



The Impact of Digitalisation on Price and Volume Measures

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1 Introduction

Digitalisation has transformed economies around the world in many different ways: new products are being invented, services are delivered in new ways, existing products change in important characteristics, products are brought to consumers outside traditional outlets, and economic transactions are organised in new ways, for example on e-platforms. The typical roles of producers and consumers are changing and traditional boundaries are getting blurred. In addition, the changes appear to be continuous and fast. Traditional statistical methods are challenged by these new phenomena.

This paper focuses on the impact of different forms of digitalisation of services on the measurement of prices and volumes in national accounts, i.e. the measurement of the volume growth of GDP and important components thereof. Since there is no broadly agreed definition of what digitalisation comprises, this paper discusses several services for which digitalisation is particularly relevant. The items chosen are online streaming, cloud computing, and e-platforms and the sharing economy.

This paper is based on the results of a Eurostat Task Force on price and volume measures for service activities.¹

2 Digitalisation and substitution

National accountants rely – to a large extent – for price and volume measurement on price statisticians to compile detailed and high quality Consumer Price Indices (CPIs), Producer Price Indices (PPIs) and others.

In European countries, CPIs² are generally constructed by following – each month – the prices of a representative basket of goods and services. The prices are observed, for the most part, by visiting outlets that sell those products. Great care is taken that the collected prices are for *the same* products as in the previous month, in order to compute pure price changes, i.e. not affected by any changes in the quality of the products followed. The indices are computed with a formula that also takes into account the importance of each product as indicated by its share in total consumption³. These shares are updated each year.

¹ Final report of the Eurostat task force “price and volume measures for service activities” (2018), available at: https://circabc.europa.eu/d/a/workspace/SpacesStore/5e22faee-ad44-4e14-a919-e555615729c3/DMES_2018-06%20Item%2013%20-%20TF%20prices%20and%20volume%20final%20report.docx

² PPIs generally follow very similar procedures, except that the prices are collected directly from the producers.

³ In practice, the shares are available only for groups of products.

When a product in the sample disappears from the market, it will be replaced in the basket with an equivalent product, if that can be found. Fully new products are introduced in the sample once a year. Generally, the introduction of new products is carried out so that it has no impact on the price index. Changes in the characteristics of products that occur during the year are taken care of by means of quality adjustment techniques, which make explicit or implicit valuations of the changes.

As a consequence of digitalisation price statisticians struggle to capture the large and fast changes in the quality of the products produced and consumed, and with the fact that many products are becoming more and more customised.

CPI compilers take care to properly reflect the shares of the different types of outlets (supermarkets, specialised shops, open markets, online shops, ...) at which consumers buy. A product can have quite different prices in different types of outlets. If certain outlets develop higher market shares, more prices from those outlets will be collected and/or receive a higher weight. When new outlets appear and become important, they enter the sample at the same time that new products are introduced (once a year).

The fundamental question is how to treat the price differences between different types of outlets. For lack of better information, statisticians traditionally assume that price differences between outlets, for the same product, are fully attributable to differences in quality of the services delivered by these outlets (i.e. that the market is perfectly competitive and outlets would charge the same price for the same bundle of product and associated services). Thus, the difference in price between a screwdriver bought in a DIY store and exactly the same screwdriver bought in a specialised shop is equal to the value of the difference in service quality between the DIY store and the specialised shop. In this classic example, most consumers would agree that the specialised shop provides the better service, as its staff is often more knowledgeable and can provide better advice on which screwdriver to buy, justifying the higher price. However, the DIY store can benefit from advantages of scale to be able to sell the screwdriver at a lesser price, which raises doubts about the assumption that the price difference is fully due to quality.

Thus, currently, most substitution between outlets is regarded as volume change. Also, the introduction of new outlets does not lead to a change in price. This methodology, which is rather standard, has often been criticised (see e.g. National Research Council (2002)). One reason for criticism is that new outlets are often cheaper than the old ones, which is automatically interpreted as meaning that they provide a lower quality service. The decline in expenditure caused by shifting to cheaper outlets is entirely treated as a decline in the quality of the services and thus leads to a reduction of the volume of GDP.

Impact of the digitalisation of services

The internet is shifting an increasingly large share of transactions from traditional to on-line stores. Shopping on-line is a different experience from shopping in brick-and-mortar outlets. There are advantages and disadvantages to consumers. Currently, the above described methodology and the fact that products bought on the internet are often cheaper than products bought in traditional shops imply that the shift to on-line shopping results, *ceteris paribus*, in a decrease in the volume of GDP.

In some areas, traditional outlets are at risk of disappearing altogether, in favour of on-line purchases. An example may be airline tickets, for which one used to go to a travel agent, but nowadays are only a few clicks away. If one could agree that this represents a quality improvement for consumers, then the official statistics are underestimating the volume of consumption. On-line banking (and other electronic financial services) has virtually replaced visits to the bank for routine transactions. None of this change is picked up in the volume of GDP.

The internet, in combination with other technological innovations, such as the smartphone, broadband, GPS location services, etc., has also produced a host of new types of services. These fall in two categories:

- *fully new services*, like social media, Google search, Wikipedia, price comparison websites. Such services are often provided totally free (and thereby also excluded from CPIs). Consumers pay indirectly by either providing personal information and/or by accepting advertisements. Discussions are on-going in the national accounts community whether (and if so, how) a value should be imputed for such free services, and, if so, how to measure their price and volume changes;⁴
- *competitors for existing services*. A good example of this is Airbnb, which provides consumers with the possibility to rent out spare rooms or other living space to other consumers. Airbnb competes directly with traditional hotels, although they provide quite a different service. It is clear that an Airbnb service cannot be directly compared to a service provided by a hotel. In price statistics, the two will be seen as different products. The market share of Airbnb, at the moment, is still limited, reducing the need to introduce it into the CPI samples. So far, the ascent of Airbnb has an impact on the CPI only through the presumably downward effect its very existence has on hotel prices. The inclusion of Airbnb in the CPI would have no direct price impact, in line with the above described methodology, i.e. the presumably lower prices of Airbnb would be seen as a lower quality service than the traditional hotels, which is a contentious assumption.

There is one consistent issue in the above examples: through the internet and other technological advances, new or alternative goods and services can be produced in a more efficient way than their traditional counterparts, i.e. at lower prices. These new products are often seen by consumers as improvements to the existing products on offer, at least in some of their characteristics. However, national accounts and price statistics generally assume that price differences can be taken to equal quality differences, i.e. a higher price must imply a higher quality. This fundamental assumption seems less and less appropriate in the modern digital economy.

⁴ For a first discussion on "free digital services", see IMF (2018), pg. 2, 11 and 13.

Example: Uber vs traditional taxis

Uber provides individuals the possibility to use their private cars to provide taxi services. The rides are arranged through a smartphone app. Uber has become, where available, a significant competitor to traditional taxis. The question for statisticians is how to reflect the rise of Uber in GDP and price statistics? Apart from the practical question of getting complete data on Uber transactions, there is the conceptual question of what additional, if any, quality Uber brings to consumers. To determine this, one would theoretically:

- find out what are the characteristics of a taxi ride that people (on average) value most. Options are price, speed, comfort, safety, ease of use, payment options, etc.,
- find a way to measure or evaluate these characteristics, and
- assign a value to them in order to be able to quality-adjust the prices.

It is obvious that this would not be an easy task. Statisticians will have to find more approximate ways to make the comparison.

3 Online Streaming

A new digital service gaining in economic importance is online streaming. Online streaming means constantly receiving the requested data without, or with only temporarily or partly, storing the content on a local device. Content is digitalised and digitally distributed and consumed. When speaking about online streaming in this paper we refer to consumer services only. This is most relevant for motion picture, video, television programmes, music, audio content, software (like online games or online applications) and e-books. While the content may still be the same, digitalisation radically changed supply, demand and processes for this content. In addition, digitalisation also gave rise to new content that didn't exist before, for example blogs and YouTube channels.

When streaming the consumer does not become owner of the content. The relevant feature is that the provider (or distributor) of content acquires from the owner of the intellectual property rights the copyright for specific content (information products) or the reproduction and distribution rights for this content. The consumer acquires the right to use this content in a specific way, and sometimes also for a specified time span. Different business models are possible. Typically the remuneration of the copyright owners (royalty payments) is either determined as a fixed amount per piece downloaded or based on the number of streams for individual works, for example each time one specific song is listened to online. In the business to consumer relation the user usually pays per item (downloaded or streamed) or on a subscription basis (payment per month, per year, etc.). Sometimes a basic service is offered for free, on which the customer has to accept advertisement in return.

Classification

Online streaming of motion pictures, videos and television programmes is classified in CPA 2.1 class 59.11.25 (Streamed video content). Typical examples of these products are Netflix and Amazon

Video. Sound recording and music streaming can be found in class 59.20.36 (Streamed audio content). Examples for this activity are Spotify or Apple Music.

Other online publishing activities, whether streaming or online reading or viewing, have to be classified in division 58 of CPA 2.1 (Publishing services). Online publishing of text, news, pictures should be classified in group 58.1 (Publishing services of books, periodicals and other publishing services). The distribution of audio books (for downloading or streaming) should also be included in this group. Online streaming of software (computer games and other software publishing) is classified in division 58.2.

The broadcasting of internet radio stations is included in CPA class 60.10 (Radio broadcasting services). The broadcasting of television channel programmes over the internet is classified in 60.20.1 (Television programming and broadcasting services). This includes also video-on-demand channels, as offered for example from Sky pay-tv broadcaster.

For consumer price indices, the ECOICOP classification is used in the EU. While the current ECOICOP is somewhat outdated, a revised version agreed at the UN Statistical Commission in March 2018 will bring considerable improvements as concerns digitalisation issues.⁵ The relevant categories, which are still subject to future implementation in ECOICOP, are:

08.3.9.2 Subscription to audio-visual content, streaming services and rentals of audio-visual content

Includes

- streaming services (film and music);
- rental, download or subscription of CDs, video tapes, DVDs, Blurays, software (excluding game software);
- subscription to cable TV, satellite TV, IPTV, and Pay-TV;
- VOD services;
- subscription to TV via decoder and rental of decoders;

09.4.3.1 Rental of game software and subscription to on-line games

Includes:

- rental of game software (games on CDs, DVDs, Blue-rays etc);
- Subscription to play online games (or streaming);

09.5.2.0 Audio-visual media

Includes inter alia:

- downloads of music and films;

09.7.1 Books

Includes inter alia:

- all electronic forms of books (e-books and audio-books);

⁵ For further details please refer to the documents presented at the 49th Session of the UN Statistical Commission, available at https://unstats.un.org/unsd/class/revisions/coicop_revision.asp

- all electronic forms of educational books (e-books and audio-books);

Prices

The CPI: Online streaming services, for example Netflix, Spotify and video-on-demand, are currently included in ECOICOP 09.4.2.3 Television and radio licence fees, subscriptions. This means that in price statistics generally online streaming services are not separately identified.

In the 2017 OECD questionnaire on digitalisation some countries explained that online streaming is not included in the CPI. Consequently it will depend on the countries' individual survey sample plan if and how online streaming services are included in the aggregated index. Secondly, it seems that countries simply price the monthly subscription fee. Necessary data to make a quality adjustment for online streaming is usually not available.

The SPPI: Currently no SPPIs for divisions 58 Publishing activities, 59 Motion picture, video and television programme production, sound recording and music publishing activities and 60 Programming and broadcasting activities are available, following the STS Regulation. For the future it is foreseen to produce SPPIs also for these at two digit levels, but not in a more detailed breakdown.

Quality changes in principle constitute a volume effect and should accordingly be taken into account in the price indices used for deflation. However, this does not mean adjusting for different qualities of the content itself; similarly as cinema tickets would not be adjusted for the quality of the film. In this context it should be taken into account that online content is in most cases dynamic and not static, i.e. it is part of the package purchased that for example a certain number of new films or songs are added every month or year, while others disappear. This would not constitute a change in quality. On the other hand a significant shift in the offer, for example the number of films or songs available is significantly increased or the speed or quality of streaming is significantly improved, should be considered a quality change. Up to now such CPIs or SPPIs have not been developed.

4 Cloud computing

First of all it should be noted that there is no commonly agreed definition of cloud computing. It is a relatively new but rapidly growing service offered over the internet. Users of cloud computing services can be private households or corporations. For private households there is also an overlap with online streaming services treated in the previous section, for example online access to a software package like Microsoft Office.

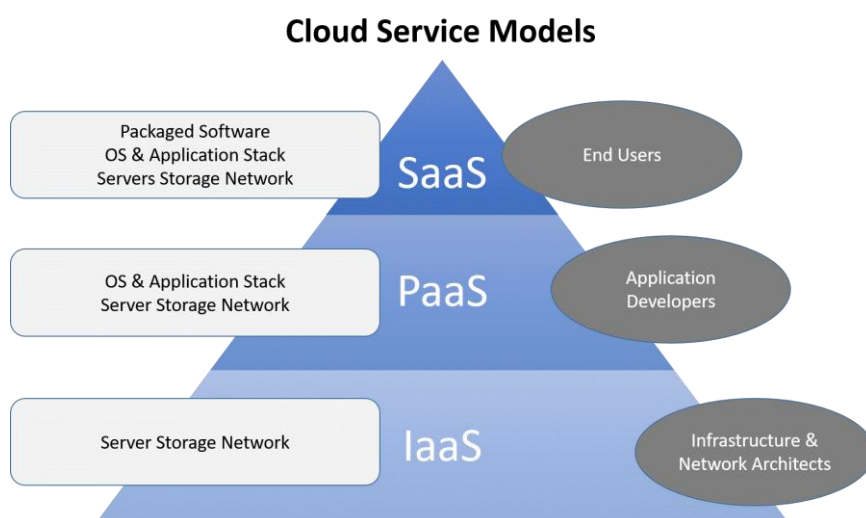
Three types of cloud computing can be distinguished:

- SaaS: software-as-a-service (email, applications for end users), e.g. Office 365;
- PaaS: platform-as-a-service (operating systems, application development, web servers), e.g. Google App Engine which allows users to build web and mobile applications; and
- IaaS: infrastructure-as-a-service (servers, networking, system management).

These services are hierarchical, as depicted in Figure 4.1. The contracts can vary much in duration and level of responsibility offered as a service. Examples of important suppliers of cloud computing services are Amazon, Google and Microsoft. An important aspect is that the supplier and user of the

cloud service can easily be located in different countries; it may even not be exactly clear to the user which unit exactly provides the service and where the supplier is located (it is "in the cloud").

Figure 4.1: Cloud service models



Source: <https://www.uniprint.net/en/7-types-cloud-computing-structures/>

Software, when used in production for more than one year, is a capital asset. An interesting and currently still open question is whether expenditures on software provided as a cloud service should also qualify as capital formation. However, this does not affect the deflation of the output of these services.

Classification

The supply of SaaS should be classified with other software: CPA 58.2 (Software publishing services). PaaS is most likely CPA 62.01 (Computer programming services) while IaaS is CPA 63.11.1 (Data processing, hosting, application services and other IT infrastructure provisioning services).

Cloud services for consumers mainly consist of SaaS and data storage and hosting services which are probably IaaS. In the ECOICOP classification, SaaS will be in 09.1.3.3 (Software), whereas IaaS is currently recorded (by case law) in ECOICOP 12.7.0.4 'Other fees and services'. In the revised COICOP classification agreed at UN level in March 2018 this category is foreseen:

08.3.3.0 Internet access provision services and net storage services (S)

Includes:

- Internet access services provided by operators of wired, wireless or satellite infrastructure;
- cloud storage, file hosting and web hosting services;
- subscriptions for email services;

Includes also

- activation and installation fees and monthly rate;

Prices

CPI: CPIs for software (ECOICOP 09.1.3.3) should include cloud-provided software when this is important. However, for the IaaS-type services no separate indices will be available yet.

An improvement can be expected with the introduction of the updated ECOICOP. However, we cannot expect for the nearest future separate CPIs for IaaS-type cloud computing services consumed by households.

SPPI: SPPIs for NACE 62 and NACE 63 are available, as required by the STS Regulation. But more detailed breakdowns are generally not produced.

Price and volume measures

The output of cloud computing services should be deflated by appropriate producer price indices that cover the specific services provided. These may be different for the different types of cloud computing services:

- SaaS: existing price indices for packaged software (CPA 58.2 or COICOP 09.1.3.3) could be used
- PaaS and IaaS: as long as specific indices for these types of services are not available, producer price indices for computer programming services (CPA 62) and Information services (CPA 63) could be used as proxy.

For the use of IaaS-type cloud services by households (HFCE) the closest possible CPI should be used for deflation.

5 E-platforms and the sharing economy

5.1 Introduction

Currently there is no commonly accepted definition of e-platforms (also referred to as online platforms or digital platforms) but, as described by Martens (2016), from an economic perspective platforms are known as “two-sided” or “multi-sided” markets where two or more types of users are brought together by a platform to facilitate an exchange or a transaction. It becomes “online” when the platform is connected to the Internet and is reachable with any device capable of connecting to the Internet (e.g., computer or mobile phone).

According to the European Commission (2016) online platforms cover a wide range of activities including online advertising platforms, marketplaces, search engines, social media and creative content outlets, application distribution platforms, communications services, payment systems, and platforms for the collaborative economy.

The European Commission goes on to say that online platforms share some important and specific characteristics. In particular:

- they have the ability to create and shape new markets, to challenge traditional ones, and to organise new forms of participation or conducting business based on collecting, processing, and editing large amounts of data;

- they operate in multisided markets but with varying degrees of control over direct interactions between groups of users;
- they benefit from 'network effects', where, broadly speaking, the value of the service increases with the number of users;
- they often rely on information and communications technologies to reach their users, instantly and effortlessly;
- they play a key role in digital value creation, notably by capturing significant value (including through data accumulation), facilitating new business ventures, and creating new strategic dependencies.

It should be noted that merely having a presence on the Internet is not sufficient for a business to be classified as an e-platform.

Of much interest, especially in terms of recent criticisms regarding what is included or not included within GDP, are e-platforms that facilitate the sharing or collaborative economy. The sharing economy is defined in a report from the UK Office for National Statistics (ONS, 2016) as *"activity that is facilitated by digital platforms which enable people or business to share property, resources, time, or skills, allowing them to 'unlock' previously unused or under-used assets. An important function of the sharing economy is that it brings together or matches suppliers to customers"*. The rest of this section will focus on collaborative economy e-platforms.

Verrinder (2016) discussed that existing studies on the collaborative economy have tended to draw a broad definition, to avoid "missing anything", but not to include on-line market places for goods. For example, a study by PwC for the European Commission, published in April 2016, identifies five key sectors (see PwC (2016)):

- Peer to peer accommodation services (households renting unused space, holiday homes)
- Peer to peer transportation (sharing a ride, car, etc)
- On-demand household services (household tasks, food delivery etc)
- On-demand professional services (consultancy, accountancy etc)
- Collaborative finance (crowd funding, peer-to-peer lending)

It appears that the business models of these platforms can differ: either transactions are recorded on a gross basis (booking the full price of the service provided and then taking part of the amount before remitting the remainder to the service provider) or a net basis (retaining a certain percentage of each transaction for their intermediation services). This creates the question of how to consistently record the consumption of the services provided – from the user perspective the cost of renting an apartment includes both the amount paid to the apartment's owner and (if relevant) the accompanying intermediation service fee. A more in-depth analysis of how to record Uber and Airbnb transactions within the national accounts will be discussed in the next sections.

The PwC analysis estimates that in the European Union in 2015, the transaction value of the services facilitated by collaborative economy e-platforms totalled 28.1 billion euros, equivalent to 0.2 percent of GDP (see Table 5.1). Although this seems comparatively small, the sector had a growth rate of 77 percent between 2014-2015. Also, the revenues received by the collaborative economy e-platforms amounted to 3.6 billion euros, with a growth rate of nearly 100 percent between 2014-2015.

Table 5.1: Revenues and transaction values facilitated by collaborative economy platforms in Europe, 2015, millions of Euros

Activity	Revenue of platform	Value of service provided
Peer-to-Peer Accommodation	1 150	15 100
Peer-to-peer Transportation	1 650	5 100
On-demand household services	450	1 950
On-demand professional services	100	750
Collaborative Finance	250	5 200
TOTAL	3 600	28 100

Source: PwC (2016), Figure 1.

5.2 Uber

This section elaborates on the recording of Uber in the national accounts, as an example to the general issues involved in the treatment of digital platforms. The aim is to develop guidance on price and volume measures, but, in order to be able to do that, the current price recording needs to be clarified first.

Hence, we'll discuss first the classification of Uber, before elaborating an example of the recording of Uber in supply and use tables, and then discuss possible deflators.

The classification issue

Uber presents itself as a technology platform enabling users of their apps or websites to arrange transportation services with independent third party transport providers. However, this will mostly differ from the perception of users, who will see Uber as a transportation service provider. Also, Uber competes with traditional taxis. Uber drivers, even if formally independent, may consider Uber to be their employer (as their source of income is generated by Uber). It is these different perceptions of the different actors involved in Uber transactions that complicate the classification of these transactions.

On 20 December 2017, the European Court of Justice settled the classification of Uber from a legal point of view. It ruled that Uber provides more than an intermediation service as the use of the app is indispensable for the service to take place and Uber exercises decisive influence over the conditions under which the drivers provide their services. It therefore finds that the “intermediation service must be regarded as forming an integral part of an overall service whose main component is a transport service and, accordingly, must be classified not as ‘an information society service’ but as ‘a service in the field of transport’”⁶.

It is this combination of providing an intermediation service and involvement in the provision of the transport service that stands Uber apart from e.g. travel agencies. In terms of CPA version 2.1, the

⁶ https://curia.europa.eu/jcms/jcms/p1_653286/en/

service is a combination of 49.32.1 (Taxi operation services) and 79.11.1 (Travel agency services for transport reservations) or 79.90.3 (Other reservation services n.e.c.). The current CPA does not provide for precisely such a combination.

Hence, it needs to be decided in which of the current CPA classes Uber's services should be classified (and as a consequence in which NACE category Uber belongs). In this respect, it should be noted that in Europe, all Uber transactions appear to be invoiced by Uber BV, Netherlands, the European head office of the company. Uber has offices in other European countries but they appear to provide advertising services or programming services. Their classification should be in line with their main activity. So the main classification question only concerns the Dutch head office.

Below, we'll analyse the possible recording of Uber in supply and use tables following different classifications.

Recording of Uber in supply and use tables

Below some options for the recording of Uber payment flows in the supply and use tables are set out. It is assumed, for simplicity, that Uber is based in the same country as the consumer and the taxi driver. In reality, the service provided by Uber should in most cases be seen as an import.

A household buys a Uber ride for 50 euro. From this, Uber pays the taxi driver 30 euro, keeping 20 euro as the intermediation fee.

a1) Treat Uber as a taxi company with self-employed drivers

Supply			Use			
	NACE 49			NACE 49		
	Driver	Uber		Driver	Uber	HFCE
CPA 49	30	50	CPA 49	30		50
			value added	30	20	

It is assumed that the taxi drivers are self-employed, providing a service to Uber. A small disadvantage of this treatment is that the total gross output of taxi services includes a double counting of the amount produced by the taxi driver (because taxi services are used as intermediate consumption to produce taxi services).

a2) Treat Uber as a taxi company with employees

If the taxi drivers are to be seen as employees of Uber, the recording would be:

Supply			Use		
	NACE 49			NACE 49	
	Driver	Uber		Driver	Uber
CPA 49		50	CPA 49		
			value added		50

b) Treat Uber as providing intermediation services to the taxi driver

	Supply			Use		
	NACE 49	NACE 79		NACE 49	NACE 79	
	Driver	Uber		Driver	Uber	HFCE
CPA 49	50		CPA 49			50
CPA 79		20	CPA 79	20		
			value added	30	20	

In this recording, the taxi driver is seen to purchase services from Uber. This does not correspond to the actual payment flows.

c) Treat Uber as providing intermediation services to households

	Supply			Use		
	NACE 49	NACE 79		NACE 49	NACE 79	
	Driver	Uber		Driver	Uber	HFCE
CPA 49	30		CPA 49		30	
CPA 79		50	CPA 79			50
			value added	30	20	

Here, the household pays Uber for intermediation services provided, who in turn purchases taxi services as intermediate consumption. The household expenses have to be reclassified from taxi services to intermediation services.

d) Split the transaction in two parts

	Supply			Use		
	NACE 49	NACE 79		NACE 49	NACE 79	
	Driver	Uber		Driver	Uber	HFCE
CPA 49	30		CPA 49			30
CPA 79		20	CPA 79			20
			value added	30	20	

Now, the household is seen to have two transactions: one directly with the taxi driver and one with Uber. It may be difficult in practice to reallocate household expenditures in this way.

Note that in these options we adhere to the NACE rule that the classification of a unit follows its dominant output. More options would be available if we allowed, for example, Uber to be classified as an intermediation company while still producing mainly taxi services:

e) Treat Uber as an intermediation company that produces taxi services

	Supply			Use		
	NACE 49	NACE 79		NACE 49	NACE 79	
	Driver	Uber		Driver	Uber	HFCE
CPA 49	30	50	CPA 49		30	50
CPA 79			CPA 79			
			value added	30	20	

A final option is to see Uber as a trader of taxi services, producing a margin:

f) Treat Uber as merchanter of services

Supply			Use				
	NACE 47	NACE 49	trade margin		NACE 47	NACE 49	
	Uber	Driver			Uber	Driver	HFCE
CPA 47	20		-20	CPA 47			
CPA 49		30	20	CPA 49			50
				value added	20	30	

However, opinions are divided on whether SNA 2008 would allow this option.

Price and volume measures

The choice between the options also impact on the choice of deflators. It should be noted first of all that Uber will likely be included in consumer price indices for taxi services. The HICP, for example, uses COICOP as classification and thus classifies transactions by purpose. COICOP does not have categories for reservation services. So for deflation of consumption using CPIs, it would be best to follow either options a) or b) above. (However, this does not answer the question how to deal with the substitution of traditional taxis by Uber – see the discussion in section 2)

Producer price indices are based on NACE; it is likely that no countries have yet included Uber. However, if the Uber fee is a percentage of the trip fare, compiling a price index for this fee is conceptually not complicated (the difficulty is of course getting information on the actual percentage).

Conclusion

From a statistical perspective⁷, option b), which considers that Uber provides an intermediation service to the taxi driver, while consumers purchase taxi services, would be an appropriate recording. This would provide a coherent deflation method for consumption, as well as for the output of taxi drivers. The intermediation service of Uber itself will need to be included in the service

⁷ It should be clear that statistical recording is not to be seen as drawing into question judicial decisions such as the case cited above.

producer price indices. The price index used for deflation in this case needs to combine the change of the underlying price for the taxi service and the change in the percentage fee for intermediation services.

Option d) is a good alternative, provided data can be obtained to distribute household expenses over the taxi service and the intermediation service.

If, at some point, it is decided that Uber drivers are legally to be seen as employees of Uber, and thereby have all the rights and responsibilities of employees (e.g. for social contributions) then for consistency reasons option a2) seems to be the only solution.

5.3 Airbnb

Hiemstra (2017) elaborates on the recording of Airbnb in the Dutch national accounts and focusses on the measurement aspects. Airbnb is an American company, which operates an online marketplace enabling people to lease or rent short-term lodging. The company was established in 2008 and is active in the Netherlands since 2009. The use of Airbnb services has grown fast in the Netherlands.

As regards the recording in supply and use tables, Statistics Netherlands treat Airbnb and similar platforms as a reservation service providing intermediation services to the home owner, resp. to the guests, corresponding to option d) in section 5.2. This does not correspond to the actual payment flows. People who rent accommodation pay the price of the accommodation service to Airbnb, plus an intermediation fee (6 to 12 percent of the accommodation price, depending on the amount). Airbnb then pays the home owner the price of the accommodation service less the intermediation fee it charges to the home owner (3 percent of the rent charged to the guests).

Besides the classification of Airbnb itself, it is also important to look at the classification of the services produced by households (as unincorporated enterprises). Statistics Netherlands classify these as accommodation services and reduces owner-occupied dwelling services to avoid double counting. This is in line with existing ECOICOP guidance. However, as e.g. employment related to Airbnb services is negligible, this has an impact on labour productivity measures for accommodation services. For this reason, Statistics Denmark has chosen to include these services under dwelling services, treating it basically in the same way as renting out to tenants. In principle, then only a mark-up is required to cover the surplus for households in renting out their residency. The classification discussion is GDP neutral, but may have an impact on the choice of deflators and hence volume growth rates.

Price and volume measures

Until now, the issue of developing appropriate price and volume measures in this context has not been given much thought. Conceptually, the compilation of a price index for intermediation services by Airbnb is not complicated, as the fee charged is a percentage of the rent. Statistics Netherlands does not yet compile a specific price index for Airbnb accommodation, so for the time being the

price index for hotel rooms is used as a proxy.⁸ In the short term this seems a reasonable approach, as the two are likely to experience the same seasonal pattern. Since Airbnb covers a range of different types of short term accommodation, a broader index covering holiday homes, caravan parks etc. may be more representative. Presently, conclusive evidence whether this is a suitable proxy over the long term is lacking.

In order to calculate the volume change for the accommodation service and the service fee charged by platforms like Airbnb it needs to be taken into account that the fee is calculated as product of the value of the underlying accommodation service and the percentage fee. The calculation of prices and volumes can, in principle, follow the methods described for ad valorem taxes in chapter 3.10 or the description for real estate agents in chapter 4.12.1 of Eurostat (2016). That implies that a price index for the fee combines the change in the price of the accommodation service and the change in fee percentage.

The possibility of substitution bias may be a bigger problem. It is believed that an Airbnb rental is significantly cheaper than comparable hotel accommodation. If this is true, and if consumers have switched to the cheaper accommodation, conventional price and volume measures will miss this effect and the resulting price index will be upward biased and consequently, the volume index will be downward biased. Further research is necessary to determine how this potential bias could be captured. See also section 2 for a discussion.

6 Conclusions

This paper discussed a variety of different aspects related to digitalisation. On the basis of these discussions, we can draw some conclusions:

- It is important to be aware of the risk of substitution bias related to the emergence of new products, the “digitalisation” of existing products or the increase in on-line shopping. In principle, in each case, an evaluation should be made whether new products or outlets constitute quality changes or not. One should be careful with the default assumption that a higher price implies a higher quality.
- Streaming services are becoming more important and will thus need to be reflected in price indices. Normal updates of the offered content are not to be seen as quality changes as they are deemed to be part of the service. On the other hand a significant shift in the offer, for example the number of films or songs available is significantly increased or the speed or quality of streaming is significantly improved, should be considered a quality change.
- Cloud computing services should, if possible, be separated in the three types described in section 4; the recording and deflation depends on the type of service.
- E-platforms like Uber and Airbnb, should be considered as providing intermediation services between households as producers and households as consumers. These intermediation services should be deflated with price indices combining changes in the fee percentages

⁸ An approach chosen by the Australian Bureau for Statistics for collecting price information on the e-platforms, but not differentiating between underlying service and intermediation fee, can be found in Kidd et al. (2018)

charged and changes in the prices of the underlying services. The services produced by the households should be deflated with dedicated price indices for these services (mostly still to be developed), or alternatively, with price indices for taxi and accommodations services, resp., as proxy. Compilers should be aware of the risk of substitution bias.

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