К ПУБЛИКАЦИИ СТАТЬИ НАДИМА АХМАДА И ПОЛА ШРЕЙЕРА «ПО-ПРЕЖНЕМУ ЛИ КОРРЕКТНО ИЗМЕРЯЕТСЯ ВВП В ЭПОХУ ЦИФРОВИЗАЦИИ?» (NADIM AHMAD AND PAUL SCHREYER «IS GDP STILL MEASURED CORRECTLY IN AN ERA OF DIGITALISATION?»)

Внедрение цифровых технологий во все аспекты жизни общества в настоящее время становится одной из фундаментальных особенностей развития цивилизации. Соответственно, разработка методологии отражения этого принципиально нового качественного феномена при формировании социально-экономических показателей приобретает значение одного из магистральных направлений современного развития статистики. В отечественных изданиях, в отличие от ряда зарубежных, пока немного публикаций по этой теме. Не сложилось еще даже устойчивого удобного - краткого и точного - русскоязычного термина, соответствующего англоязычному «digitalisation», обозначающего понятие «процесс внедрения цифровых технологий». Не претендуя на окончательные формулировки, используем для этого понятия термин «цифровизация».

В статье Н. Ахмада и П. Шрейера - статистиков из ОЭСР, входящих в современную мировую элиту специалистов по национальным счетам, рассматривается проблема совершенствования расчетов ВВП с учетом новой реальности, формирования цифровой экономики. Важным достоинством статьи является то, что в ней представлено системное описание тем, требующих рассмотрения для развития расчетов ВВП в контексте все более расширяющейся цифровизации.

Авторы подчеркивают, что одной из главных характеристик цифровой экономики являются прямые («пиринговые») операции между потребителями (физическими лицами) на основе интернет-взаимодействия, обеспечиваемого корпоративным сектором. В качестве наиболее известных примеров можно назвать систему заказа такси «Uber» или систему найма жилья «AirBnB». Безусловно, услуги, предоставляемые домашними хозяйствами друг другу в области аренды жилья, транспорта, торговли подержанными товарами и др., по методологии СНС всегда включались в ВВП. В условиях цифровизации экономики радикально увеличивается объем этих рынков и перед статистиками встает задача не столько совершенствования методологии, сколько ее практической реализации, обеспечивающей корректный учет новых объемов услуг, а также обоснованную оценку оплаты услуг интернет-посредников. В статье обсуждаются эти вопросы применительно к рынкам аренды жилья, транспортных услуг, торговли, финансового посредничества.

Актуален анализ влияния цифровизации на корректность учета деятельности домашних хозяйств как производителей. Авторами статьи, в частности, поднимается вопрос относительно такого базового положения методологии СНС, как определение границ производства, а также разграничения предметов длительного пользования на потребительские товары и элементы основного капитала, и др. Большое внимание уделено обсуждению новых моделей финансирования, складывающихся на основе цифровых технологий. Отдельно рассматриваются вопросы учета трансграничных потоков интеллектуальной собственности и активов, опирающихся на знания, а также вопросы электронной торговли. Особое внимание уделяется новым проблемам измерения реальной динамики ВВП, возникающим в связи с цифровизацией экономики.

В целом статья представляет несомненный профессиональный интерес для отечественных статистиков.

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IS GDP STILL MEASURED CORRECTLY IN AN ERA OF DIGITALISATION? *

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Recent years have seen a rapid emergence of new disruptive technologies, with digitalisation being a common characteristic. These include new platforms that facilitate Peer-to-Peer transactions, new activities such as crowd sourcing, a growing category of the 'occasional self-employed' and prevalence of 'free' media services, funded by advertising and 'Big data'. Against a backdrop of slowing rates of measured productivity growth, this has raised questions about the conceptual basis of GDP and whether current compilation methods are adequate.

This paper examines the statistical challenges posed by digitalisation. It delineates between conceptual and compilation issues and highlights areas where further investigations are merited. The overall conclusion is that, on balance, the accounting framework for GDP looks to be up to the challenges posed by digitalisation. Many practical measurement issues remain, however, in particular concerning price changes and where digitalisation meets internationalization.

Keywords: System of National Accounts, GDP, digitalisation, measurement, productivity, prices, sharing economy.
JEL: E01, E20, E31, C80, H26, I30, O3, O47.

1. Introduction – the digitalised economy

Recent years have seen a rapid emergence of new and often disruptive information and communication technologies with new forms of intermediation, service provision and consumption that have become generally characterised as the Digitalised Economy [15], continuously redefining and transforming the way we work and indeed live. But there are increasing concerns that, as ubiquitous as it is, it is in large part absent from our statistics. The advent of new digital innovations, such as Big Data, was expected to spark off a new wave of productivity growth, similar to those seen in the past, *e.g.* as a result of electrification, and the ICT wave in the 1990s but this has not, at least yet, materialised, raising a number of questions. Some of these relate to better understanding the role that these new technologies play in fostering productivity and economic growth, such as whether potential benefits are lagged, and the mechanisms and policy levers that can be pulled on to ensure that maximum benefits can be extracted. But many, and increasingly so, relate to measurement.

These concerns are of course understandable. The scale and pace of digitalisation impacts not only on the way in which businesses operate but also on the way in which consumers engage with businesses and with each other. For businesses, digitalisation provides scope for improvements in production processes and access to new markets, but digitalisation itself has also spawned many new businesses, and ways of doing business, whilst also providing significant scope for profit shifting across international borders. And digitalisation has also impacted on the role of the consumer, with households increasingly engaging in intermediation services that blur the divide between pure consumption and participative production.

This paper attempts to address the multitude of measurement issues raised by digitalisation, particularly in light of the productivity slowdown observed in recent years [14], which has occurred at a time of rapid technological change, increasing participation of firms and countries into global value chains, and rising education levels in the labour force, all of which are generally associated with higher productivity growth. These seemingly contradictory facts have revived the debate on whether the productivity slowdown is a transitional phenomenon, longer-term condition, or indeed a function of mis-measurement. However, it is important to note that the slowdown is not a recent phenomenon and indeed predates both the crisis and the current technological wave characterised by the

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digitalised economy. Of course this does not necessarily mean that mis-measurement is not an issue, rather it indicates that at best it cannot be singled out as the sole culprit [5]. The remainder of this paper investigates the scope for mis-measurement looking individually at a range of transactions that characterise the digitalised economy.

2. New forms of intermediation of peer-to-peer services

Although there is as yet no single definition of the digitalised economy there is at least a broad convergence around the idea that one of its manifestations is peer-to-peer (consumer to consumer) transactions facilitated by web-based intermediaries in the corporate sector. Perhaps the best known examples today are Uberpop and AirBnB but others such as e-Bay have provided similar intermediation services for considerably longer.

Despite the new lexicon 'sharing economy', 'Uberisation', etc. it is important to recognise that the underlying transactions are in and of themselves not new. Households have long engaged in peer-to-peer transactions such as the provision of dwelling rental services, the provision of taxi services (often unlicensed), and the sale of second hand (and indeed new) goods (*e.g.* via car boot sales and classified adverts). And GDP, at least conceptually, captures all of the related transactions and value-added created.

What is different about today's digitalised economy is the scale of these transactions. For instance, AirBnB now has a market capitalisation close to that of Hilton Hotels group. Such developments are driven both by the opportunities provided by web-based intermediaries to reduce entry barriers, increase market size and minimise risks (both for the providers and the producers of the related services), and the explosion in computing power and access to broadband that has facilitated consumer access.

The question therefore is not whether the conceptual accounting framework for GDP includes these transactions, rather it is whether the compilation practices are sufficiently robust today. Many of the characteristics of the 'sharing' economy, as described above, are common to informal economy transactions, *i.e.* transactions between unincorporated enterprises. But one aspect that differs concerns the role of the intermediary. The first question, therefore, is whether the current tools available to statistical offices can accurately capture the intermediation fees charged by the new digital intermediaries. To the extent that the intermediaries are in scope for traditional business surveys, their activity is likely to be as well captured in the accounts as other registered entities. Where the entities are not registered in the national territory and, so, the transactions between households and the intermediary are cross border, other complications (not unique to the sharing economy) may arise (as discussed below).

Four generalised modes of Peer-to-Peer (P2P) transactions, differentiated by the underlying activity of the sharing economy are considered below. A fifth mode relating to Business to Business and Business to Consumer transactions is also considered.

2.1 Dwelling services

To what extent statistical information systems are able to accurately measure the scale of market transactions in dwelling services between households is difficult to say. Certainly in most countries the provision of such services is often accompanied by a requirement to register the related income for tax purposes. For long-term lettings, especially those facilitated by letting agencies, there is not likely to be a significant degree of under-recording, however this may not be the case for short-term occasional lettings. Prior to the advent of specialised (digital) intermediaries these infrequent lettings are likely to have been relatively small in scale and may not have been recorded exhaustively; indeed in some countries legislation permits tax-free letting services beneath a certain threshold. The advent of AirBnB has almost certainly increased the scale of these activities but there are two important factors to consider in assessing their impact on GDP.

The first and perhaps most important concerns the imputation already included in the national accounts for dwelling services (owner-occupied rent). These estimates assume that owner occupiers occupy their homes full-time, so, in theory, any unrecorded activity from short-term market lettings, such as those that typify AirBnB-type transactions, will, at least in part, be covered by the imputation for owner-occupied rent. Some value of output will go amiss however as short-term rentals are likely to fetch a higher value than the longer-term rental values that underlie the estimates for owner-occupied housing. These differences will reflect additional mark-ups including charges in return for the use of fixtures and fittings (*e.g.* furniture, Wi-Fi access) and associated labour input. More evidence is needed to gauge the importance of these mark-ups.

The second relates to the administrative nature of the intermediaries themselves and the scope they

provide to improve measurement. Whereas in the past, infrequent short-term lettings were unlikely to have been recorded, registration via intermediaries is likely to increase the propensity for individuals to declare income to the tax authorities, especially in countries where VAT or a consumption tax is applied. AirBnB invoices, for example, include the name and address of the household engaged in letting services. Moreover the intermediaries themselves are also likely to have to declare their turnover, either directly for corporation tax, VAT and consumption tax[1] purposes or indirectly for occupancy or tourist tax purposes.

It will be important for countries, and in particular those with data-sharing arrangements with the tax authorities, to capitalise on this source of information to develop estimates of any additional value of dwelling services that may arise in conjunction with new forms of transactions. At the same time, national accountants should be careful to avoid any double-counting of activity already included in imputed rent.

2.2 Business and transportation services

One important feature of the sharing economy is the role of intermediaries in bringing together unincorporated service providers (typically the self-employed) and households (consumers). The best known example is Uberpop but there are many other (and increasingly so) operators in this market.

Again, the underlying activities in and of themselves are not new, and have been traditionally captured using the numerous approaches related to the informal and non-observed economy. Typically, for unincorporated units this has meant using labour force surveys that capture the income of the self-employed and also secondary activities of employees. Often these estimates are augmented with household expenditure surveys used in supply-use tables. But where the activities involve an agreement between the two parties to engage in a cash transaction that avoids the payment of tax, notably VAT, it is unlikely that the activity will be recorded in GDP at all. However, partly offsetting this, at least for productivity measures, is the likelihood that the associated labour input will also be unrecorded.

The emergence of a wide host of intermediary service providers that link consumers to producers, coupled with increased and widespread broadband access, is likely to have significantly increased the scale of these activities by, typically, the 'occasionally self-employed', requiring an examination of new approaches to measurement. Labour force surveys may continue to provide a useful vehicle for measuring these activities but they can only ever present an approximate approach and given the potential (and still uncertain) scale of these activities it may be necessary to identify complementary sources.

However, as was the case for dwelling services, although the intermediaries themselves may have increased the size of a long-standing measurement problem they may also provide a solution. This is because their turnover will reflect the underlying activities conducted, and additional administrative information may also be available relating to hours worked and sector of activity. Countries are encouraged to explore the feasibility of using data collected by intermediary service providers to improve the estimates of activities of unincorporated enterprises providing transportation services.

One additional complication presented by the growth in these activities concerns the nature of the underlying goods used to provide the services. The most important concerns motor vehicles used to provide occasional taxi-services, which raises issues concerning the delineation of consumer durables and gross fixed capital investment (dealt with below).

2.3 Distribution services

A third important platform of the sharing economy relates to intermediaries (such as e-Bay) bringing together buyers and sellers of goods (typically second hand but also new). Where these transactions concern unincorporated enterprises (below an administrative threshold) and households, in most countries, the standing assumption is that the distribution margin (in practice the value-added) is negligible or indeed zero. So, for example, if a household sells a second hand car via private listings to another household, the transaction will generate no recorded value-added by the household. If the activity relates to the buying and selling of a new good (and again for small scale activities) it is also unlikely that any value-added will be recorded.

Once again, the increased scale of transactions facilitated by digitalisation may require a different approach to measurement. However, to some extent, there is a natural barrier of sorts to the size of the problem. For those unincorporated enterprises able to

[1] AirBnB charges VAT on its service fees for customers from the European Union, Switzerland, Norway, Iceland, and South Africa and Japanese consumption tax for customers from Japan and collects an occupancy tax in Amsterdam, San Francisco and Portland.

achieve scalability there is an increased likelihood of registering their activity for tax purposes, especially if they cross the VAT registration threshold and almost certainly if their customer base expands to corporations. For all other unincorporated enterprises, the assumption remains that transactions for each unit are not likely to be significant. The convention of not recording any value-added in these cases continues to appear reasonable.

2.4 Financial Intermediation Services

Crowdfunding and the more narrowly defined Peer-to-Peer lending have emerged as not insignificant new sources of alternative financing in recent years. The latter refers specifically to intermediaries providing, in essence, liquidity transformation services, linking creditors and borrowers, while the former captures in addition broader forms of financing that typically reflect equity based stakes, or other explicit rewards, for creditors (again typically through an intermediary, and so share characteristics with venture capital vehicles).

Again, notwithstanding issues relating to cross-border trade, the value-added of the intermediaries, typically captured through explicit fees, will be, at least in theory, captured in GDP. On the other hand, the creditors and borrowers engaged in P2P transactions either seek higher returns (creditors) or access to finance and lower rates of borrowing (borrowers) and so are engaging in productive services typically associated with financial intermediaries such as providing liquidity, transforming maturities and accepting risks. But these are only recorded within GDP when performed by financial intermediaries, reopening questions on the scope of the System of National Accounts (SNA)[2]; although direct comparability with services provided by banks remains overly simplisti, as banks also provide a whole host of other services (convenience services such as offering safe deposits, the use of cash machines, accounting services etc.)

Notwithstanding delineation issues on the SNA production boundary, although still relatively small[3], the size of the activity is likely to increase over time, warranting an improved understanding of the size of P2P lending across countries, at least relative to conventional lending, appears to be warranted.

2.5 Other intermediaries

Digital intermediaries are not of course only concerned with household-to-household transactions. Many intermediaries are engaged in linking producers to consumers, where at least one party is a corporation. Notwithstanding potential cross-border complications (discussed below), these, in isolation, present little conceptual or measurement difficulties. The appearance of new, web-based intermediaries in the corporate sector, merely results in a shift of intermediation revenues and value-added from traditional providers (such as a travel agent) to web-based providers (such as Booking.com), and as long as the institutions are recorded in administrative registers (as they would almost certainly be for large-scale players and those that engage in transactions with other corporations) their activities should be recorded in the national accounts. Note that the amounts involved here are the margins or service fees charged for the intermediation, not the value of the transacted service itself (such as the accommodation fees for hotel rooms or private accommodation rentals).

3. Consumers as producers: blurring the production boundary

The pervasiveness of internet access by households has blurred the traditional borderlines between household production for market purposes, own account production, consumption, and leisure. Increasingly households are involved in activities that would previously have been included in GDP because they were carried out by a market operator. Perhaps the best example is the use of internet search engines or travel websites to book flights and holidays. But there are many other examples that merit consideration under this broad umbrella: self-check in at airports, self-service at supermarkets, cash withdrawal machines and on-line banking to name but a few.

These innovations have all helped to transform the way consumers engage with businesses and brought with them associated benefits but they also involve greater participation on the part of consumers, and indeed involvement in activities that used to be part of the production process[4]. Because the involvement of

[2] See for example, http://unstats.un.org/unsd/nationalaccount/aeg/2013/M8b-2.pdf.

[3] For example Price Waterhouse Coopers estimates P2P turnover (reflecting the commission and not the underlying lending flows) in 2013 at $163 million in the United States, equivalent to 0.14% of the total value added in the Finance and Insurance industry).

[4] However it is important to recognise that prior to digitalisation, consumers were not entirely detached from the production process, either. They would still have to look at the proposals for example made by the travel agent and wait in long queues to cash in cheques or withdraw money, so one could make an argument that in some cases digitalisation has decreased the participation of consumers in the production process (at least in terms of time spent).

the consumer displaces traditional activity, the question is whether this increased 'displacing' participation should be included in GDP, one of the main arguments being that GDP would be higher, for example, when a travel agent acts as an intermediary to conduct the search compared to when the individual conducts the search his/herself.

By convention the simple answer is no, and so current estimates of GDP, as defined, are not affected by the inability to record these participatory activities. Moreover the issue relating to lower/higher GDP depending on whether the consumer conducts the activity or not is neither new nor without precedent. There has been a long standing critique that many services provided by households for their own consumption (cooking, cleaning, baby-sitting, shopping) could in theory be provided by a third-party and so should be included in GDP. This has not happened, partly on the grounds that they would create other distortions to GDP that would significantly reduce the usefulness of GDP for macro-economic policy making, and partly because of the valuation difficulties[5] involved. Instead the approach and response of the national accounts community has typically been to encourage the development of satellite accounts that capture these non-market household services as a tool to provide improved insights into material well-being and a complementary view of GDP.

That is not to say however that this resolves all of the problems. For instance, the increased participation of consumers in activities suggests that there may have been quality changes in the final services provided, requiring a careful consideration of the implications on volume estimates of GDP.

4. Consumer durables and investment

The increased participation of households in informal activities brings with it questions related to the delineation of dual use consumer durables and gross fixed capital formation. The SNA does not provide prescriptive guidance on when durables should be included as investment when they are used by households both for own-use and also in production. As such it is not clear whether current national compilation systems are able to capture increased investment that may have taken place by households in their capacity of producers. A reclassification of consumer durables as investment does not affect GDP but has a direct bearing on measures of capital, and by implication, multi-factor productivity. A better understanding of how countries make the relevant distinction and the source information used would clearly be welcome in order to assess the potential impact on productivity measures.

5. Free and subsidised consumer products

Free digital products for consumers are frequently put forward as examples of output or consumer welfare that goes unnoticed in GDP figures. Such products include free apps for smartphones or tablets and free search capacity provided by websites such as Google. For instance, Brynjolfsson and McAffee [4] argue that

> *"[...] There is a huge layer of the economy unseen in the official data, and for that matter, unaccounted for in the income statements and balance sheets of most companies. [...] the trends in the official statistics not only underestimate our bounty, but in the second machine age they have also become increasingly misleading."*

To frame this discussion, it is important to note that the provision of free services by corporations to households is not a new phenomenon[6]. Households have long become accustomed, for example, to receiving free media services (television and radio) financed implicitly via advertising. In this sense, digitalisation has merely increased the scale of free or subsidised. But digitalisation has brought with it another complexity, relating to the mode of financing. Whereas in the past the financing model was driven by advertising revenues or an attempt to create brand awareness, today's models are also increasingly financed by the acquisition of Big Data (on consumer preferences, characteristics and spending patterns). These two modes of 'finance' are considered in turn below.

5.1 Financing via advertising

Financing via advertising involves a triangular set-up between the service provider, consumer and advertiser (see Figure 1). The free (or subsidised) product is put at the disposition of the consumer and financed by advertising services for which there is an explicit transaction between the service provider and the advertising company. Assuming, for simplicity, that the services are provided for free, the sales generated by the service provider correspond to the value of advertising services. Implicitly, therefore, the value of the free service pro-

[5] See Ahmad and Koh [1]; Schreyer and Diewert [23].

[6] See Vanoli [25] or #A4.16 of the Research Agenda of the System of National Accounts [9].

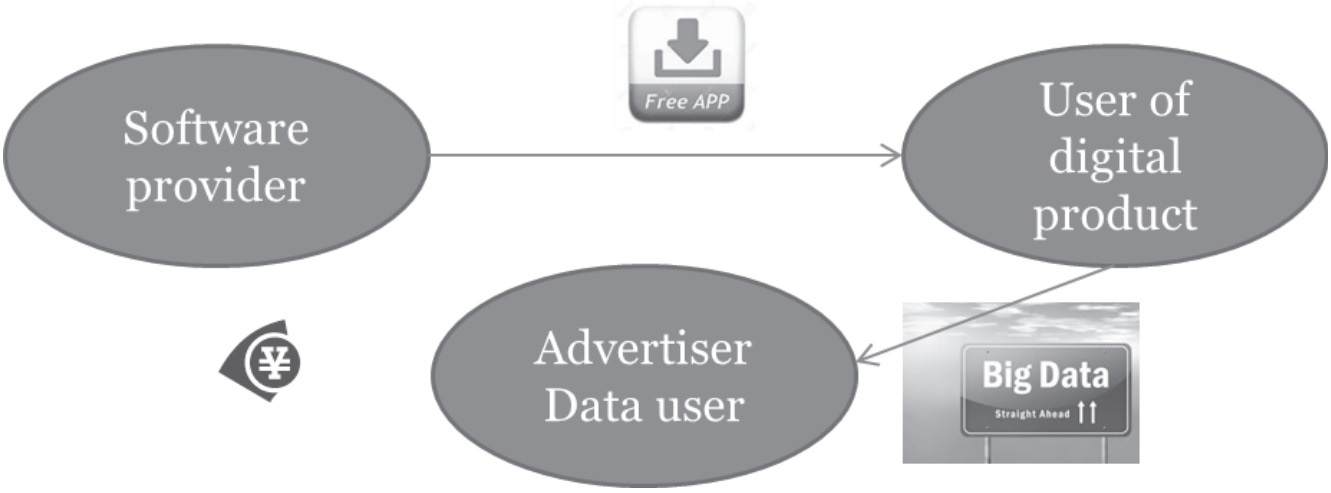

Figure 1. **Free products and triangular transactions**

vided to the consumer can be equated with the value of the corresponding advertising services.

Because there is no explicit payment by the consumer there is an argument that GDP is underestimated by the value of the free services received. Certainly GDP would be lower compared to the counterfactual, where advertising revenues are not used to subsidise the service. But this, to some extent overlooks the fact that, under the 'free' model, the consumer does indirectly pay through the higher prices paid for advertised products (as the firms paying for the advertising recoup their costs). In which case, other things being equal, overall GDP would be equal in both cases; the only difference being different consumption patterns of consumers in the two cases.

Nakamura and Soloveichik [13] put forward a different (albeit similar) proposal (of particular interest because it provides estimates) that equates the time spent by households watching advertisements as an act of production, for which they are paid by the advertising firm, and in turn pay for the (previously free) services to the service provider. Consequentially, under this proposal, no explicit transaction would be recorded between the service provider and the firm paying for the advertising service, and both GDP and household consumption would be higher.

The authors impute a value of production by unincorporated household enterprises equal to the value of advertising receipts and use data on advertising expenditure for different media, along with an estimated price index to gauge the quantitative impact of recording household production in this way on real GDP growth. Across about 80 countries, the imputed services consumed by households grew considerably faster (at 6.7% per year) than overall GDP in real terms, although as they note, because of the relatively low share of advertising-supported entertainment in GDP the imputation has a negligible impact on GDP growth. It is also interesting to observe that the nominal GDP share estimated by the authors has been remarkably stable over the last three decades, indicating that the exclusion of an imputation for advertisement-financed free services does not create a systematic downward bias in real GDP growth.

However, the Nakamura and Soloveichik proposal stretches the third-party criterion of the accounting framework to its limits, as ultimately the effect is to engage in an activity that increases one's own propensity to consume advertised products (and only indirectly has a third party effect if households engage in convincing others to buy the goods). In addition it is necessary to consider the proposal in the context of long-standing considerations relating to the possible inclusion of brands as produced assets in the accounting framework, which could result in a double counting of expenditures on advertising.

Moreover the proposal necessarily ignores the captive nature of households and the fact that they have little control of the price charged for their services, which ultimately is determined by the service provider. There are also complications pertaining to the actual valuation of the imputed flows of consumption, income and production. The accounting proposals typically assume that the value of the 'free' products equals the observed value of advertising services but this producer-based valuation may not correspond to a consumer based valuation[7].

[7] For estimates in OECD countries see Ahmad and Koh [1], Fraumeni [10] or Landefeld, Fraumeni and Vojtech [12]; for a recent theoretical treatment see Schreyer and Diewert [23].

Whatever the precise measurement, it is clear that consumer valuation should not attempt to measure total consumer welfare arising from the use of free digital products, just as the value of traditional market products is not a measure of consumer welfare[8]. Measures of the total value of consumer welfare such as consumer surplus are at odds with the conceptual basis of measuring GDP and income, let alone any welfare measure that goes beyond consumption and encompasses quality-of-life dimensions. There is no question about the importance of such measures and the OECD's work in this area[9] is but one example. However, measuring production and income is a different objective from measuring welfare. In addition, some elements of consumer welfare are automatically present when price indices that embrace a consumer perspective are used for measuring real GDP (see below).

5.2 Financing via Data… and Databases

The second avenue for the financing of free digital products is collecting and commercially exploiting the vast amounts of data generated by users of digital products. In many ways, this financing model resembles the advertising model: there is an implicit transaction between consumers (who provide data) and producers (who provide digital services for 'free' in return). A third party may or may not be involved. Economically speaking, the service provider finances its free services by building up a digital asset (volumes of data) that is subsequently used in the production of data services.

The model proposed for advertising could also be applied here, resulting in GDP increasing. However the analogy is more complicated here as there is no obvious proxy to establish the value of the services provided for free. One approach could be to consider the value of the additional investment added to the database (owned by the service provider or a third party) but estimating the inherent value of new data is complicated. Moreover this presupposes that the whole is equal to the sum of the parts, in other words that the sum of individual pieces of data provided by households is equivalent to the totality of that data in a single dataset.

However even if it were possible to derive meaningful estimates there is a risk that, in imputing these values, the national accounts inadvertently opens the door to the capitalisation of knowledge (and by extension human capital). It was, at least in part, to avoid this that the SNA recommended that only the costs of physical maintenance and construction of databases are included as produced capital, rather than the earnings potential of the data embedded in the database itself.

An added complication is that firms are increasingly engaged in the creation of Big Data without any explicit exchange (free or subsidised products) being made in return to consumers (e.g., supermarkets collecting scanner data). This would lead to an imputed exchange in the national accounts for some provisions of data and none in others; in much the same way that consumers are exposed to advertising in a multitude of ways without there necessarily being an explicit exchange in return.

However the arguments for an imputation should not necessarily be dismissed on the grounds that they are impractical nor because they open the door to capitalisation of knowledge. Indeed, more research is needed to come to grips with the accounting treatment of new modes of financing for free products and the consequence for the valuation of databases and knowledge more generally.

6. Free assets produced by households

The provision of free services to consumers is not the only area where 'free' is in and of itself an issue for the accounts. Conceptual difficulties also emerge when considering the creation of 'public goods' using labour provided for free, and where financing is typically only provided by donations (as opposed to paid services for the use of the goods, whether directly as fees or indirectly via other forms of financing *e.g.* advertising). Wikipedia and Linux are two well-known examples.

It is beyond contention that these have provided significant benefits for consumers and a case can be made that time spent on these activities includes an element of production but it is also clear that, within the current accounting framework at least, the services they provide as well as the work involved in their creation (correctly) do not enter into GDP.

This is not to say that they do not have value per se nor that they are excluded from the production boundary, as they clearly have value to users and can play an important role in the production process, but because production is free, by extension so too is the value of the assets[10].

[8] See Schreyer [22] for a discussion of GDP and welfare.

[9] OECD [16, 17, 18].

[10] Note that assets that have not been produced freely (at zero cost) but are available for free are included in the accounts and balance sheets [21].

That being said a better understanding of the economic benefits (and impact) through satellite accounts, in particular to households, but also to businesses (who may reduce recorded investment costs through the use of freely available software) would be welcome; not least to assess the potential consequences on estimates of multi-factor productivity that occur when paid for software is substituted by free software.

7. Cross-border flows of intellectual property and knowledge based assets

The 2008 SNA recognises five categories of intellectual property assets:

i. Research and development;

ii. Mineral exploration and evaluation;

iii. Computer software and databases;

iv. Entertainment, literary and artistic originals; and

v. Other IPPs.

With the exception of mineral exploration and evaluation, IPPs are subject to substantial international trade. As is clear from the OECD's work on Base Erosion Profit Shifting, intellectual property products have increased the ability of firms to shift the registration (legal ownership) of their IPPs from one (high-tax) jurisdiction to another (low-tax), and as a consequence also shift the underlying value added created by these assets.

Unlike many of the issues raised above, the issue here is not necessarily that the related flows (payments and receipts) from the use of the assets are not recorded in the accounts – the issue is whether the flows necessarily align with national accounts concepts of economic ownership (*i.e.* who runs the risks and receives the rewards), rather than legal ownership. One factor that has meant that current estimates are likely to default to legal ownership in practice reflects the fact that taxes are paid and recorded on the basis of legal ownership, and adjustments that relocate assets to the territory of the economic owner actually using them in production would result in further imputations of somewhat incongruous cross-border taxes.

This means that current estimates, and comparability, of GDP and productivity figures across countries may be affected. Further work is needed to ensure that there is an underlying consistency between assets on the balance sheets, used for productivity analysis, and output[11]. One important avenue for exploration would be through the development of accounts that break down national accounts estimates by activity (value added, expenditures and sales of IPP assets and services), and producing corresponding estimates of productivity, capital-labour shares, and primary income (payments and receipts) for foreign affiliates, domestically owned firms with affiliates abroad, and other domestically owned firms.

8. E-commerce

The OECD's Guide to Measuring the Internet Economy [19] defines e-commerce transactions as "*the sale or purchase of goods or services, conducted over computer networks by methods specifically designed for the purpose of receiving or placing of orders*". It is important to note, under this definition, that 'the goods or services are ordered by these methods, but the payment and the ultimate delivery of the goods or services do not have to be conducted online.

For transactions occurring within the economy and where at least one party is a registered enterprise, there is no particular reason to believe that e-commerce transactions present any greater difficulty for GDP measurement than transactions conducted using other modes. As noted above e-commerce transactions between households may present some difficulties but despite the growth in this activity in recent years it is only in rare circumstances (when in all likelihood the household will appear as a registered enterprise) that value added is likely to be underestimated, and so the problem is negligible; particularly when one factors in the balancing and validation process that supply-use tables embody.

Some problems may exist for goods transactions. In many countries Customs statistics only record imports of goods above a certain value, missing out on smaller transactions whose importance

[11] This problem - a disconnect between capital stock estimates and recorded GDP, and hence productivity estimates - is exacerbated when the scope of digitalised assets is expanded, as many have argued. The most commonly used classification (of a broad scope of what has become known as Knowledge Based Assets) was developed by Corrado, Hulten and Sichel [8]. Where these estimates have been used in productivity analysis they typically assume that the knowledge based assets recorded in a given country are only used in production in that country, but the assets themselves in particular brands owned by multinationals and organisational capital, can be used in practice to generate value added across a number of countries. This is likely to mean that productivity estimates will in turn be affected.

may have grown through e-commerce. That being said, because most of the value of ***e-commerce goods*** transactions will be B2B and large scale, cross-border e-commerce goods transactions are not expected to create significant measurement errors in GDP.

It is difficult however to be as confident when it comes to cross border ***e-commerce services*** transactions (such as streaming and downloading), as data is generally scarce (and where there is the added complication of illegal downloads). UNCTAD, the Universal Postal Union, and the WTO have recently set up a Technical Group, including the OECD, to better measure e-commerce transactions, and it is hoped that this will deliver improvements in measurement and an indication of the scale of the current measurement problem.

9. Prices and Volumes

The sections above have all focused on the possible (mis)measurement effects of digitalisation on *current price measures* of value added and GDP. But digitalisation also creates significant challenges for prices, and hence *volume based measures* of GDP and productivity. As was the case for current price measures many of these challenges are not new, and are merely exacerbated by digitalisation.

One challenge is ***customisation*** that is enabled by digitalisation. With products (in particular services but increasingly also goods) becoming more unique, price comparisons that control for quality differences become more complicated. The Eurostat-OECD *Methodological Guide for Developing Producer Price Indices for Services* (SPPI, 2014) [20] provides detailed advice on this issue by product, highlighting a number of approaches that could be used for measuring price changes in specialised products (contract pricing, model pricing, component pricing, hedonic methods) but the fact remains that accurately measuring quality changes remains challenging. However, it is perhaps important to put the issue of 'customisation' into its appropriate context when considering volume measures of GDP. Notwithstanding issues raised by the substitutability of products (see below), the objective is to measure price *changes*, not the price *level* of the product. Consequently, proxy estimates that employ comparable price changes over comparable (non-customised) products may limit the scope of potential errors on volume estimates.

A notable characteristic of digitalisation relates to the multiplicity of '*pricing models'*. The Bean Review (paragraph 3.15) [2] observes:

> *"The pricing model for many internet and mobile services is one where a basic version is available for free with an enhanced version available to paying subscribers (the so-called 'freemium' model). Moreover, where a service is financed through a subscription, the subsequent use of the service is unlimited (i.e. there is a fixed cost for access but a zero marginal cost of use). This implies that the monetary transaction, even when recorded, fails to reflect the volume of digital product consumed; in effect, the price per unit is not observed."*

The implication here is that the volume of consumption may be under, or indeed over, stated. This is indeed the case if the unit of the service provided, and hence price measurement, is simply defined as 'one access to a digital service', regardless of the quantity of contents available and potentially downloadable by the subscriber. However, standard procedures of quality adjustment of price indices would in principle readily account for say a doubling of the offered contents in a streaming service by registering a corresponding drop in prices.

Moreover it is important to put the issue of product (quantity) paid for and product (quantity) consumed into some context because it is not new. The average consumer for example will often purchase goods (typically food) that they may not eventually consume, especially when supermarkets create incentives (*e.g.* 3 for the price of 2). But it is clear that the accounts correctly record the purchases and not the actual consumption. The same can be said for digitalised products. In other words, whether a consumer downloads 10 movies rather than 5 from their unlimited subscription does not matter for GDP estimates (although this is another matter when considering consumer surplus).

As noted above, an important feature of digitalisation is in its creation of *new business models*. The Bean Review [2] examines the case of accommodation services and conjectures that there may be a downward bias to volume measures:

> *"Gross value added from the accommodation services [provided by AirBnB] are currently deflated by the Services Producer Price Index (SPPI) and the Consumer Price Index (CPI). Both indices contain hotel prices but not Airbnb prices. Some analysis from 2013 suggests that renting an entire flat through Airbnb was 20% cheaper than renting a hotel room, whereas*

renting a single room within an Airbnb host's home was almost 50% cheaper. Moreover, an Airbnb rental is arguably superior to a hotel room due to the variety of choice, access to a kitchen, etc. Consequently, the failure to reflect the price of Airbnb rentals in the price deflator for accommodation services suggests that the value added generated by that sector may be underestimated, even assuming that Airbnb nominal expenditures are fully captured through surveys (which is a strong assumption)" (p. 94).

The underlying assumption made in the Report is that AirBnB rooms are of higher quality than comparable hotel rooms. So the use of a price index that only refers to hotel rooms will fail to capture the switch to cheaper AirBnB rooms and underestimate the total volume of accommodation services. But the assumption of superior quality of AirBnB rooms is not without contention nor is the presupposition that the two ways of providing accommodation services should be treated as a single product.

Getting quality change and switching between products right may very well be the greatest challenge presented by digitalisation as it is not, of course, limited to AirBnB nor indeed to new business models *per se*. The internet has had a democratising effect that has reduced the space between buyers and producers, in the process piloting consumers towards cheaper suppliers and producers of goods and services, even with the same country. This reduces, other things being equal, recorded consumption for a given basket of products. But conventional price indices may not be able to capture this substitution effect, similar to the well-known outlet bias problem (assuming of course that quality is unchanged, which as highlighted above is not necessarily a given). Naturally, this may also have implications for the productivity paradox mentioned earlier. Further investigations to determine how current price indices capture this potential bias, and indeed whether the substitution in and of itself should necessarily be captured as a price or a quality change are necessary.

But these are not the only issues raised by digitalisation. Long-standing challenges remain in some of the more mature problem areas, such as software for example, where the evidence points to significant differences in measurement approaches (Figure 2).

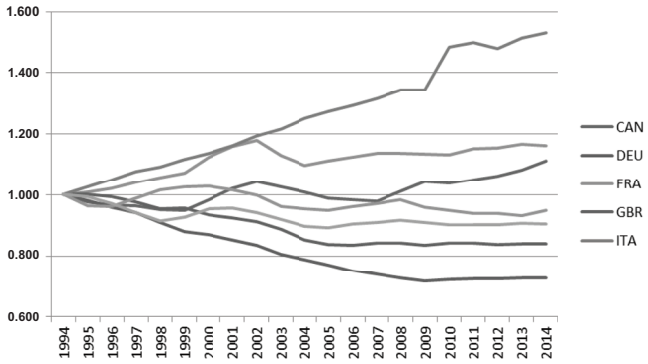

Figure 2. **Price indices for software investment, selected OECD countries, 1994 = 1**

Source: OECD Productivity Database, March 2016.

Nor is this issue necessarily limited to software. Similar differential divergent movements might also be expected in other areas, such as ICT equipment[12] and research and development deflators. And other classic issues relating to quality versus price also remain in large part unresolved; notably the quality changes implied by increased consumer participation in intermediation activities, such as self-service supermarkets, all of which require further consideration.

However, as in other cases noted above, although digitalisation has increased the size of the problem it may also be part of the solution. There is considerable scope to complement traditional methods of price measurement with new data sources and data-gathering techniques, including scanner data and web-scraping, which provide capacity to collect large samples of prices at high frequency - weekly or even daily. With a higher frequency of price collection, the turnover of models between periods of price collection is reduced, making it easier to match models[13] between consecutive periods, and so improve the ability to control for quality change. In addition this can help to reduce the size of the well-known 'new goods bias' where prices of newly introduced models fall quickly in the period immediately following their introduction.

Currently, when prices are collected and re-sampled infrequently (every month, quarter or year), but the model change is rapid, additional methods of quality adjustment are invoked, such as hedonic pricing methods[14]. But more timely collection using digitalised sources may provide robust, and more efficient, alternatives.

[12] See, for instance, Byrne and Corrado [6].

[13] The Matching model technique is an established method to compare prices while controlling for quality change.

[14] ILO et al. [11], Boskin et al. [3] brought the quality adjustment issue to the fore as the largest single element in the estimated bias of the U.S. CPI. A body of literature evolved in regards to the quality adjustment of high-tech products, aptly overviewed and assessed by Triplett [24].

A good example is Cavallo and Rigobon [7] in reference to MIT's *Billion Prices Project*. The authors point out that "Online prices offer a simple solution to this [new goods] problem by providing a large number of uncensored price spells for all models on sale at any point in time. With this type of data, a simple index using overlapping qualities can closely approximate official indexes that use complex hedonic quality-adjustment methods." (p. 19). They demonstrate the capacity of high-frequency online price collection for dealing with quality change by showing monthly inflation rates for televisions in the US market that closely approximate the results of the hedonic price index constructed by the U.S. Bureau of Labor Statistics.

10. Conclusions

On balance the accounting framework used for GDP looks to be up to the challenges posed by digitalisation. Where conceptual issues do arise, these have been flagged up as actions within the 2008 SNA Research Agenda, or are of limited significance to overall GDP.

At the same time however it is also clear that in many areas, that affect both GDP and productivity, practical measurement remains a challenge - not least in the context of cross-border flows such as intra-firm flows of intellectual property and e-commerce transactions, where work is on-going.

In many of the areas where measurement is problematic, the underlying issue is not new. What is new is the scale of the problem. With new intermediaries and new modes of doing business increasing the size of more informal (sharing economy) transactions between households, conventional methods, which have hitherto provided rough estimates for these flows may no longer be appropriate. However the very cause of the increased size of the problem (the new intermediaries) may also be a source of the solution, in that they provide potential access to new administrative data that records what were previously largely invisible (non-observed) transactions.

But this is not the case for all measurement challenges. The measurement of price change and in particular the distinction between quality and price change, which is both a practical and conceptual consideration, require increased and concerted efforts, not least because of the anecdotal and real evidence that points to widespread differences across countries. However, notwithstanding the conceptual challenges posed, by participative production for example, again, digitalisation, and its scope to provide more frequent data collections, may itself provide part of the solution.

At the same time, it is clear (notably from the discussions on free services, the increasing participation of households in the production process, and prices) that digitalisation brings further into focus the fact that GDP is a measure of production and not a measure of welfare or consumer surplus[15]. This reinforces the need to complement GDP with other indicators that capture well-being.

Perhaps the most pertinent conclusion that can be drawn however is the need for more evidence on current country practices in dealing with the issues raised above as well as empirical estimates of some of the phenomena at hand, to gauge the size of current challenges and as a means to develop more targeted best-practice recommendations.

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ПО-ПРЕЖНЕМУ ЛИ КОРРЕКТНО ИЗМЕРЯЕТСЯ ВВП В ЭПОХУ ЦИФРОВИЗАЦИИ?

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Во вводной части статьи авторы обращают внимание на то, что отличительной особенностью современных инновационных технологий становится их цифровизация. К примерам новых типов инновационных технологий, для которых общей характеристикой служит цифровизация, можно отнести новые виды деятельности (например, краудсорсинг), хозяйственные операции между «эпизодически самозанятыми» лицами, распространенность свободных медиасервисов, финансируемых за счет рекламы, и большие данные. На фоне замедления темпов роста производительности эти тенденции порождают вопросы в отношении концептуальной основы ВВП и подвергают сомнению адекватность современных методов сбора и обработки информации.

В статье исследуются статистические проблемы, связанные с цифровизацией. Авторы приводят аргументы в пользу теоретико-методологических и практических подходов к организации соответствующего информационного обеспечения, определяют те проблемные области, которые заслуживают дальнейшего изучения. Общий вывод состоит в том, что в итоге принципиальная схема рассчетов ВВП позволяет решать проблемы, вызванные цифровизацией. Между тем многие практические вопросы измерения остаются без ответа, в том числе и те, которые касаются изменения цен и идентификации процессов цифровизации в тех сегментах экономической деятельности, которые глубоко интегрированы в мировую экономику.

Ключевые слова: система национальных счетов, цифровизация, производительность, измерения, цены, совместное потребление.

JEL: E01, E20,E31,C80, H26, I30, O3, O47.