
UNCTAD INSIGHTS

FDI in the digital economy: a shift to asset-light international footprints

Bruno Casella and Lorenzo Formenti*

The digital economy is becoming an ever more important part of the world economy. It is revolutionizing the way we do business, and it has important implications for foreign direct investment (FDI). However, little systematic analysis has been done to investigate the investment patterns of digital multinational enterprises (MNEs). This study, conducted in the context of UNCTAD's World Investment Report 2017 (WIR17), is an attempt to fill some of the gap in knowledge and to provide an impetus for future research. It proposes a new interpretative framework for the digital economy, builds an extensive sample of digital and ICT MNEs, and profiles their international operations. Its main findings are that MNEs in highly digitalized industries have a "lighter" FDI footprint than traditional MNEs; they tend to concentrate their operations in a few highly developed countries and their investment patterns are shaped by fiscal and financial motives more than those of traditional MNEs. As digital technologies and business models tend to disseminate across the broader economy, this may suggest the onset of a new era of international production and MNE internationalization paths. This paper sheds light on the methodology underpinning the analysis in WIR17 to ensure full replicability and to prepare the ground for further work in the area. It also builds further on the discussion in WIR17, proposing broader implications for international business and new avenues for future research.

Keywords: FDI, digital economy, multinational enterprises, ICT

1. A changing global economy: the rise of tech and digital MNEs

The global economy is transforming, prompted by production and consumption revolutions. As cautious optimism fuels economic recovery, technological change

* Authors are affiliated with the United Nations Conference on Trade and Development. The corresponding author is Bruno Casella (bruno.casella@unctad.org). Authors gratefully acknowledge the guidance and insights received from James X. Zhan and Richard Bolwijn. The views expressed in this article are solely those of the authors and do not represent the views of the United Nations.

is changing the way goods and services are produced, paving the way to a fourth industrial revolution that will affect society at large (Schwab, 2016).

The digital economy is becoming an increasingly important part of this transformation. It can be defined as the application of internet-based technologies to the production and trade of goods and services. Not only is it affecting the daily lives of a growing number of people, it is also encompassing an ever greater part of the world economy. The internet industry contributes almost four percentage points to GDP in the largest economies, those that generate 70 per cent of global GDP (Atkinson and Stewart, 2013). It is also pervasive in the act of doing business. As an increasing number of small and medium-sized enterprises (SMEs) buy and sell online, it is estimated that the value of web-based business to business (B2B) transactions alone is about a third higher than the entirety of business to consumer (B2C) transactions (UNCTAD, 2015).

With the rapid growth of the digital economy, the importance of digital and technology multinational enterprises (MNEs) in international production has increased dramatically. The rapid rise of tech MNEs represents one of the most noteworthy trends in the world of global megacorporations in recent years. Between 2010 and 2015, the number of tech companies in UNCTAD's ranking of the top 100 MNEs more than doubled, from 4 to 10. Tech MNEs have not only gained weight in the universe of the largest global multinationals, but they also represent by far the most dynamic players. In the same period, the assets of these MNEs increased by 65 per cent and their operating revenues and employees by about 30 per cent, against flat trends for other top 100 MNEs (UNCTAD, 2017a; UNCTAD, 2017b).

In light of these trends, a fundamental question for research and policy analysis is whether, and how, digitalization is changing the internationalization strategies of MNEs. It is generally argued that digitalization may lead to a retreat in FDI, as it enables MNEs to operate globally and engage in foreign markets without a physical presence (Eden, 2016; McKinsey Global Institute, 2016). As (traditional) motivations for market-seeking FDI and (tangible) resource-seeking FDI are partially undermined by digitalization, other types of FDI may become more important. These include knowledge-seeking FDI and to some extent also financial- and tax-driven FDI. These investment patterns may affect MNEs' international production footprints, with important implications for development in host countries. In particular, MNEs in highly digitalized sectors are expected to have a lighter international footprint than other MNEs, which involves generating large volumes of sales abroad by investing relatively less in productive assets, as well as retaining the largest interests in (developed) home countries.

Important research questions are therefore, is empirical evidence supporting these expectations? Are there significant differences between digital and traditional MNEs in the observed investment patterns and international footprints? And if so,

can digital MNEs be considered harbingers of a new FDI paradigm that will affect international production as a whole?

These issues are clearly central to the discussion of the future of international production. Nevertheless, empirical research in this area reveals considerable gaps in knowledge. Although there is mounting interest in fast-growing tech and digital MNEs, and their impact on the global economy, a comprehensive mapping of the digital economy at the firm level is still missing. Appendix 1 shows that existing firm-level sources either lack a digital focus or, conversely, emphasize only specific aspects or subsectors of the digital economy, limiting their usefulness for capturing the fundamental trends and shared features of the digital economy. Similarly, despite the fact that digital economy studies have mushroomed in recent years, the foreign investment angle has been less debated, at least from an empirical economics perspective. Indeed, only limited empirical research has been conducted on the way digitalization is changing the motivations and determinants behind firms' internationalization efforts, and more specifically, the impact these efforts have had on their international footprints.¹

Against this background, UNCTAD developed a comprehensive framework for mapping the digital economy and the firms operating in the digital economy (WIR17). It constructed a novel database of the 100 largest digital MNEs and 100 largest ICT MNEs, complementing its well-established database of the 100 largest non-financial MNEs (see for example WIR17, table I.5). The data sets contain comprehensive information on the international sales and assets of each MNE. The framework and the data sets provide the basis for the analysis and the findings presented in this paper.

This paper is organized as follows. Section 2 presents in detail the analytical steps for the construction of the underlying database of digital and ICT MNEs: the definition of a conceptual framework for mapping digital and ICT firms, the selection and classification of the top 100 firms and the collection of the relevant indicators of international activity at the firm level. On the basis of these indicators, it is possible to elaborate a comprehensive analysis of MNEs' investment patterns,

¹ Nachum and Zaheer (2002, 2005) found that efficiency and the quest for intangible knowledge assets are the most important motivations for digital FDI, whereas market-seeking and resource-seeking investment are much less relevant than in traditional industries. Some related studies have analysed the impact of ICT and digital technologies on the governance of global value chains (GVCs). Foster and Graham (2016) looked at the way internet-based digital technologies shape modern global production networks, with a view to incorporate digital advances in existing theoretical frameworks. Rangan and Sengul (2009) argue that ICT adoption facilitates control in outsourcing and other non-equity relationships, through constant information exchange. On the opposite side, Chen and Kamal (2016) associate ICTs with higher in-house production and intra-firm trade. From a pure trade perspective, Cassetta, Meleo and Pini (2016) argue that adoption and use of digital technologies positively affect enterprises' exporting behaviour.

in relationship to their level of digitalization, both across different categories of digital and ICT MNEs and in comparison with traditional MNEs. The results of this analysis are presented in section 3, where the main findings are discussed. Finally, as one key purpose of this research is to lay the ground for future analytical efforts towards obtaining a better understanding of the implications of digitalization on MNEs' international activity, section 4 suggests a number of promising directions for further research.

2. UNCTAD's analytical framework, database and indicators for mapping digital economy MNEs and their international footprints

2.1. UNCTAD framework for mapping the digital economy

UNCTAD's framework for mapping the digital economy represents the first attempt of its kind to comprehensively chart the digital economy players. It is characterized by three building blocks (figure 1). At its foundation are ICT firms that provide the infrastructure and tools that make the internet accessible to individuals and businesses. Its core is represented by digital firms, characterized by the central role of the internet in their operating and delivery model. Finally, the broad economy rests on digital infrastructure and digital content in the process of the digitalization of traditional activities.

In UNCTAD's analytical framework, *digital firms* include purely digital players (internet platforms and providers of digital solutions) that operate entirely in a digital environment and "mixed" players (e-commerce and digital content) that combine a prominent digital dimension with a physical one.

Specifically, *internet platforms* (search engines, social networks, other platforms) are companies providing digital services through internet and cloud-based platforms; e.g. search engines and social networks. "Other platforms" includes sharing economy platforms, e.g. transaction platforms (eBay) and open-source platforms (Red Hat). The category *digital solutions* (electronic and digital payments, other digital solutions in the cloud) describes a variety of players with core activities based on, or strictly linked to, internet technologies. Among them: cloud hosting and computing, web hosting and email services, electronic and online payments, and digital solutions for business management and for financial applications (fintech).

Among the mixed players, *e-commerce* (internet retailers, other e-commerce) consists of specialized and non-specialized online stores and online travel and booking agencies, focusing on fully online and online-born retailers. It also includes agencies specialized in online marketing and advertising. The last category in the

Figure 1. UNCTAD framework for mapping the digital economy



Source: Based on World Investment Report, 2017.

scope of digital MNEs, *digital content*, (digital media and entertainment, information and data providers) includes producers and providers of digital content, such as media (music, video, e-books and online magazines, online courses) and gaming (“classic” video games, online games, mobile games, multiplayer interactive games). It also captures “big data” providers, and providers of marketing and customer intelligence, as well as economic, business and credit information.

The second macro-category *ICT firms* includes IT companies producing hardware and software, as well as telecommunication firms. *IT hardware and software* covers the broad categories of manufacturers of ICT hardware (computer brands) and components (e.g. the semiconductor industry) as well as software houses and providers of assistance. *Telecom* players are owners of the telecommunication infrastructure on which internet data is carried.

Appendix 2 provides a more detailed description of UNCTAD’s taxonomy, including the main caveats and points of attention for each category.

2.2. The new UNCTAD databases of the top 100 digital and ICT MNEs

The construction of the databases of the top 100 digital and top 100 ICT MNEs consisted of two operational steps.

The first step required a selection of the largest 100 such MNEs in terms of operating revenues or sales. For this purpose, extensive screening of company data and information was conducted using Bureau Van Dijk’s Orbis database as the primary source of firm-level information. Where information from that database was ambiguous or not sufficient, alternative sources were employed, including the Thomson One database, company financial reporting and non-technical sources, such as top company rankings (generic and dedicated), company websites and the press.

The second step involved a comprehensive classification of the top digital and ICT companies into the categories of the UNCTAD digital framework. The allocation of firms to categories and subcategories was based on the main activity or main source of revenues.

The detailed steps for the selection and classification of the top 100 digital and ICT MNEs are described in appendix 3.

UNCTAD’s new databases allow systematic profiling and ranking of digital and ICT MNEs across all main digital areas. It is currently the most extensive effort of its kind. These new data sets complement UNCTAD’s well-established top 100 MNEs database, ranking non-financial MNEs, including digital and non-digital industries, based on their international presence. The combination of the “traditional” top 100 database with the new databases of the top 100 digital and ICT MNEs provides a

powerful data bank for analyses to compare and contrast investment patterns and international footprints.

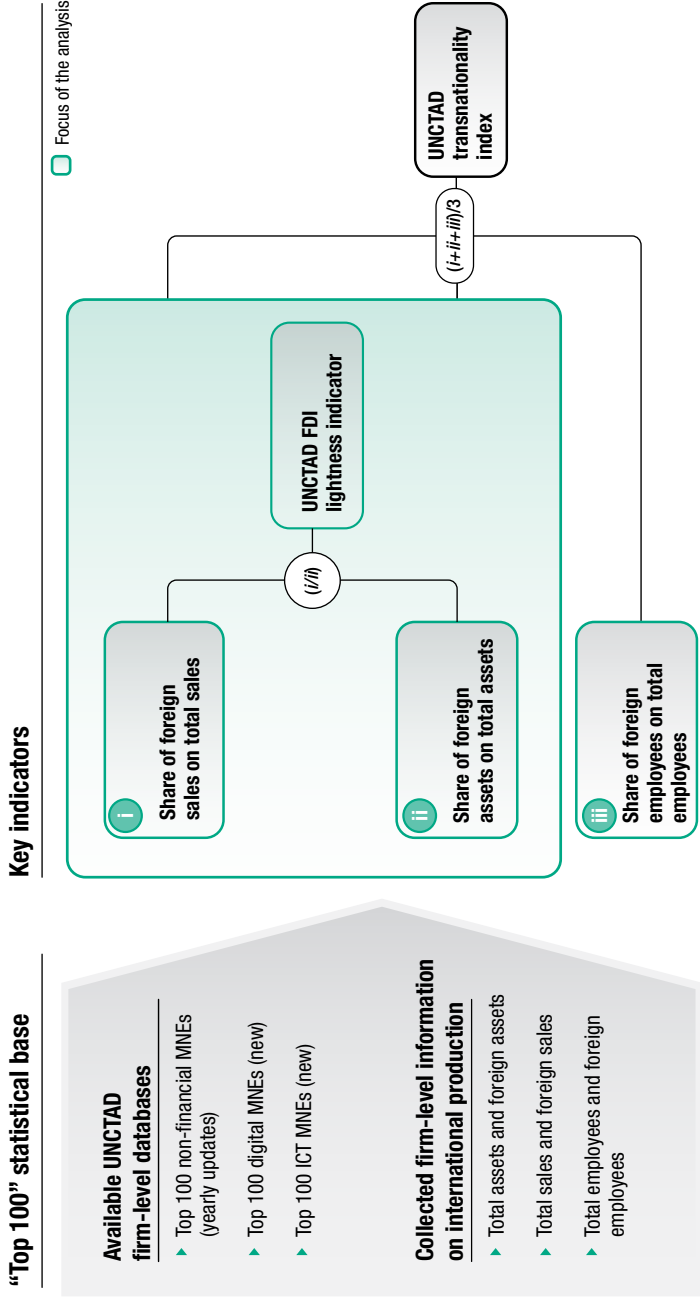
2.3. Indicators of MNE international activity and FDI asset lightness

The main new indicator developed by UNCTAD for the analyses of the international footprint of digital MNEs is the “FDI lightness indicator”. It is defined at the level of the individual MNE as the ratio between the share of sales generated by foreign affiliates and the corresponding share of foreign assets. It reveals the extent to which a company is able to generate sales abroad given its stock of foreign assets. It is low (between 0 and 1) when the share of foreign assets is higher than the share of foreign sales (a “heavy” footprint); it equals 1 when the two shares are the same; it is high (above 1) when the share of foreign assets is lower than the share of foreign sales (a “light” footprint).

The construction of the FDI lightness indicator employs consolidated information on assets and sales of foreign affiliates reported by publicly listed MNEs and usually published in the notes to consolidated financial statements. The approach in this study builds on the established methodology followed by UNCTAD for the analysis of the top 100 largest non-financial MNEs. Figure 2 provides an overview of the UNCTAD statistical base and analytical toolkit for the analysis of the top 100 MNEs and defines the specific scope of this analysis.

Appendix 4 provides the complete list of digital and ICT MNEs, classified according to the digital categories and subcategories defined in the UNCTAD digital framework. For each MNE, it also reports size in terms of total sales and assets (2015), share of sales and assets generated by foreign affiliates, and the resulting FDI lightness indicator. Finally, summary values of the lightness indicator are retrieved from data on individual firms, for each category and subcategory of digital and ICT MNEs. Issues related to the computation of (weighted and unweighted) summary values, together with other technical complexities involved in the construction and operationalization of the FDI lightness indicator, are further discussed in box 1.

Figure 2. The FDI lightness indicator (in the context of the UNCTAD analytical work stream on the top 100 MNEs)



Source: Authors.

Box 1. Issues with the construction of the FDI lightness indicator

The construction of the FDI lightness indicator requires the collection of the shares of sales and the shares of assets generated by foreign affiliates for each MNE in the database, based on the companies' financial reports. Some challenges arise from the fact that reporting of foreign activity (sales and assets) is not fully standardized across companies.

i. Share of foreign sales. Gathering information on the share of foreign sales (or operating revenues) is relatively straightforward, as most publicly listed companies explicitly report the geographic breakdown of sales. However, it is important to note that some companies allocate sales based on their operations and others on the location of their customers. For the first group, foreign sales coincide with the sales of foreign affiliates, while for the second group foreign sales also include exports. In the sample of top digital MNEs, about 30 per cent of companies report geographic sales based on operations, 40 per cent report based on customer location and the remaining 30 per cent do not specify this information. Notwithstanding these differences, both reporting approaches provide an indication of the foreign commercial presence of individual MNEs that can be effectively used for the purpose of this study.

ii. Share of foreign assets. The analytical treatment of the share of foreign assets is more challenging. The main issue is related to the perimeter described by the share of foreign assets. Companies provide a geographic breakdown of assets using different baselines. Only a minority of MNEs provide the geographic breakdown of total assets. The majority provides the breakdown of long-lived assets, and a sizeable share limits the geographic segmentation to property, plant and equipment (PP&E). For digital MNEs, there may be significant differences in the value of PP&E, long-lived assets and total assets, with the value of PP&E in particular covering only a small portion of total assets. Netflix (see box figure 1.1) provides a clear example of such cases.

From a conceptual perspective, this issue has limited implications as the main focus of this analysis is on tangible fixed assets, a component fully covered by the geographic breakdown of the assets. Nevertheless, the different baselines limit the comparability of the individual data across the sample and affect the calculation of the summary values of the FDI lightness ratio for groups of MNEs. To address this issue, summary values have been calculated using both a weighted approach and an unweighted approach. In the weighted approach, the share of foreign assets reported by each firm is applied to the firm's total assets to provide a common baseline for the calculation; in this way, each MNE in the group is weighted by the size of its total assets. In the unweighted approach, summary values are instead

/...

Box 1. Issues with the construction of the FDI lightness indicator (concluded)

simply calculated as the groups’ medians of the shares of foreign assets reported by each firm. This approach does not “stretch” the perimeter of the geographic breakdown to include all assets and does not weigh for the size of the MNEs; it merely computes descriptive summary statistics on the basis of the information available at the firm level.

Box figure 1.1. Illustration: The case of Netflix

Asset composition

	As of December 31,	
	2015	2014
Assets		
Current assets:		
Cash and cash equivalents	\$ 1,809,330	\$1,113,608
Short-term investments	501,385	494,888
Current content assets, net	2,905,998	2,166,134
Other current assets	215,127	152,423
Total current assets	5,431,840	3,927,053
Non-current content assets, net	4,312,817	2,773,326
Property and equipment, net	173,412	149,875
Other non-current assets	284,802	192,246
Total assets	\$10,202,871	\$7,042,500

Asset geographic breakdown

	As of December 31,	
	2015	2014
(in thousands)		
United States	\$159,566	\$138,704
International	13,846	11,171

Geographic information covers only a small share of the assets
(i.e. foreign PP&E negligible share of total assets)

- ▶ **Property, Plant and Equipment (PP&E) at less than 2% of total assets**
- ▶ **Foreign share of PP&E at less than 10% of total PP&E**
- ▶ More relevant items “Non current content assets” at 42% of total assets and 90% of total fixed assets. Likely made of intangibles retained in the United States
- ▶ Geographic breakdown provided only for PP&E

Source: Authors.

3. Analyses and headline results

To assess the potential impact of digitalization on international production more broadly, i.e. on international investment patterns of all MNEs, it is useful to re-think the UNCTAD framework more explicitly in terms of exposure to the internet. As illustrated in figure 3, UNCTAD's digital framework can be mapped into a conceptual matrix positioning digital categories on the basis of their internet intensity (the internet intensity matrix), along two dimensions: production and operations (vertical axis) and commercialization and sales (horizontal axis).

At the top end of the matrix are the purely digital MNEs, the group of internet platforms and providers of digital solutions, where both operations and sales are digital. At the lower end of the matrix is the heterogeneous group of non-ICT, non-digital firms, some of which are gradually moving towards digital adoption in operations and sales, as confirmed for example by the growing importance of e-commerce in traditional business. An intermediate position is covered by digital MNEs with mixed models (digital content and e-commerce) and the group of ICT MNEs (IT and telecom), whose core business activities combine physical and digital elements.

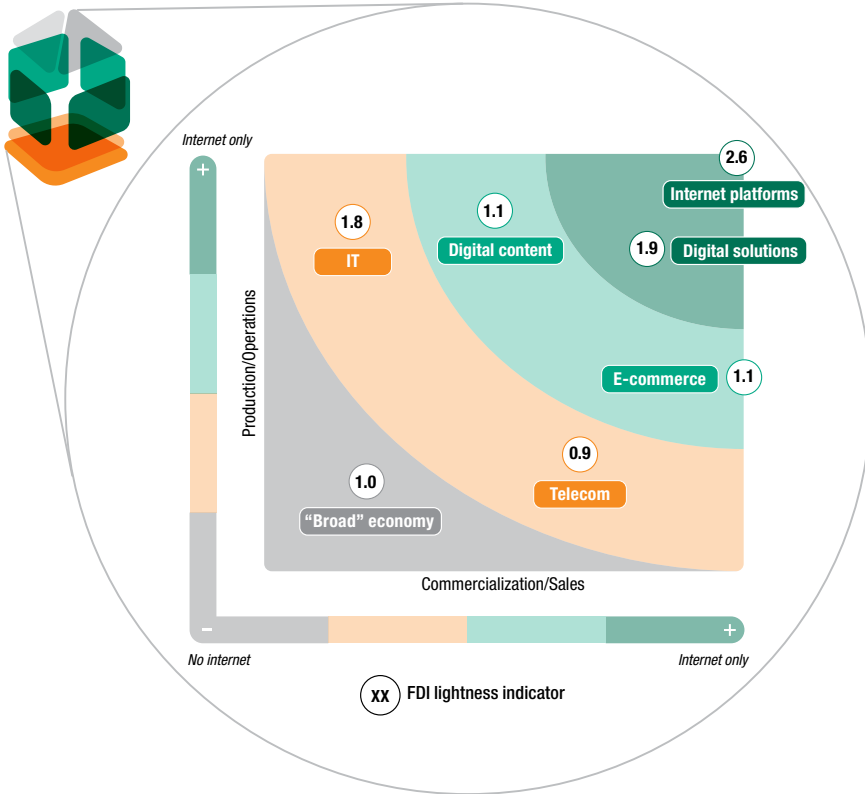
Figure 3 clearly shows an increase in the FDI lightness ratio as companies' positioning on the internet intensity matrix moves towards delivery and operating models characterized by higher internet intensity. It is important to note that this pattern is not driven by a few large companies; the results are consistent when replacing the weighted values of the FDI lightness indicator (i.e. weighted by the sizes of the MNEs) with the unweighted ones (the median values in the group) (see also discussion in box 1).

The pattern of the FDI lightness indicator illustrated in figure 3 confirms a link between the level of digitalization and the lightness of investment; this is the key trend documented and discussed in WIR17 (FDI asset lightness).

The analyses suggest two further relevant FDI patterns related to digitalization. These are: a re-balancing of international production towards the developed world (FDI de-democratization) and the prominence of financial and fiscal motives in MNE investment decisions (FDI financialization). These three big trends are further discussed below and summarized in figure 4, which also reports some key figures to document the size of the transformation at play. The patterns discussed here apply, primarily to digital and tech MNEs, but there are signs that they are starting to spread across the MNE universe.

FDI asset lightness. The internet is transforming the international operations of MNEs, making a physical presence overseas less fundamental and thus lightening the footprints of MNEs' international production.

Figure 3. FDI lightness indicator and the Internet Intensity Matrix



Source: Based on WIR17.

In business models characterized by higher internet intensity, the weight of foreign assets relative to foreign sales tends to be lower. Thus, MNEs in internet-intensive sectors exhibit a higher FDI lightness ratio. Comparing the extreme ends of digital exposure in figure 3, internet platforms have a share of foreign sales that is more than 2.5 times the share of foreign assets, against roughly the same share for traditional MNEs (see also WIR17, figures IV.7, IV.8 and IV.9).

Furthermore, digitalization tends to break the operational nexus between foreign sales and foreign assets. Not only do highly digital MNEs tend to realize more foreign sales with less foreign assets, there is in fact no correlation between the two, suggesting that commercial presence in foreign markets has no apparent bearing on international investment choices. Across internet platforms in the UNCTAD

sample, the linear correlation coefficient between the share of foreign sales and foreign assets is close to 0 (see also WIR17, figure IV.10).

FDI de-democratization. The light international footprint of digital MNEs, coupled with their quest for knowledge and technology assets, fuels a reversal of the democratization trend in FDI (the increase of the share of developing countries in global inward and outward FDI over the last decades).

Most digital MNEs are from developed countries, in particular the United States. Over 60 (63) of the top 100 digital MNEs have their parents in the United States, followed by the United Kingdom (7) and Germany (6); the first three countries account for more than 75 per cent of the largest MNEs. This concentration is more pronounced in the category of internet platforms, where 10 of the 11 MNEs in the sample are from the United States. By contrast, the presence of top digital MNEs from developing economies is marginal, with only four in the top 100 (see WIR17, table IV.1).

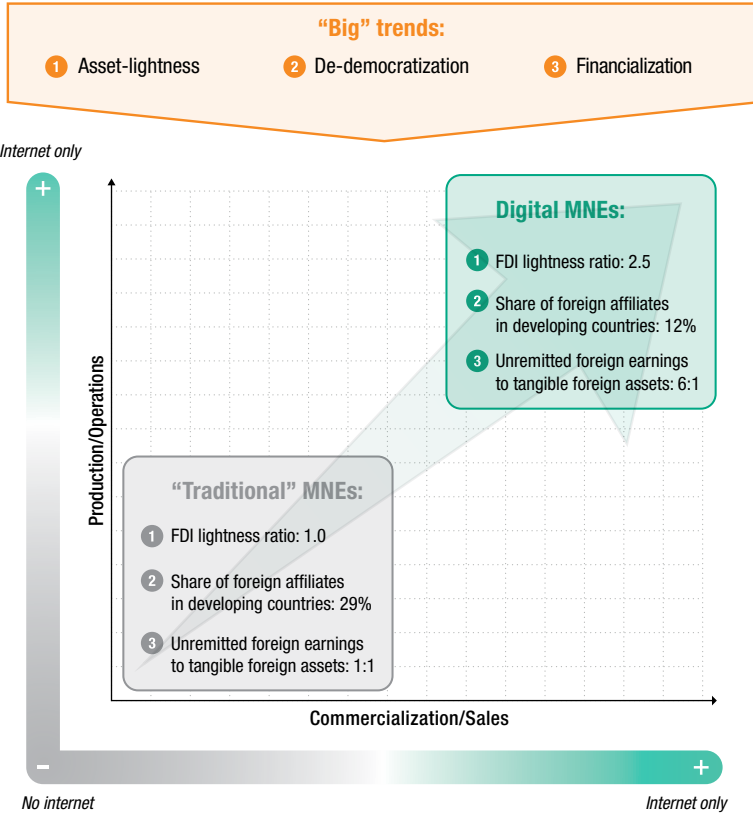
Analogously, subsidiaries of digital MNEs are highly concentrated in developed countries, particularly the United States, whereas their presence in developing economies is marginal. Only 12 per cent of the foreign affiliates of top digital MNEs are located in developing economies, against about 30 per cent for traditional MNEs. The United States has the lion's share, covering alone 40 per cent of subsidiaries of digital MNEs, almost twice the share for other MNEs (21 per cent) (see also WIR17, table IV.1).

FDI financialization. A light international footprint, with limited investment in tangible assets and large volumes of international sales, giving digital MNEs strong liquidity and high spending capacity, provides fertile ground for financial and tax-driven patterns of investment.

Distinctive features of the asset composition of digital and tech MNEs are the limited share of tangible assets compared with intangibles and the large share of cash and cash equivalents (see WIR 17, figure IV.3). A deeper dive into the data reveals that a sizable part of this cash is retained overseas, likely for tax optimization purposes. The largest tech megacorporations from the United States are keeping overseas about 62 per cent of their total foreign earnings, a share almost three times higher than that of other United States MNEs (23 per cent). This share corresponds to about US\$385 billion, equivalent to about six times the estimated value of foreign tangible assets. This fact suggests that these resources are used only in small part to finance foreign productive capacity, with their bulk channelled into non-core operations, driven by financial or tax-related motives² (see WIR17, figure IV.11).

² It should be noted, however, that the phenomenon of high retained foreign earnings is strictly linked to the United States territorial tax system and could be less relevant for MNEs from other countries. Changes in the United States corporate tax system may significantly affect overseas retained earnings of tech and digital MNEs.

Figure 4. Three big trends of international investment in the digital era



Source: Authors.

The onset of a new era for international production?

These trends describe an entirely new multinational business model and have the potential to radically transform the international operations of many MNEs. One of the findings of the analysis is that the process of digital disruption is, for now, mostly limited to digital MNEs and MNEs with strong links to the digital economy, either as providers or enablers. For other MNEs, traditional business models are still quite persistent.

A key question is when and to what extent traditional MNEs will move up the digitalization path (from the bottom left part of the internet matrix to the top right).

Indeed, the rapid growth of online channels in traditional industries shows that companies are already moving towards digitalization of commercial activity (x-axis in figure 3). Digitalization of production (y-axis in figure 3) is clearly more challenging, but technological developments and “industry 4.0” approaches are expected to provide increasing support to the transition. Finally, the penetration of leading digital MNEs into larger portions of the real economy, also outside typical digital markets, will give a further impetus to the digitalization of more traditional activities.

4. Avenues for future research

The work in this paper also provides (an initial) impetus to further theoretical and empirical efforts towards a better understanding of the implications of the digital economy in the globalization patterns of international production. Its main inputs and value added for future research work lie in two areas. First, it describes UNCTAD’s approach to the empirical analysis of digital corporations, leading to a list of the top 100 digital and ICT MNEs that can be used as a basis for firm-level analysis of relevant dimensions of digital MNEs, both within and beyond the international production/investment angle. Second, it hints at some disruptive trends in international investment patterns, calling for further empirical work but also for some deeper theoretical accommodation. This section suggests some possible research directions.

i. Digital investment determinants

Digital technologies are putting into question the traditional motivations behind FDI, leaving the way open to a new set of determinants. For digital MNEs, this translates into a shift of focus in international investment from heavy, market- and resource-driven FDI to light, knowledge-seeking and financial FDI. The exploitation of factor cost advantages is being replaced by the access to key intangible assets as the main driver behind cross-border investment. Building upon this piece of research, micro-econometric analysis can be conducted to help “explain” the motivations behind digital FDI empirically. International footprint indicators may be used to model specific dimensions of FDI in the digital economy, such as international market outreach (share of foreign sales), the degree of internationalization of operations (share of foreign assets or number of subsidiaries), location (country of incorporation), ownership (country of the ultimate owners) and so on.

ii. Firm-specific attributes

A number of firm-specific characteristics, such as age, size, location and value chain role, may also affect the way digital firms invest globally. These firm-specific attributes represent (possible) other angles from which to look at the international

operations (and footprint) of digital and ICT MNEs. Indeed, although this study documents a clear pattern in international footprints that is based on the digital intensity of businesses, across firms within the same or very similar business models there is still significant variability to explain, variability that is not captured by the digital dimension alone.

iii. FDI project data analysis

The digital and ICT database may be linked to external sources of data on FDI projects, such as the Financial Times fDi Markets database, with a view to attaching to the current statistical base information, whether qualitative or quantitative, on foreign investment projects. Running empirical analysis, either in an advanced-descriptive or predictive form, will enable researchers to build upon these findings and look at what hides behind firm-level international profiles. This analysis might help in addressing specific issues related to digital FDI that are not captured by consolidated information on segments. Examples of key investment dimensions include type (greenfield, merger and acquisition (M&A)), motivations, location and impact (capital expenditure, job creation, tax revenues).

iv. Beyond the international production and investment angle

Tech and digital corporations, in particular megacorporations, are the subject of huge interest in the political arena, in the research arena, in the public opinion arena. The obvious reason is that they are by far the most innovative, fastest growing and dynamic players in the global economy. The feeling that they will be driving a change that is likely to radically transform the way we live is shared. For this reason, every day new analyses appear on the ways in which such corporations operate different dimensions of their business and affect economies and societies. However, most of these investigations are based on anecdotal evidence, focusing on one or a few selected companies. As already discussed, this has partly been due to the lack of a comprehensive database of digital and tech MNEs. In this respect, UNCTAD's database provides a rich basis for addressing questions about digital and tech MNEs in a more systematic fashion. All companies included are publicly listed, and most are from developed countries with very good reporting standards. This implies that it is fairly easy to retrieve from commercial databases (such as Bureau Van Dijk's Orbis and Thomson One) and from financial accounts, a significant wealth of historical financial and operational information. With such information at hand it is possible to explore in depth many dimensions of digital MNEs' activity, including growth, operational performance, employment generation, innovation patterns, financing strategies, and, importantly, to compare such dimensions with those of more traditional MNEs to assess the likelihood of a convergence scenario.

References

- Atkinson, R., and L.A. Stewart (2013). "The economic benefits of information and communication technology". ITIF factsheet, Information Technology Innovation Foundation, Washington, D.C.
- Cassetta, E., Meleo, L. and M. Pini. (2016). The role of digitalization in the internationalization of Italian manufacturing firms. *L'Industria*, 37(2): 305-327. 10.1430/84077. Il Mulino.
- Chen, W., and F. Kamal (2016). "The impact of information and communication technology adoption on multinational firm boundary decisions". *Journal of International Business Studies*, 47(5): 563–576.
- Eden, L. (2016). "Multinationals and foreign investment policies in a digital world". E15Initiative, International Centre for Trade and Sustainable Development and World Economic Forum, Geneva. www.e15initiative.org.
- Foster, C.G., and M. Graham (2016). "Reconsidering the role of the digital in global production networks". *Global Networks*, 17(1): 68–88.
- McKinsey Global Institute (2016). *Digital Globalization: The New Era of Global Flows*. New York: MGI.
- Nachum, L., and S. Zaheer (2002). "MNEs in the digital economy?" Working Paper No. 236, ESRC Centre for Business Research, University of Cambridge, UK.
- Nachum, L., and S. Zaheer (2005). "The persistence of distance? The impact of technology on MNE motivations for foreign investment". *Strategic Management Journal*, 26(8): 747–767.
- Rangan, S., and M. Sengul (2009). "Information technology and transnational integration: Theory and evidence on the evolution of the modern multinational enterprise". *Journal of International Business Studies*, 40(9): 1496–1514.
- Schwab, K. (2016). *The Fourth Industrial Revolution*. Geneva: The World Economic Forum.
- UNCTAD (2015). *Information Economy Report 2015: Unlocking the Potential of E-commerce for Developing Countries*. New York and Geneva: United Nations.
- UNCTAD (2017a). *World Investment Report 2017: Investment and the Digital Economy*. New York and Geneva: United Nations.
- UNCTAD (2017b). *World Investment Report, 2017*, Technical Annex to Chapter IV. http://unctad.org/en/PublicationChapters/wir2017ch4_Annex_en.pdf.

Appendix 1. Existing databases of digital firms

Generic (no digital economy focus)			
Type	Source	Name	Description
Global surveys and databases	International organizations	World Bank Enterprise Surveys Database	<ul style="list-style-type: none"> • No MNE focus • Surveys conducted at country level on a broad population of firms • Includes information on business use of digital technologies, based on survey results
		OECD Activity of Multinational Enterprises (AMNE) Database	<ul style="list-style-type: none"> • MNE focus: data on foreign affiliates by country of origin (inward) or location (outward) • Indicators on production, employment, exports and R&D
		Private sector	Financial Times fDi Markets – Company Database
Top company lists or rankings	International organizations	Orbis Database, Bureau van Dijk	<ul style="list-style-type: none"> • No MNE focus: multi-purpose business intelligence data source • Financial statement data, including ownership structures
		UNCTAD Top 100 MNE Ranking	<ul style="list-style-type: none"> • MNE focus • List of top 100 non-financial MNEs published annually • Indicators on MNE international footprint (foreign assets, sales, employees), by sector
		EU Industrial R&D Investment Scoreboard's Top 2500	<ul style="list-style-type: none"> • MNE focus • Ranking of top 2,500 firms by R&D spending, published annually • Indicators on R&D expenditure and intensity
	Private sector	Forbes Global 2000 and 500; Fortune Global 500; S&P 500	<ul style="list-style-type: none"> • MNE focus, not specifically meant for research • Annual ranking of top companies by size/market capitalization • Multiple metrics
			/...

Appendix 1. Existing databases of digital firms (concluded)

Dedicated (digital economy focus)			
Type	Source	Name	Description
Top company lists or rankings	International organizations	UNCTAD Information Economy Reports – Specialized Lists	<ul style="list-style-type: none"> • MNE focus, segment-specific: software, cloud economy, e-commerce • Various metrics with focus on size, featuring 10 to 25 top companies • Published once, as a part of research projects with thematic focus
	Private sector	Mediobanca Top 23 "Websofts"	<ul style="list-style-type: none"> • MNE focus, sector-specific: software and web companies • Published once, as a part of a research project • Several metrics on business and financial performance
		PwC Global 100 Software Leaders	<ul style="list-style-type: none"> • MNE focus, software houses • Published annually, includes side lists of top 25 fastest-growing cloud companies and top 30 software companies in emerging markets • Two metrics: total revenues and software revenues (value and per cent)

Source: Authors.

Appendix 2. UNCTAD taxonomy of the digital economy

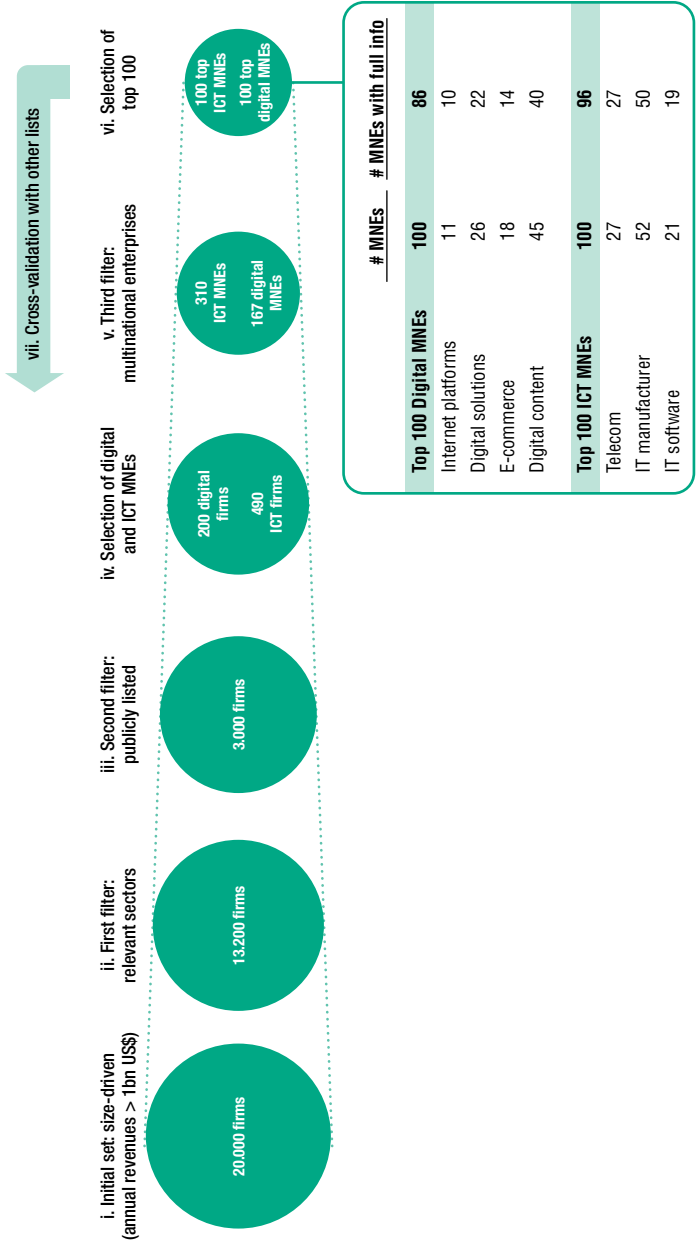
Category	Subcategory	Description of the scope	Caveats/points of attention
Internet platforms	<ul style="list-style-type: none"> Search engines Social networks Other platforms 	<ul style="list-style-type: none"> Companies providing digital services through internet and cloud-based platforms, search engines and social networks. Includes sharing economy platforms (e.g. transaction platforms (Ebay) and open-source platforms (Red Hat)). 	<ul style="list-style-type: none"> Only company-wide platforms such as Alphabet (Google) or Facebook. Internet platforms provided by digital and IT MNEs as part of a broader digital offer (for example, iTunes of Apple or Audible of Amazon) not captured in this category.
	<ul style="list-style-type: none"> Electronic payments Other digital solutions 	<ul style="list-style-type: none"> Includes a variety of players with core activities based on or strictly linked to internet technologies. Providers of electronic and digital payments, cloud hosting and computing, web hosting and e-mail services, digital solutions for business management and for financial applications (fintech). 	<ul style="list-style-type: none"> Miscellaneous category, “blurry” perimeter. Examples of (potentially relevant) business not included: cybersecurity companies (classified as software providers under ICT MNEs), credit card issuers (considered predominantly financial firms).
E-commerce	<ul style="list-style-type: none"> Internet retailers Other e-commerce 	<ul style="list-style-type: none"> Specialized and non-specialized online stores and online travel and booking agencies. Includes agencies specialized in online marketing and advertising. 	<ul style="list-style-type: none"> Only full online and online-born commerce. E-commerce channel of traditional business and multichannel retailers not captured in this category (even when online segment is fast growing and/or prominent).
	<ul style="list-style-type: none"> Digital media Games Info and data 	<ul style="list-style-type: none"> Producers and providers of digital content – media (e.g. music, video, e-books, online magazines) and gaming (e.g. “classic” video games, online games, mobile games, multiplayer interactive games). Production relying on digital formats or files; delivery through both traditional channels (e.g. cable TV for digital media) and online channels (e.g. internet TV and OTT). Online channel growing fast but relative share depends on the product (higher for music and games, lower for video and books). Database-related products and services: big data providers, marketing and customer intelligence, and providers of economic, business and credit information. 	<ul style="list-style-type: none"> Borderline category with elements of digital and traditional business: <ul style="list-style-type: none"> Companies not digitally born (with exceptions such as Netflix), predating the digital revolution – but turning content from other formats into fully digital. Part of business delivered through channels other than the internet, but internet channel fast growing and expected to be leading in the near future.
Digital content			

Appendix 2. UNCTAD taxonomy of the digital economy (concluded)

Category	Subcategory	Description of the scope	Caveats/points of attention
ICT MNEs	IT	<ul style="list-style-type: none"> Developers of software; providers of assistance and IT consultancy. Major software houses, turning from a physical delivery model (with physically installed applications) to remote service applications delivered on demand. Category bordering “Digital solutions”. Manufacturers of ICT hardware (computer brands) but also components (e.g. semiconductor industry). 	<ul style="list-style-type: none"> IT software MNEs increasingly becoming digital MNEs while turning from physical delivery model to cloud-based (e.g. Software as a Service or Platform as a Service). Very broad category; wide range of players with different exposures to digital economy, from very large for leading computer brands to relatively limited for component producers.
	Telecom	<ul style="list-style-type: none"> Owners of the telecommunication infrastructure on which internet data is carried. Increasingly active also as providers of internet services and OTT contents. 	<ul style="list-style-type: none"> Part of the business of telecommunication players best suited to the digital categories (e.g. platforms or digital solutions (convergence between telecommunication and tech/media) but basic connectivity still the primary source of revenues.

Source: WIR17.

Appendix 3. Detailed steps for the construction of the top 100 digital and ICT database



Source: Based on WIR17.

i. Extraction of the initial sample. The initial pool of companies extracted from the Bureau Van Dijk's Orbis database includes some 20,000 firms with annual operating revenues above \$1 billion (date of extraction: between December 2016 and February 2017).

ii. First filter: relevant sectors. The initial pool is then narrowed down to 13,200 companies, excluding companies that operate in industries with limited digital exposure, i.e. primary, manufacturing (with the exception of manufacture of computer, electronic and optical products (NACE 26)), utilities and construction.

iii. Second filter: publicly listed companies. The reference units for this analysis are corporate legal entities listed on stock exchanges worldwide. This condition, which excludes some main players (e.g. Uber and Airbnb), is motivated by two reasons. First, unlisted companies usually do not disclose the minimal amount of information on financials and international activity necessary to carry out this analysis. Second, focusing on listed companies greatly reduces the risk of double-counting of consolidated accounts within the same corporate group, because subsidiaries of listed parents are usually not listed on their own (with a few notable exceptions).

iv. Selection of digital and ICT MNEs. The selection procedure was differentiated between digital MNEs and ICT MNEs.

- **Digital MNEs.** The standard industry classifications used in company databases, such as NACE or NAICS, are not sufficient for the identification of digital firms. Digital firms are indeed classified on the basis of what they produce and sell, independent of their level of digitalization. Examples are Amazon (classified as "Retail sale of books in specialized stores" according to its NACE core code), Netflix ("Renting of video tapes and disks") and Expedia ("Travel agency activities"). This makes the identification of digital MNEs challenging and unfeasible without significant manual effort. Such effort entails one-by-one screening of companies' trade descriptions.
- **ICT MNEs.** The scope of ICT MNEs (IT hardware and software, and telecommunication) is more easily matched with commonly used industry classifications. Broadly speaking, four NACE two-digit categories – "Telecommunication", "Manufacture of computer and electronic components", "Computer programming" and "Information services" – cover the range of ICT MNEs and provide a limited and manageable set of candidate companies for the top 100 selection.

v. Third filter: MNEs. The use of the transnationality condition follows from the observation angle of this study, which is the international footprint of digital firms. This filter employs an operational definition of multinational enterprise (MNE) specific to this analysis, which may differ from other standard definitions. In this context, a company qualifies as MNE if (a) its foreign affiliates' revenues or assets (or both)

exceed 10 per cent of the total; or (b) it has a significant number of subsidiaries outside the home economy (excluding affiliates in offshore financial centres).

vi. Selection of the top 100. From the set of candidate publicly listed digital and ICT MNEs, the procedure required selecting the 100 largest in terms of operating revenues. However, since the main goal of the database is to analyse the international footprint of digital and ICT MNEs, another filter is introduced to exclude companies that do not report any information on foreign sales or foreign assets.³ Of the selected 100 digital and 100 ICT MNEs reporting information on at least one of the two, 86 digital and 96 ICT MNEs (respectively) reported both foreign assets and foreign sales, thus providing the complete informative basis needed to perform the analysis.

vii. Cross-validation with other lists. Although there are no other comprehensive lists of digital and ICT MNEs, scattered information on relevant digital and ICT players can be found in different published lists, which can be either generic or dedicated (see also appendix 1).

Generic lists, such as the Forbes 500, include relevant firms that are broadly classified as ICT within a larger selection. Some relevant digital areas, such as cloud services and e-commerce, may be underrepresented. Especially if selection is based on company size, it is critical to build separate lists for digital MNEs and ICT MNEs to ensure sufficient representation of the former, which usually are smaller. To illustrate the point, of 39 companies that feature both in UNCTAD's selection and in the Forbes 500, only 4 are digital MNEs; the rest are ICT MNEs.

Dedicated lists of ICT and digital firms are published in different contexts and are usually market-specific. These lists do not address the broad digital industry but rather provide a picture of the competitive landscape of specific market segments. Often the selection is based on segment-specific criteria (e.g. "the most innovative companies in cloud computing" or "the fastest growing e-commerce firms"). Their scope is too narrow to enable a comprehensive mapping and description of the variety of digital and ICT players, as required for this analysis.

Despite their limitations, these lists provide a useful external benchmark to make sure that no relevant digital and ICT MNE was missed in the selection process. UNCTAD's selection was then cross-validated against the Forbes 500, Fortune 2000 and S&P500, among the generic lists, and against UNCTAD's Information Economy Reports (companies reported in several editions) and reports by consulting firms, such as the PwC Global 100 Software Leaders, among the dedicated lists.

³ Geographic segmentation of assets and sales is not part of companies' standard financial reporting; not all companies in all jurisdictions need to report this information, even if they are listed. For United States companies – the majority of MNEs in the sample – reporting of geographic information is mandatory (unless companies state that foreign business is not relevant); however, in other jurisdictions, particularly in developing countries, reporting standards are more lax.

Appendix 4. UNCTAD top 100 digital and ICT database

Table 1. Top 100 digital MNEs, by sales or operating revenues

	Classifica- tion first level	Company name	Classification second level	Total sales (\$ million)	Total assets (\$ million)	Share of foreign sales (%)	Share of foreign assets (%)	Ratio between share of foreign sales and share of foreign assets
1	Internet platforms	Alphabet	Search engines	74,989	147,461	54	24	2.25
2		Facebook	Social networks	17,928	49,407	53	21	2.51
3		Ebay	Other platforms	8,592	17,755	58	7	8.89
4		Yahoo	Search engines	4,968	45,204	20	6	3.12
5		IAC/Interactive	Social networks	3,231	5,189	26	8	3.49
6		Groupon	Other platforms	3,120	1,796	34	41	0.84
7		LinkedIn	Social networks	2,991	7,011	38	18	2.15
8		Naver	Search engines	2,773	3,741	33	NA	NA
9		Twitter	Social networks	2,218	6,442	35	7	4.93
10		Red Hat	Other platforms	2,052	4,155	34	30	1.13
11		Match Group	Social networks	1,020	1,909	32	41	0.77
Internet platforms total				123,882	290,071	50	19	2.63
<i>(Internet platforms median – unweighted)</i>						<i>35</i>	<i>19</i>	<i>2.38</i>
12	Digital solutions	Automatic Data Processing	Other digital solutions	11,668	43,670	15	10	1.50
13		First Data Corporation	Electronic payments	11,451	34,362	14	11	1.36
14		PayPal	Electronic payments	9,248	28,881	50	7	7.61
15		Salesforce	Other digital solutions	6,667	12,763	26	11	2.39
16		VMware	Other digital solutions	6,647	15,746	50	15	3.28
17		FIS	Other digital solutions	6,595	26,269	41	16	2.48
18		Worldpay Group	Electronic payments	5,873	6,122	71	NA	NA
19		NetApp	Other digital solutions	5,546	10,037	45	15	2.99
20		Insight Enterprises	Other digital solutions	5,373	2,014	32	33	0.96
21		United Internet	Other digital solutions	4,045	4,222	10	16	0.65
22		Amdocs	Other digital solutions	3,718	5,331	86	62	1.40
23		Nasdaq	Other digital solutions	3,403	11,861	29	33	0.89
24		Citrix Systems	Other digital solutions	3,276	5,468	39	21	1.83
25		Global Payments	Electronic payments	2,898	10,510	29	20	1.46
26		Broadridge Financial Solutions	Other digital solutions	2,897	2,880	11	16	0.70
27		Equinix	Other digital solutions	2,726	10,357	48	50	0.96
28		Super Micro Computer	Other digital solutions	2,216	1,166	37	24	1.53
29		Akamai Technologies	Other digital solutions	2,197	4,182	27	43	0.62
30		Rackspace Hosting	Other digital solutions	2,001	2,014	32	36	0.88
31		Transcosmos	Other digital solutions	1,993	1,248	13	40	0.34
32		Cimpress	Other digital solutions	1,788	1,464	NA	79	NA
33		Godaddy	Other digital solutions	1,464	3,499	26	0	..
34		Worldline	Electronic payments	1,336	1,468	65	NA	NA

/...

Table 1. Top 100 digital MNEs, by sales or operating revenues

	Classifica- tion first level	Company name	Classification second level	Total sales (\$ million)	Total assets (\$ million)	Share of foreign sales (%)	Share of foreign assets (%)	Ratio between share of foreign sales and share of foreign assets
35	Digital solutions	Workday	Other digital solutions	1,162	2,730	16	NA	NA
36		Verisign	Other digital solutions	1,059	2,358	40	3	14.67
37		Servicenow	Other digital solutions	1,005	1,807	34	30	1.13
Digital solutions total				108,253	252,427	32	17	1.90
<i>(Digital solutions median – unweighted)</i>						<i>32</i>	<i>18</i>	<i>1.43</i>
38	E-commerce	Amazon	Internet retailers	107,006	65,444	36	32	1.13
39		Alibaba Group	Internet retailers	15,639	56,353	8	NA	NA
40		Priceline Group	Other e-commerce	9,224	17,421	80	17	4.77
41		Expedia	Other e-commerce	6,672	15,486	44	11	3.95
42		Naspers	Internet retailers	5,930	16,723	54	NA	NA
43		Rakuten	Internet retailers	5,922	35,435	20	67	0.29
44		Amadeus IT Group	Other e-commerce	4,260	7,625	96	96	1.00
45		Cnova	Internet retailers	3,804	1,853	50	75	0.66
46		Zalando	Internet retailers	3,221	2,304	47	NA	NA
47		Bechtle	Internet retailers	3,076	1,252	31	30	1.04
48		Sabre	Internet retailers	2,961	5,394	60	4	14.23
49		Travelport Worldwide	Other e-commerce	2,221	2,929	66	50	1.33
50		Asos	Internet retailers	1,907	854	57	0	..
51		Systemax	Internet retailers	1,855	710	64	53	1.20
52		Liberty TripAdvisor	Other e-commerce	1,565	7,285	48	17	2.91
53		Criteo	Internet retailers	1,323	842	91	51	1.77
54		Copart	Internet retailers	1,268	1,650	20	24	0.82
55		Yoox Net-a-Porter Group	Internet retailers	1,004	3,053	89	NA	NA
E-commerce total				178,857	242,613	42	38	1.11
<i>(E-commerce median – unweighted)</i>						<i>53</i>	<i>31</i>	<i>1.27</i>
56	Digital content	Comcast	Digital media	74,510	166,574	8	NA	NA
57		Time Warner	Digital media	28,118	63,848	27	NA	NA
58		21st Century Fox	Digital media	27,326	48,193	29	10	2.98
59		Liberty Global	Digital media	18,280	67,867	61	63	0.97
60		Sky	Digital media	16,138	23,483	30	7	4.55
61		Tencent Holdings	Games	15,846	47,265	6	23	0.28
62		CBS	Digital media	13,886	23,765	14	2	7.17
63		Viacom	Digital media	12,488	22,508	25	7	3.47
64		Thomson Reuters	Info & data	12,209	29,095	40	40	1.00
65		Liberty Interactive	Digital media	9,989	21,180	26	44	0.58
66		News	Digital media	8,292	15,483	53	62	0.85
67		Netflix	Digital media	6,780	10,203	29	8	3.60
68		RTL Group	Digital media	6,564	8,924	63	71	0.90
69		Alliance Data Systems	Info & data	6,440	22,350	22	16	1.34
70		Discovery Communications	Digital media	6,394	15,864	49	48	1.01
71		Iheartmedia	Digital media	6,242	13,673	26	28	0.91
72		Nielsen Holdings	Info & data	6,172	15,303	38	16	2.33

/...

Table 1. Top 100 digital MNEs, by sales or operating revenues (concluded)

Classification first level	Company name	Classification second level	Total sales (\$ million)	Total assets (\$ million)	Share of foreign sales (%)	Share of foreign assets (%)	Ratio between share of foreign sales and share of foreign assets
73	S&P Global	Info & data	5,313	8,183	40	11	3.53
74	Grupo Televisa	Digital media	5,117	16,359	14	4	3.33
75	Activision Blizzard	Games	4,664	15,246	48	27	1.79
76	Wolters Kluwer	Info & data	4,581	8,817	96	72	1.34
77	Electronic Arts	Games	4,396	7,050	57	22	2.61
78	Experian	Info & data	4,355	7,407	79	85	0.92
79	Mediaset	Digital media	3,740	7,726	28	18	1.53
80	Axel Springer	Digital media	3,587	7,082	48	69	0.69
81	Prosiebensat.1 Media	Digital media	3,550	5,789	16	17	0.93
82	Moody's	Info & data	3,485	5,103	42	58	0.72
83	Equifax	Info & data	2,664	4,509	23	18	1.32
84	Graham	Digital media	2,586	4,353	26	18	1.42
85	AMC Networks	Digital media	2,581	4,265	18	43	0.42
86	Teradata	Info & data	2,530	2,527	44	17	2.60
87	Konami	Games	2,222	2,918	33	11	3.09
88	Gartner	Info & data	2,163	2,175	38	22	1.69
89	Verisk Analytics	Info & data	2,068	5,594	NA	56	NA
90	Modern Times Group	Digital media	1,921	1,954	71	73	0.97
91	Sanoma	Digital media	1,869	3,010	63	89	0.71
92	GfK	Info & data	1,680	2,006	75	62	1.22
93	Dun & Bradstreet	Info & data	1,637	2,267	19	35	0.54
94	Ubisoft Entertainment	Games	1,587	2,301	92	NA	NA
95	Nexon Co	Games	1,579	3,532	89	64	1.38
96	Transunion	Info & data	1,507	4,443	18	17	1.06
97	Take Two Interactive Software	Games	1,414	2,590	47	NA	NA
98	Entertainment One	Digital media	1,156	2,366	76	71	1.07
99	Verint Systems	Info & data	1,130	2,356	62	58	1.07
100	Factset Research Systems	Info & data	1,127	1,019	33	16	2.00
Digital content total			351,883	758,522	36	32	1.14
<i>(Digital content median – unweighted)</i>					<i>38</i>	<i>25</i>	<i>1.27</i>
Total digital			762,875	1,543,633	40	27	1.49
<i>(Digital median – unweighted)</i>					<i>37</i>	<i>23</i>	<i>1.35</i>

Source: UNCTAD, World Investment Report, 2017, Technical Annex to Chapter IV (available online: http://unctad.org/en/PublicationChapters/wir2017ch4_Annex_en.pdf)

Note: Companies are ranked by sales within each category ("classification first level"). Allocation of companies to categories and subcategories ("classification second level") is based on principal activity.

Table 2. Top 100 ICT MNEs, by sales or operating revenues

	Classifica- tion first level	Company name	Classification second level	Total sales (\$ million)	Total assets (\$ million)	Share of foreign sales (%)	Share of foreign assets (%)	Ratio between share of foreign sales and share of foreign assets
1	IT devices & components	Apple	IT devices	215,639	321,686	65	39	1.65
2		Samsung Electronics	IT devices	171,126	206,550	90	31	2.88
3		Hon Hai Precision Industry	Components	135,996	70,038	99	91	1.09
4		International Business Machines	IT devices	81,741	110,495	63	54	1.15
5		Sony	IT devices	71,968	148,037	71	24	3.00
6		Intel	IT devices	55,355	101,459	80	29	2.75
7		Dell Technologies	IT devices	50,911	45,122	52	29	1.81
8		Toshiba	Components	50,165	48,083	59	36	1.67
9		Cisco Systems	IT devices	49,247	121,652	47	20	2.40
10		HP	IT devices	48,238	29,010	63	58	1.09
11		LG Electronics	IT devices	48,195	30,971	75	21	3.59
12		Legend Holdings	IT devices	47,728	47,176	68	45	1.53
13		Lenovo Group	IT devices	44,912	24,933	72	65	1.11
14		Fujitsu	IT devices	42,078	28,645	40	20	2.00
15		Pegatron	IT devices	36,826	14,445	85	73	1.16
16		Quanta Computer	IT devices	30,562	16,129	100	83	1.21
17		Telefonak-tiebolaget Lm Ericsson	IT devices	29,253	33,689	98	34	2.93
18		Compal Electronics	IT devices	25,709	9,950	100	65	1.53
19		Taiwan Semiconductor Manufacturing Company	Components	25,593	50,292	89	3	31.30
20		Flextronics	Components	24,419	12,385	65	65	1.00
21		Sharp	IT devices	21,856	13,945	70	20	3.43
22		Wistron	Components	18,911	8,811	37	81	0.46
23		Jabil Circuit	Components	18,353	10,323	91	76	1.19
24		SK Hynix	Components	16,032	25,312	94	19	5.01
25		ZTE	Components	15,433	19,192	47	17	2.69
26		Nokia	IT devices	14,778	22,782	91	42	2.16
27		Asustek Computer	IT devices	14,331	10,122	86	46	1.89
28		Kyocera	Components	13,137	27,480	59	31	1.91
29		Texas Instruments	Components	13,000	16,230	88	47	1.85
30		Western Digital	IT devices	12,994	32,862	72	60	1.20
31		Micron Technology	Components	12,399	27,540	84	74	1.15
32		Inventec	IT devices	11,999	5,332	94	62	1.52
33		Seagate Technology	IT devices	11,160	8,252	70	64	1.09
34		China Greatwall Computer Shenzhen	Components	11,129	6,078	60	NA	NA
35		TPV Technology	Components	11,062	5,932	61	47	1.30
36		Innolux	Components	11,048	11,756	72	16	4.38

/...

Table 2. Top 100 ICT MNEs, by sales or operating revenues

Classification first level	Company name	Classification second level	Total sales (\$ million)	Total assets (\$ million)	Share of foreign sales (%)	Share of foreign assets (%)	Ratio between share of foreign sales and share of foreign assets	
37	AU Optronics	Components	10,990	12,176	67	27	2.44	
38	Murata Manufacturing	Components	10,751	13,476	93	30	3.12	
39	TDK	Components	10,230	12,879	92	77	1.20	
40	Seiko Epson	Components	9,700	8,358	76	38	1.99	
41	Japan Display	Components	8,782	7,226	89	NA	NA	
42	Advanced Semiconductor Engineering	Components	8,596	11,083	88	40	2.21	
43	Acer	IT devices	8,003	5,211	92	78	1.18	
44	STMicroelectronics	Components	6,897	8,195	76	83	0.91	
45	Alps Electric	Components	6,872	4,997	81	40	2.05	
46	Asml Holding	Components	6,845	15,802	100	24	4.14	
47	Lite-On Technology	Components	6,582	6,361	30	3	9.76	
48	Mediatek	Components	6,471	10,657	95	16	6.00	
49	Renesas Electronics	Components	6,155	7,541	56	17	3.31	
50	Nxp Semiconductors	Components	6,101	26,354	97	94	1.03	
51	Tokyo Electron	Components	5,895	7,044	82	22	3.79	
52	Nvidia	Components	5,010	7,370	87	22	3.90	
IT devices & components total			1,637,164	1,887,427	75	39	1.91	
<i>(IT devices & components median – unweighted)</i>					<i>78</i>	<i>40</i>	<i>1.90</i>	
53	IT software & services	Microsoft	IT software & services	85,320	193,694	52	43	1.22
54		Hewlett Packard Enterprise	IT software & services	50,123	79,679	61	51	1.21
55		Oracle	IT software & services	37,047	112,180	53	33	1.63
56		Accenture	IT software & services	34,798	20,609	99	96	1.03
57		NEC	IT software & services	25,048	22,138	21	5	3.95
58		Qualcomm	IT software & services	23,554	52,359	98	18	5.61
59		SAP	IT software & services	22,637	45,061	87	92	0.94
60		Tata Consultancy Services	IT software & services	16,379	13,475	93	80	1.16
61		NTT Data	IT software & services	14,338	16,517	31	10	3.12
62		Capgemini	IT software & services	12,972	17,671	79	79	1.01
63		Cognizant Technology Solutions	IT software & services	12,416	13,061	21	81	0.26
64		Atos	IT software & services	11,633	11,628	84	79	1.07
65		Infosys	IT software & services	9,418	11,371	97	NA	NA
66		CGI Group	IT software & services	8,145	8,915	86	76	1.13
67		Wipro	IT software & services	7,726	10,665	90	NA	NA
68		Harris	IT software & services	7,467	11,996	6	4	1.51

/...

Table 2. Top 100 ICT MNEs, by sales or operating revenues (concluded)

Classification first level	Company name	Classification second level	Total sales (\$ million)	Total assets (\$ million)	Share of foreign sales (%)	Share of foreign assets (%)	Ratio between share of foreign sales and share of foreign assets
69	Computer Sciences	IT software & services	7,106	7,736	57	57	1.00
70	Samsung SDS	IT software & services	6,698	5,400	47	4	11.07
71	Datalec	IT software & services	6,455	3,383	92	94	0.98
72	Adobe Systems	IT software & services	5,854	12,707	47	21	2.23
73	HCL Technologies	IT software & services	4,640	5,931	97	52	1.85
IT software & services total			409,774	676,177	63	46	1.38
<i>(IT software & services median – unweighted)</i>					<i>61</i>	<i>52</i>	<i>1.21</i>
74	Telecom	AT&T	146,801	402,672	4	5	0.94
75		Nippon Telegraph and Telephone	102,468	186,770	16	32	0.51
76		Softbank Group	81,271	183,851	55	66	0.83
77		Deutsche Telekom	75,368	156,686	64	64	1.00
78		Vodafone Group	59,013	192,587	85	90	0.94
79		America Movil	51,970	75,349	67	46	1.44
80		Telefonica	51,407	133,882	72	77	0.84
81		Orange	43,805	99,540	54	57	0.96
82		BT Group	27,426	61,345	22	10	2.19
83		Telecom Italia	21,467	77,550	25	12	2.08
84		Telstra	19,242	32,144	5	8	0.63
85		Altice	15,841	70,545	98	97	1.01
86		Bharti Airtel	14,553	33,900	7	25	0.27
87		Telenor	14,549	23,259	77	76	1.01
88		Emirates Telecommunication Group	14,215	34,926	43	60	0.72
89		Saudi Telecom Company	13,507	25,776	10	5	1.92
90		Swisscom	11,771	21,317	16	18	0.93
91		Vivendi	11,717	38,046	59	62	0.94
92		Telia Company	10,268	30,094	58	71	0.80
93		Vimpelcom	9,625	33,854	53	60	0.90
94		MTN Group	9,460	20,191	75	66	1.14
95		Ooredoo	8,835	25,866	77	75	1.02
96		Level 3 Communications	8,229	24,017	19	17	1.10
97		Millicom	6,730	10,363	100	100	1.00
98		Mobile Telesystems	5,917	8,965	10	16	0.63
99		Vodacom Group	5,436	5,342	23	34	0.67
100		PCCW	5,072	9,646	17	16	1.07
Telecom total			845,964	2,018,482	42	46	0.92
<i>(Telecom median – unweighted)</i>					<i>53</i>	<i>57</i>	<i>0.94</i>
Total ICT			2,892,902	4,582,086	63	43	1.48
<i>(ICT median – unweighted)</i>					<i>71</i>	<i>44</i>	<i>1.21</i>

Source: UNCTAD, World Investment Report, 2017: Technical Annex to Chapter IV (available online: http://unctad.org/en/PublicationChapters/wir2017ch4_Annex_en.pdf).

Note: Companies are ranked by sales within each category ("classification first level"). Allocation of companies to categories and subcategories ("classification second level") is based on principal activity.