



Free services

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1. Introduction

Since the world wide web became available for public and commercial use, the Digital Economy has been growing immensely, especially in the last two decades. Nowadays the effects of the digital economy are ingrained in many facets of our life and lifestyle and probably in all sectors of the economy. Significant concerns are whether the Digital Economy is being appropriately measured. There are many attempts to categorize the impact of the digital economy on traditional sectors. The Digital Economy still accelerates and National Statistical Offices are behind, applying the established System of National Accounts (SNA).

A feature of Digital Economy, we discuss in this paper, is the proliferation of new and free goods and services. Free goods often have an implicit price. The positive quantity of these goods that are consumed have a zero measured value. There is no observable market price and the SNA excludes them entirely from GDP. Free consumer entertainment and information from the Internet, largely supported by advertising revenues, has a major impact on consumer behaviour, see for e.g. Brynjolfsson, Eggers, & Gannamaneni (2018) and Diewert (2017). Some economists believe that gross domestic product growth is underestimated because GDP excludes most online entertainment (Brynjolfsson & Oh, 2012).

In this paper we deal with the questions: What are free services? How can we categorize or measure it? Are there arguments to include them in the national accounts? Is that even possible? We present a framework to identify free services, the suppliers and users and the business models that are used to produce free services. When these questions are answered and products of free services are identified we investigate whether there is a significant contribution of the free services and whether they significantly affect GDP.

Another aspect of free services is consumer surplus. Free services have a great impact on our welfare and lifestyle and some studies measure large increase in consumer surplus caused by free services, see for example Brynjolfsson & Oh (2012). People do not pay for free services by cash, but by “attention” or time. Then free services could be measures in terms of for example time spent on internet on free gaming or social media.

There are many recent publications that either try to handle free services from the perspective of the SNA, or from consumer surplus. In this paper we focus on the methods proposed in the literature on including Free Services in the SNA. Not all of this research is new, for e.g. Cremeans (1980) proposed a method for valuing radio, television and newspapers and magazines offered to consumers free of charge in the United States. While Cremeans (1980) estimates the value of free services Nakamura, Samuels & Soloveichik (2016) introduce an experimental GDP methodology which includes advertising supported media in both final expenditures and business inputs. For example, Google Maps would be final expenditures when it is used by a consumer to plan vacation driving routes. On the other hand, the same website would be a business input when it is used by a restaurant to plan delivery routes.

This paper starts in chapter 2 with a broad overview of the literature on free services. Based on the literature overview in section 3 we present a framework to understand free services and discuss in more detail two approaches from the literature: Ahmad & Schreyer (2016) and Nakamura, Samuels & Soloveichik (2017). In chapter 4 we apply the method proposed by Ahmad & Schreyer (2016) and Ravets (2016), to include final consumption by businesses in SNA replacing intermediate use to

measuring free services in the Netherlands. In order to apply this method we propose to use occupation data. We made a selection of eight occupation that we assume contribute mostly to generating free services. We conclude with discussion in Section 5.

2. Literature

The definition of free services in the literature can be summarised as **all services** that are provided **free of charge** by households and companies (not government) to households, companies and government. That definition is broad, and in practice there is discussion about its composing parts. What is free? Who are the producers and users of free services? And how should it be measured? This chapter discusses the many aspects and dimensions of free services in the literature.

No paper achieves covering all the relevant aspects and dimensions of free services. On the one hand there are papers that focus on the technicalities of measuring specific free services in terms of utility (Internet) or value-added (like free TV, or marketing-sponsored services). These papers are very much focused on one service or group of similar services. On the other hand there are papers that try to measure the Digital Economy or Internet Economy as an industry or in a satellite account, as part of the System of National Accounts (SNA). For the purpose of this research report these papers lack as they discuss concepts that differ in scope from free services: they include concepts that do not necessarily apply to (all) free services and/or only include free services that are either on the Internet or that are digital.

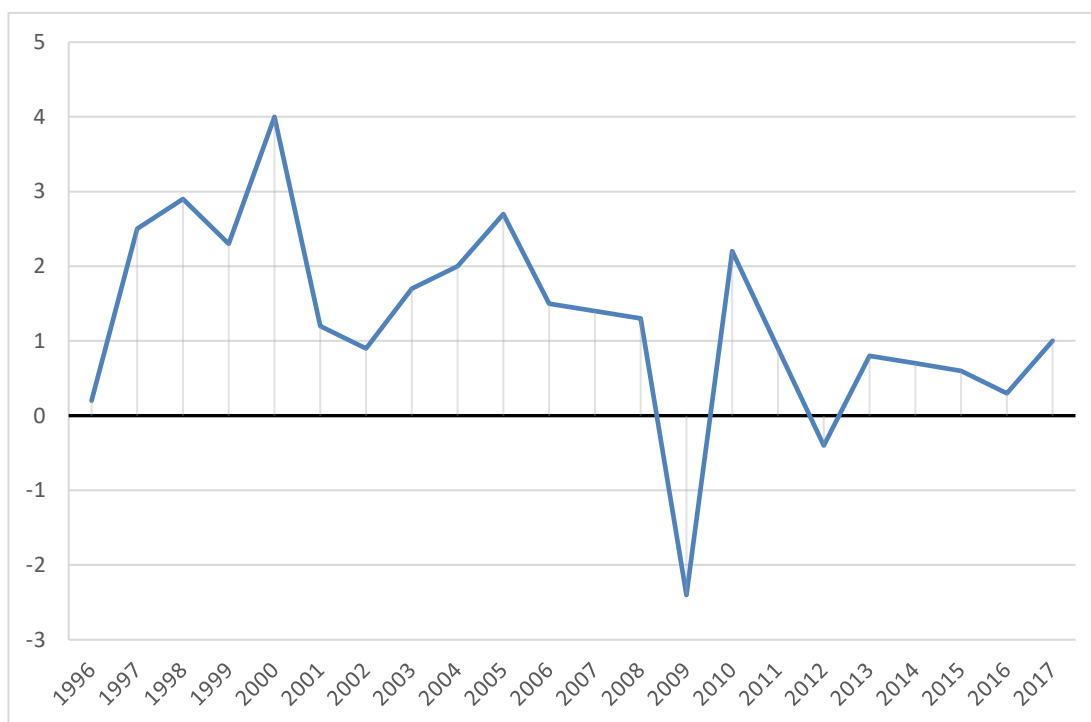
However, bringing the relevant literature together does lead to many insights concerning free services. This chapter first discusses the productivity puzzle as a cause for the (renewed) interest in free services. As an economics primer, we then discuss the difference between GDP and consumer welfare, especially when free services are concerned. From there the discussion of the literature focuses on the inclusion of free services in the national accounts. Then we show that interest in free services is not new and already on the agenda for a long time. Recent papers mostly consider free services to be an important feature of the digital or internet economy, and here it becomes clear few insights have changed, although more data sources have become available. After all this, we get into another discussion relevant to free services, being the measurement of prices and volumes. Lastly, we bring together the business models, underlying free services, and inclusion approaches that have been identified in this chapter.

2.1 Productivity puzzle

The decline of labour productivity growth in the G7 countries (Ahmad & Schreyer, 2016), and the Netherlands too (figure 1), is puzzling economists. The decline might be caused by changes in the real economy, but there is also a growing literature that points at the measurement of productivity growth. The macro-economic measurement of productivity in the economy relies on the national accounts. The national accounts framework generally does not measure and does not include goods and services that have no price, with government services as an important exception. Therefore free services have attracted attention as they are free (of monetary costs), and as such are not included in macro-economic consumption.

The digital or internet economy supposedly creates new business models where households can consume services for “free” (free services), often meaning there are no monetary costs. Therefore, the production and consumption of free services is not (fully) part of the national accounts. Also, growth of the underlying assets, often not included in the national accounts, has “typically, and significantly, outpaced growth in tangible assets [that are included]” (Ahmad & Schreyer, 2016). Not accounting for free services might therefore (partially) explain the decline of measured productivity growth. Indeed, according to IMF (2018) free services need to be considered for accurate deflation and measurement of productivity.

Figure 1 Labour productivity (value added) in the Netherlands²



But, did the computer age introduce free services as a phenomenon? And, is mismeasurement of productivity even new? In 1987 Robert Solow already famously said that "[y]ou can see the computer age everywhere but in the productivity statistics."³ After a discussion of GDP versus consumer welfare, we will show that free services are actually not new at all.

2.2 GDP versus consumer welfare

The literature considers roughly two ways to measure free services in monetary terms. One way is to measure the utility of (specific) free services. Utility is derived from surveyed willingness-to-pay or opportunity cost approaches.⁴ Another way is to include free services within the national accounts framework, either by imputing extra final consumption by business, by imputing a viewership services industry by households, by recording costs made to gather data as investments, or “simply” by applying prices that are adjusted for free services.

These two ways distinguish between including free services in a measurement of consumer welfare or a measurement of GDP. The IMF (2018) makes this distinction when it says “rapid increases in free digital services and household non-market production made possible by digitalization have widened the gap between GDP growth and household welfare growth.” Measurement of either is challenging too as many activities that lead to free services do not occur within well-defined, final product markets, as measured by the national accounts, and privacy concerns and fake news might even be negative contributors to social welfare. (OECD, 2013)

Despite this clear distinction, between GDP and consumer welfare, the concept of GDP has attracted concerns. The IMF (2018) states for example that “welfare gains from digital products—particularly

² Statistics Netherlands: <https://opendata.cbs.nl/Statline/#/CBS/nl/dataset/84546NED/table?dl=22C52>

³ Robert Solow, “We’d better watch out”, New York Times Book Review, July 12, 1987, page 36.

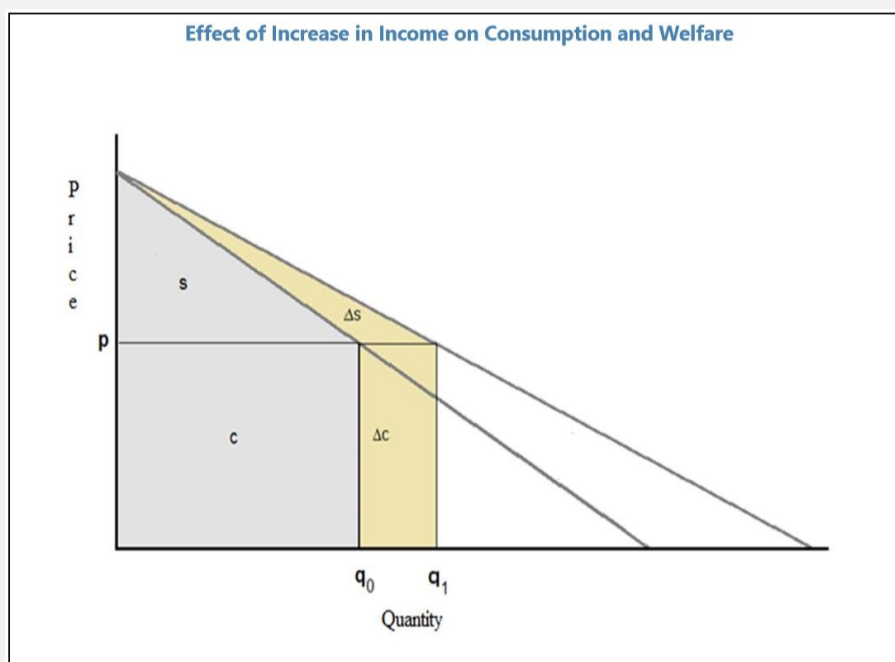
⁴ Another good primer on the difference between value added (GDP) and consumer surplus (utility) can be found in section 1 of Nakamura, Samuels, & Soloveichik (2016). The same section also explains Total Factor Productivity (TFP) and TFP growth.

when they become ‘free’—are being neglected.” Free services are indeed neglected in nominal GDP, as they have no price. The real question therefore is whether real GDP does capture the welfare gain from free (digital) services. (IMF, 2018)

Under the right circumstances the development of GDP can still give an indication of the development of consumer welfare. Requirement for that is that current features of the economy, that develop differently from the measured economy, are somehow added to an adjusted GDP. Free services might be such a feature that does not follow the same trajectory as GDP currently measured. See box 1 ‘Link Between Consumption and Welfare Growth’, from IMF (2018), for more explanation.

Box 1 Link Between Consumption and Welfare Growth (IMF, 2018)

- 1 The level of consumption, measured by price times quantity, understates welfare because it excludes the consumer surplus. In the diagram below, the initial position of the demand curve implies a quantity consumed at price p of q_0 , making consumption equal to the area of rectangle c . Consumer surplus, defined as the excess of the willingness-to-pay over the amount paid, is given by the part of the area under the demand curve that is above the price line, the triangle labelled s . Welfare is measured by the area under the demand curve out to q_0 , $c+s$.
- 2 The growth of real consumption equals (or approximates) the welfare growth. Assume that income growth causes the demand curve to shift to the right, so that the quantity consumed becomes q_1 . The price is constant, so nominal consumption growth, given by $(c+\Delta c)/c$, equals real consumption growth, q_1/q_0 . Welfare growth, given by $(c+\Delta c+s+\Delta s)/(c+s)$, also equals real consumption growth.
- 3 The weights used to calculate aggregate growth of real consumption are based on prices as the measure of value. These weights allow aggregate growth to approximate the welfare growth.



So, when developments strongly differ, within and outside of the so-called production boundary of the national accounts, GDP is no longer a good proxy for welfare. The production boundary tells statisticians to measure some activities as part of the economy (business transactions) and not others (cooking at home). Most production of goods and services by households is not included in GDP because of this boundary. Diverging developments for example happen when activities move through this boundary, from being measured in GDP to not being measured. When previously a service was ad-supported and becomes subscription-based, GDP will rise because only the latter is included in GDP, while consumers will probably consume less of the service. An example are sports events going from broadcast TV to subscription TV. Services moving through this boundary result in discontinuities in measurement and therefore mismeasurement of growth. (Soloveichik, 2014) (Nakamura, Samuels, & Soloveichik, 2016) An adjusted GDP can overcome these problems.

The response from the Bureau of Economic Analysis (BEA)⁵ is indeed to come up with an adjusted GDP to answer concerns “that measured GDP growth since 2000 is too low because it excludes online entertainment.” The BEA refers for example to Brynjolfsson & Oh (2012), Ito (2013) and Boston Consulting Group (Dean, 2012), for these concerns. “The much higher numbers [in these studies] are a consequence of their different methodologies. [These] studies use indirect methods to estimate the consumer utility gained from leisure time spent online. However, (...) there are many areas of the economy where consumer spending on an activity is much lower than total utility for that same activity,” (Soloveichik, 2014). Estimates derived from utility can and should not be related to GDP or other aggregates from the national accounts. Instead, the BEA makes its own estimates that do conform to the System of National Accounts. (Nakamura, Samuels, & Soloveichik, 2016)

Considering the same literature, Ahmad & Schreyer (2016) conclude that “from a conceptual perspective GDP does not look to be deficient.” We agree. Moreover, it has been shown that an adjusted GDP can be a good proxy for welfare. For those reasons, the remainder of this chapter will discuss papers that mainly try to include free services in the national accounts or as (part of) a satellite of the SNA. In the next chapters we will focus on extending GDP to include free services.

2.3 Free entertainment

The issue of free services was put on the SNA 2008 Research Agenda by noting that some expenses of companies are actually a form of individual consumption (full text in box 2 ‘Final consumption of corporations’). This is when companies make expenses while households benefit from them, like supporting free (entertainment) media such as television and radio broadcasting. Media companies have for a long time even organised events to subsequently sell subscriptions. A media company (RCS MediaGroup) for example organises the Giro d’Italia bicycle race, and this race was originally started by a newspaper.⁶ Expenses on such events and media, by corporations, are currently measured as intermediate inputs, and not as final consumption. “In contrast, media is included in final expenditures if it is supported by the government, non-profits or consumer payments.” (Soloveichik, 2014)

⁵ Soloveichik (2014), Nakamura, Samuels, & Soloveichik (2016), and Nakamura, Samuels, & Soloveichik (2017).

⁶ “Tour d’Italie ou Giro d’Italia” [Tour of Italy or Giro d’Italia] (in French). Larousse.fr. Retrieved 18 December 2018.

Box 2 Final consumption of corporations

“A4.16 In the SNA, no final consumption is recorded for corporations because corporations are not considered to be final users of goods and services, except for capital products which, with the exception of valuables, are acquired for the purpose of production. However, large corporations often undertake sponsorship of cultural and sporting events. To date, the SNA regards the payments involved as a form of advertising but it could be argued that they are a form of individual consumption and could be treated as final consumption expenditure of corporations and social transfers in kind to households. Further, by imposing regulations such as environmental standards, the government may achieve the same effect as if they levied taxes and spent the income on environmental protection, which would be treated as collective consumption. There may thus be instances where it would be more appropriate to record some expenditures by corporations as final consumption.” (United Nations, 2008)

Already in 1980 Cremeans examined and attempted “to solve [this] longstanding ‘puzzle’ in national economic accounting. Radio and television broadcasting are services clearly designed for and used by consumers but not purchased by them and, consequently, not counted in personal consumption expenditures.” Cremeans (1980) “argues that the puzzle is resolved by recognizing the nonmarket exchange between the consumer and the broadcaster; the consumer provides the reception and display of audiovisual advertisements in his home in return for broadcast entertainment.” This idea expands the production boundary by including an activity of households as an economic activity in the national accounts.

The conventional treatment is that the advertiser has advertising costs and benefits from higher sales, while the media company produces entertainment that attracts viewership, as an audience to be targeted by advertisers. Households are only consumers under this treatment. This approach is argued for by Okun (1971) because “if market behavior doesn't tell you how much something is worth, you have no way to tell,” and therefore these free services should not enter into GDP.

Cremeans (1980) is critical of this conventional treatment of media services. First, media services like TV and radio can be seen as a “public good” because once a household invests in a TV or radio it is impossible for (most) producers to restrict consumption of the entertainment it produces. Households also seem to substitute paid services (visiting a movie theatre), with free services (watching television at home). This substitution distorts the measurement of final consumption of households: the volume of some consumption is measured, while consumption of some substitutes is not. Also, as government services, paid for by taxes (on soap), are counted as final consumption, broadcasting services, paid for indirectly from the sale of soap, can be similarly counted towards final consumption. “[B]oth meet the broader definition of what constitutes consumption.” (Cremeans, 1980)

The paper therefore proposes to introduce a so-called “Household Display Enterprise” (HDE). Table 1 gives the reconciliation of the impact of introducing this HDE to a Soap-TV Economy. Households become producers of “display time” which is then sold to media companies. Households no longer consume receivers, electricity or repairs, but these are recorded as capital expenditures and intermediate inputs.⁷ The media companies in turn use the produced display time as a new intermediate input to sell advertising space to advertising agencies, and to sell entertainment to households to consume (\$11,749 million).⁸

⁷ The resulting profit estimates seem very sensitive to the proportion of display time that is attributed to (eventually) selling advertising and watching entertainment.

⁸ “This separation of functions parallels the concept of the owner-occupant of residential housing (...)” (Cremeans, 1980)

Table 1 Reconciliation of Conventional and Alternative Estimates

(Based on U.S. Data for 1976)

	Millions of Dollars	
	Income	Product
GNP—Conventional (Table 1)	17,555	17,555
Plus Household Display Enterprise Value Added		
Depreciation	5,650	
Imputed interest	1,538	
Profit	2,024	
	9,212	
Less Consumer Purchases		
New receivers		(8,297)
Electricity		(1,401)
Repairs		(1,136)
		(10,834)
Plus Consumer Purchases		
TV entertainment		11,749
Plus Sales of New Receivers to Investment		8,297
GNP—Alternative (Table 3)	26,767	26,767

The paper finally suggests to include all media supported by advertising, even if they are not entirely free. In that case, “more than half of the additional income [introduced by this alternative approach] comes from the imputed return on investment in consumer durables”.

2.4 The Internet and Digital economy

The issue of free media and services has attracted renewed attention with the advent of the Internet and digitalisation. Slowing rates of productivity growth have raised questions about the conceptual basis of GDP, and whether current compilation methods adequately capture the Internet and digitalisation. (Ahmad & Schreyer, 2016)

This new literature sometimes extends previous work like that of Cremeans (1980). Any new insights are often also relevant to the concept of free services. However, internet use does not equate use of free media. Internet is also used for online shopping and mobile banking for example (Nakamura, Samuels, & Soloveichik, 2016). Therefore this section makes clear that measuring and analysing the Internet and Digital economy overlaps with the concept of free services, but it is not the same.

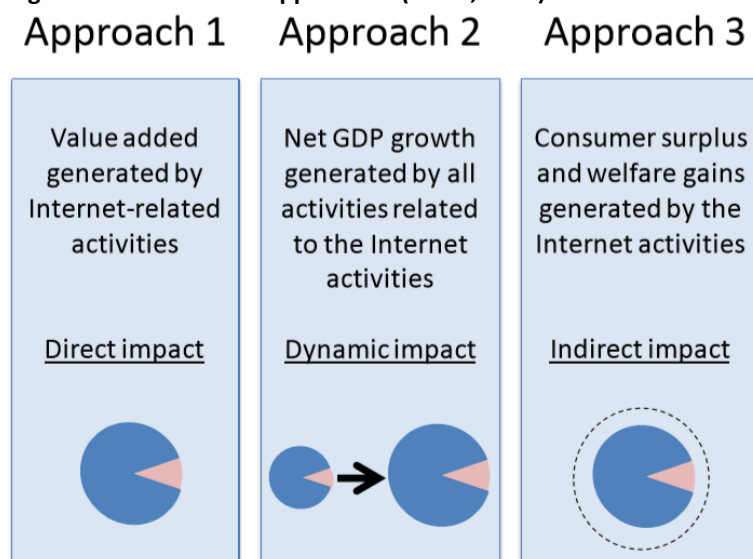
2.4.1 Measuring the Internet Economy

The OECD (2013) focuses on measuring the Internet Economy and gives guidance on how to deal with measurement challenges, and on how to distinguish measures of an economic phenomenon. Measurement challenges need to be overcome as the “effect on non-market interactions and consumer surplus is [perceived to be] (...) profound.” However, “[n]on-market interactions on the Internet are broadly characterised by the absence of a price and market-clearing mechanism.” These interactions are therefore not captured by GDP. This is where measuring the Internet economy overlaps with measuring free services.

To make free content and services available on the Internet, companies use an advertising-driven business model. Advertising is visible in the national accounts as an intermediate input of companies. As there is no single model for market or non-market interactions, the Internet’s impact on consumer surplus is hard to estimate. This problem also makes inclusion of free services in the national accounts difficult and experimental at best. (OECD, 2013)

An analysis must declare how it tries to measure the impact of the Internet, as it “affects almost all economic activities and its impact is found in numerous short and long-term economic processes.” The same holds true for the measurement of free services. To this end the OECD (2013) distinguishes between three approaches for measuring the Internet Economy: direct, dynamic, and indirect, see figure 2. All quotes in this paragraph are taken from OECD (2013).

Figure 2 Measurement approaches (OECD, 2013)



Direct impact

The direct impact approach “groups studies that measure the size of the Internet economy expressed as part of GDP. Studies that follow this approach look at those parts of the economy that are closely related to the Internet. These parts are then aggregated, and the result is interpreted as a conservative measure of the Internet economy since they only capture effects that can be separated out of specific sectors of the economy.”

Under this approach the goal is “to provide a clear, statistical methodology to assess the size of the direct, economic impact of the Internet.” This identification strategy is “extremely difficult” for Internet-related activities, and seems even harder for free services. Having said that, with clear practical boundaries it is possible to show how much activities in the national accounts might be related to the provision of free services, like the amount of advertising that is recorded.

Dynamic impact

The dynamic impact approach looks at the impact “that the Internet might have on all industries and hence on the rates of productivity growth and eventually GDP growth. (...). Consequently these studies evaluate the contribution of the Internet to the net growth of the economy as measured by official statistics.”

The question for free services is then whether efficiency gains across the economy apply too. Arguably, open source software expectedly results in efficiency gains for companies that choose to use it. Moreover, new free services on the Internet have made it easier to start a business, without

capital-intensive investments. In the start-up phase it is also much cheaper to scale up (or scale down) activities, which intuitively contributes to efficiency gains.

Indirect impact

The indirect impact approach examines “the effects of the Internet on economic phenomena like consumer surplus or how the Internet contributes to social welfare gains. These studies look at the additional impacts of the Internet on economic welfare that are not necessarily measured by official statistics.”

Here the question for free services is whether the Internet has made targeted advertising much easier, therefore more attractive, and hence able to finance more ‘free services’ than before. One would expect a company to spend more on advertising when the expected benefits are higher. In that case, the proportion of free services consumed by households might increase compared to total consumption. Then the argument that GDP growth is a good indicator for welfare growth (see box 1) no longer holds.

2.4.2 Measuring the ‘Free’ Digital Economy

As noted in paragraph 2.2, the BEA has responded with a chain of papers to critiques that productivity growth has been missed in the national accounts, because of free services on the Internet and through digitalisation. Consumers indeed often do not pay for anything out of pocket online, but someone else is paying for the generated entertainment. Free services are supported by different business models, like advertising, marketing and business models like “Ubiquity first, Revenue Later” (URL).

Experimental methodology

The BEA authors introduce experimental methodologies that include advertising and marketing supported media in final expenditures and develop input-output and productivity accounts for such media. As in Cremeans (1980), the BEA (Soloveichik, 2014) “studies advertising-supported media which provide real value to viewers.” Under the experimental methodology, “[c]onsumers produce advertising viewership and then barter it to media companies in return for entertainment.” It “assumes that media companies earn money by selling advertising services to outside companies.” Contrary to Cremeans (1980), the BEA papers do “not consider the production process for this viewership” and do not make explicit how households produce viewership (Nakamura, Samuels, & Soloveichik, 2016).

They go on to show that “recent GDP growth in the United States changes very little” and is actually slightly lower when just considering advertising. Only material impact is found when including marketing-supported media in the estimate. The resulting “productivity statistics show faster [total factor productivity (TFP)] growth in the online media industry and slower TFP growth elsewhere.”

The experimental methodology also improves measured consumer welfare. This happens because it treats advertising- and marketing-driven entertainment more similar to other kinds of media, like government-supported or paid-for media.

An important additional consideration in Nakamura, Samuels, & Soloveichik (2016) is that not all advertising revenue is spent on providing free media. Part is spent on the advertising sales department for example; these are intermediate expenses. “When calculating [these] non-media costs, we assume that these within-category ratios are fixed from 1929 until 2013.” These assumptions strongly influence the outcomes. They also distinguish between use of free media by

consumers and businesses, using “a variety of data sources to split media usage between consumers and businesses.” (Nakamura, Samuels, & Soloveichik, 2016)

The authors go on to explain that “[h]olding real media output fixed, our experimental methodology treats more Internet surfing as an increase in inputs and therefore a reduction in TFP for the media industry.” It seems odd to impute increasing inputs, while this increase might be because they value the output more. Likewise, if businesses have less trouble finding business information and hence view fewer ads, this means they decrease their inputs. This seems counter-intuitive. Moreover, internet use does not equate the use of free media. (Nakamura, Samuels, & Soloveichik, 2016)

The “experimental methodology does not require any major conceptual changes to SNA, [as it treats] the household production of the service of providing access to advertising as a form of production by an unincorporated household enterprise.” This treatment is similar to the “imputed rental value for owner-occupied housing, which could be seen as a form of household production.” (Soloveichik, 2014)

“One might argue that advertising-supported media is an intermediate input embedded in final output – and therefore [this] experimental methodology double-counts advertising-supported media. However, that argument assumes that consumers can’t watch advertising-supported media without buying the products. (...) Advertising-supported media is available to everybody without any purchase requirements. The market price for advertised products only covers the products themselves, not the shows they’re advertised on” (Soloveichik, 2014). That the market price also covers the advertising costs of the producer, does not alter that the market price is exclusively the price of the good or service.

Nakamura, Samuels & Soloveichik (2016) reach a humble conclusion: “Advertising-supported media may be important to consumer welfare. But it is not a new source of economic activity that only arose in 1998. As a result, including advertising-supported [media] in final demand does not change the overall trajectory of GDP growth much.”

Nakamura, Samuels & Soloveichik (2016) also introduce a treatment of the Ubiquity Now, Revenue Later (URL) business model. In this business model a company starts offering an (almost) free service (or good) to build market share first, and only generate revenue later. The authors argue “that customer reviews and other user generated content account for a large share of the network effects associated with the URL business model, and therefore even non-media companies are partially media companies. The barter transaction associated with customer reviews is conceptually similar to the barter transaction associated with advertising viewership.”

Most important extension of Nakamura, Samuels & Soloveichik (2017) to the previous papers is the inclusion of marketing-supported information besides advertising-supported media. Marketing in this case refers to company expenses on content production to achieve revenues, besides advertising. This could be for example a free app it provides, that does not show up as an advertising cost. The paper also shortly considers the opportunity costs of in-house advertising. This is the case where a free service is offered to upsell premium products (eg. freemium games like Candy Crush). The authors conclude these are too small to consider.⁹ The question is whether this is (still) true.¹⁰

⁹ More on freemium can be found in paragraph 3.2.

¹⁰ “[Epic] has used the overwhelming success of its popular videogame ‘Fortnite’ as a springboard to raise more money. (...). Since the free-to-play game was released last year, Epic has netted more than \$1 billion in revenue from microtransactions (...)

Estimates of the impact of free services

Soloveichik (2014) eventually estimates “that advertising-supported online entertainment added \$20 billion to GDP in 2011.” Later, Nakamura, Samuels, & Soloveichik (2017) estimate that the inclusion of free digital content makes real annual GDP increase by 1.53 percent from 2005 to 2015 instead of 1.42 percent, even when the full consumer surplus benefits from free goods are not measured. The authors also find that the personal consumption expenditures (PCE) and core PCE deflators would have risen 0.1 percentage more slowly.

The low impact of the BEA methodology in this chain of papers, before including marketing-supported content, has also to do with numerator-denominator logic. When you include production of viewership and consumption of free media, you do this in both periods. There can only be serious impact if this production and consumption develops differently from the rest of the economy.

The inclusion of marketing in Nakamura, Samuels, & Soloveichik (2017) demands a data hungry imputation of in-house marketing activities (eg. the labour cost of a “writer at a car manufacturing company”). Including marketing-supported content in the estimate of the contribution of “free” services to GDP leads to a significant upward impact on GDP growth. Nakamura, Samuels, & Soloveichik (2017) “demonstrates that measuring the full value of the Internet requires that one goes beyond Internet publishing companies that produce advertising-supported media to the universe of companies with Web pages and Twitter accounts.”

Disadvantages

An important downside of the approach of these BEA papers is that they “impute a value for advertising-supported media based on estimated costs.” However, especially in the digital age, the marginal cost of an extra unit of production approaches zero. On the consumption side, the extra unit does have a marginal value, proven by the time people spend watching, and by the substitution from paid-for services (newspapers, magazines) that takes place: “Consumers are clearly willing to substitute from one media to another.” Therefore, the contribution to final expenditures of free services cannot feasibly be measured with a production side approach. It introduces the exact same problems as with the measurement of government and healthcare services and their productivity. Clearly, such an ‘inputs=outputs’ approach is unsatisfactory (Bean, 2016).

Troubling with introducing marketing-supported content to the methodology is also to determine where to stop. Many services agents for example offer free introductory consultations, like mortgage agents. Should that be in final expenditures? And how about free parking offered by the supermarket where you get groceries? The proposed approach blurs the distinction between intermediate and final use, with many alternative boundaries to choose from.

Another disadvantage of including marketing-supported content is that if different outlets have different marketing needs, that are recorded differently in the national accounts, you may wrongly measure the contribution to GDP of marketing-supported services when the outlet split changes. Say, a retailer offers free parking at its shops with a coupon and then decides to start an online shop. The online shop gets supported by marketing (presence on social media) and the retailer can lower its expenses on offering free parking. The marketing shows up as final consumption under this experimental methodology, but whether the free parking does likewise is unclear.

as players forked out to upgrade character outfits and dances,” in Investopedia, “How Tencent Changed 'Fortnite' Creator Epic Games' Fortunes”, <<https://www.investopedia.com/news/how-tencent-changed-fortnite-creator-epic-games-fortunes/>>.

2.4.3 Towards a framework for measuring the digital economy

Ahmad & Ribarsky (2018) propose a new satellite account to measure the digital economy against criticism that current estimates of GDP are not able to capture digital transformation. It makes clear that an agreed-on definition is one of the important things to make a concept measurable. But it is hard to define the digital economy.

Besides definition, another question is whether measurement of digitalisation should reflect the dynamic impact or just the direct impact, see also figure 2. The dynamic impact of digitalisation would be the total value and effects on all industries. The direct impact would only be the value of enabling platforms (Facebook, Google, etc.). This difference in scope makes defining the digital economy difficult. The same is true for free services. The included case study by Barefoot, Curtis, Jolliff, Nicholson & Omohundro (2018) also does not include advertising revenue of companies that offer free services, which shows thinking of concepts is easier than measuring them.

The proposed satellite account (Ahmad & Ribarsky, 2018) introduces, among other things, two “radical” innovations. The first innovation is data as a third product category besides goods and services. This is necessary to register transactions facilitated through data and better understand the business models that they support. Inclusion of data as a third product category would help analysing new business models and their underlying production structures. For our analysis of free services we do not need this innovation, as we will only try to estimate consumption of free services and will be agnostic about why companies provide them. The second innovation is a new product free digital services. This innovation is radical because it extends the production boundary. This is useful for us as it applies to the inclusion of (all) free services. These free digital services do raise concerns about multifactor productivity. Transactions concerning these new public goods do not show in the national accounts, because they are free. Examples are open-source or free software, like Wikipedia and Linux. When they are not in the national accounts, they also do not contribute to measured productivity.

When Ahmad & Ribarsky (2018) operationalise the proposed framework, they conclude “that guidance will need to be developed to estimate and indeed identify the underlying value of these ‘free’ and ‘non-monetised’ transactions.” Besides that, not all free services are digital and hence not all them belong in this proposed satellite.

2.4.4 The Internet Economy

A Eurostat paper (Ravets, 2016) “presents the challenges which the internet gives for national accounts, linked to the appearance of new products (part 1) and of new business models (part 2), and examines alternative recording treatments of media services (including internet services) in national accounts (part 3).”

The first part asks whether the internet allows for the appearance of new goods and services, or that it is only a new means to access the same (or similar) goods and services. Does the internet create new goods with its particular problems for price and volume measurement, or does it modify the quality of existing services and is this impact properly accounted for now?

New business models are discussed in the second part which concludes that, conceptually, the national accounts capture these new models. However, there are measurement difficulties exacerbated by the Internet. These new business models go across borders more often, especially making transactions with households hard to capture, and many of the new services are free, due to online advertising, and therefore have little value in the national accounts.

Part three concludes with three alternative treatments of media services in the national accounts. These alternatives try to solve the situation that “consumer utility in reading, listening or watching media is not reflected in household final consumption expenditure”. Another method that would start from time-use surveys is also mentioned, “but this would entail difficult conceptual and measurement issues.” (Ravets, 2016)

The paper points out “[in] order to roughly estimate this under-representation, it is worth considering the **net receipts** of advertising for media, that is the amounts which - after margins - allow media to finance the information, cultural and entertainment services that they provide to households. (...) The underlying approach is [to estimate the additional production, income and expenditure] on the basis of the two distinct activities exercised by the periodical : the periodical produces media services in the form of information, entertainment and cultural services ; the periodical is also a seller of space for advertising.”

The three approaches in practice are:

- 1 “Impute an additional output for information, cultural and entertainment media services, consumed by the public as household final consumption.” Weakness of this approach is “an artificial increase of the operating surplus of the S.11 [Non-financial Corporation] sector”.
- 2 “A final consumption for corporations (advertisers), using an analogy between cheap media financed by advertising and social transfers in kind.” Weakness of this approach is again “an artificial increase of the operating surplus of the S.11 sector”. Moreover, “final consumption of corporations is not yet identified in 2008 SNA”. This approach is similar to the proposal by Ahmad & Schreyer (2016).
- 3 “A new imputed household service[, which] introduces an imputed new category of services produced by households ‘reading, listening and watching advertisings’ and is arguable the most ‘radical’ of the solutions.” This approach is similar to that in Cremeans (1980) and the BEA papers. No impact on the S.11 sector is an advantage too. But, “creation of an imputed new service produced by households” is seen as unattractive.

2.4.5 Measuring the Digital Economy

The IMF (2018) discusses policy issues concerning measuring the digital economy and criticizes current practices and states that “a change in the conceptual framework of GDP to directly include ‘free digital services’ in consumption would not be warranted.” To the IMF, the possible growth measurement problems can be grouped into three categories: 1) the conceptual boundaries of GDP, 2) prices of new and improved digital products, and 3) unrecorded digital sector output. The IMF (2018) too believes “[t]he lack of a generally agreed definition of the ‘digital economy’ (...) and the lack of industry and product classification (...) are hurdles to measuring the digital economy.”

The IMF (2018) is a proponent of quality-adjusting prices for new or free digital services: “[q]uality improvements conceptually represent increases in real output[, and the] gains from the initial appearance of truly novel goods are difficult to quantify.” They are critical of Nakamura, Samuels, & Soloveichik (2017) when they write “imputed income that the consumer simultaneously receives and returns differs in important ways from actual money income, and imputed producer revenue differs in important ways from actual revenue.”

“Also, research on expanding the measure of investment to include collection of data may imply a modification of the GDP production boundary,” (IMF, 2018). It can be argued that collection of data increases sales over time and this can therefore be seen as an investment, as is true for advertising (Nakamura, Samuels, & Soloveichik, 2016). But brand equity and investment in it through advertising is not part of the SNA either now.

Table 2, taken from IMF (2018), also includes Wikipedia, open source software and free media from online platforms, funded by advertising, in the potential size of the digital sector. Especially Wikipedia and open source are conceptual problems as most production of such content is not driven by advertising or marketing. Charitable initiatives are a different “business model”.

Table 2 Possible Size of the Digital Sector in the United States, 2015 (IMF, 2018)

Product group	Percent of GDP
<i>Included in GDP (on a value-added basis):</i>	
ICT equipment, semiconductors and software	2.8
Telecommunication and Internet access services	3.3
Data processing, and other information services	0.7
Online platforms, including e-commerce platforms	1.3
Platform-enabled services, (e.g., the “sharing economy”)	0.2
Total (with incomplete adjustment for double counting of output)	8.3
<i>Conceptually not included in GDP, or missed for procedural reasons:</i>	
Wikipedia and open source software	0.2
Free media from online platforms funded by advertising	0.1
“Do-it-yourself” fixed capital formation of online platforms	0.3
Output of MNEs attributed to tax havens	0.4
Total (with incomplete adjustment for double counting of output)	1.0
Source: Staff estimates based on official U.S. data, Nakamura, Samuels and Soloveichik (2017), Byrne, Corrado and Sichel (2017), and Guvenen <i>et al.</i> (2017).	

Geographical boundaries make measuring free services with a production approach especially hard. “Also, free media funded by advertising (which should be captured in trade statistics) may involve international flows of unpriced data on which the advertising depends. Platforms often produce services with unpriced cross-border data flows as intermediate inputs. These data flows have economic importance, but little progress has been made on measuring them.” (IMF, 2018)

Although the IMF (2018) is critical of changes to concepts, “[p]roposals to change the treatment of free media funded by advertising and collection of users’ data [do] merit further research. (...) Free services to attract platform users is a more general phenomenon than advertiser-funded media, and the broader implications need to be understood.”

2.5 Prices and Volumes

The issue of free services can also be approached from a prices and volumes angle, without introducing the elaborate additions of the previous sections. Here concerns are the ongoing difficulty of measuring quality change, whether volumes are measured correctly for bundled, subscription, and free services, and that substitution to online services may not be captured by conventional price indices, similar to the outlet bias problem. (Ahmad & Schreyer, 2016)

The questions then are:

- 1 Are free services new goods with its problems for prices and volumes measurement?¹¹
- 2 Do they modify the quality of existing services, and is this impact properly accounted for?

The authors of IMF (2018) ask from the statistical community to focus on prices and volumes when researching free services: “Capturing the welfare in GDP from free digital replacements is primarily a price and volume index problem, not (...) a production boundary problem.” “Shifts of market production to outside the GDP boundary have been cited as a source of downward distortion in GDP in the digital age. (...) Proposals to use hypothetical shadow prices to value free digital products to capture their effects on welfare growth or productivity growth are inconsistent with the underlying conceptual frameworks for measuring those concepts” (IMF, 2018). Moreover, the longer a service is free, the harder it becomes to establish a shadow price.

To include (partially) free services in GDP the IMF (2018) suggests to account for complementary goods when doing quality adjustment: “[i]f Internet access is viewed as a product, growth in [free] online content and faster connection speeds would represent quality improvements, but other changes in the online environment imply quality declines; both] could be captured in real consumption by quality-adjusting the deflator.” At present, “researchers [already] disagree on how completely BEA’s current price indexes capture quality change in the goods and services used to access media,” (Nakamura, Samuels, & Soloveichik, 2016).

Nakamura, Samuels & Soloveichik (2016) also point out that a practical implementation of this approach, as suggested by IMF (2018), allocates productivity growth to the wrong industry. “Holding nominal output fixed, [the] decline in quality-adjusted prices for television sets would result in a real output increase for the TV equipment producing industry. In turn, this real output increase would result in an increase in measured TFP, even if there is no change in the direct product or process of the TV equipment producing industry.” This change in TFP should not be attributed to the TV equipment industry, but to the media industry. (Nakamura, Samuels, & Soloveichik, 2016)

Moreover, Nakamura, Samuels & Soloveichik (2016) are also critical of quality adjustment, with prices of zero. “One possible treatment would be to view the entertainment with advertising as having the same real value but falling in price to zero. (...) But the same economic formulas do not work well when analyzing goods and services with zero prices. For example, it is difficult to explain why consumers sometimes pay to avoid advertising if the price for advertising-supported media is zero. Furthermore, if the situation should reverse and a price be paid, the rate of inflation for that item cannot be calculated.”

We think that conceptually, quality adjustment is an attractive solution to accounting for free services. However, the mentioned problems and need for more research to properly do quality adjustment for free services, make it virtually impossible to implement this approach in this report.

2.6 Business models and inclusion approaches

The literature shows that several markedly different business models are underlying free services, leading to very different measurement and conceptual problems. There are free services supported by advertising, marketing or commission, where only the consumption side is missing. There are also

¹¹ “The gains from the initial appearance of truly novel goods are difficult to quantify.” (IMF, 2018)

business models that run into huge short term losses to invest in a customer base and/or database (eg. start-ups). Another business model is charitable/non-profit initiatives (eg. Wikipedia).

We summarise the literature into six typical business models that lead to the provision of free services. These six models are: advertising-driven, marketing-driven, data-driven, “Ubiquity first, Revenue Later” (URL), charity, and freemium.

Moreover, we can classify the different approaches to inclusion of free services in the national accounts in six classes. These six approaches are: Final consumption by businesses, Imputation of transactions, Non-produced assets as investments, Quality adjustment, Time / Surplus, and, Substitution.

The characteristics of these business models and inclusion approaches are discussed in more detail in the next chapter. Here we conclude with a summarising matrix of the literature according to the models and approaches each paper discussed, see table 3. Each cell mentions the papers that discuss that combination of business model and inclusion approach. For example Ahmad & Schreyer (2016) mention and discuss the data-driven business model for free services, and that it could be included through final consumption by businesses.

Table 3 Matrix of business models and inclusion approaches

	Advertising-driven	Marketing-driven	Data-driven	URL	Charity	Freemium
Final consumption by businesses	(United Nations, 2008) (Ahmad & Schreyer, 2016) (Ravets, 2016)		(Ahmad & Schreyer, 2016)			(Bean, 2016)
Imputation of transactions	(Cremeans, 1980) (Soloveichik, 2014) (Ravets, 2016) (Ahmad & Schreyer, 2016) (Nakamura, Samuels, & Soloveichik, 2016) (Nakamura, Samuels, & Soloveichik, 2017) (Ahmad & Ribarsky, 2018)	(Nakamura, Samuels, & Soloveichik, 2017)	(Ahmad & Schreyer, 2016) (Ahmad & Ribarsky, 2018)	(Nakamura, Samuels, & Soloveichik, 2017)	(Ahmad, 2018)	(Bean, 2016) (Nakamura, Samuels, & Soloveichik, 2017)
Non-produced assets as investments	(Ahmad & Schreyer, 2016) (Ahmad & Ribarsky, 2018)		(Ahmad & Schreyer, 2016) (Ahmad & Ribarsky, 2018)	(Nakamura, Samuels, & Soloveichik, 2016) (Ahmad & Schreyer, 2016) (Ahmad & Ribarsky, 2018)	(Ahmad & Schreyer, 2016) (Ahmad & Ribarsky, 2018)	(Ahmad & Ribarsky, 2018)
Quality adjustment	(Ahmad & Schreyer, 2016) (Nakamura, Samuels, & Soloveichik, 2016) (Ravets, 2016) (Konijn, 2017) (Ahmad, 2018) IMF (2018)					(Bean, 2016) (Ahmad & Schreyer, 2016)
Time / Surplus	(Brynjolfsson and Oh 2012) Boston Consulting Group (Dean, Digrande, Field, Lundmark, O'Day, Pineda, and Zwillenberg 2012) (Ito, 2013) (OECD, 2013) indirect IMF (2018)					
Substitution	(OECD, 2013) <i>dynamic</i>					

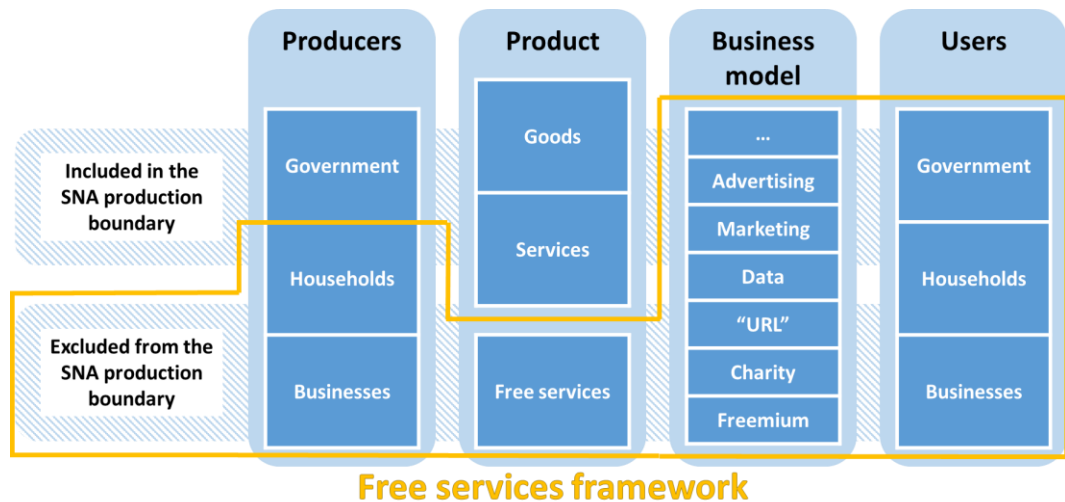
3. Framework

In this section we try to construct a general framework for free services. We start with the separate attributes of free services: the definition, structure and business models, relation with the SNA and the current approach. Given these separate elements we next formulate new approaches for including free services in the national accounts.

In the literature discussed above many parts of this framework can be found, however it seems that each research focusses on certain exemplifications of free services. Here we want to give a complete description of free services. We realise that the exploding rate of digitalisation induces new structures for business models and new kinds of free services. Due to these rapid changes the framework and the classification will need updates in time. In this framework we do not consider consumer welfare. Even though it is unquestionable that free services affect our life and have a great effect on consumer welfare (Brynjolfsson, Eggers, & Gannamaneni, 2018). More research in this direction should and will be carried out, however these questions are beyond the scope of our paper.

Recent studies for the digital economy have heavily inspired the framework for free services shown in figure 3. See for example Ahmad & Ribarsky (2018) and IMF (2018). Following concepts in these studies, we will consider the framework of free services to be a combination of a product, its producers and users, related and employed business models, and the current representation in the national accounts.

Figure 3 Dimensions of free services



Inspired by Ahmad & Ribarsky (2018).

3.1 Free services, producers and users

Free services are **all services** that are provided **free of charge** by households and companies (non government) to households, companies and government. Government is excluded on the production side because the production of government is treated as collective consumption, and therefore already included in GDP, contrary to free services that are not delivered by government.

Producers of free services can be all businesses, and also households. Users can be all households, businesses, government agencies that use internet search engines, watch television channels, listen to radio stations or use other services that are delivered without monetary costs, and that are supported by the business models in figure 3.

Free services include watching or listening television and radio that include advertising, watching free YouTube films, downloading and playing free computer and smartphone games, and also non-digital services like for e.g. watching a cycling match or even free parking. In return for these free services households and companies for example grant the free services providers access to their internet use history (cookies) and other personal information.

A list of free services :

- **Television and Radio:** commercial television and radio stations: in the Netherlands these are e.g. RTL, SBS television stations and SkyRadio, 538 radio stations.
- **Print media:** all free available newspapers, local or nationwide, Yellow Pages, Telephone directory and other.
- **Digital free services:** free apps on smartphones, free entertainment on the Internet, see table 4.
- **Education:** edX, Coursera, Codecademy, Coding Bootcamps
- **Sports events:** All sport events where customers may participate or watch for free, for e.g. marathon, cycling race events and other.
- **Real estate:** free parking, air-conditioning, nice environment (greenery, benches, meeting area)
- **Other services:** Free introductory consultations (like at a mortgage agent).

Table 4 Internet (digital) free services

Categories	Examples
Social networks	Facebook, LinkedIn, Instagram, Snapchat
Online games	Candy Crush, Fortnite
E-mail	Gmail, Hotmail, Yahoo
Instant messaging	WhatsApp, Skype, Telegram
Videos/Movies	YouTube
Search engines and tools	Google, Bing, Yahoo
Information and open source	Wikipedia, Google Scholar, Quora, IMDB, Linux, R
Classifieds/Auctions	eBay, Craigslist
Productivity	Google Docs, Evernote
Navigation apps	Google Maps, Maps
Storage	Dropbox, Box, OneDrive
Information apps	Health apps
Education apps	Language apps, Duolingo

3.2 Business models

We would like to investigate what is the mechanism of the production of free services. Provision of free services is not a new phenomenon, but due to digitalisation its magnitude and influence on our welfare and lifestyle is increasingly visible and growing (for example the use of free online games, or use of Twitter #-tags on television, billboards and in written media). The number of companies that provide Internet services has grown in the past two decades and is still growing. Also many traditional companies change their business models. The majority of

content provided is offered to consumers at little to no cost, and consumers have grown accustomed to accessing information on the Internet for free.

“It may seem contradictory, that companies that operate Internet businesses are able to make substantial profits each year despite not charging for services. Companies such as Google, Facebook, Yahoo and Twitter have numerous ways in which they can generate revenue while continuing to offer their unique Internet services at no cost to consumers.” (Investopedia)

In the literature the following categories of business models are identified:

1. Financing via advertising,
2. Marketing-driven models,
3. Financing via data,
4. “Ubiquity now, Revenue Later”-Business models using investments,
5. Charity and free assets produced by households
6. Freemium.

Financing via advertising: Advertising for households include television, radio, YouTube, Facebook, Google. Here we could use a model similar to that of Nakamura, Samuels, & Soloveichik (2017). Some media receive all their revenue from advertisers while consumers pay nothing. This is often true for TV broadcasters. Others media receive part of their revenue from advertisers and part from consumers. Magazines with some advertising are an example of this.

Marketing-driven models. Data is gathered on the millions of users that spend time on free content sites, including specific user location, browsing habits, buying behavior and unique interests. User data is beneficial to companies offering products and services on the Internet when used as marketing research. E-commerce companies tailor their marketing campaigns to a specific set of online consumers. Programmatic marketing¹², interchangeable with advertising, provides the opportunity to reach a specific customer, in a specific context.

Financing via data. 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). Large platforms such as Facebook, Uber and Google use the collected consumer data for financing their business. These platforms provide free information and free services to households, that have become indispensable. Some of these companies and platforms aggressively monopolise the market. This way such companies generate revenue through the collected data from users. The platforms provide or sell consumer data information back to companies who want or need it. Collected consumer data and monopoly of providing services increases the value of the platform. “Some companies have even built an entire business model around consumer data, whether they create targeted ads or sell to a third party. Customer data is big business.”

<https://www.businessnewsdaily.com/10625-businesses-collecting-data.html>

¹² “Programmatic marketing is automated bidding on advertising inventory in real time, for the opportunity to show an ad to a specific customer, in a specific context..... Programmatic marketing is seen as the future of advertising on the web, with Google targeting 60% of digital advertising budgets spent on Programmatic by next year. According to Forrester, programmatic will account for the majority of all digital advertising spending over the next few years.” Smart insights: <<https://www.smartinsights.com/internet-advertising/internet-advertising-targeting/what-is-programmatic-marketing/>>

“Ubiquity now, Revenue Later”-Business models using investments. These business models use investments (venture capital) or their own budget to gain significant market share by offering free services. The end goal of this business model is to generate revenue (and profit) in the future. Uber, WeWork and Google Maps are examples of such construction. Uber and WeWork have not been profitable for years, and have piled on billions of losses.

Freemium. Software developers produce two different versions of the same program. One with a small price and another with ads. “The freemium business model works by offering simple and basic services for free for the user to try and more advanced or additional features at a premium. This is a common practice with many software companies, who offer basic software free to try but with limited capabilities, and is a popular model for game companies as well. All people are welcome to play the game for free, but additional lives or special game features are only unlocked when the user pays for them.”¹³

Charity and free assets produced by households. These include cross-border flows of intellectual property and knowledge based assets. Examples of assets produced by households are Wikipedia, Linux and R. These assets have global ownership and will be hard to assign to any country. Services and work involved for making these products are not in GDP. On the other hand the assets that are freely available but were created involving costs are included in the accounts and balance sheets.

3.3 System of National Accounts (SNA)

The production of free services is practically invisible in the national accounts because the transactions that lead to the consumption of free services are non-monetary. Only monetary transactions that are linked to the production of free services are recorded in the national accounts, like the costs of advertising. Arguably inclusion of free services in the SNA is needed. We observe that free services also replace paid services, for example open source software is often used, online booking platforms replaced traveling agencies, Google Maps monopolises the navigation maps market. In these cases the question arises whether the developments of final consumption and productivity are still measured correctly.

We give an overview of how and to what extent each category of the business models from the previous subsection is included in the national accounts:

Advertising supported media. is considered as intermediate expense in the production of the goods being advertised in the SNA. SNA’s current method only counts Television and Radio broadcasts, by government and non-profit, in final consumption. Advertising expenditures are part of revenues and intermediate use.

Marketing driven. expenditures are hard to measure in practice. Most marketing expenditures are part of intermediate use or wages (employees producing marketing content).

Financing via data. Purchase of this data is part of revenues and intermediate use, though less visible than advertising. However when large data transaction cannot be traced and matched with money transfers (which indeed not always occur), these are not included in GDP. The research question here is how to include the values of data in the SNA. Fees for (curated) data,

¹³ <https://www.investopedia.com/terms/f/freemium.asp>

also called data licensing, are a possible indication. Another question is if and to what extent data depreciate.

“Ubiquity now, Revenue Later”. For the companies that use venture capital to provide free services expenditures will be accounted, though a big part might not count as investment.

Freemium. For the freemium business model revenues obtained from premium versions are included in the SNA. The value of the free products, however, is hard to estimate. It could be considered as an investment. However if these businesses collect freemium user data and use these data for their premium product marketing research or for improving or updating premium products, the cost could be seen as R&D.

Charity and free assets produced by households. These free services are not included in the SNA. It is difficult to measure and value the use of Wikipedia and open source software. Though obviously the consumption of encyclopaedias on paper has dropped because of Wikipedia, for example.

3.4 Current situation

The literature offers several approaches for defining the value of free services in GDP and welfare terms. As mentioned above, we focus on an approach that conforms to SNA concepts. For the Dutch case this means that it must be reasonably possible to implement these approaches in the context of national accounts supply and use tables (SUT).

We use a simple example of Soap-TV economy from Cremeans (1980) to describe free services in the SUT for the current situation.

Figure 4 Soap – TV economy

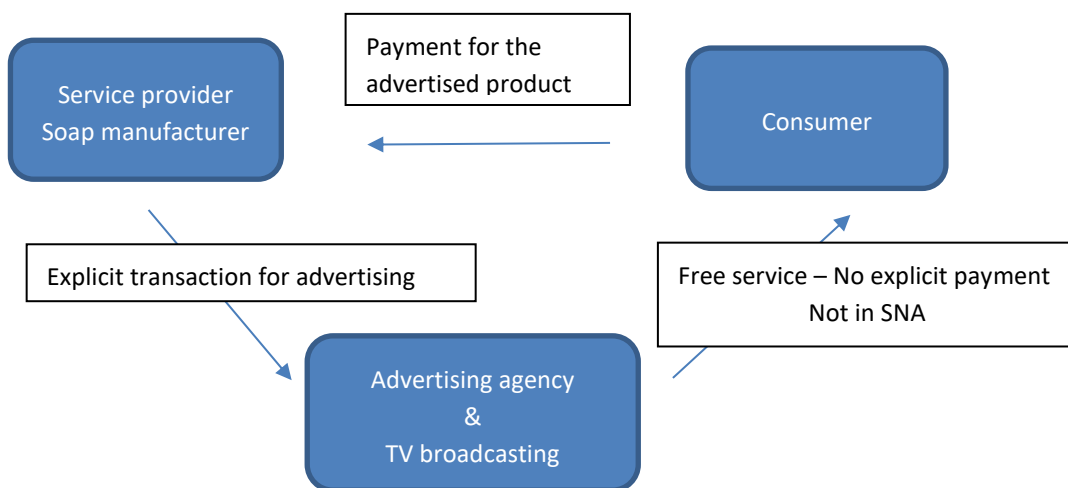


Figure 4 and table 5 show the current situation using the Soap – TV economy example. In this example the soap manufacturer buys the soap commercial from the advertising agency. Consumer gets to watch the soap opera for free, and buys the soap. Table 5 shows how this economy (using fictive figures) is booked according to the SNA. Negative numbers under the product column are costs. Figures in table 5 are as follows:

- The soap manufacturer has no value added, just sales and advertising.
- The advertising agency sells advertising to the soap manufacturer (\$ 6,721) and buys display time from the TV broadcasting company (\$ 5,115). It also buys services e.g. the rental of

- The TV broadcasting sells display space and time and other services to the advertising agency (\$ 5,115). It produces and broadcasts TV signals (entertainment and commercials).
- The miscellaneous industry includes the production companies, electric utility, the television receiver manufacturers and all the other industries.

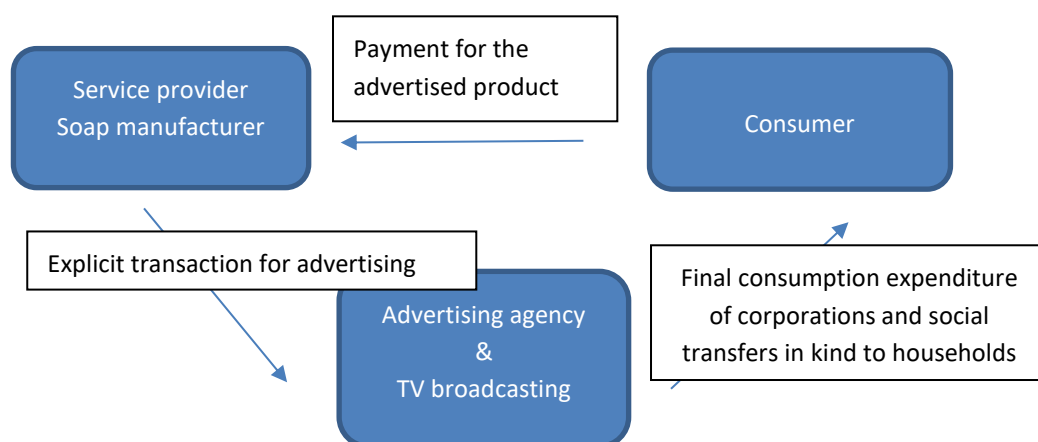
Sector	Description	Sector of origin	Sector of destination	Income T \$	Product T \$
1	Soap Manufacturer				
	Soap			4	6,721
	Advertising	2			-6,721
	Value added			0	0
2	Advertising Agency (TV)				
	Advertising		1		6,721
	Display time/space	3			-5,115
	Other services	3			-174
	Other intermediate purchases	5			-298
	Value added			1,134	1,134
3	TV Broadcasting				
	Display time/space		2		5,115
	Other services		2		174
	Other intermediate use	5			-2,725
	Value added			2,564	2,564
4	Consumers				
	Soap	1			6,721
	Electricity	5			1,401
	Repair services	5			1,136
	TV receivers	5			8,297
	Total consumer purchases				17,555
5	Miscellaneous Industry				
	Other intermediate use		2		298
	Other intermediate use		3		2,725
	Electricity		4		1,401
	Repair services		4		1,136
	TV receivers		4		8,297
	Value added			13,857	13,857
	National Income and Product			17,555	17,555
	Income	Production		Expenditure	

Free services 28

3.5 Imputation of final consumption by businesses

The first approach is the imputation of final consumption by businesses replacing intermediate use. For this approach we first rely on Ahmad & Schreyer (2016). The idea is to treat advertising, and other similar costs made when creating free services, as final consumption expenditure of corporations and social transfers in kind to households. The imputation of final consumption by business demands very little expansion of the existing SUT, and boils down to transferring values from intermediate use to final consumption. The idea is that companies, through their intermediate inputs, pay for services that are provided for household consumption, for free. These services are not used to generate the outputs of the using economic sector. So, for example, the intermediate use of broadcasting time by an advertising agency is not just intermediate use, but actually to some extent a mechanism that creates free services (television entertainment) for consumers.

Figure 5 Soap – TV economy, advertising as individual consumption.



As an example, in figure 5, the final consumption by corporations that goes to consumers as a free service is passed on by the advertising agency. That is the display time and space that the advertising agency bought for a consumer and practically gave away as a free gift. For this transaction we create a new entry in final consumption.

This approach is relatively easy to implement, as it requires:

- Very little expansion of the existing SUT.
- Merely transfers values from intermediate use to final consumption.
- The data requirement, besides the SUT, is information about the proportion of intermediate use (of advertising/marketing) that does not lead to the provision of the free service but covers other expenses like that of sales agents.

Table 6 expands the Soap-TV economy of the previous section to include imputed final consumption by businesses. The difference is:

- The advertising agency now buys two types of display time from the TV broadcasting company.
- It still buys of display time (\$ 2,390) as an intermediate input. These are the costs of the advertising department and administration at the TV broadcasting company.
- In addition, it buys of display time (\$ 2,725) that is gifted to households as free entertainment. For this amount actors, screenwriters and other creatives have been working to offer the entertainment to households.

- This \$ 2,725 of entertainment display time is recorded as final consumption by businesses for this approach, raising GDP through the expenditure approach by the same amount. As a consequence value added increases, raising both the production and income approach of GDP.

Table 6 Extended Soap-TV economy

Sector	Description	Sector of origin	Sector of destination	Income T \$	Product T \$
1	Soap Manufacturer				
	Soap		4		6,721
	Advertising	2			-6,721
	Value added			0	0
2a	Advertising Agency (TV)				
	Advertising		1		6,721
	Display time/space (non-entertainment)	3			-2,390
	Other services	3			-174
	Other intermediate purchases	5			-298
	Value added			3,859	3,859
2b	Advertising Agency (TV)				
	Display time/space (entertainment)	3			2,725
	Total corporate consumption				2,725
3	TV Broadcasting				
	Display time/space		2		5,115
	Other services		2		174
	Other intermediate use	5			-2,725
	Value added			2,564	2,564
4	Consumers				
	Soap	1			6,721
	Electricity	5			1,401
	Repair services	5			1,136
	TV receivers	5			8,297
	Total consumer purchases				17,555
5	Miscellaneous Industry				
	Other intermediate use		2		298
	Other intermediate use		3		2,725
	Electricity		4		1,401
	Repair services		4		1,136
	TV receivers		4		8,297
	Value added			13,857	13,857
National Income and Product				20,280	20,280
Income		Production		Expenditure	

There are some conceptual caveats to this approach, but for an experimental estimate, this approach suffices. The data requirement, besides the SUT, is information on the proportion of intermediate use (of advertising/marketing etc.) that does not lead to the provision of the free service but covers other expenses like that of sales agents.

3.6 Imputation of production by households of viewership services

The second approach is the imputation of production by households of viewership services, production of free services with that viewership service as an intermediate input, and finally consumption by households of that free service. This approach means that the production of several inputs and outputs at the different companies, and at households are explicitly defined and estimated.

This approach recognizes the nonmarket exchange between the consumer and the broadcaster. The consumer gets audio-visual advertisements in return for broadcast entertainment. In this approach households are not only consumers but also producers. Current national accounts ignore this role of households. In this approach households are active producers of viewership services that they barter for consumer entertainment.

Table 7 expands the base Soap-TV economy to include production of a viewership service by households, the Household Display Enterprise (HDE). The difference is:

- The TV Broadcasting industry now buys two types of display time from households (HDE).
- One is the intermediate input to serve advertising (\$ 437). The other is the channel through which the TV broadcasting company serves entertainment (\$ 738).
- Households become producers of “display time” for a total value added of \$1.175. As consumer this value added is used to consume free entertainment.
- This \$ 1.175 raises GDP through the expenditure approach as consumption is higher. As there is more value added, created at the HDE, both the production and income approach of GDP are higher.

This is the most ambitious approach in the literature and a full implementation of Nakamura, Samuels, & Soloveichik (2017), as explained in more detail in paragraph 2.4.2. This approach is very data-demanding. It needs for example data on the share of intermediate use of companies that is spent on marketing (also internal expenses) and a good split between time spent on watching advertising and actual entertainment. This split helps establishing the (reservation) price of the time spent by households watching advertisements. This can be considered the price of the viewership services produced by households that are sold to the TV broadcasting company in exchange for watching the free non-advertisement content.

Table 7 Household Display Enterprise in a Soap-TV economy

Sector	Description	Sector of origin	Sector of destination	Income T \$	Product T \$
1	Soap Manufacturer				
	Soap		4a		6,721
	Advertising	2			-6,721
	Value added			0	0
2	Advertising Agency (TV)				
	Advertising		1		6,721
	Display time/space	3			-5,115
	Other services	3			-174
	Other intermediate purchases	5			-298
	Value added			1,134	1,134
3a	TV Broadcasting (Advertising)				
	Display time/space		2		5,115
	Other services		2		174
	Display time/space	4b			-437
	Other intermediate use	5			-391
	Value added			4,461	4,461
3b	TV Broadcasting (Entertainment)				
	Entertainment		4a		1,175
	Display time/space	4b			-738
	Other intermediate use	5			-2,334
	Value added			-1,897	-1,897
4a	Consumers				
	Soap	1			6,721
	Entertainment	3b			1,175
	Electricity	5			1,401
	Repair services	5			1,136
	TV receivers	5			8,297
	Total consumer purchases				18,730
4b	Household Display Enterprise				
	Display time/space		3a		437
	Display time/space		3b		738
	Value added			1,175	1,175
5	Miscellaneous Industry				
	Other intermediate use		2		298
	Other intermediate use		3a		391
	Other intermediate use		3b		2,334
	Electricity		4b		1,401
	Repair services		4b		1,136
	TV receivers		4a		8,297
	Value added			13,857	13,857
National Income and Product				18,730	18,730
Income		Production		Expenditure	

4. Imputation of final consumption of free services in Dutch SNA

In the previous section we described two different approaches to estimate the share of free services in the economy (see sections 3.5 and 3.6). In this section we will estimate the contribution of free services to Dutch GDP following the first approach, by imputing final consumption by businesses (Ahmad & Schreyer, 2016). The idea is to treat advertising, and other similar costs made when creating free services, as final consumption expenditure of corporations and social transfers in kind to households. We chose this method due to limited time and data available to us. As mentioned above the second approach presented in Nakamura, Samuels & Soloveichik (2016) requires more information and data (see Appendix A) in combination with meticulous research.

In order to apply the approach by imputing final consumption defined in section 3.5, we need to determine which fraction of intermediate use is actually consumption by businesses of free services, for all industries in the Netherlands. In Soap – TV economy that is information on display time that is gifted to households as free entertainment. In table 6 this amount is \$2,725. Actors, screenwriters and other creatives have been working to offer the entertainment to households.

It is not obvious how to determine the fraction of intermediate use that produce free services. We propose the following;

- 1 Define the fractions of intermediate use that is actually consumption by businesses of free services, which are then freely provided to consumers, using occupation data;
- 2 Use a input-output table with which industry is using inputs from which industry, so that we can apply estimated fractions.

This also means we ignore the possibility that free services enter and leave the Netherlands through international trade or through international broadcasting.

In the following subsections we discuss these two parts separately.

4.1 Estimates of the fraction of free services using occupation data

We need to estimate fractions of the production that are actually free services, in each industry. We propose to calculate these fractions based on employee wages and hours worked in each industry. We have selected the occupations that we assume mostly contribute to advertisements and hence free services. Free services reach consumers mainly through advertisements, therefore according to our model these occupations contribute to free services. For example if we find designers working within the agriculture industry, we assume that they create websites for farmers or carry out other activities related to advertising or promotion.

The selected occupations¹⁴ that would generate free services are:

- Authors and linguists
- Journalists
- Visual artists
- Other creative and performing artists

¹⁴ Translated from the Statistics Netherlands classification for occupations, with reference to the titles of ISCO 2008.

- Graphic and product designers
- Artistic and cultural associate professionals
- Sales, marketing and public relations professionals
- Telecommunications and broadcasting technicians

The occupation data that is available to us, can be obtained from the Labour Force Survey (LFS). The LFS is a rotating panel survey consisting of five waves, collecting information about labour of households and individuals. For our study we consider only individuals and not households. In this survey respondents fill in their occupation, among other variables. Next to the occupation we need to know in which industry each respondent is employed. Therefore we link the respondents with an employment register (ER) and obtain the corresponding industry. The ER is an administrative data set that combines information from different administrative sources, mainly from Tax authorities but also from the Centre for Work and Income (CWI) and the institute for employees insurances (in Dutch Uitkeringsinstituut Werknemers Verzekeringen (UWV)). The ER consists of administrative information on persons, households, jobs, benefits and pensions. It covers the entire Dutch population, including persons living abroad but working in the Netherlands or receiving a benefit or pension from a Dutch institution.

From the linked data we obtain estimates of the number of employees, wages earned, and hours worked for the eight occupations within each industry. For each industry we also have the labour accounts estimates (integral part of the national accounts) for the total wages, and total hours worked for the Netherlands, in each industry.

The ratios of the wages and hours worked of persons with the occupations that generate free services and the total wages and hours worked gives us the fractions we need. These fractions are next multiplied to the supply and use tables of the national accounts.

Below we describe the steps we took in more detail. For simplicity we describe this process for one year:

- 1 Consider the LFS from the year 2014. We first selected respondents of the Labour Force Survey (LFS) that have the 8 selected occupations.
- 2 There are in total 7,893 LFS respondents with the selected occupations. For these persons we try to link the employment register (ER) data of 2014. Not all persons could be linked. Only for 5,477 persons we could find employment records. Persons that were not linked were mostly self-employed. The LFS has the weights for obtaining the population totals. These LFS weights were corrected by the factor $7,893/5,477$. Here we assume that persons that were not linked have the similar LFS weights as the ones that were linked.
- 3 The employment register (ER) includes information on industry, wages and hours worked. From the linked data we obtain estimates for each occupation and each industry for the population totals.
- 4 Within the selected 8 occupations we made a two different groups: marketing and the other 7 selected occupations. We have two reasons for this. It helps us later to relate our results to the literature, which distinguishes between advertising in a narrow sense and marketing in a broad sense. Moreover, we believe these two groups of occupations have a different nature when generating free services. Marketing often contributes to better performance of the businesses.
- 5 From the linked data we obtain the estimates of wages and hours worked for the selected 8 occupations for each industry. These are the numerators of the

fractions for free services. The denominators of these fractions are the total values for wages and hours worked of all occupations obtained from the Dutch labour accounts (StatLine, Statistics Netherlands).

- 6 With the results from the previous two steps we then derive the fractions for free services for all industries.

The application of these fractions to the Dutch national accounts, and the resulting GDP figures, are discussed in the next section.

4.2 Adding free services to the Dutch national accounts

To determine the contribution of free services to GDP we have chosen to impute final consumption by businesses. For this calculation we will show below that we need the fractions found in the previous section:

- Fractions of hours by creators of free services and marketers in an industry.
- Fractions of wages by creators of free services and marketers in an industry.

We apply these fractions to the input-output table of the Dutch national accounts. This table tells us which outputs (in euro) of an industry are intermediate use of other industries. Beneath is a small subset of the input-output table. The rows depict the supplying industry (or other sources), and the columns the users, like other industries for their intermediate use. For example the food processing industry uses almost 9 billion euro of output from the agriculture industry as intermediate use.

Table 8: Subset of the Dutch input-output table, 2015 (Statistics Netherlands) in million euros.

Supply \ Use	Extraction of crude petroleum and gas	Manufacture of food products	Energy supply	Real estate excl. imputed rents
Agriculture	7	8,914	3	20
Energy supply	1,235	197	2,339	137
Water collection and distribution	7	66	11	11
Legal services, administration etc.	6	214	44	207

Parts of the intermediate use of Dutch industries will be transferred to two new types of consumption:

- Consumption by businesses of free services, excluding marketing.
- Consumption by businesses of free services, marketing.

This means we distinguish explicitly between marketing, and all other selected professions. This is one of the important differences driving the different outcomes of Nakamura, Samuels & Soloveichik (2016) and Nakamura, Samuels & Soloveichik (2017). Arguably free services created by marketing people have a different nature from those by the other selected professions. The other professions lead (more directly) to services ready for consumption. That being said, here is room for future research.

First, we look at the original Dutch GDP and its components for 2015, using the expenditures approach. Total GDP was 690 billion euro. Consumption by households was 305 billion euro, in 2015, and 44% of GDP.

Table 9: Dutch GDP and its components, million euros, 2015

Component	Value
Gross fixed capital formation	152,533
Final consumption, general government	172,354
Final consumption, households	305,372
Final consumption, NPISHs	5,444
Imports of services	-165,668
Imports of goods	-352,926
Exports of services	151,980
Exports of goods	418,373
Changes in inventories incl. valuables	2,546
Gross domestic product (GDP)	690,008

Then we add free services to the table by applying the found shares to each combination of supplying and using industry. The shares we use are those of the supplying industry. The idea is that the activities of the selected occupations at the supplying industry lead to the creation of free services, that are paid for by the using industry. When we apply the estimated proportion factors for each industry we assume that the proportion of free services is the same in each use industry.

This leads to the following table, which shows how many free services would be transferred from intermediate use to consumption by businesses. It distinguishes between the different kinds of shares we calculated, based on hours worked and salaries paid. Moreover, we separate free services that would be generated by marketing professionals, and by the other selected occupations. In addition we assume that two industries do not produce free services. These are the publishing and marketing industries. We assume that the selected occupations in these particular industries only generate paid-for outputs.

Table 10: Free services added to GDP, million euros, 2015

Component	Hours	Wages
Consumption of free services, excluding marketing	8,651	6,910
Consumption of free services, marketing	15,038	13,949
GDP	23,689	20,858

According to this analysis adding free services to GDP, by transferring intermediate use to consumption by businesses, adds between 7 and 23.7 billion euro to GDP. This translates to 1-3.4% of GDP and 2.3-7.8% of consumption by households, which does exclude collective consumption, among other things. The contribution of free services is highest when the fraction transferred is based on hours worked, and lowest when based on salary. This is an indication that occupations that lead to free services in industries have a lower value added than primary activities. This is not entirely unexpected as the services are gifted away of course.

A share of 1-3.4% of GDP for consumption of free services moreover does not contradict the findings of Nakamura, Samuels & Soloveichik (2017) for the US. In this research we have made assumptions that can be made more precise with further research. We expect the bandwidth of our estimate to narrow then.

5. Discussion

A large number of studies on digital economy and in particular free services by leading economists from agencies such as IMF, OECD, Eurostat, BEA etc. recognise a great need for understanding the phenomenon of free services and the necessity to measure free services, its products and effects on the economy, GDP and welfare.

In this paper we gave a review of the literature on free services. These papers present several methodological ideas on how to include free services into current SNA or create a satellite account of free services. In spite of the number of papers reviewed, we did not find a complete overview of free services that define all its dimensions. In this paper we propose a definition and a framework of free services, including products, suppliers and users and business models that are used to produce free services.

Further we explore in more detail two different approaches from the literature. Approach 1 by Ahmad & Schreyer (2016) treats advertising as individual consumption and includes it in the SNA as final consumption expenditure of corporations and social transfers in kind to households. Approach 2 by Nakamura, Samuels & Soloveichik (2017) is a very data demanding approach. This approach treats 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. In Appendix 7 we give a summary of data sets used in this research.

We modified the first approach in order to apply it to Dutch supply and use tables. As mentioned above this approach is relatively easy to implement; however it required information about the fraction of intermediate use of advertising/marketing (free services). Our suggestion is to use occupation data to estimate this fraction.

We estimated these fractions based on the occupation data from the Labour Force Survey (LFS), Employment Register (ER) and the Dutch labour accounts tables. During this estimation process we made quite a few assumptions:

- We assume that only the chosen eight occupations contribute to free services and that they don't contribute to any paid production.
- For the persons from the LFS that could not be linked with the ER we assumed that the LFS weight were similar to the LFS weights of linked persons.
- To obtain the estimate for the proportion of free services in each industry we combine the LFS and the labour accounts totals. We did not investigate how comparable these estimates are. For example whether the underlying data sources have the same population coverage or not.
- When we apply the estimated proportion factors for each industry to the input-output tables we assume that the proportion of free services in is the same in each using industry.

These assumptions contribute to the precision of the estimates. However the goal of this data experiment was to obtain an indication of the production of free services within each industry and within GDP. We observed that the share of free services in GDP varies between 1 and 3.4 percent depending on how we define the free services: based on the hours worked or wages and whether we include marketing or not. The choice between these definitions and

assumptions is not obvious. One can argue that marketing mainly contributes to business development and just a small part of it contributes to free services. However it is very hard to identify this part. The results of these simple sensitivity analyses show that the outcome under different assumptions and different definitions does not vary much. In (Nakamura, Samuels, & Soloveichik, 2017) the authors estimated the share of free services (advertising and marketing and businesses earn and use as intermediate input) for the United States in 2015 at 311 billion dollars of total DGP 18,037 billion dollars, that is 1.7 percent. This estimate is very similar to the estimates we presented for the consumption without marketing.

The aim of this paper was to find the ways on how to include free services in the SNA. We presented an approach of using occupation data for the method in Ahmad & Schreyer (2016) to estimate the share of free services in GDP for the Netherlands. Many assumptions were made, and some could be disputable. However as said above further research should be carried out in order to temper some of these assumptions. It would be interesting to compare results we obtained for the Netherlands with similar results for other EU countries. The method we propose here is relatively easy to replicate. This could be an interesting subject for future research.

Another approach discussed in this paper is a price and volume approach for free services. The goal then is to investigate quality change for products that are now free or are complementary to free products. More research should be carried out before we could have the GDP estimates with quality adjustment for free services.

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7. Appendix A

List of datasets used by Nakamura et.al. (2016)

Production of Media By Industry: 1929-2014

Unfortunately, the **Economic Census** does not report online advertising revenue for print publishers or video revenue for Internet publishers. The only data tracked is total advertising revenue for each industry. A variety of datasets was used to split industry advertising revenue by media category.

The **Newspaper Association of America** for digital advertising. No similar data on magazines, but the **Service Annual Survey** does track the overall share of revenue earned online. This total includes both digital advertising revenue and also digital subscription revenue.

Annual reports published by the **Internet Advertising Bureau** (IAB) and other sources to track online radio and television advertising.

Nominal Advertising Revenue by Media: 1929-2014

The primary dataset here is the 2007 **Economic Census**. That Census reports advertising revenue for newspaper publishers (NAICS 51111), magazine publishers (NAICS 51112), radio broadcasters (NAICS 51511), television broadcasters (NAICS 51512), cable networks (NAICS 5152) and internet publishers (NAICS 516 in 2002 and 51913 in 2007 and 2012).

For print newspapers, the **Newspaper Association of America** provides series data from 1950 until 2013.

Before 1950, authors use estimates from the **CS Ad Expenditure Dataset** (Galbi 2008). That data is also available online for free.

For print magazines, the **Service Annual Survey** (SAS) provides the total magazine advertising from 2005 until 2013. The Economic Census provides total magazine advertising from 1947 until 2007. The CS Ad Expenditure Dataset was used before 1947 and as an interpolator between Economic Census years. None of these datasets splits online advertising revenue from print advertising revenue. Authors use the online share estimates developed earlier to estimate print revenue alone.

Forrester Data on Media Time Use: 1929-2014

The primary data on time use was provided by Forrester, a survey company. Data on weekly time use for 'reading newspapers (not online)', 'reading magazines (not online)', 'listening to the radio (not online)', 'Using the Internet for personal purposes' and 'Using the Internet for work purposes' was used in the paper.

Other Data on Media Time and Media Consumption: 1929-2014

Authors also use **Nielsen data** to track television viewership back to its beginning. From 1980 until 2007, they use **Arbitron data**. Like the Nielsen data, they did not buy Arbitron's full dataset. Instead, used a summary prepared by the **Corporation for Public Broadcasting**. In addition an **article 'More Power'** (Sponsor 1949) that reports radio listenership in 1949, 1946 and 1943 was used.

For television, data from **IMDB.com** was used to split viewership between programs and advertising. Also the **book 'Radio After the Golden Age: The Evolution of American Broadcasting Since 1960'** (Cox 2013) was used.

8. Appendix B

8.1 Business models

	Advertising-driven	Marketing-driven	Data-driven	“Ubiquity now, Revenue Later”	Charity	Freemium
Examples	Google, Facebook, Twitter, LinkedIn, Commercial TV/Radio, Free newspapers	Any company that produces marketing content that is valued by consumers.	Google, Facebook, Twitter, LinkedIn	Uber, Google Maps	Wikipedia, Linux	LinkedIn, Newspapers with soft paywalls, Cloud services (OneDrive, Dropbox), Online games, Software
Business model	Amass an audience, based on which one can sell (targeted) advertising.	Supply wanted content to consumers, and hope for leads.	Selling information about groups of people, basically in competition with survey companies.	Amass a user base and/or gain significant market share and then start charging a (higher) price.	Free labour and/or donations	Provide paid services, that subsidise either a leaner free basic version or a free service for a specific audience (eg. students). Or, provide a free service that advertises the premium product. (Nakamura, Samuels, & Soloveichik, 2017)
Valuation	Advertising fees, minus acquisition costs.	Marketing expenditures, which is hard to measure in practice because a lot of marketing happens in-house.	Fees for (curated) data, also called data licensing. Probably minus acquisition costs (= depreciation of data?).	Investments? Venture capital / discounted cash flow?	Paid alternative? Cost of free time spent?	Inherent in the subscription and advertising fees that are received?
Present inclusion	Advertising expenditures are part of revenues and intermediate use.	Most marketing expenditures are part of intermediate use and/or salaries (= employees producing marketing content).	Purchase of this data is part of revenues and intermediate use, though less visible than advertising.	Expenditures by these companies are accounted for, though a big part might not count as investment.	Hardly, though obviously for example the consumption of encyclopaedias has dropped.	Subscription and advertising revenues are accounted for, as are the incurred costs for providing the free service.

8.2 Inclusion approaches

Inclusion approach	Final consumption by businesses	Imputation of transactions	Quality adjustment
Idea	Part of advertising expenditure by businesses is actually final consumption, with a transfer in kind to households, see SNA Research Agenda (United Nations, 2008)	Impute consumption and intermediate use of free services, or even provision of a “viewing service” (reception & display) by households. The watching service might be “balanced” (in NA terms) with TV hours watched, (mobile) internet penetration etc.? Account for substitution of paid for software/services with free software/services for better measurement of multifactor productivity.	Most free services are somehow connected to a paid service (broadband, telephone and cable subscriptions). When the free services are “bundled” with paid services, the prices of these paid services can be quality adjusted accordingly.
Method	The proportion of advertising that leads to the provision of free services is recorded as final consumption by businesses instead of intermediate use.	Split off from households a “household reception & data enterprise”, that gets imputed payments to offer reception of either TV, radio or internet. Optionally, this enterprise invests in reception devices, which should therefore be removed from consumption. Accounting for this production process is not necessary however (see the BEA/Nakamura papers). Compare owner-occupied housing in the present national accounts.	1) Quality-adjust the concerned service (eg. broadband access) directly, considering for example what paid for service was substituted. Downside is that the value added shows up at the broadband supplier and not at the media provider. (Nakamura, Samuels, & Soloveichik, 2016) 2) Introduce free services margins to bridge the gap between the quality of the service provided (eg. broadband access) and the quality of the service including free services (eg. Google Search). These new margins only have a value in constant prices, price zero, and are produced by the free services providers or imported. This ought to solve the Nakamura critique.
Sources	SBS and SUT; a source on which media advertising is spent, and a determination of whether a medium provides a free service.	SUT, time-use, split between consumers and businesses, price indexes for all kinds of media.	1) CPI? 2) SUT; a way to estimate the level of margins could be to look at expenses of replaced services, like print media. The drop consumed paid for media can be compensated by an increase in free services margins.
Impact (OECD, 2013)	Dynamic / Indirect	Dynamic / Indirect	Direct / Dynamic

Inclusion approach	Non-produced assets as investments	Time / Surplus	Substitution
Idea	Besides investment in certain goods and services, other assets should be included in the asset boundary. Companies supply free services to build a brand name, gather a user base and accumulate data. Most expenditures incurred towards these are currently seen as intermediate use, and not as investments. Account for substitution of paid for software/services with free software/services for better measurement of multifactor productivity.	1) Consumers “pay” with their time. (Mobile) internet penetration might provide “macro” insights. 2) Consumers derive utility from free services, which is possible to estimate by surveying willingness-to-pay.	Determine the replaced service and value the free service, based on what it replaced. The replaced paid for service gives an indication of the willingness to pay of consumers. (OECD, 2013)
Method			
Sources		Time surveys? Internet; access, use and facilities.	CPI?
Impact (OECD, 2013)	Direct?	Indirect	Indirect

9. Appendix C

NACE	Description	Profession	Jobs_Share	Hours_Share	Salary_Share
01	Agriculture	All, except marketing	0.50	0.43	0.47
01	Agriculture	Marketing	1.20	1.40	2.22
02	Forestry and logging	All, except marketing	4.43	5.56	1.81
02	Forestry and logging	Marketing	4.74	5.78	6.32
03	Fishing and aquaculture	Marketing	7.61	5.83	3.88
B	Mining and quarrying	All, except marketing	0.55	0.41	0.57
B	Mining and quarrying	Marketing	2.20	2.05	1.99
10-12	Manufacture of food and beverages	All, except marketing	1.50	1.49	1.43
10-12	Manufacture of food and beverages	Marketing	4.38	4.72	5.58
13-15	Man. of textile-, leatherproducts	All, except marketing	4.28	3.76	3.54
13-15	Man. of textile-, leatherproducts	Marketing	3.09	3.32	3.70
16-18	Man. wood en paperprod., printing	All, except marketing	5.69	5.29	4.18
16-18	Man. wood en paperprod., printing	Marketing	4.69	4.58	4.53
19	Manufacture of coke and petroleum	All, except marketing	1.49	1.73	1.43
19	Manufacture of coke and petroleum	Marketing	2.41	2.48	2.91
20	Manufacture of chemicals	All, except marketing	0.98	0.94	0.68
20	Manufacture of chemicals	Marketing	5.31	5.45	4.72
21	Manufacture of pharmaceuticals	All, except marketing	0.75	0.71	0.38
21	Manufacture of pharmaceuticals	Marketing	4.80	5.04	4.84
22	Manufacture rubber, plastic products	All, except marketing	1.95	1.92	1.78
22	Manufacture rubber, plastic products	Marketing	5.04	5.31	5.95
23	Manufacture of building materials	All, except marketing	1.16	0.98	0.88
23	Manufacture of building materials	Marketing	3.79	4.08	4.44
24	Manufacture of basic metals	All, except marketing	0.77	0.57	0.77
24	Manufacture of basic metals	Marketing	1.70	1.69	1.99
25	Manufacture of metal products	All, except marketing	0.86	0.92	0.82
25	Manufacture of metal products	Marketing	2.43	2.52	2.65

26	Manufacture of electronic products	All, except marketing	1.79	2.08	1.71
26	Manufacture of electronic products	Marketing	7.31	7.88	7.08
27	Manufacture of electric equipment	All, except marketing	3.02	2.92	2.76
27	Manufacture of electric equipment	Marketing	7.40	7.48	7.26
28	Manufacture of machinery n.e.c.	All, except marketing	1.59	1.60	1.43
28	Manufacture of machinery n.e.c.	Marketing	4.39	4.34	4.10
29	Manufacture of cars and trailers	All, except marketing	1.29	1.44	1.53
29	Manufacture of cars and trailers	Marketing	2.07	1.86	2.32
30	Manufacture of other transport	All, except marketing	1.40	1.13	0.84
30	Manufacture of other transport	Marketing	3.40	3.16	2.79
31-32	Manufacture of furniture; other	All, except marketing	1.19	1.29	1.24
31-32	Manufacture of furniture; other	Marketing	1.38	1.50	2.10
33	Repair and installation of machinery	All, except marketing	0.64	0.56	0.55
33	Repair and installation of machinery	Marketing	2.87	2.81	2.86
35	Energy supply	All, except marketing	1.80	1.35	0.97
35	Energy supply	Marketing	5.49	5.17	4.17
36	Water collection and distribution	All, except marketing	1.09	0.87	0.70
36	Water collection and distribution	Marketing	2.32	1.83	1.31
37-39	Sewerage and waste treatment	All, except marketing	0.39	0.30	0.35
37-39	Sewerage and waste treatment	Marketing	2.04	1.52	1.67
41	Construction buildings, development	All, except marketing	0.43	0.27	0.14
41	Construction buildings, development	Marketing	0.57	0.41	0.36
42	Civil engineering	All, except marketing	0.96	0.92	0.84
42	Civil engineering	Marketing	0.90	0.70	0.69
43	Specialised construction activities	All, except marketing	0.35	0.31	0.28
43	Specialised construction activities	Marketing	1.51	1.40	1.50
45	Sale and repair of motor vehicles	All, except marketing	0.44	0.25	0.16

45	Sale and repair of motor vehicles	Marketing	2.95	3.05	3.55
46	Wholesale trade (no motor vehicles)	All, except marketing	2.48	2.17	1.78
46	Wholesale trade (no motor vehicles)	Marketing	8.88	9.14	9.11
47	Retail trade (not in motor vehicles)	All, except marketing	1.72	1.58	1.51
47	Retail trade (not in motor vehicles)	Marketing	1.29	1.52	1.96
49	Land transport	All, except marketing	0.35	0.19	0.18
49	Land transport	Marketing	0.51	0.44	0.71
50	Water transport	All, except marketing	0.99	0.22	0.08
50	Water transport	Marketing	0.70	0.56	0.42
51	Air transport	All, except marketing	0.92	0.94	0.59
51	Air transport	Marketing	0.69	0.61	0.46
52	Warehousing, services for transport	All, except marketing	0.97	0.83	0.82
52	Warehousing, services for transport	Marketing	1.26	1.17	1.25
53	Postal and courier activities	All, except marketing	1.91	0.63	0.45
53	Postal and courier activities	Marketing	1.01	1.23	1.58
I	Accommodation and food serving	All, except marketing	1.82	0.83	0.65
I	Accommodation and food serving	Marketing	1.30	0.96	1.06
58	Publishing	All, except marketing	57.05	56.46	50.48
58	Publishing	Marketing	13.61	12.96	10.17
59-60	Movies, TV and radio	All, except marketing	86.77	80.08	68.85
59-60	Movies, TV and radio	Marketing	9.79	7.33	5.48
61	Telecommunications	All, except marketing	4.06	3.67	3.09
61	Telecommunications	Marketing	12.03	10.61	9.80
62-63	IT- and information services	All, except marketing	5.38	3.88	2.23
62-63	IT- and information services	Marketing	9.69	8.52	7.71
64	Financial institutions, no insurance	All, except marketing	2.16	1.51	0.88
64	Financial institutions, no insurance	Marketing	5.85	5.41	4.20
65	Insurance and pension funding	All, except marketing	1.50	1.53	1.11
65	Insurance and pension funding	Marketing	4.24	4.12	3.74

66	Other financial services	All, except marketing	1.15	0.74	0.54
66	Other financial services	Marketing	2.43	2.23	1.85
68	Renting, buying, selling real estate	All, except marketing	1.28	0.73	0.61
68	Renting, buying, selling real estate	All, except marketing	1.28	0.73	0.61
68	Renting, buying, selling real estate	Marketing	2.37	2.20	1.91
68	Renting, buying, selling real estate	Marketing	2.37	2.20	1.91
69-70	Legal and management consultancy	All, except marketing	3.32	1.31	0.82
69-70	Legal and management consultancy	Marketing	4.68	4.01	3.08
71	Architects, technical services etc.	All, except marketing	3.01	2.36	1.84
71	Architects, technical services etc.	Marketing	3.22	2.88	2.73
72	Research and development	All, except marketing	4.78	4.32	3.39
72	Research and development	Marketing	4.50	3.74	4.12
73	Advertising and market research	All, except marketing	26.55	24.90	18.14
73	Advertising and market research	Marketing	30.80	27.23	27.28
74-75	Other specialised services	All, except marketing	17.13	14.41	12.07
74-75	Other specialised services	Marketing	6.32	4.63	5.06
77	Renting and leasing of tangible goods	All, except marketing	4.68	2.89	1.53
77	Renting and leasing of tangible goods	Marketing	4.94	5.17	4.39
78	Employment activities	All, except marketing	3.75	1.22	1.24
78	Employment activities	Marketing	2.59	1.24	1.42
79	Travel agencies, tour operators etc	All, except marketing	4.26	3.22	2.16
79	Travel agencies, tour operators etc	Marketing	8.32	6.90	4.53
80-82	Security, other business services	All, except marketing	0.97	0.78	0.74
80-82	Security, other business services	Marketing	1.22	1.28	1.54
84	Public administration and services	All, except marketing	1.13	1.10	0.95
84	Public administration and services	All, except marketing	1.13	1.10	0.95
84	Public administration and services	Marketing	2.32	2.27	2.10
84	Public administration and services	Marketing	2.32	2.27	2.10

85	Education	All, except marketing	2.81	1.71	1.56
85	Education	All, except marketing	2.81	1.71	1.56
85	Education	Marketing	1.59	1.33	1.07
85	Education	Marketing	1.59	1.33	1.07
86	Human health activities	All, except marketing	0.72	0.56	0.52
86	Human health activities	Marketing	0.94	0.94	0.79
87-88	Care and social work	All, except marketing	0.60	0.41	0.36
87-88	Care and social work	Marketing	0.63	0.70	0.73
90-92	Arts, culture and lotteries	All, except marketing	37.03	23.83	20.92
90-92	Arts, culture and lotteries	Marketing	7.41	6.76	5.90
93	Sports and recreation	All, except marketing	2.41	1.55	1.26
93	Sports and recreation	Marketing	3.82	3.87	3.36
94	Membership organisations	All, except marketing	10.05	5.67	5.12
94	Membership organisations	Marketing	9.70	9.90	8.61
95	Repair computers and consumergoods	All, except marketing	1.48	0.21	0.12
95	Repair computers and consumergoods	Marketing	2.08	2.99	3.59
96	Other personal services	All, except marketing	0.60	0.41	0.53
96	Other personal services	Marketing	0.71	0.63	0.99
T	Activities of households	All, except marketing	0.90	0.55	0.49
T	Activities of households	Marketing	0.69	0.55	0.55