countries (Manyika & Roxburgh 2011). Looking more broadly World Bank data estimates that ICTs accounted for 17% of GDP growth in developing countries in the previous ten years but that this impact was more constrained than in the global North (World Bank 2016).

Digital economy growth rates everywhere are faster than the total economy growth – so the digital economy is growing as a proportion of the overall economy – with current growth rates particularly high in the global South. For example, the Internet economy in the G20 is said to be "growing at 10% a year – significantly faster than the overall G20 economy. The growth is even higher in developing economies, at 15-25% annually" (WEF 2015). Looking at specific or related elements, the fastest growth of e-commerce is in the global South (UNCTAD 2015), the fastest growth of cross-border links is in emerging economies (Manyika et al. 2016), and main growth in the mobile sector is coming from the global South (GSMA 2016).

This pattern of greater-than-global-average growth in the global South looks set to continue. For example, Accenture (2017) predicts 5% annual growth in the global digital economy to 2020, lifting it to 25% of global GDP, but future annual growth rates in developing countries are typically cited as double-digit (e.g. Statista 2017a, Statista 2017b). Growth *potential* in developing countries is identified as even greater, such as claims that growing the Internet to the size of the mobile sector in Africa would lead the Internet economy to form 10% of African GDP by 2025 (Manyika et al. 2013), or the claim that doubling adoption of ICTs at the base of the economic pyramid would lead to a net global gain of US$6.3tn in GDP and create 77 million new jobs within a decade (El-Darwiche et al. 2012). Yet there are significant barriers to realising this potential.

iii. ***The digital economy contributes significantly to employment***. The digital (IT/ICT) sector is estimated to account for around 1% of the workforce in developing countries, and nearly 4% in the global North; perhaps around 2.5% of the global total (OECD 2014, World Bank 2016). This would suggest around 3% of the global workforce in the digital economy as per Figure 3's definition. As with GDP figures, there are significant exceptions in the global South. For example, around 2m workers (just under 5% of the workforce) in the Philippines are estimated to be working online, with

[11] And nearly 12% of employment, though this may include indirect employment.

at least half of those working in call centres (Vidaurri 2015, Lund & Manyika 2016)[12]. And there are estimated to be just over 3m workers directly employed and a further 7-10m indirectly employed via the Indian IT sector in 2014 (Heeks 2015), while an estimated 6m in total are employed directly and indirectly as a result of the Indian Internet economy (Gnanasambandam et al. 2012).

Despite future concerns about automation, the general narrative is of employment creation via the digital economy. McKinsey data (Nottebohm et al. 2012) claims that, globally, the Internet creates 3.1 jobs for every job that it destroys, with this effect higher in aspiring economies (3.2 created) than in developed economies (1.6 created); and with digitisation claimed to have created 17m jobs in emerging economies just between 2009 and 2011 (El-Darwiche et al. 2012). As with many other figures, there are suggestions that employment statistics for the digital economy are underestimates. To offer just one example, OECD figures put ICT sector employment at 4.5% of the UK workforce but more direct estimates put the figure at 11% (House of Commons 2016).

Labour productivity in the digital economy is generally higher than that in the overall economy. For example, labour productivity was US$90,000 per head in the general economies of the OECD, and more than US$160,000 per head in the ICT sector (OECD 2014), which fits roughly with the idea of nearly 4% of employment but more like 6% contribution to GDP/value added. The specific ratio will depend on the digital economy sub-sector: productivity levels were 160% above those of the total economy in telecommunications services but only 21% higher in IT services (*ibid.*)[13]. The ratio may be higher in developing countries: for example, in India average labour productivity per worker in the mid-2010s was around US$10,000 but in the software industry was more than US$37,000 (Heeks 2015).

[12] In 2013, average monthly wages just within the BPO sector ranged between US$675 and US$1,320: three to six times higher than the average monthly wage of US$215 (ILO 2014).

[13] Mobile industry data reflects the former: employment (17m in 2015) is around 0.6% of the global workforce but the industry produces 1.5% of global GDP (GSMA 2016).

D. Summary

Economic and political imperatives are combining with technological innovation to spur growth of the digital economy, with growth levels particularly high in developing countries. This growth must be strategised by the private sector, guided by government, and analysed by civil society and academe. Yet the foundations for these actions are missing with definitions, concepts and measures of the digital economy currently in rather a mess.

This paper has charted different definitions of the digital economy – including their development over time – to provide a three-scope model. The digital (IT/ICT) sector is the core of the digital economy but the scope of the digital economy is argued to stretch beyond this, encompassing a set of emerging digital business models. Though included by many digital economy definitions, we differentiate wider applications of digital technologies in existing businesses; seeing these as within scope of the broader "digitalised economy".

Measuring the digital economy faces challenges of fuzzy boundaries, poor data quality, pricing problems, and invisibility of much digital activity. Acknowledging many caveats, we see the digital economy as defined here probably making up around 5% of global GDP and 3% of global employment. Overall measures hide significant unevenness: the global North has had the lion's share of the digital economy to date, but growth rates are fastest in the global South. Potential growth rates in the global South – if barriers could be overcome – are even higher. Separate investigation will be required of opportunities, barriers, and good-practice interventions that are required to realise this potential of the digital economy to deliver significant development impacts.

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