Twenty-fourth Meeting of the Advisory Expert Group on National Accounts

Inter-secretariat Working Group on National Accounts

Paris, France

16 – 18 October 2023

SNA/M3.23/4B

Chapter 22 (2025 SNA)/Chapter 16 (BPM7): Digitalisation

Version circulated for AEG review

Chapter 22: Digitalisation

BPM7 Chapter 16 – Digitalisation

(new chapter)

Note: This draft chapter has been prepared jointly to cover the full range of topics to be included in the SNA and BPM chapters on digitalization. Only those issues that are relevant for external sector statistics will be included in the BPM; likewise, only those issues that are relevant to national accounts will be included in the SNA.

A. Introduction

22.1 Falling costs and increased capabilities to process, transmit, and store digitized data have resulted in the pervasive integration of digital technology into goods and services and activities of production and consumption. This transformation of economic activity and daily life through the pervasive application of digital technology is referred to as digitalization. Digitalization is enabled by information technology (IT) hardware including semiconductor chips and computing and communication equipment, software, the internet, cloud computing architecture, and wireless telecommunication services.

22.2 The profound impact of digitalization on production, consumption, investment, trade, prices, finance, communication, and other aspects of the economy calls for enhanced visibility of digital activities, products and transactions in the macroeconomic accounts. Furthermore, to compile these accounts, the wide variety of digital products that have appeared as part of digitalization must be measured in accordance with the broad conceptual framework of the SNA, so guidelines on applying this framework to digital products and digital assets are needed.

22.3 Measurement issues associated with digitalization, or that touch on digitalization, are also discussed in other chapters of the SNA/BPM, and other manuals. To increase the visibility of digitalization, chapter 11 of the Balance of Payments and International Investment Position Manual, recommends showing computer and information services as a first-level services category in the balance of payments current account The capital account chapter in the SNA and the chapters on goods and services account in the BPM discuss the types of digital fixed assets, which include information and communications technology (ICT) equipment, software, data and databases, and digital elements of research and development. Also, the financial accounts chapter of the SNA and the chapter on classification of financial assets and liabilities in BPM discuss classification of crypto assets with a corresponding liability, security crypto assets, and electronic money (e-money). Finally, the SNA chapter on prices and volumes considers the types of measurement issues that often arise for digital products.

22.4 To provide a consolidated view of measuring and reporting on key aspects of digitalization, and to cover additional aspects of digitalization, this chapter explains the measurement of products and assets that have emerged as part of digitalization and recommends tools for increasing the visibility of digitalization. The rest of this chapter is organized as follows. Section B discusses digital services and digital assets used in production or that provide a record of ownership rights. Section C discusses non-financial digital platforms that act as intermediaries, and the measurement of free digital platforms in GDP. Section D discusses digitalization and the financial system, with subsections on new financial services and means of payment enabled by digitalization, financial digital intermediation platforms, and fungible digital assets, including crypto assets. Section E provides an overview of the issues and challenges for measurement of prices and volumes presented by digital products and the recommended solutions to these challenges. Section F concludes the chapter with a section on analytical tools to increase the visibility of digitization, including a thematic account based on the digital supply and use tables (SUTs), and an extended account showing an alternative treatment of the consumption of free services of digital platforms.

B. Digital Goods and Services

22.5 Services supplied over the internet are a defining feature of the digital economy. These digital economy services include wholesale and retail e-commerce distribution services, priced and free services of online platforms, audio and video streaming, mobile money, and digital financial services. Their production and consumption are enabled by digital fixed assets of ICT equipment, software, and data and databases, digital consumer durable goods, and by mobile and fixed line digital communication services.

22.6 Digitalization has also resulted in, and been accelerated by, the emergence of cloud computing as a new way of accessing IT resources. It has also resulted in new types of assets, including data assets, artificial intelligence (AI) systems, and fungible and nonfungible crypto assets. The conceptual and measurement issues raised by cloud computing, and by data assets, AI, and non-fungible tokens are discussed in this subsection, while online platforms, digital financial services and digital assets such as fungible crypto assets are discussed below in subsections C and D.

1. Cloud computing

22.7 Cloud computing technology has enabled a shift in the location where most computing occurs from users' premises to remotely located data centers accessed over a network, sometimes referred to as "the cloud". Furthermore, the growing use of cloud computing services has caused large scale substitution of purchased IT services for ownership of hardware and software assets. Cloud computing services are primarily used as an input into the production of other goods and services (i.e., for intermediate consumption), and many of the services delivered over the internet are produced with inputs of cloud computing services.

22.8 Cloud computing services consist of computing, data storage, software, and related IT services accessed remotely over a network, supplied on demand and with measured resource usage. Measured resource usage allows pay-per-use charging based on actual resources consumed. (Charges for some services, such as data storage, may instead be based on predetermined limits on the IT resources accessed.) Measured resource usage also helps allocate resources efficiently because cloud computing technology takes advantage of resource pooling. Another characteristic of cloud computing technology is rapid elasticity, which means that users with fluctuating or fast-changing computing needs can scale their consumption up or down as circumstances warrant.

22.9 Cloud computing products are divided into three broad categories: infrastructure-as-a-service (IaaS), which gives the user on-demand access to hardware such as a virtual server, platform-as-a-service (PaaS), which also includes access to a software platform, and software-as-a-service (SaaS), which includes access to the application software. Users of IaaS or PaaS provide their own software license, or software original. In addition, business process as a service (BPaaS) is a type of cloud computing service in which specialized software is used to automate common business functions or tasks. A large variety of detailed products are offered within these broad categories, and the length and complexity of the product list can be a challenge for construction of a price index for cloud computing services.

22.10 Consuming purchased cloud computing services is not the only way to access IT resources remotely: IT users may own equipment and software that is housed off-premises in a datacenter. Datacenter computing services comprise cloud computing services and hosting and colocation services. Owners of IT hardware assets such as servers often lease space for these assets in a remote data center. Colocation or hosting datacenters lease rack space for servers and supply access to network bandwidth along with the physical infrastructure required for large-scale computing.

22.11 Cloud computing users with long-term contracts for dedicated access to a server in a cloud computing datacenter are considered as economic owners if the operating risk is borne by the user, making the contract a financial lease. Also, rather than paying per-use licensing fees to access a software product supplied by the cloud computing enterprise, cloud computing users may hold long-term license for a software product that they access in the cloud. If the term of the software license is more than a year, the license conceptually represents a software asset of the user, and one-year software licenses that automatically renew are also treated on the same lines, for practical reasons. Software subscriptions from software publishers that come with a long-term license are software assets, not intermediate consumption of software services. This follows the treatment of software licenses outlined in paragraph 10.100, 2008 SNA (and its update from 2025 SNA chapter 11).

22.12 Equipment and software fixed capital formation of cloud computing enterprises includes own-account components. Large cloud computing enterprises may design their own equipment and hire a contract manufacturer to assemble it, and they often develop software in-house.

22.13 Data center construction is also part of the fixed capital formation associated with cloud computing. Real estate enterprises that specialize in the construction and operation of data center buildings often lease data center buildings to cloud computing enterprises. If the cloud computing enterprise bears the operating risks, the lease should be treated as a financial lease.

22.14 To provide increased visibility into use of cloud computing and hosting services and the fixed capital formation associated with these activities may require showing additional product detail for existing classifications. This could be done as part of a digital supply and use table (SUT), which is discussed further in Section F.

22.15 Cloud computing services are often supplied across borders, and important suppliers of these services are multinational enterprises with domestic and foreign datacenters connected by cross-border networks. The consumption of these services takes place in the location of the production process into which they are an input. For example, if a business in country A purchases computing services from a cloud computing establishment in country B, the computing services will be an export of country B and an import of country A. In balance of payments, these services are recorded as part of the standard component computer and information services (refer to Chapter 11, Services Account, *BPM7*) for further details. The resource pooling aspect of cloud computing technology, which means that workloads can shift between servers or even establishments, can make it hard to know where the physical production of a computing service occurred. However, spending on exported and imported cloud computing should be possible to track. Also, a reconciliation of the estimate of net exports of cloud computing services implied by the reported gross exports and imports of these services to the estimate of net exports implied by the reported production and consumption of cloud computing services within an economy may help improve the accuracy of the estimates of exports and imports (or consumption) of cloud computing services.

22.16 Hosting and colocation services are exported when foreign-owned servers and software are hosted in a domestic data center. Similarly, these services are imported when locally owned IT assets are hosted in a foreign data center. The investment in the IT assets should be recorded in the economy of their owner.

2. Data assets

22.17 One of the effects of digitalization has been the emergence of data as an important type of produced intangible asset. In the digitalized economy, a significant portion of the value of many enterprises may be attributable to their data holdings, and many products and production processes depend on data. Digital enterprises' data assets enable them to match suppliers, products, or information to buyers' needs, and producers of all types use data for purposes such as developing and implementing product improvements, improving operational efficiency and customer experiences, planning, and marketing.

22.18 Data as an asset is defined as information content produced by accessing and observing phenomena and recording, organizing and storing information elements from these phenomena in a digital format and that provides an economic benefit when used in productive activities. Digitized information that does not provide a direct economic benefit to its owner, including ancillary data generated as a by-product of operations, is excluded. Data assets are produced when information on observable phenomena (OP) such as facts, behaviors, and characteristics is recorded, organized, and stored in digital format.

22.19 Producers derive economic benefits from data assets by creating databases that bring together data from different sources and that are organized and structured to facilitate analysis, and by extracting insights and knowledge via this analysis. The types of intellectual property products created along this value chain include data, database, software, and research and development assets.

22.20 Most data assets are created for own-account purposes. The value of own-account data assets is measured by their cost of production. The cost-based measure of own-account investment in data assets includes the expenses to develop a data production strategy, to collect and record the information elements of interest, and to access the OP.

22.21 Digital platforms often collect data on their users and the content they create. If the subjects of the data collection receive payments for granting access to their OP, those payments are also part of cost of producing the data asset. Payments for authorization to collect data on users' OP are classified as distributions of income and included in rents. Agreeing to collection of one's data (such as when visiting a free online platform after accepting the license agreement) does not fall within the definition of production and is therefore not a service. (Platform users who receive payments for undertaking specific actions to assist the collection and recording of data on their OP do supply a service, but such cases are likely to be too rare in practice to be worth distinguishing.) Although rents are payments for access to a non-produced asset, in the case of payments for authorization to users' data, the right to control one's data, and the general right to privacy, are not the type of asset that is recordable on a balance sheet.

22.22 The SNA asset boundary for fixed assets includes produced assets used in production for more than a year, so data that is expected to be used in production for more than a year is conceptually a fixed asset. For practical reasons, however, own-account production of data assets includes data that is used in production for less than a year except for "transitory" data that has value for only a short time. As service lives of under a year are likely to be common for own-account data assets, the service life assumed for own-account data assets should be relatively short.

22.23 Expenditures to update or add to an existing own-account data asset are also capitalized. Suppliers of software and connected equipment with embedded software or AI systems often collect data on users to update or add to their data assets. Expenses to collect users' data for these purposes are part of investment in data assets.

22.24 Purchases of data may be either fixed capital formation or intermediate consumption of data services depending on the duration of the use of the data in production and the limitations on the purchaser's use of the data. The sale of the data original, which would include rights to sell copies of the data or access to the data and all other ownership rights, supplies a data asset to the purchaser. Copies of long-lived data with general rights to use the data in production for more than a year are also classifiable as fixed assets of the purchaser. However, a non-exclusive right to access a copy of the data for a limited or specific purpose will generally be treated as a service. Also, the right to use a purchased copy of the data for less than a year is a service analogous to an operating lease.

22.25 Data and databases are conceptually distinct types of intellectual property products, but it is generally not feasible to measure them separately. The same types of inputs are often used in the production of both data and databases. Moreover, transactions in databases generally include the value of the data stored in the database. Data and databases are therefore combined into a single detailed class of intellectual property (IP) product known as *data and databases.* This asset type is then further combined with *software including artificial intelligence* to form a higher-level class of IP product. (Refer to Table 11.4, Treatment of Intellectual Property, in *BPM7*, for details on the recording of data and databases in balance of payments and to the discussion of intellectual property products in SNA2025 chapter 11 for general guidelines.) Nevertheless, *data* is separately identified in the label of these IP product classes because "data" refers to the information content that has been recorded in digital form while "databases" refers to files of data organized in such a way as to permit efficient access and effective use of the data. The costs of producing databases include planning and implementing the structure and design of the database and organizing the data in a way that facilitates its use.

3. Artificial intelligence (AI)

22.26 Artificial intelligence refers to capabilities of a computer program, or system controlled by a computer program, of recognition, reasoning, communication, and prediction that emulate human recognition, reasoning, and communication. AI programs may also be capable of learning. Although, they perform tasks that normally require human intelligence, AI programs often use data beyond a scale that humans could analyze.

22.27 Many of the innovative products and product features associated with digitalization are made possible by AI technologies. Among these technologies are text mining, image recognition, speech recognition, natural language generation, machine learning, and deep learning. In addition, applications of AI include translation,

predictive modeling, risk assessment by lenders and insurers, data analytics, writing summaries of the content of large textual databases, autonomous control of robots, drones and vehicles, face recognition, fraud detection, and cybersecurity. AI has greatly expanded the types of jobs or job elements potentially subject to automation. In addition, AI (and the digital technology of 3D printing) has the potential to affect international trade by making goods and services economical to produce in new locations.

22.28 The transformative impact of AI calls for the provision of granular data to permit analysis of the prevalence of AI and of questions such as the effect of AI on the labor market. To support the provision of this data, artificial intelligence systems are distinguished as a special type of software within a class of intellectual property product identified as "Computer Software, including Artificial Intelligence Systems", with the separate reporting of AI encouraged as an "of which" item. AI is also distinguished as a type of intellectual property product in the definition of this product group. AI is classified aa a special type of software even though AI systems frequently include data and hardware elements, because the system is controlled by software even when these elements are present. However, the equipment that contains an embedded AI system (or other embedded software) is still classified as equipment. Refer to Table 11.4 (Treatment of Intellectual Property), *BPM7*, for details on the recording of AI in balance of payments.

22.29 The general compilation guidelines for software, data and databases in chapter 11 of the 2025 SNA/chapter 11 of BPM7 also apply to AI software, but AI uses data and machine learning in ways that present some special issues. Large amounts of data are often used to train AI software, and some databases are created for the specific purpose of training an AI software program. In addition, AI programs may access a database as part of their operations. The value of the data used to train AI software or in the operations of the AI software should be recorded separately from the value of AI software, as the data could have multiple uses. However, a database created solely as a step in the production of an AI computer program and that cannot be re-used may be included in the costs of producing the AI program if this cost is used to measure the value of the program.

22.30 A feature of AI software with machine learning capabilities is that its performance may improve over time. This machine learning tends to extend the life of the AI software with this capability. However, follow-on investment after the software has been put into service is not limited to software with learning capabilities: updates delivered over the internet may allow all types of software and equipment controlled by embedded software to improve over time. These ongoing improvements may justify assuming a longer service life for software with machine learning capabilities.

4. Nonfungible tokens (NFTs)

22.31 Nonfungible tokens (NFTs) are digital records hosted on a blockchain that are associated with a digital or physical asset or product but that are distinct from that asset or product. NFTs certify ownership of rights to use and benefit from the asset and may also serve to certify the asset's authenticity. They are nonfungible because the associated asset is unique and not interchangeable with other assets in the same class the way that the units of a fungible crypto assets are. Payments for NFTs usually must be made in the crypto currency native to the blockchain on which the NFT is hosted.

22.32 NFTs are classified into three classes: (1) those that convey no ownership rights and only allow for personal use of another asset or product; (2) those that convey limited ownership rights, beyond personal use for another asset or product; and (3) those that convey full ownership rights for another asset or product. The main classification of NFTs is based on the type of rights conveyed rather than on the characteristics of the associated asset or good. The purchase of an NFT could, based on these rights, be classified as consumption, as an acquisition of a non-produced asset, or as neither (assuming that the associated asset is already recorded). However, NFTs vary widely both in the ownership rights they convey and in the type of digital and physical asset or good to which they are linked.

22.33 NFTs that convey no ownership rights and only allow for personal use of another asset or commodity (e.g., the right to display a video clip of a scoring play in a sporting event or of a piece of digital art for non-commercial purposes) are in the first category. The purchase of an NFT that only gives rights to personal use of an item is treated as consumption. This type of NFT is not an investment item because it cannot be used in production and generally does not serve as a store of value. However, in rare cases, an NFT in this category

that commands a high price when first auctioned and that has enough exclusivity and appeal to have a lasting value may qualify as a valuable. Treating the initial purchase of NFTs in this class as a consumption expenditure implies that their creation represents the production of a service. In the case of cross-border transactions in this type of NFT, such services are recorded under computer and information services.

22.34 The second type of NFT conveys limited ownership rights to another asset or commodity that go beyond personal use to include use for commercial purposes.NFTs that convey limited ownership rights are in the SNA/BPM asset class containing contracts, leases and licenses if they confer valuable benefits that the holder can realize in practice. Assets in this class are non-produced, nonfinancial assets. The ownership rights conveyed to the NFT holder may affect the value of the encumbered asset. Further information on contracts, leases and licenses is provided in SNA chapter 27/BPM chapter 14.

22.35 The third type of NFT conveys full ownership rights. NFTs that convey full ownership are a method of recording and verifying ownership of an underlying asset. That asset should already be recorded in the national accounts. An NFT that conveys full ownership is a digital recording of ownership similar to a property title, not a separate asset. Purchasing an NFT in this category is therefore a way of purchasing the underlying asset. In the case of cross-border transactions in this type of NFT, if the underlying asset is digital, it is treated based on the principles for recording such assets (goods or computer services). If the underlying asset is a physical asset (e.g., a house property), treatment follows the existing principles for recording such assets.

C. Digital Platforms

22.36 Operators of digital platforms are service providers that facilitate interactions via the internet between two or more distinct but interdependent sets of users (either firms or individuals). Because they help users to connect with, or interact with, other users, platforms are subject to network effects. (Network effects arise when the value of a product to each user depends on the number of other users of the product or family of products.) The opportunities for beneficial interactions with other platform users increase with the number of users in general or the number of users on the other side of the platform, so adding users makes the platform's services more valuable. For example, the price that advertisers are willing to pay increases with the audience size.

22.37 Platform operators are distinguished from e-commerce firms, which take possession of the goods they sell, or directly produce the services they sell. However, both e-commerce firms and digital platforms use data to produce matching services, either of customers with products that suit their needs, of users with each other, of producers with consumers, or of funders with borrowers. Digitally-enabled services of matching producers with consumers or funders with borrowers are known as digital intermediation. Digital intermediation is a service of using digital technology and data to match parties that desire to transact with each other and to facilitate their transactions.

22.38 There are three types of digital platforms:

a. *Nonfinancial digital intermediation platforms* (DIPs) facilitate transactions between buyers and sellers for the ordering and delivery of goods and services for a fee or commission, without taking ownership of the goods and services that are intermediated.

b. *Free digital platforms* facilitate non-commercial interactions between users or provide entertainment and information services and are usually funded by advertising and the collection of data on their users.

c. Finally, *financial digital intermediation platforms* mediate funding or payment transactions. Financial DIPs are discussed below in the section on digitalization and the financial system.

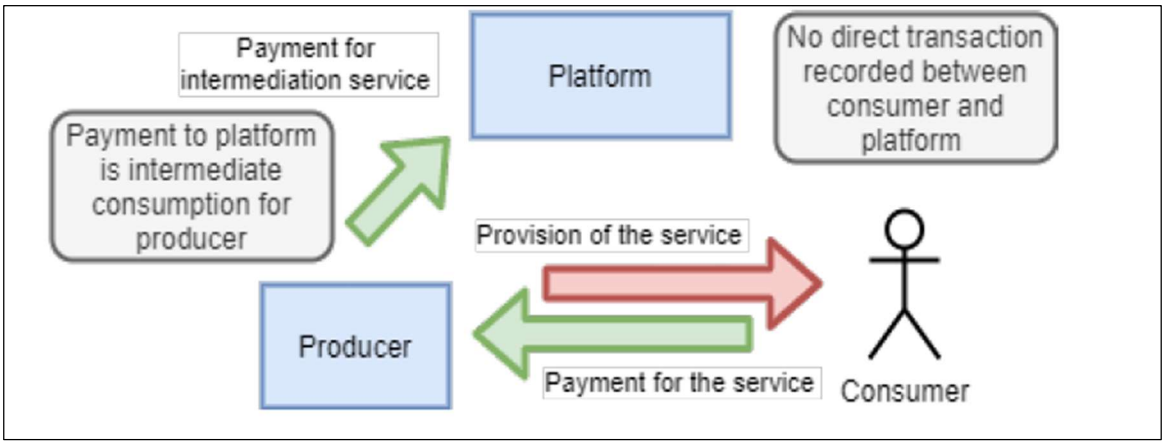
1. Nonfinancial digital intermediation platforms (DIPs)

22.39 In addition to helping buyers and sellers of goods and services to find each other, nonfinancial DIPs facilitate ordering, payment for, and delivery of, goods and services supplied by institutional units on the seller side of the platform to institutional units on the buyer side of the platform. DIPs charge fees for these digital

intermediation services. To increase parties' willingness to transact, they may also provide quality assurance through steps such as vetting the parties that have access to the platform.

22.40 Nonfinancial DIPs often accept customers' payments for the goods and services produced by platform users and deduct their intermediation service fee from the amount passed through to the producers of the goods and services. Regardless of the way in which the payment for the good or service being intermediated takes place, the output of the DIP consists only of the digital intermediation services, which are recompensed through a fee or commission. To capture the economic substance of the transactions in which the platform passes on the payment for the good or service after deducing its fee or commission appropriately in macroeconomic statistics, these payment flows must be rerouted to include a direct sale of the output of the producers using the platform to the buyers using the platform and a purchase by those producers of intermediation services supplied by the platform. These transactions recorded for DIPs after any necessary rerouting are shown in Figure 22.1.

Figure 22.1. Transactions of Digital Intermediation Platforms, after Rerouting as Necessary



Note: The intermediated product can be either a good or a service

22.41 Recording the transactions intermediated by the DIP as taking place directly between the producer-side users of the platform and the buyer-side users of the platform and recording the platform's intermediation services as purchased by the producer-side users of the platform has three advantages: (1) it allows the production of the goods and services sold via the platform to be included in the appropriate industry; (2) it allows the consumption of those goods and services to be included in the appropriate class of commodities; and (3) its accounting for the consumption of platform's output is consistent with its accounting for the transactions between the users on the two sides of the platform. If a thematic account on the digital economy is compiled, the total value of the goods and services sold with the assistance of DIPs should be reported there.

22.42 Digital intermediation services are frequently supplied across international borders by non-resident platforms that do not have a local affiliate. Goods and services supplied by resident producers and consumed by resident buyers in transactions intermediated by a non-resident platform should be recorded as produced and consumed in the compiling economy. Further, the fee or commission received by the DIP should be recorded as an import of digital intermediation services of the compiling economy. Refer to Chapter 11, Services Account for details on the specific recording in balance of payments. If the non-resident DIP collects the payments for the goods and services that it intermediates, this will require rerouting the payments so that the goods and services are not treated as being exported and then returned as imports with a marked-up price.

22.43 Digital intermediation services can also facilitate exports by resident suppliers of goods or services or imports from foreign suppliers of goods or services. Digital intermediation services used by an exporter are included in the value of the exported good or service. For example, if a DIP located in country A facilitates the supply of a service by a resident of country B to a resident of country C, the price paid by the buyer in country C is the value of service exported by country B and imported by country C, and the fee or commission charged by the platform is the value of digital intermediation services exported from country A and imported by country B. Domestically produced digital intermediation services used by the producer of an imported good

or service should conceptually be treated as an export of services and included in the value of the imported good or service. However, this treatment may require rerouting the fee or commission paid to the DIP to pass through the foreign producer. If the source data to compile these rerouted flows are unavailable, assumptions may be needed to impute the rerouted flows.

22.44 In general, services sold for a fee or commission are straightforward to measure, but in the case of DIPs and the goods and services that they intermediate, compilation challenges are common. Rerouting the payments collected by a DIP to the producers of the intermediated goods and services may require data that are lacking, making assumptions necessary. Also, determining whether intermediation services are being provided may be difficult because transactions between platform users may be hard to distinguish from transactions in which the platform takes possession of the good or uses the service as an intermediate input to produce a different service, or is acting as an employer. These latter cases should be treated as e-commerce activity.

22.45 Furthermore, by allowing producers to interact with previously unreachable consumers, including those in other geographical locations, DIPs have provided selling opportunities to producers previously excluded from the market. Selling opportunities created by DIPs have led to growing activity by informal household enterprises, which are likely to be missing from business registers and other standard sources of statistical information. They have also led to rapid growth of small international transactions in goods and services that may be missed by standard sources of trade data. Another common compilation challenge from DIPs providing cross-border intermediation services is that source data on DIPs with no local presence and on the activity that they intermediate is not easily available.

2. Free digital platforms and free digital products

22.46 Digitalization has been marked by the emergence of free digital platforms as part of daily life and a general expansion in the availability of free digital products. The SNA framework that values the free outputs of nonmarket producers such as nonprofit institutions funded by donations by the cost of production does not apply to most of these free digital products because they are supplied by a commercial enterprise. The outputs of commercial enterprises are valued by their price, which is zero in the case of a free product. The emergence of free digital platforms and products as part of digitalization has therefore raised questions about whether the output of the digital economy is fully included in GDP.

22.47 Free products supplied by market producers are included in GDP as part of the price of other products they help sell or with which they are bundled either directly or indirectly. Taken together, the items in the bundle generate at least enough revenue to cover the operating costs of the supplier of the free product, so the overall output of the supplier of the free digital product is not undermeasured. Free products are supplied by both platforms and non-platforms.

• *Free products supplied by non-platform firms*

22.48 In the non-platform case, the free output and the priced output are marketed to the same set of customers, and the function of the free output is to promote sales of the priced output to those customers. Suppliers of digital products frequently adopt a "freemium" pricing strategy, in which a free basic version of the product promotes sales of upgrades or a premium version of the product. In these cases, the price of the promoted output includes a mark-up that covers the cost of supplying the free output that has facilitated its sale.

22.49 Rather than being free, the promotional output may have a low price that is subsidized by the fully priced product. For example, low-priced printers may boost the sales of high-priced ink cartridges, with the price of the printer supplies funding the subsidy to the printer's price. Taken together, the sales of the items in the bundle give the value of the producer's output.

22.50 Although a zero or artificially low price of an output that is paid for as part of the price of another output does not cause undermeasurement of the producer's total output, it does affect the measured composition of this total. The relative values ascribed to the items in the bundle can matter for the measurement of fixed capital formation if a free or cross-subsidized item used for fixed capital formation is bundled with items used for intermediate consumption, such as the supplies needed to operate a piece of equipment, or the training, maintenance and helpdesk services needed to use a free software product. Also, the relative values

assigned to the different parts of the bundle could affect the measurement of exports, imports, or trade patterns if a multinational enterprise sources different parts of the bundle from different countries. Finally, the effect of these relative values on the weights of the price and volume indexes could matter for measurement of the volume growth of GDP if the prices of the items in the bundle behave differently.

- *Free Digital Platforms*

22.51 A few free digital platforms (such as public wikis created and maintained by communities of volunteers) are owned by a nonprofit institution serving households and operate as non-market producers, meaning that their output is not sold for an economically significant price. The output of non-market producers is valued by the cost of production. Nevertheless, the production costs of nonprofit free platforms may be modest in comparison with physical indicators of its output such as number of visits or scale of content it hosts because volunteers may do much of the work. The work of volunteers is outside the production boundary of the SNA.

22.52 Most free platforms are commercial enterprises. Two-sided (or multi-sided) commercial platforms often charge a price for their services to the users on one side of the platform and supply free services to the users on the other side of the platform to attract and retain these users. The free services increase the value of the platform's services to the users on the priced side of the platform by allowing them to reach more users on the free side of the platform. For example, the value of a software product used to create documents and reports in a certain format depends on how many people can read the documents, so the software's publisher can increase demand for the product by supplying free software for reading the documents. The users who fund the platform by purchasing priced services recoup this expense as part of the transactions with the users on the free side of the platform enabled by the platform's services.

22.53 Free digital platforms offer services such as social media, search, and access to content providing entertainment and information. Commercial free digital platforms are generally funded by advertising and the collection of data on their users, while non-digital free radio and television broadcasters are funded just by advertising.

22.54 Platforms funded by advertising services frequently assemble the audience that the advertisers want to reach by supplying free services. They then include the cost of supplying the free services needed to assemble the audience in the price charged to advertisers. The advertisers, in turn, include the cost of the platform's advertising services in the price of the product sold with the help of the advertising. Both the platform and the firms that advertise on the platform receive at least enough income from the prices at which their output is sold to cover their operating costs. The standard method of measuring the value of a market producer's output by the producer's sales is therefore applicable to both the platform and the funder side users of the platform. Furthermore, households' expenditures on the products advertised on the platform include the cost of the platform's services embedded in the price of the advertised products.

22.55 Digital platforms that collect and store data on users produce data assets as a type of own-account investment (and may also sell rights to use the data). The value of own-account investment in data assets is usually measured by the cost of production. However, the platforms may also collect short-lived data on recent browsing behavior used as an intermediate input for targeted advertising. The value of this short-lived data is part of the price of the advertisement targeting services. More generally, user data collected by digital platforms whose economic life does not exceed a quarter can be assumed to be used for intermediate consumption, with its value embedded in the price of the products it helps produce.

- *User-generated content*

22.56 Users of free platforms frequently create user-generated content such as videos, articles, photos, and product reviews both as a leisure activity and for commercial purposes, such as receiving advertising revenue. Creating content for leisure purposes is outside the SNA production boundary. Unless the creator receives remuneration, user-generated content is assumed to have been created for leisure purposes. Households that receive monetary remuneration for their uploaded content can be considered unincorporated household enterprises supplying services. If the purchaser is a non-resident, these services should be included in exports of services.

22.57 The economic benefits that free platforms receive from user-generated content include attracting users to the platform, selling advertising, and adding to the platform's stock of data assets. These economic benefits are a positive externality of the sort that frequently arises from producers' interactions with their customers and are not a basis for inferring that the creator of the unpaid user-generated content has produced a service used by the platform. However, the cost of supplying free services to the platform users who create content may be included in the platform's own-account investment in data assets. Furthermore, an extended account with an alternative approach to measurement of households' consumption of the services of free platforms can optionally treat user-generated content as a service produced with inputs of the platform's free services and used by the platform as an input in its own-account production of data assets.

22.58 In addition to posting content free platforms that receive advertising revenue, content creators may publish on digital intermediation platforms that facilitate collection of subscription fees in return for a share of the fees. Although most of this content is likely to have a short economic life, content created for commercial purposes that yields economic benefits for the content creator over more than a year is an intellectual property asset of the creator classified as long-lived entertainment, literary and artistic originals.

- *Free Software*

22.59 Software products are often free to download, although the services of the platform hosting the software code may not be free. The free software may be used by households for final consumption, or it may be used in production. Copies of free software are frequently supplied across borders.

22.60 App stores are a type of DIP where the service that is intermediated (the app that households download to their phone or other device) is often free. Free and subsidized apps used by households may be funded by advertising, by collection of data on their user, by purchases of premium versions that they encourage, or by other services whose use they facilitate. Like the services of online platforms funded by advertising, the services of apps funded by advertising are purchased indirectly as part of the price of the advertised product.

22.61 Open-source software refers to free software whose source code is publicly available under a license to copy, use, inspect, modify, and share. Open-source software is used in production by corporations, governments, and nonprofit institutions. It is usually developed, maintained, and supplied by a corporation, university, government research office, or nonprofit institution whose investment to develop the open-source software original would be included in a general estimate of own-account software investment based on costs of production, such as the compensation expense for software developers.

22.62 The work to develop a complex software product is often spread across multiple locations, and open-source software products may contain components developed in multiple economies. In the case of software produced by a multinational enterprise, the headquarters or one of the foreign affiliates may acquire full ownership of the software original by funding the software's development.

22.63 Even though open-source software does not generate licensing fee income for its developer, it can qualify as an asset of its developer. The producer of an asset is an economic owner if the producer bears the risks of production in order to claim benefits associated with the use of the asset. Open-source software developed by corporations is usually funded through sales of complementary services, such as training and support, or by other products it helps sell. Open-source and other free software may also help increase the number of users on a platform or enhance the developer's reputation and profile. Open-source software supplied across borders may be funded by cross-border sales of complementary services or other products.

22.64 Open-source software is sometimes developed by individuals working independently. Unpaid production of open-source software originals by volunteers is outside the SNA production boundary. However, independent developers of open-source software for commercial purposes are unincorporated household enterprises investing in own-account software.

22.65 The value of open-source software copies supplied by enterprises may be embedded in the price of other, complementary outputs that the open-source software helps sell or that are bundled with the open-source software. These purchased outputs may be software or services used for intermediate consumption. If software users substitute open-source software funded by mark-ups on intermediate consumption items for purchased software, measured software investment will be reduced. Measured software investment is also

reduced if software users substitute open-source software distributed by a government entity or nonprofit institution operating as a non-market producer for purchased software. The SNA values outputs of nonmarket producers by their cost of production, not the willingness-to-pay of the users of these outputs as potentially inferred from the price of a substitute product that has similar capabilities.

- *Increasing the Visibility of Free Digital Platforms and Products*

22.66 The value of the free services that advertiser- and data-funded digital platforms supply to households is relevant for analytical purposes and for understanding the broader impact on household consumption of the emergence of these free platforms. Alternative measures of household final consumption expenditures and the output of free digital platforms that include the households' direct consumption of the services of advertiser- and data-funded digital platforms may be presented in an extended account on free digital platforms, as discussed in Section F below.

22.67 The effect of free platforms and free digital products on volume growth of household consumption is also conceptually relevant for understanding the impact of digitalization on prices and volumes. Free digital products and the measurement of prices and volumes is discussed in section E.

D. Digitalization and the Financial System

1. New Financial Services and Means of Payment Enabled by Digitalization

22.68 Digitalization has resulted in the appearance of new financial service products and payment mechanisms. The new digital financial services fall within existing categories of products, and the new digital payment mechanisms fall within existing asset categories. However, they should be reported as "of which" items (or as part of the product detail in a thematic account on the digital economy and in the associated digital supply and use tables) when they are important and can be separately identified.[1] The potentially important digital suppliers of services include financial digital intermediation platforms, crypto currency exchanges, digital providers of insurance services (InsurTech), digital banking platforms operating solely online (neobanks), e-money issuers, and online only foreign exchange bureaus and money transfer operators. The potentially important digital payment mechanisms are e-money (which includes mobile money), and digital assets that are used as means of payments including fungible crypto assets, and central bank digital currencies (CBDCs).

2. Financial Digital Intermediation Platforms

22.69 Financial digital intermediation platforms provide matching services and facilitate financial transactions between suppliers of funds and users of funds. They do not take ownership of the financial assets arising from claims on the users of funds or incur liabilities to the suppliers of funds. They receive fees or commissions for their services and are classified as financial auxiliaries (S126). They differ from conventional financial intermediaries, which incur liabilities on their own account and acquire financial assets and which charge for their financial intermediation services implicitly through interest rate margins.

22.70 There are three types of financial digital intermediation platforms: (1) peer-to-peer and other online lending platforms, (2) equity-based crowdfunding platforms, and (3) philanthropic crowdfunding platforms. Peer-to-peer lending platforms facilitate loans between households. The other type of lending platform matches households seeking loans to institutional investors seeking creditworthy borrowers. Providers of capital on equity-based platforms receive equity stakes in the businesses they fund. The funding transactions mediated by philanthropic crowdfunding platforms are current transfers or, potentially, capital transfers, and an element of the services these platforms perform is vetting of causes that are seeking assistance.

22.71 Another type of financial digital intermediation platform consists of crypto asset exchanges. Crypto asset exchanges are online platforms that allow users to buy, sell and stake (lend) cryptocurrencies and other crypto

[1] *BPM7* recommends introducing "of which" category for i) fintech companies within the subsector classification; and ii) instruments or services classifications where necessary to separate out fintech-related instruments and services.

assets for a fee or commission. Crypto assets with a corresponding liability (e.g., non-algorithmic stable coins, debt and equity security crypto assets) are classified as financial assets (see paragraph 22.76 for the classification of crypto assets). Since such financial assets are generally among the assets traded on a crypto asset exchange, these exchanges [OBJ]o are classified as financial auxiliaries. [OBJ]income received by crypto exchanges from bid-ask spreads is treated similarly to the income from bid-ask spreads of security dealers and market makers.

3. Digital Assets, including Fungible Crypto Assets

22.72 Digital assets are digital representations of value recorded on a cryptographically secured distributed ledger or using a similar technology. They include crypto assets and CBDCs, which may be designed as crypto assets but which do not necessarily use crypto asset technology. Digital assets differ from e-money. E-money is monetary value stored electronically on a physical device such as card or phone or stored remotely, which represents a liability of the e-money issuer and is denominated in a fiat currency. E-money must represent general purchasing power (i.e., it can be used for making payments to a variety of other entities).

22.73 Crypto assets are digital representations of value that use cryptography and distributed ledger technology (DLT) such as blockchains to enable parties to transact directly with each other without the need for a trusted intermediary. DLTs allow transactions to be recorded, synchronized, and shared simultaneously on multiple nodes in a decentralized network. Blockchains create cryptographic records of transactions and ownership that are impossible to alter.

22.74 Crypto assets are classified as either fungible or non-fungible. Fungible crypto assets are divisible and not unique (e.g., one bitcoin is equal to any other bitcoin and can be divided into equal pieces of similar value). Conversely, non-fungible crypto assets (most commonly known as nonfungible tokens or NFTs) are unique and non-divisible – see Section B.4. Fungible crypto assets are classified into three broad categories: (1) those designed to act as a general medium of exchange (which are further divided in those with, and those without, a corresponding liability); (2) those designed to act as a medium of exchange within a platform or network (again divided into those with, and those without, a corresponding liability); and (3) security tokens. Security tokens always have a corresponding liability and should be recorded as debt securities, equity securities, or financial derivative depending on the nature of the claim on the issuer.

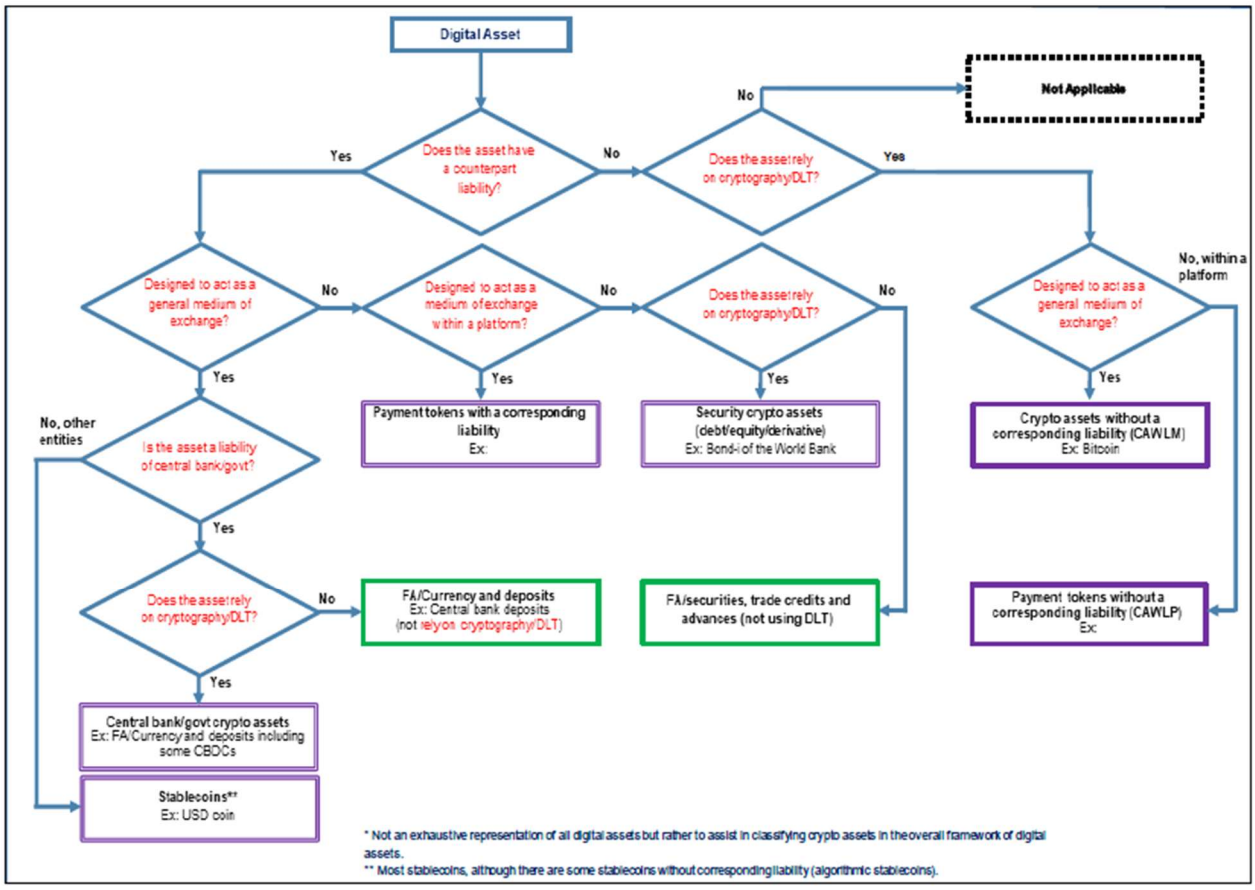
22.75 A digital assets decision tree to aid in identifying fungible crypto assets according to the above typology and other digital assets that have a corresponding liability appears in Figure 22.2. Digital assets with a corresponding liability include CBDCs, security tokens, payment tokens with a corresponding liability, and most stablecoins. Payment tokens entitle the holder to future access to a good or service. Stablecoins aim to maintain a stable value relative to a specified asset such as a fiat currency or gold, or a specified basket of assets, usually by being backed by assets of the issuer. The stability mechanism might also be an algorithm that responds automatically to changes in demand for the asset.

22.76 All types of crypto assets are within the SNA asset boundary. Crypto assets with a corresponding liability are classified as financial assets, while crypto assets without a corresponding liability are classified as non-produced, non-financial assets within a separate category. (If a crypto asset without a corresponding liability is ever able to gain widespread acceptance as a general medium of exchange, the guidance on its classification may be re-considered.) The capital account, financial account, and balance sheet chapters of the SNA (chapters 11, 12, and 14) and the classification of financial assets and liabilities (chapter 5) and the capital account (chapter 14) chapters of the BPM provide additional details.

22.77 Validation of crypto asset transactions is a service. The process of validating transactions in crypto assets is known as mining in the case of crypto assets without a corresponding liability that rely on proof of work for ensuring the security of transactions. This process includes the release of new units of the crypto asset as an implicit fee paid to the miner validating the transaction. The miner validating the transaction also receives an explicit fee in crypto assets paid by the party initiating the transaction, which is normally the sender/seller. The validation services that are rewarded with newly released units of the crypto asset are assumed to be collectively consumed by the existing holders of units of that crypto asset, while those rewarded by the explicit fee are consumed by the transactor paying the fee (normally the sender/seller). Refer to Chapter 7, *2025 SNA* and Chapter 11, *BPM7* for details on the recording of output of mining and cross-border validation

services.

Figure 22.2 Decision Tree for Classifying Digital Assets



Note: Nonfungible crypto assets (NFTs) are not covered in this decision tree.

E. Measuring Prices and Volumes of Products affected by Digitalization

22.78 Many of the measurement challenges arising from digitalization involve prices and volumes rather than the output at current prices. Price and volume measurement challenges are particularly common for products affected by digitalization because price change is straightforward to measure only when the products and their characteristics remain static. Digitalization has transformed household consumption and caused rapid change in products' characteristics and sources of supply. New digital products regularly disrupt existing ones, new models or service contracts frequently embody quality improvements, digital intellectual property products and services with no physical units of measurement are growing in importance, and free products often appear or cease to be free.

22.79 Regular and timely refreshment of the samples of models (and outlets) used to calculate the price indexes for products subject to frequent quality improvements to keep them representative of current purchasing patterns is the first step in compiling deflators that capture these products' quality change. Secondly, the appearance of new models and the exit of obsolete models must be handled in a way that allows the price index for the product to reflect the value of the quality changes.

22.80 The commonly used "matched models" procedure for handling entry of new models and exit of old ones when constructing the price index for a product considers only the price changes of the continuing models in calculating the change in the index. Any model not present in both periods is excluded from the subsample

used to calculate the change in the index. Leaving these models out of the index calculation avoids the risk of counting price differences due to quality differences as inflation; i.e., as a price change caused by the passage of time. However, the method implicitly assumes that the quality-adjusted price of the new model equals the price of the model it is replacing (after adjusting for the general change in price of the product between the last period with the exiting model's price was observed and the first period when new model's price is observed). Newly introduced models of products benefiting from advances in digital technology often offer substantially improved quality at about the same price as the model they replaced.

22.81 To capture the price and volume impact of quality changes in digital products, the prices of new models must be adjusted for the value of their quality difference from the models they replace. Hedonic regression models relating the price to the product's characteristics are a recommended method for adjusting prices for quality change. A version of hedonic modeling that allows quality adjustment at scale when analyzing the sort of large dataset generated by ecommerce transactions uses machine learning methods to predict the price of the new model in the previous period and the price of the old model in the current period.

22.82 Another technique used to adjust the price of a digital good for a quality change is options pricing, which averages observations on the differences in the price of the item caused by a characteristic offered as an option. Regardless of the quality adjustment procedure used when a quality change is observed in the data used to compile the price index,

22.83 A price measurement problem known as seller substitution bias occurs when buyers obtain a substantially identical product at a lower price from a new digitally enabled source of supply. For example, ride sharing services from a DIP may offer lower prices without a significant sacrifice in quality compared to the taxis, or a good may sell for less online than offline. The impact on the average price paid of a shift in households' shopping patterns to new source of supply can be captured by compiling a unit value price index (in which the total expenditure is divided by the total quantity purchased.) However, the composition of a unit value index must be homogeneous, as the maintained assumption is that all the items included in its calculation have the same per-unit intrinsic value.

- *Measuring quality change in ICT goods and goods with ICT components*

22.84 Frequent quality changes in ICT equipment and ICT durable goods enabled by rapidly advancing semiconductor chip technology have been a challenge for price index compilers ever since the emergence of computing devices based on this technology. New models of these goods have often offered a large improvement in performance at almost the same price as the previous model, yet the standard "matched models" method for price index compilation implicitly assumes that the quality-adjusted prices of the two models in an overlap period are the same. Furthermore, the measurement problem of quality changes enabled by semiconductors has spread as digitalization has proceeded, as embedded semiconductors and software now enable quality improvements in many kinds of equipment and durable goods, including motor vehicles.

22.85 Hedonic regression methods or the option price method can be used to estimate the value of quality changes associated with model replacements to enable the price indexes for ICT goods and goods with IT components to capture their quality improvements. If these methods are not feasible, information on the cost of production of a new product feature may be used to adjust the product's price index for the quality change. For example, a new capability of a motor vehicle made possible by embedded semiconductors and software might be valued by the producer's cost of adding this feature plus the usual distribution margins included in the retail price.

- *Software and data*

22.86 Software and data assets play critical roles in the success of many digital firms. The growing importance of software has expanded the range of uncertainty around the deflator for investment in IT products because the volume and quality of different software packages are hard to assess, and in-house production of software is common. The price or volume growth of own-account software and data must generally be inferred from the prices and volumes of the inputs, either assuming no productivity change or using the rate of productivity change of a related activity. Another option for deflating custom software is to use the price index of a related

product, such as standardized software products sold by software publishers. Continuous improvements in the performance of AI software through machine learning are not included in the volume of software investment, as learning-by-doing is a positive externality of many business processes.

22.87 Data is an idiosyncratic asset, with wide variation in its value depending on the context and circumstances. The volume and value of gross investment in data are measured by the volume and value of the inputs used. However, holding gains and losses may change the value of the data, and normal obsolescence will have a downward effect on its volume.

- *Cloud computing*

22.88 Obtaining the pricing data needed to compile deflators for the consumption of cloud computing services may require international collaboration, as these services are often supplied across borders. The main measurement challenges for compiling deflators for the production of cloud computing services are the length and complexity of the menu of services offered, and the frequent introductions of new products or modifications of existing products. However, a sample of stable, representative products from each product class (IaaS, PaaS and SaaS) can be used to estimate a deflator for cloud computing output. If that is not feasible, physical indicators of the volume of services produced may be combined using weights based on revenue shares to construct a volume index for output of cloud computing services.

- *Internet and telecommunications services*

22.89 The volume of internet and telecommunications services consumed by households has risen substantially as households spend more time online via broadband and mobile connections and consume more digitally delivered content. Data transmission speeds have also improved. However, commonly used methods for constructing consumer price indexes and producer price indexes for telecommunications services may result in a deflator that fails to capture this evident volume growth. To capture the change in the cost of purchasing a given volume of internet and telecommunications services, samples of contracts, products and carriers must be kept up to date and prices must be adjusted for quality changes, as data transmission speeds and capacity and mobile coverage improve.

22.90 However, volume indexes constructed from physical indicators such as data usage are a more direct way to capture the volume growth of consumption and production of internet and telecommunications services than deflating by the available price indexes. The use of a single physical indicator is algebraically the same as deflating by unit value index based on that indicator. To minimize the risk of distortion from changes in the composition of the aggregate being measured, the physical volume indicators should be measured for detailed types of products and aggregated with expenditure or revenue weights should be used to obtain the overall volume index.

- *E-commerce and digital intermediation platforms*

22.91 Deflators for household final consumption expenditures on items sold online must adequately represent prices from e-commerce outlets and suppliers, and from suppliers selling on digital platforms, because online prices may have different trends from offline prices. Furthermore, the high frequency of changes in online prices will often make a monthly unit value a more suitable measure of the price of an item in a month from an online supplier than the supplier's price at a point in time during the month. Finally, if item-level data on expenditures are available for the online sellers, they should be used for the weights in a price index formula that is resistant to chain drift (which is distortion caused by fluctuating weights in chained indexes.)

22.92 Online prices from e-commerce retailers and platforms such as ridesharing and short-term rental platforms drivers are often lower than offline prices for comparable items. The change in the average price paid by households when households substitute a source of supply with a different price level for their old source of supply for an identical item conceptually represents a decline in the deflator for household final consumption expenditures. In practice, however, practical difficulties and concerns about possible unobserved differences in quality usually keep price index compilers from capturing the possible price decline associated with the

switch to online sources of supply.

- *Expanded access to variety and customization*

22.93 The information provided by digital platforms and e-commerce suppliers enables households to locate the detailed varieties whose characteristics best match their tastes and needs from among the vast array of products available for purchase online. Digitalization has also increased opportunities for product customization. By expanding households' access to variety and improving the matching of product's characteristics with the tastes and needs of the households that consume them, digitalization has improved the efficiency with which goods and services are used once they have been produced. Households' material well-being (or welfare) from consumption of goods and services has therefore grown faster than production of goods and services. This source of welfare gain could be relevant for an extended concept of consumption volume used for analytical purposes. The welfare gains from better use of output once it has been produced are, however, not part of the production that is measured by the national accounts. Similarly, the welfare gains from inventions of new digital products with novel characteristics are beyond the scope of the price and volume measures of the SNA.

- *Free digital products*

22.94 Conceptually, the increased availability to households of free products brought about by digitalization represents a decline in the price and an increase in the volume of the household final consumption basket. The effect of appearance of a free product is straightforward to measure in the case where the free product directly replaces a priced product. When an item that households must purchase separately becomes free, the same total expenditure will command a greater volume of goods and services and the effect on the household consumption deflator will be given by the decline in the cost of the bundle. However, when the services of free digital platforms start to be bundled in the prices of advertised products, the theoretical decline in the cost of the bundle will depend on the assumed value of the free digital platform services. An extended account that values the free services of digital platforms by their cost of production is discussed below in the subsection on "Analytical Tools to Increase the Visibility of Digitalization."

22.95 The free digital services and embedded product capabilities in devices such as the smartphone that have appeared since the start of digitalization often enable households to achieve outcomes that previously required purchases of market goods and services. They may also save time or allow their user to do things that they previously could not do. However, the assumptions required to measure the effects on the household final consumption deflator of the appearance of a free digital good that is not a direct replacement for a priced good would often have unacceptable effects on the replicability of the results. Theoretical effects on deflators and volume growth associated with the appearance or disappearance of free digital products that are impossible to measure without hard-to-justify assumptions are beyond the scope of the measures of the national accounts.

F. Analytical Tools to Increase the Visibility of Digitalization

22.96 Digitalization has had profound effects on the economy, and the production and use of digital products contributes to economic growth and rising living standards. Additional detail on the impact of digitalization and the growth of the digital sector is needed for a full understanding of the performance and the evolution of digitalized economies because the aggregates presented in the standard national accounts classifications provide only limited information on the transactions, products and activities affected by digitalization. Distinguishing the digital components of those standard aggregates will also provide reassurance to the users of the national accounts that the output and consumption of digital products is being fully measured as part of those aggregates.

22.97 In the standard classification of industries and commodities published in the national accounts, digital products are often combined with other products in broader aggregates and are scattered across different aggregates. Visibility into digital firms and products is therefore limited. A thematic account on the digital

economy, and a digital supply and use tables (SUTs) are flexible tools for showing the impact of digitalization on the economy, where flexibility means that the content that is appropriate to include depends, in part, on which aspects are locally important and practical to measure. Compilation of the digital SUTs will help to ensure the accuracy and consistency of the data presented in the digital economy satellite account, while the the digital economy satellite account will help communicate the key information contained in the digital SUTs in a convenient and accessible way along with additional context.

22.98 The third tool for increasing the visibility of digitalization is an extended account on the free services supplied to households by digital platforms Households' consumption of the free services of digital platforms funded by advertising and the collection of data on their users is a major element of the digital transformation, and an important part of the gains in economic welfare associated with digitalization. An extended account can present an alternative framework that provides a separate measure of the value of the unpriced services that these free digital platforms supply to households (which is subsumed in other aggregates in the main sequence of accounts).

1. Thematic Account on the Digital Economy

22.99 The main purpose of the thematic account and the accompanying digital supply and use tables (SUTs) is to increase the visibility of activities, products and transactions affected by digitalization that are subsumed in broader aggregates in the standard classifications of the national accounts. They provide alternative aggregations and additional product detail that separately identify digital segments of industries, digital products, and digitally ordered transactions. The digital SUTs also serve to facilitate the compilation of the digital economy thematic account, while a thematic account can communicate the key information from the digital SUTs in a convenient and effective format.

22.100 In developing a digital economy thematic account, the items that are most important for understanding the structure of the domestic economy and its uses of digital products should be prioritized. The potentially important items include the output and value added of ICT goods producers, cloud computing, telecommunications and other ICT service industries, digital platforms funded by advertising and data collection, non-financial digital intermediation platforms charging fees and the services intermediated by these platforms, financial digital intermediation platforms, e-commerce wholesale and retail distribution services, digital only firms providing financial and insurance services, and other service providers operating only digitally.

22.101 The thematic account should summarize the uses of digital products, including uses for own-account and purchased investment. The investment needed to support digital activity is also relevant for an analysis of the impact of digitalization. In addition to ICT equipment, software, and data, this investment includes the infrastructure of data centers and networks used in the production and delivery of digital services.

22.102 Trade flows of digital goods and services are important to include in the thematic account on the digital economy. A decomposition of exports and imports by major category of digital goods and services may also be important to report to show the source of the differences between domestic production and domestic uses of the items in these categories. International transactions that are digitally ordered or digitally delivered are additional aspects that should be highlighted in the thematic account. Furthermore, the share of domestic transactions that are digitally ordered transactions is an important indicator of the penetration of e-commerce that is also appropriate to include.

22.103 The indicators in the digital economy thematic account need not be limited to products within the SNA production boundary. The free services that digital platforms supply to households valued by their cost of production can be reported as an addendum item.

2. Digital Supply and Use Tables

22.104 The digital supply and use tables start with the conventional SUTs and add rows on digital transactions and products and columns on new digital industries. This ensures that the framework for analyzing digital transactions, products and industries is aligned with existing classifications and takes advantage of these classifications. The supply table classifications allow a decomposition of the sources of supply of digital

products including imports, and the use table classifications allow a decomposition of the uses of digital products for intermediate consumption, final consumption, investment, and exports.

22.105 Digital SUTs analyze the impact of digitalization on the economy along three dimensions: type of transaction, type of product, and type of actor. Their design includes spaces for all potentially relevant transactions, making the number of possible entries in the added rows and columns large. To reduce the compilation burden and source data requirements, the most important aggregates can be prioritized. The recommended priority items include (a) the output and gross value added of digital industries, (b) intermediate consumption of digital intermediation services, cloud computing services, and ICT goods and digital services in the aggregate, and (c) a decomposition of expenditures by nature of the transaction.

22.106 E-commerce transactions are defined by digital ordering. To provide insight into digitally ordered transactions, the digital supply table includes rows that distinguish the digitally ordered transactions in each product, along with a further decomposition into transactions ordered directly from a counterparty, transactions ordered through a resident digital intermediation platform, and transactions ordered through a non-resident digital intermediation platform.

22.107 Transactions in which the product is digitally delivered may also be important to distinguish. The portions of the output of domestic industries and imports that are digitally delivered may be shown in "of which" columns in the digital supply table. The portions of household final consumption and exports that are digitally delivered may also be shown in "of which" columns in the digital use table.

22.108 The recommended or encouraged rows on digital products cover ICT goods, cloud computing, digital intermediation services, and other digital services. A row on data used in production may also be included. Also, an addendum on products beyond the standard production boundary may have rows for free services of digital platforms and free services of online communities of volunteers. Including imputed values of these free services in the digital SUTs will facilitate compilation of an extended account on free digital services.

22.109 The digital SUTs include recommended new columns covering seven digital and digitally enabled activities. The first of these new column covers the industries that enable digital activity, which consist of the ICT sector industries of computer and peripheral manufacturing, communications equipment manufacturing, software publishing, internet and other telecommunications services, and data processing services. The other new columns cover: digital platforms funded by advertising and data collection; digital intermediation platforms; producers dependent on digital intermediation platforms; e-tailers; financial service providers primarily operating digitally; and other producers operating only digitally.

3. Extended Account to Increase the Visibility of the Free Services of Digital Platforms Consumed by Households

22.110 Free digital platforms funded by advertising and collection of users' data have become part of daily life and the time spent by households using platforms offering free services such as social media, search, entertainment, and information suggests that households place a high value on the free services of digital platforms funded by advertising and data collection. An estimate of the value of these free services is therefore relevant for understanding and analyzing the impact of digitalization on the growth of household consumption of goods and services. Yet the value of the free services of platforms funded by advertising and collection of users' data is not estimated as part of compiling the standard sequence of economic accounts because the cost of supplying these services is implicitly included in the price of the advertising services and data sold by the platform and the platform's own-account investment in data assets. In effect, in the standard sequence of economic accounts, the digital platform is itself the user of the free services, and the benefits that households derive from these services are merely a positive externality of the production of advertising services and data assets.

22.111 To provide information on households' direct consumption of the "free" services of digital platforms funded by advertising and data collection, compilation of an extended account showing the value of these services is encouraged. Extended accounts are a flexible tool for presenting concepts that extend SNA boundaries, including expanded measures of economic activity and household final consumption expenditures that extend the production boundary.

22.112 Households' consumption of the free services of advertiser-funded digital platforms can be included in an extended account as part of expanded measures of household final consumption expenditures and output. Although letting these services be consumed twice, once by households as they use the platform and a second time by the platforms as they produce advertising services and data assets, would cause double counting in a measure GDP, expanded measures of economic activity and household consumption that reflect the simultaneous consumption of these services by the households using the platform and by the platform itself are analytically useful .

22.113 In the framework of the extended account, households' consumption of unpriced services produced by the platforms' software and hardware assets in exchange for providing a license to collect data on their observable phenomena (OP) can also be included. The licenses to collect the households' data are viewed as a payment in kind for the platform's unpriced services and the platform's unpriced services are viewed as a payment in kind for the license to collect the users' data.

22.114 The imputed values of items that are bartered for each other (the unpriced platform services consumed by households and the opportunities for the platform to collect the households' data) must be the same. Consequently, there are four theoretical ways to value the platforms' unpriced services: (1) the platform's cost of producing the free services, (2) the value that the households place on the free services, (3) the value that the households place on the privacy of their data that they give up, and (4) the economic benefits that the platforms derive from users' attention and access to users' data. The need for consistency within the system of measures of the transactions of the free platforms makes the cost of producing the services the most suitable of these four theoretical values for the extended account. Own-account investment in data assets is usually measured by the cost of production approach, so valuing the licenses to collect data on users' OP by the cost producing the platform services exchanged for these licenses would be consistent with the general approach to measurement of own-account investment in data assets. Cost of production is also more practical to estimate than the other three theoretical values of the platform's free services.

22.115 Although the payment in kind from the platform to the households consists of services produced by the platform, the license to access the households' OP received in return is not a service produced by the households. and the imputed payment for that license is classified as a rent (rsee paragraph 22.21 for additional details). Licensing collection of data on one's OP is not a production activity – households' OP are not a produced asset, so access to households' OP cannot be considered consumption of the services of a produced fixed asset. However, if households actively assist in the collection of their data, the steps they take to assist with the data collection can be considered a production of services (but cases of such active assistance are rare).

22.116 The expanded measures of free platforms' output and value added in the extended account will include the imputed value of the free services consumed by households. The balance of primary incomes of the platforms will, however, be unchanged. The platforms' extra value added from imputed sales of services to households will equal the platforms' imputed payments of rent for the licenses to collect households' data. Household saving will also be unchanged because the imputed household consumption expenditures on platform services will equal households' imputed income from licensing collection of their data.

22.117 In addition to allowing collection of data on their OP, households provide economic benefits to free platforms by creating and supplying user-generated content without monetary compensation. In the standard sequence of accounts, households that receive monetary payments for the content they post online are unincorporated household enterprises producing services, but content supplied without payment is beyond the production boundary. To increase the visibility of households' unremunerated creation of user-generated content, the extended account can treat user-generated content that is uploaded without monetary payment as part of a barter transaction in which platform user receives unpriced platform services in exchange for the user-generated content. Under this alternative approach, the platform's unpriced services are used by the content creators as inputs to produce the user-generated content and the user-generated content is used by the platform to produce data assets. The net effect is to increase in the measure of the platforms' own-account investment in data assets.