Accounting for the digitalized economy

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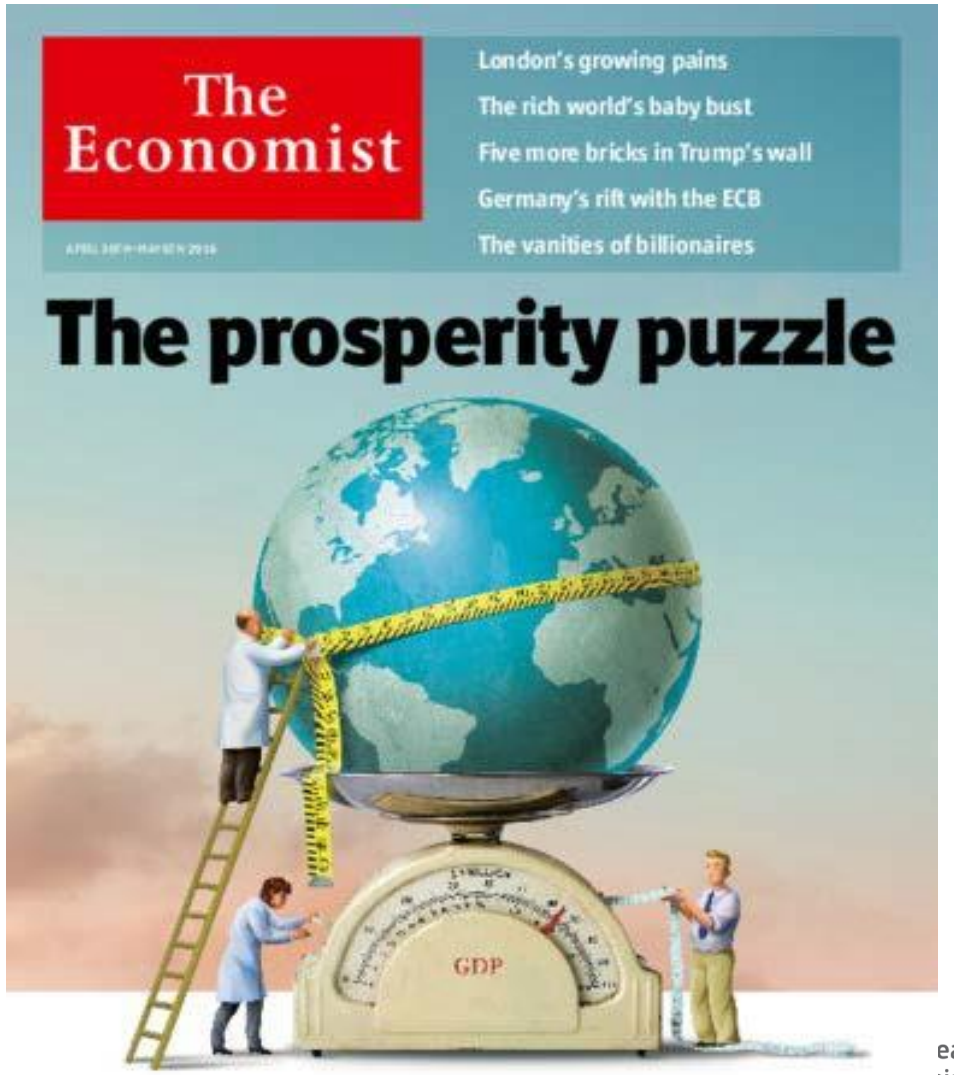
IARIW : August 2022

Is this what everyone thinks?

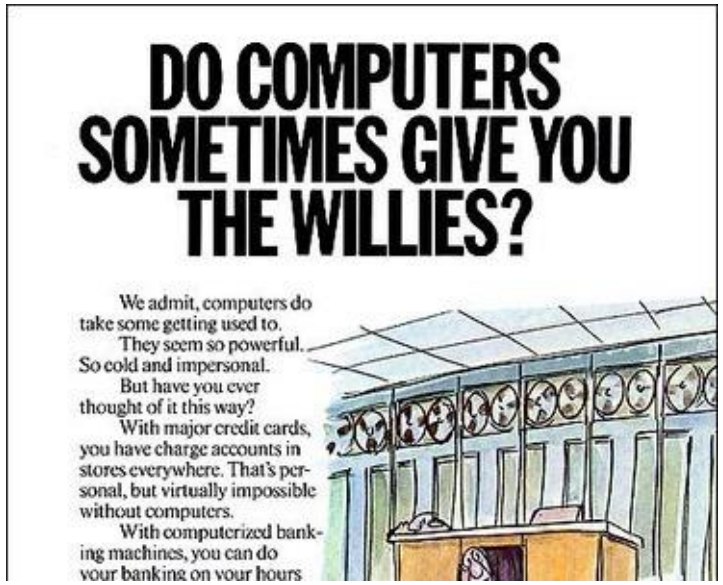
"*These days it seems that a growing fraction of innovation is not measured at all. In a world where houses are Airbnb hotels and private cars are Uber taxis, where a free software upgrade renews old computers, and Facebook and YouTube bring hours of daily entertainment to hundreds of millions at no price at all,* ***many suspect GDP is becoming an ever more misleading measure.***"

The Economist Apr 30th 2016



Those familiar logos…

But is all of this really new?



What has digitalisation ever done for us?

- Digitalisation has allowed firms to radically alter production processes and access to markets using digital tools.
- Digitalisation has permitted consumers to access a larger variety of goods and services, while exercising greater control over the characteristics of the transaction.
- Despite digitalisation being everywhere in our professional and personal lives, it is not clearly identifiable in economic indicators, and some key drivers/innovations are not (well) covered in SNA – data, cloud computing, AI, “free” products….

Where is the digital economy in macroeconomic statistics?

Digital transformation is largely hidden in the core economic accounts.

- With fast-changing production chains, overall value added may remain the same, but the current frameworks don't clearly show impact of digitalisation.
- Digitalisation can remove players (direct online booking) or add additional players (intermediary platforms).
- Digitalisation blurs the boundaries between produced and non-produced, including for "free products"
- The role of data (and related online advertising) is not well represented

Four main topics to cover today

1. Digital Supply-Use Tables (“Digital SUTs”)
2. Data and ‘free’ services
3. Cloud computing
4. Artificial intelligence

Other relevant SNA Update topics not covered today: Crypto-currencies, Non-Fungible Tokens, Digital Intermediary Platforms

1. Increasing the visibility in economic statistics through compilation of Digital SUTs

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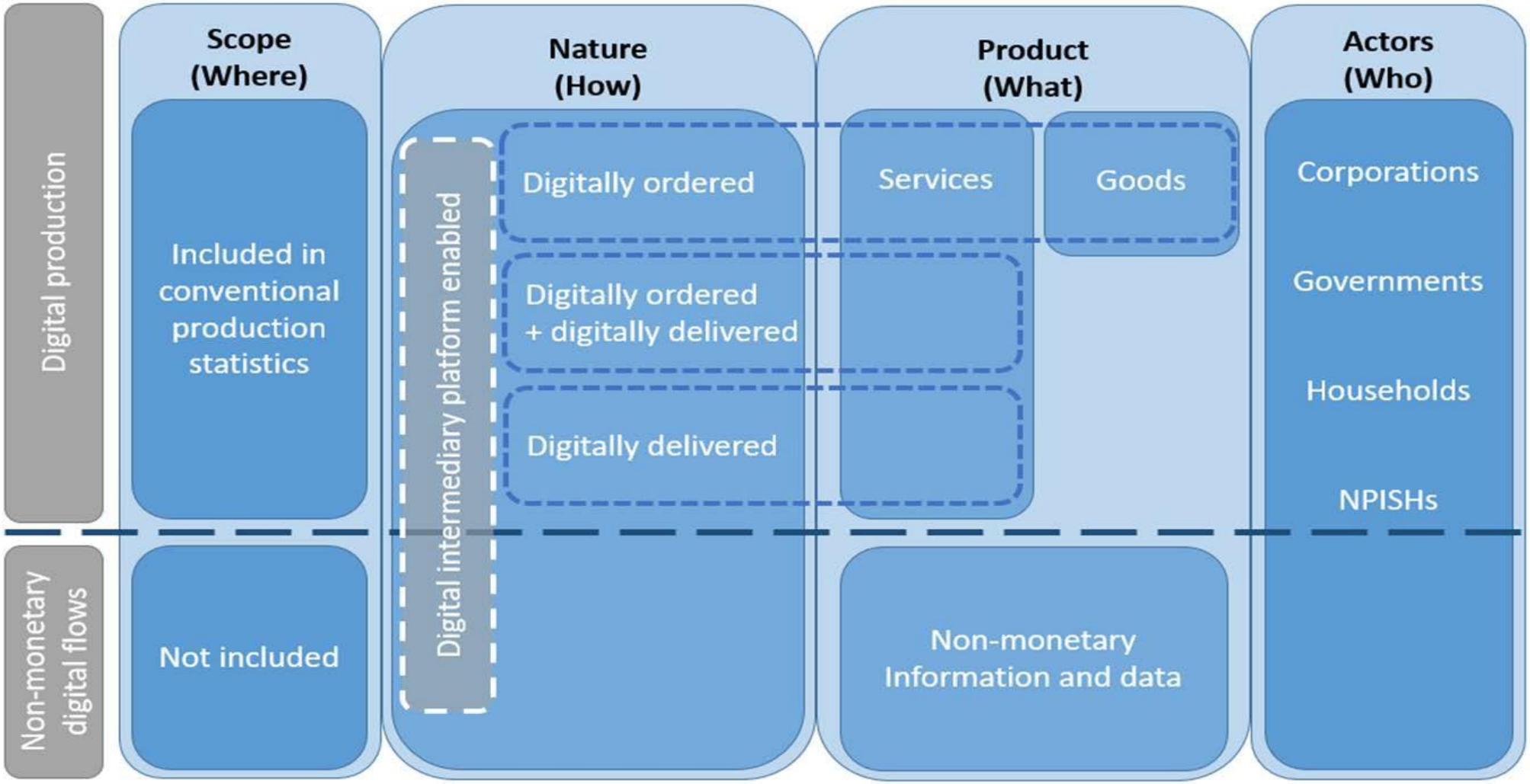
Digital SUTs – preferred framework



Digital Supply-Use tables framework

The framework includes the following extensions to conventional SUTs

- 5 rows under each product, representing the nature of the transaction.
- 4 additional product rows representing digital products (ICT goods, digital services, cloud computing and digital intermediary services).
- 7 additional industry columns representing the new digital industries.
- Additional columns allowing for the representation of services that have been
  - digitally delivered.
  - digitally ordered.
  - digitally ordered and digitally delivered.

[Scope to expand framework to include non-monetary digital flows e.g., data]

Outputs of the Digital SUTs

Digital SUTs provides a set of indicators on digital activity:

- Total E-commerce in the economy.
- Spending on ICT goods and digital services by industry.
- Imports and exports of digital services.

It does not provide a single "digital economy" estimate.

It does not quantify the contribution of digitalisation to the output of a specific industry

- E.g., it is unable to explicitly measure digitalisations' impact on the production of orange juice.

Could be extended to include free goods (e.g., data).

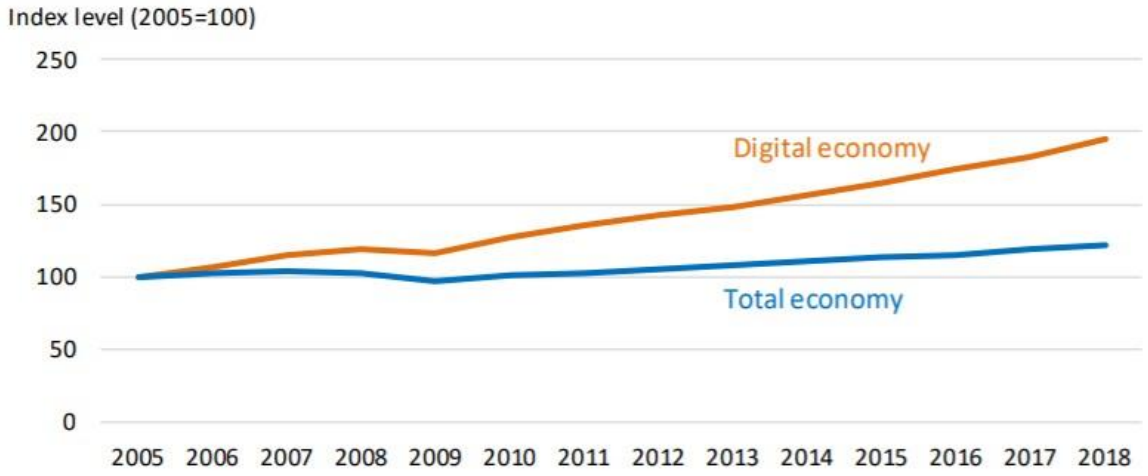
CBS (NL) SUT model

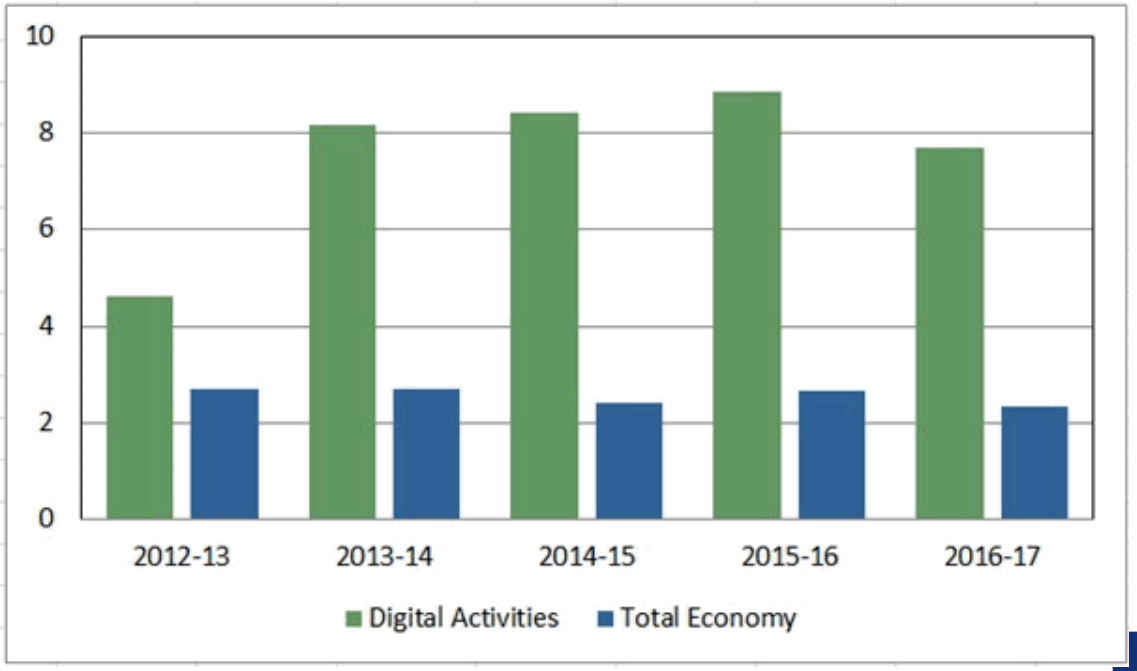
Supply table 2018			Total Digital industries					Total Supply	
	Transaction type	Digital industries	Digitally delivered	Not digitally delivered	Industries (ISIC)	Delivery type total total ISIC industries	Import	Delivery type total Import	Digitally delivered	Not digitally delivered
Digital Products		€	€	€	€		€		€	€
	1. Digitally ordered	€	€	€	€		€		€	€
	1a. Ordered directly from a counterparty	€	€	€	€		€		€	€
	1b-I. Ordered via a resident platform	€	€	€	€		€		€	€
	1b-II. Via non-resident platform	€	€	€	€		€		€	€
	2. Not Digitally ordered	€	€	€	€		€		€	€
Products (CPA)		€	€	€	€		€		€	€
	1. Digitally ordered	€	€	€	€		€		€	€
	1a. Ordered directly from a counterparty	€	€	€	€		€		€	€
	1b-I. Ordered via a resident platform	€	€	€	€		€		€	€
	1b-II. Via non-resident platform	€	€	€	€		€		€	€
	2. Not Digitally ordered	€	€	€	€		€		€	€
Total Products	By Transactiontype	€	€	€	€		€		€	€

European Commission

Country examples – digital economy

- **United States**, Average annual real growth 1998–2018.
- **“Digital economy” growth at 5.2%**
- Total economy at 1.5%



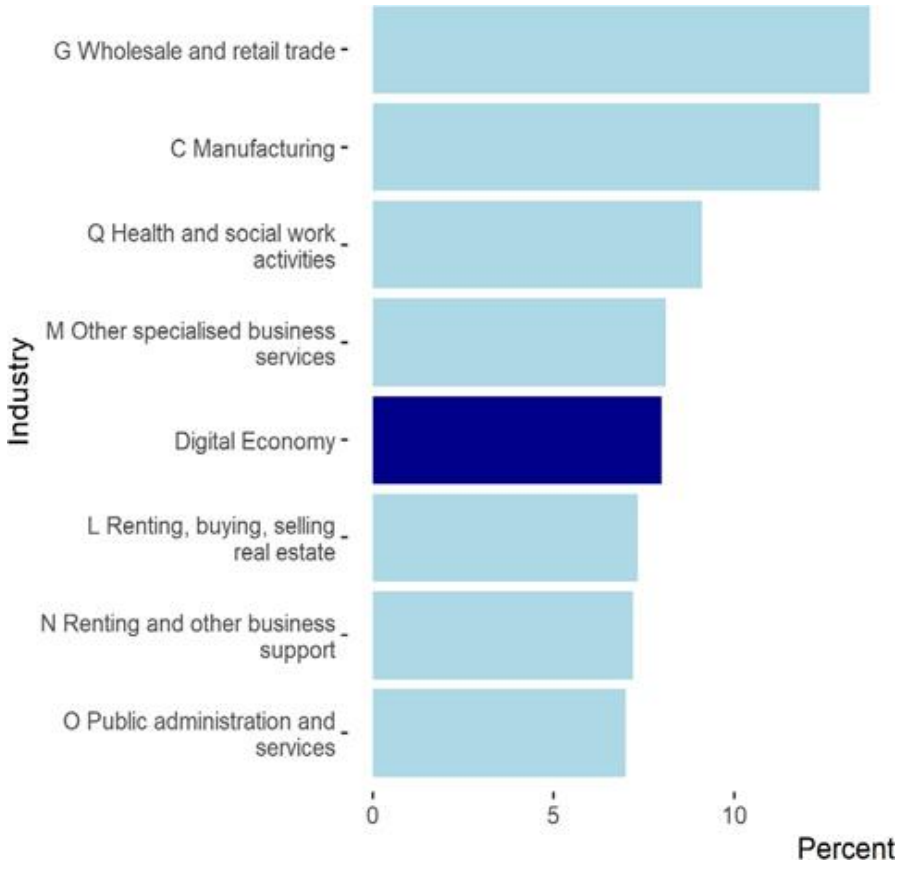


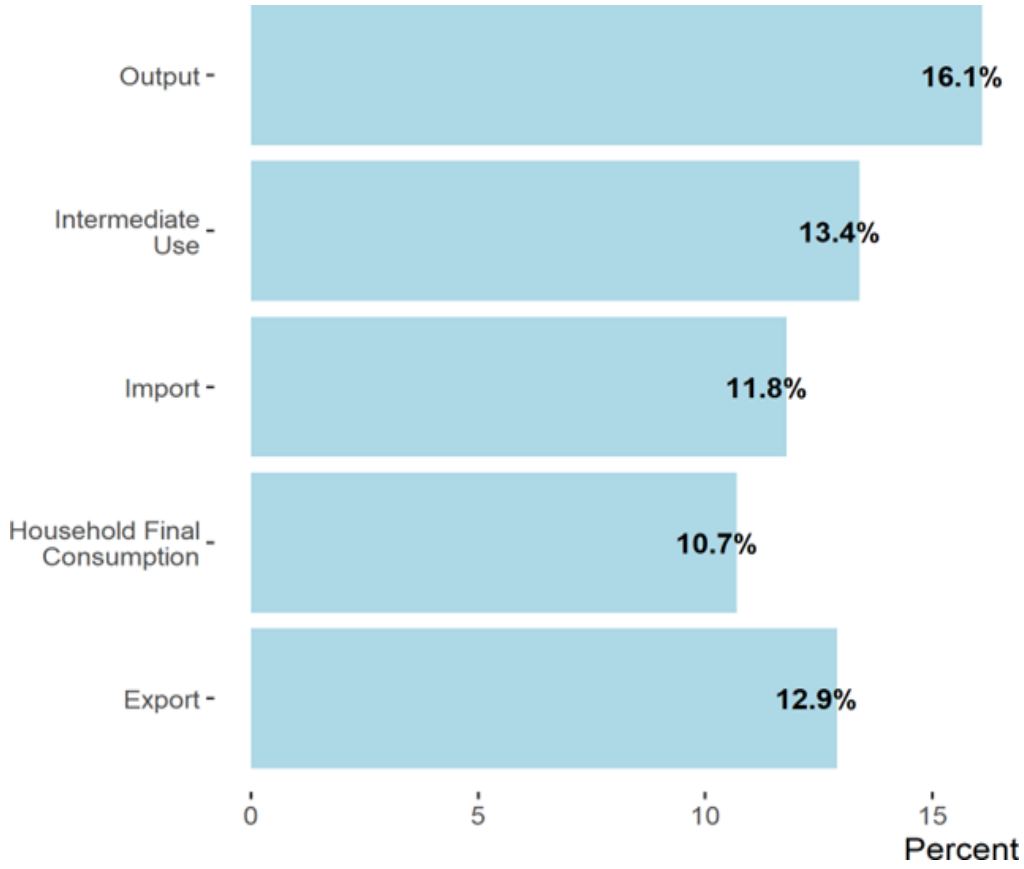
Australia, average annual growth 2012-13 to 2016-17.

- **“Digital Economy” growth at 7.5%**
- Total economy at 2.5%

This work aligns with 2008 SNA

CBS (NL) Digital SUT project





European Commission

Compilation issues (NL)

- Lack of source data:
  - Resident vs non-resident platforms
  - Imports of digital intermediary services
  - Cloud versus other digital services (e.g. software)
  - Self employed persons not included in ICT usage survey
  - Transaction types not available at product/CPA level
- Problems of continuity in data sources:
  - Digitally ordered based on experimental research on Mode of Supply
  - Content of ICT usage survey changes every year
  - Use of reports from private research companies that may not be regularly updated
- Unable to find practical approach for:
  - Digital only firms providing financial and insurance services
  - Other producers only operating digitally

Conclusions

- Digital SUTs are key to increasing the visibility of digitalization in NA
- Digital SUTs: an extension of the national accounts through supplementary tables. Do not affect the ‘core’ accounts.
- Step by step approach.

Status

- GN endorsed by the AEG. Now concentrating on implementation issues.
- Several countries have started working on the framework, targeting priority indicators.

2. Data and ‘free’ services

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Including data in the SNA?

- Data is an increasingly significant cost of production
- Data can be used as a one-off product, or held as a nonfinancial asset
- Data can be recognised as a stand-alone product
- Data is currently recognised only through computerised databases

Data in the 2008 SNA – current coverage

- SNA 2008 paragraphs 10.112 – 10.114 gives a definition of a database:

  Databases consist of files of data organised in such ay as to permit resource-effective access and use of data .

- Data is taken as a “given” – no definition, and no recognition outside their being an element of a computerised database management system (DBMS)

Classification is

- AN 1173: Computer software and databases
  - AN 11731: Computer software
  - AN 11732: Databases

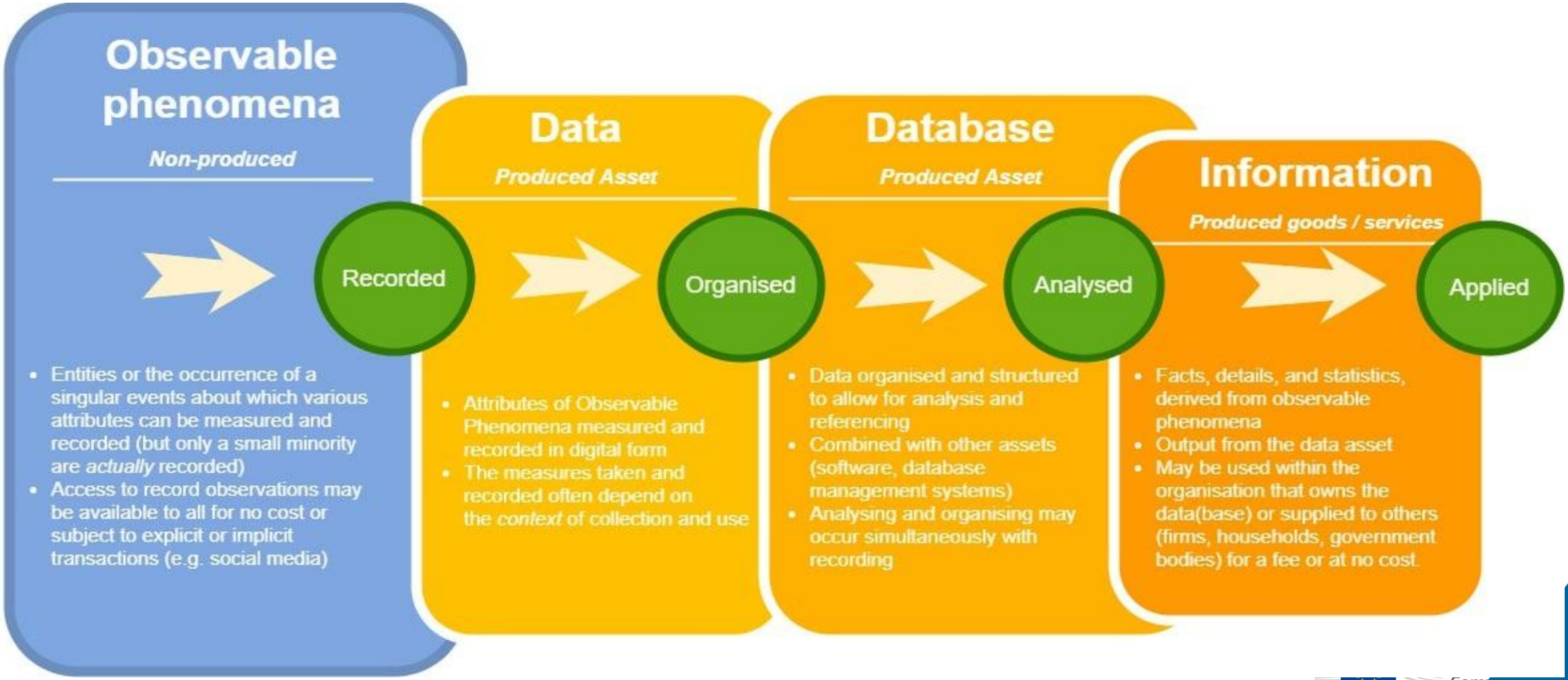
Data in the SNA – current coverage

- Databases are usually created on own account
- Their value is estimated through a sum of costs approach
- The value of the database should be estimated separately from the value of the supporting computer software (the DBMS)
- "*the cost of preparing data in the appropriate format is included in the cost of the database, but not the cost of acquiring or producing the data*"

Emerging recommendations for the SNA Update

- Data is recognised separately as an Intellectual Property Product
- It is usually created on an own account basis
- Data is a stand-alone digitised product, recorded as an asset if used repeatedly over time
- Data does not suffer wear and tear, but does suffer change in value either through obsolescence or appreciation

The OP – Data pathway



Definitions

- Data is created from observational phenomena (OPs)
- *OPs are a fact or situation whose characteristics or attributes can be recorded. The information elements of OPs are regarded as non-produced and of no value, unless they are purchased directly*
- *Data is information content that is produced by accessing and observing phenomena, and recording, organising and storing information elements from the OPs in a digital format, which provide an economic benefit when used in productive activities*

Emerging recommendations for the SNA Update

- The definition of data excludes data in non-digital form, and data not used directly in production
- OPs are not of value until they are transformed into data.
- It is proposed that data is created when the information of the OPs is digitalised.
- The data can be valued through a sum of costs approach

Possible changes for the SNA Update

- In the SNA 2008, the sum of costs approach for databases does not include the cost of acquiring or producing the basic data.
- This will be changed so that the data can be valued through a sum of costs approach
- As the OPs are non-produced, payment for access is a form of rent
- TESTING will now take place for the main aspects of identifying and measuring production of data

Impact on rent?

- SNA 2008 only recognises rent for the use of natural resources
- In order to include rent in the sum of costs approach for data, a new category of rent would be required
  - “rent on other non-produced non-financial assets”
- Separate Guidance Note on rent being prepared

Possible changes for the SNA Update

- Recognition of data as a created product requires a change to the classification
- Proposed new classification hierarchy:
  - Data
    - Data sets
    - Databases
  - Computer software

Measurement issues

- It may be difficult to disentangle data from existing estimates of databases.
- Estimation of the value of data created on own account should be made through the standard “sum of costs” approach, with payments for acces to OPs included.
- The net present value approach would arguably better reflect the changes in value, both up and down. However this was rejected due to the unavoidable arbitrary nature of the assumptions required to relate the volatile demand for data to the value of an asset.
- Challenge to separating out “ancillary” data not used in production.

Messages from the Global Consultation

- There was agreement that data is produced and generally a capital asset when created on own account
- Broad agreement that the sum of costs approach for own account creation of a capital asset should include payments to access OPs
- There was widespread lack of experience in estimating the value of data used in production. More research was needed, and the ability to separate the value of data content of databases from the supporting software was a concern. Overlap of data with databases, and R&D was another concern.

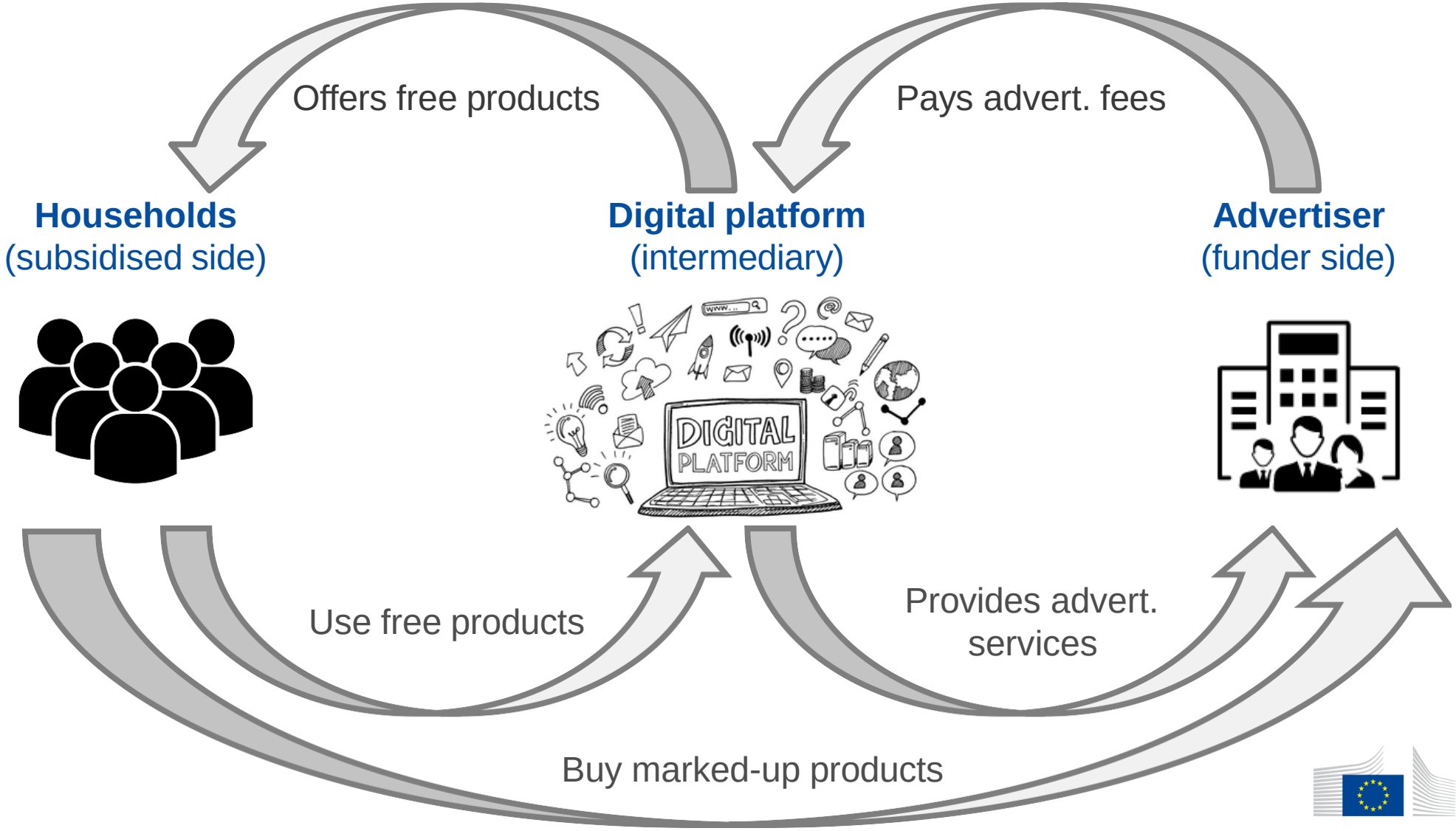
Providing “free services” to households

- “Youtube” is given an example in the following slides, as a typical product aimed at householders who do not pay for a digitised service provided through a web-site.
- Householders use Youtube™ (the provider) as a free service
- The normal access to short videos on YouTube unavoidably also receives advertising
- Youtube charges the advertiser, or sells them marketing data gathered through operation of the web-site
- The advertiser treats these both as production costs, and recovers this charge through increasing the price of the product being advertised

Providing “free services” to households

- To use the “free” product, the householder watches advertising and/or reveals their identity and their interest in recreational activities – these are data as they are already observed and structured
- Youtube can charge advertisers for access to this data set
- The advertiser can then target their message to individual households, by topic and recipient
- This is another cost incurred in selling the product

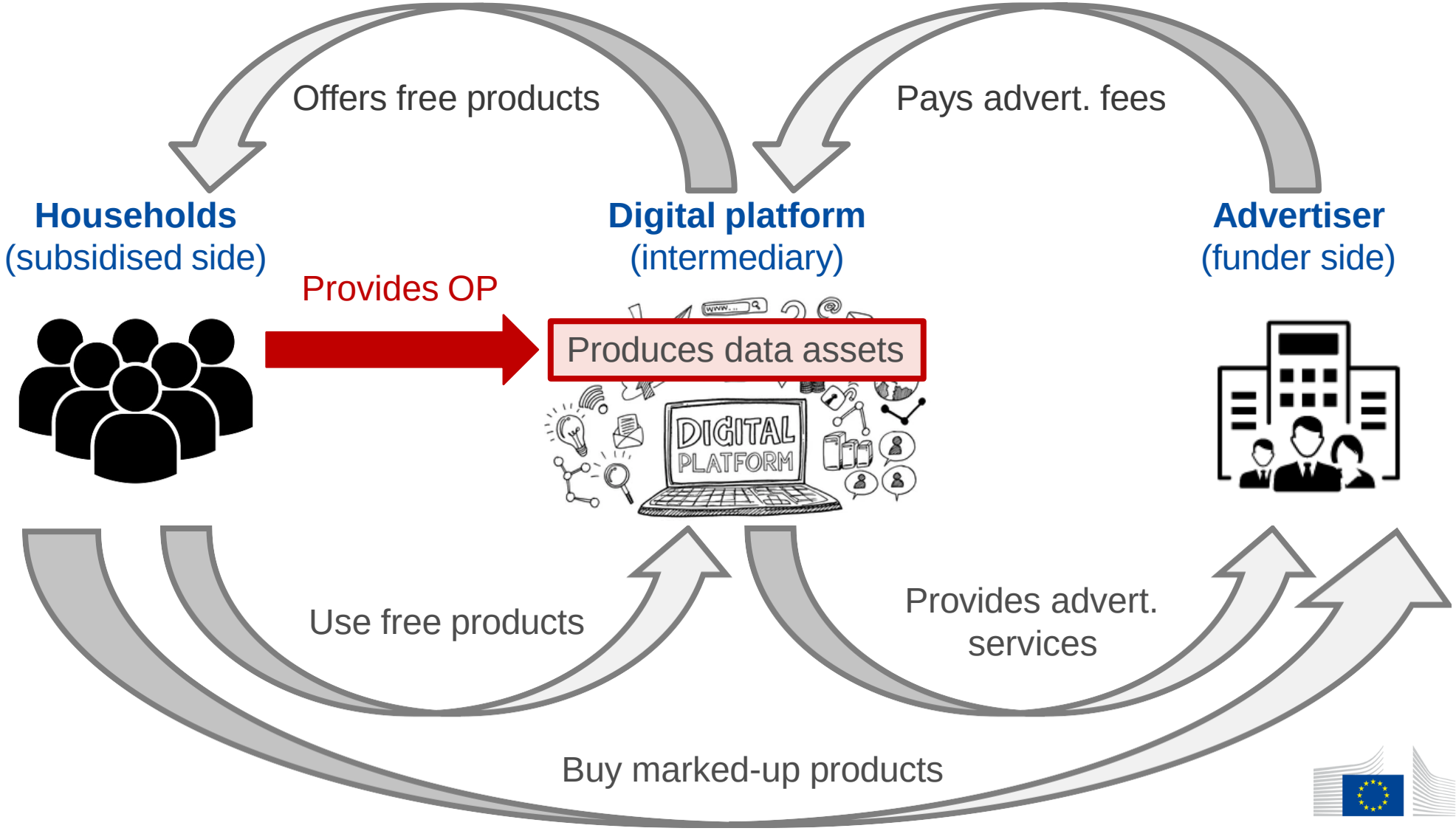
Free products: GN on **current** SNA treatment



Providing “free services” to households

- The householder perceives their use of Youtube as giving them a free service
- This will be displayed in a satellite account – an extension to the SNA
- Both the fee for advertising, and the fee for access to the customer database, are included in the margin charged by the advertiser to their customers.
- In the satellite account, these charges can be displayed to reveal the “role” of the households

Free products: GN in SNA **satellite account**



3. Cloud computing

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What is cloud computing?

- Cloud computing provides on-demand IT services via remote access through the internet. These services will often cross national boundaries.

- It was introduced in 2006 by Amazon as Amazon Web Services (AWS), based on the services used within Amazon to launch its third-party market place.

- It has since grown dramatically in size, and others such as Dropbox, Google, Alibaba and Microsoft Azure have entered the market and offered their own cloud computing services

What is cloud computing?

- Cloud computing offers the following packaged services:
  - Infrastructure as a service (IaaS)
  - Platform as a Service (PaaS)
  - Function as a Service (FaaS), and
  - Software as a Service (SaaS)

What is cloud computing?

- Cloud Computing provides these services to replace the similar services generated internally by large corporations
- Amazon Web Services describe their product as “the on-demand delivery of computer power, database storage, applications and other IT resources via the internet with pay-as-you-go pricing.”
- The US National Institute of Standards and Technology (NIST) defines cloud computing as a service offering “ubiquitous, convenient, on-demand network access to a shared network access to a shared pool of configurable computing resources . . . That can be rapidly provisioned and released.”

How big is cloud computing growing? Why is that?

- Gartner (technology research company) published reports on cloud computing that put the global industry revenue at $200 billion in 2018, and projected that the revenue would rise to over $330 billion by 2021.
- This growth rate is chiefly driven by economies of scale.
- Customers can enjoy large benefits from shared technology advances and storage capacity – cloud computing servers can have double the capacity utilisation of conventional servers
- Cloud computing enables agile change in scale and capacity requirements

Treatment of cloud computing in the USA

- The Bureau of Economic Analysis (BEA) classifies cloud computing as “Data Processing, hosting and related services”
- Payments for their services are normally classified as purchases of services - intermediate consumption
- The BEA treats using subscription software as investment in fixed assets rather than payment for services, avoiding a break in the series of software investment subscriptions

The effect of replacing internal computing power with bought-in services

- Reducing the role of computer services supplied internally through owning computers, storage and appropriate software, is replaced by pay-as-you-go payments for services provided through remote access to cloud computing.
- Where remote access to cloud computing is across country national borders, domestic measures of GVA and GDP will fall.
- If the import of cloud computing services was equal to the value previously supplied by internal capital assets, net measures of value added and domestic production would be unchanged.

Measuring cloud computing services in practice

- Cloud computing services are often provided from abroad.
- Multinational cloud computing corporations are unlikely to provide the value of services supplied to individual countries
- This information must be collected by the recipient countries, to avoid mismatch between supply and demand by reconciling individual country imports with supplier exports

Measuring cloud computing services in real terms

- Quantifying the services provided by cloud computing in volume terms is typically extremely difficult where IPPs provide services from abroad
- The bundle of services is heterogenous, and liable to new product development on a regular basis
- A practical solution is to assume that the price indices for a few of the most common services with simple structure can be applied to a wider range of products

Emerging recommendations

1. Cloud computing is sufficiently large and growing to justify separate classification of the services provided, for both national accounts and balance of payments

2. Software subscriptions are usually classified as purchases of a service, rather than purchases of software fixed assets.

3. Licences for the use of software and hardware services hosted in the cloud computing corporation should be examined to determine whether the effective owner is the cloud computing corporation, or the user.

4. Artificial Intelligence

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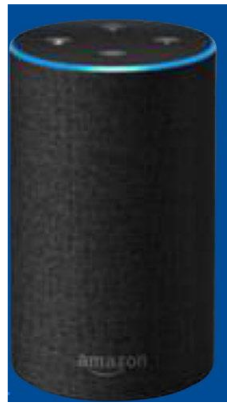
What is AI?

- Alan Turing used the term “thinking machines” in the 1950s.
- John McCarthy (2004) coined the term “artificial intelligence” defined as “getting a computer to do things which, when done by people, are said to involve intelligence.”
- IBM: “Artificial intelligence leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind.”
- Wikipedia: “AI is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by animals including humans.

AI applications

- Automated speech recognition (ASI): processes speech into text.
- Customer service: online virtual agents, chatbots etc
- Computer vision: photo-tagging, radiology imaging, self-driving cars
- Recommendation engines: Using past consumption behaviour data, AI algorithms can be used to develop more effective selling strategies.
- Automated stock trading.



Artificial Intelligence and National Accounts

- Given the growing importance of AI and it's impact on the economy, we need to evaluate whether current macroeconomic accounting standards and classifications effectively record and present Artificial Intelligence.
- **Specifically,** national accountants need to;

i. consider whether AI activity and its output fit within the current production and asset boundaries.

ii. discern the nature of the product and how it is valued and recorded.

iii. examine whether the current classifications and set of accounts properly present the activity to users.

AI definition?

- Keep it rather general to give space for future developments…

“AI is a computer program operating a system capable of recognition, reasoning, communication, and prediction simulating human recognition, reasoning, and communication.”

Proposed SNA classification of AI

- SNA and BPM do not currently mention AI, BUT Intellectual Property Products (IPPs) capture many of the characteristics of AI:
  - Usually the result of “R&D” and depends on “Computer software and databases”
- GN proposes expanding concept of IPPs to include:

“… ***the creation of intelligent systems*** *that the developers can market or use to their own benefit in production….”*

- As AI is a type of computer program, a viable way forward is to include a definition of AI under a revised SNA asset class – *Computer Software, Databases and Artificial Intelligence Systems.*

AI and the National Accounts

- AI is produced and falls within the production and asset boundaries
- AI is a computer program and takes on SNA characteristics of software in the accounts (such as “own-account”).
- Own-account software is often valued as “sum of costs of production”. AI uses access to a “training datasets” or other databases to “learn and reason” from

e.g. a self driving car needs to learn road signs and distinguish roads, cars, pedestrians etc.

- BUT, preparation of training datasets and those needed to operate AI (e.g. geo-positioning data not for the exclusive use of the AI) should be excluded from sum of costs approach (in data or as IC borne by the users of the AI).

Embedded AI

- AI is often embedded on a device / machine e.g.in autonomous vehicles, robots, and household devices. It is not possible or practical to separate the AI from the machine.
- So, the same treatment as embedded software.
- If the purchaser needs to pay a regular fee for the use of the AI, then AI under licence can be treated as a fixed asset if “it is expected to be used in production for more than one year and the licensee assumes all the risks and rewards of ownership”

Quality improvements

- The improved predictive ability of the AI is an important productivity increase and this should be reflected in the volume measures.
- If the AI is purchased, the improvement will be matched by a corresponding price decrease in the subscription cost of the improved AI.
- If the AI is owned by the firm outright, the improvement will be reflected in the increased capital service flow from the improved AI.

Classifications: CPC and ISIC

CPC (products)

- Update CPC to include AI
- Update business surveys to collect data on use of AI technologies
- Collect information on expected lifespan of the asset

ISIC (activities)

- The need to update ISIC is less clear as AI is largely developed “in-house” or as part of software development (not a separate AI industry).
- But to understand impact of AI, separate ISIC classes for AI will help

Summary of emerging recommendations

1. AI is produced and falls within the SNA production and asset boundaries. GN recommends recording it together with software.
2. Update the definition of IPPs to include “the creation of intelligent systems..”
3. Include the following definition of AI in the updated SNA/BPM**: “AI is a computer program operating a system capable of recognition and reasoning consistent with human recognition and reasoning.”**
4. AI is closely related to data. GN proposes the cost of producing data sets to train AI be included in the value of data, rather than own-account AI.
5. Reflect AI in the activity (ISIC) and product (CPC) classifications.