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Measuring digital trade in bop – a supplementary estimate of private households' digital purchases using internet data¹

Annette Meinus and Benny Hessel,

Deutsche Bundesbank

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Abstract

As digitalisation progresses, a variety of digital goods and services such as app purchases, streaming subscriptions and online games have become more and more important for international trade. These direct micro-transactions between businesses and consumers (B2C) have to date found little recognition in official statistics. As costs for them typically fall below national reporting thresholds, data gaps occur both in the national accounts and in the balance of payments statistics. To the best of our knowledge, this paper is the first to illustrate a step-by-step procedure to compile digital micro-transactions from a balance of payments point of view under the change of ownership principle using freely available internet data. Following the definitions of digital trade provided by the OECD, WTO and IMF handbook on "Measuring Digital Trade", we use freely available internet data to establish a bottom-up approach and break down the market of digitally traded services into five market segments in order to identify and quantify imports of German private households. The chosen approach turns out to be an appropriate and flexible procedure not only for closing the data gaps in external statistics, but also for taking into account novel market trends and changing user needs in a timely manner. The final results show that digital purchases certainly contribute € 7.4 billion to service imports in 2019 in the balance of payments in Germany.

Keywords: balance of payments, external trade, digital trade, international trade in services statistics, digitalisation

¹ This paper is based on a common project by the National Statistical Office (Destatis) and the Deutsche Bundesbank (bop section) which was launched in November 2018. The authors wish to thank Jens Walter for helpful comments.

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1. Introduction

Growing digitalisation is widely affecting international trade as it not only creates new opportunities for businesses to sell their products to broader markets, but also provides customers around the world access to completely new services, such as streaming services, online games, apps for smartphones or cloud services.

These B2C transactions, i.e. direct transactions between businesses and consumers, have to date found little recognition in both the national accounts and the balance of payments (bop) statistics, not least because such micro-transactions often fall below German reporting thresholds.² On the business side, reporting thresholds might be of minor relevance as they are typically surpassed by business to business (B2B) transactions. However, in the case of services consumed by households, those transactions most probably lead to data gaps which have to be closed to follow international concepts such as the BPM6 (Balance of Payments and Investment Position Manual Sixth Edition) or the 2008 SNA (The System of National Accounts, 2008) to include all transactions made between resident entities and the rest of the world.

The work described in this paper aims to fill these data gaps. To the best of our knowledge, this paper is the first to illustrate a step-by-step procedure to compile digital micro-transactions from a balance of payments point of view under the change of ownership principle using freely available internet data.³

In an effort to develop a better understanding of which sales are generated through digital trade in Germany, a bottom-up approach was established to identify and quantify private households' international digital purchases. The approach is focused on the debit side, i.e. on purchases by German private households' abroad. Although, to some extent, a potential under-reporting of micro-transactions on the credit side might be of relevance as well. However, this data gap is considered to be significantly lower than on the debit side, as the number of German providers of digital services such as video-on-demand or online games is rather limited.

The remainder of this paper is organised into four sections. Section two gives a brief overview of the relevant definitions, the conceptual framework following the OECD, WTO and IMF handbook on "Measuring Digital Trade" as well as the working definition of digital trade used in this paper, while section three describes the estimation model on private households' digital purchases in detail and discusses the main data sources that were used. Section four summarises the results for Germany identified in the relevant market segments, whereas section five holds the concluding remarks and considers some future steps.

² The legal basis is provided by Section 11(2) of the Foreign Trade and Payments Act (Außenwirtschaftsgesetz – AWG) and, building on this, Sections 67 et seq. of the Foreign Trade and Payments Regulation (Außenwirtschaftsverordnung – AWW).

³ In October 2017 Statistics Denmark presented a similar approach at the Expert Group Meeting on Measuring Digital Trade using NGO data and splitting the online market into five categories (Burman and Khalili (2018)).

2. Conceptual framework

The estimation model is based on the OECD, WTO and IMF handbook on "Measuring Digital Trade". The handbook aims to provide a conceptual framework to define digital trade on the one hand, and a mechanism to bring together and share existing national and international efforts on measuring digital trade and/or dimensions of it that could be used to identify and develop best practices on the other hand. Although it has not yet been finalised, as it is considered to be a living document that will be continuously updated as measurement practices mature, a first version was published in December 2019 in which basic definitions have been already developed.

The handbook adopts a statistical definition of digital trade based on the nature of transaction, and not so much on the nature of the product traded. It defines digital trade as the share of current cross-border trade in goods and services that has been digitally ordered and/or digitally delivered.⁴ Equally, because of the considerable interest in understanding who is engaged in digital trade as well as of the relevance for the balance of payments, information on the actors is also needed.

That being said, it is crucial to mention that the estimation model described in the following is limited to a specific part of digital trade, as it is not able nor should it be able to estimate digital trade in its broad definition as outlined in the handbook. It focuses on services (product dimension) that were delivered via digital channels (digitally delivered or platform enabled) by foreign enterprises to resident private households (actors). In other words, it aims to estimate all digitally delivered consumption-related sales generated by households i.e. micro-transactions that fall below any national exemption threshold and are thus not subject to reporting requirements for international trade (for instance, a subscription to a video-on-demand service). Therefore, goods or services that are purely digitally ordered (e-commerce transactions⁵) are not considered here, even though they might be under-reported in external statistics as well (de minimis trade).⁶

3. Estimation model

Following a bottom-up approach, the estimation model in this paper breaks down the market for digitally traded services into categories or so-called market segments. By the time the paper is published, five (major) categories will have been identified: video-on-demand, digital audio content, buying and using software, gambling, and cloud services.

⁴ It is shown in the handbook that all digitally intermediated transactions (by intermediation platforms) are included in one or both of digitally ordered and digitally delivered, yet they are separately identified in the framework.

⁵ According to the OECD definition, e-commerce is defined as follows: "An e-commerce transaction is the sale or purchase of a good or service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders." OECD Guide to Measuring the Information Society, 2011

⁶ For further information on the conceptual framework of digital trade that goes beyond what is described in this paper, please see the handbook.

For two reasons, it was decided to concentrate on those above-mentioned market segments. First, they are expected to be the most significant segments when it comes to household demand in terms of digital services. Second, it seemed more promising and practicable to gather information for those segments than for others such as digital matching platform fees or e-learning services.

The chosen approach turns out to be an appropriate and flexible procedure for closing the data gaps in external statistics. It is considered to be flexible in the sense that, on the one hand, new categories such as e-learning etc. can be considered, researched and included anytime while, on the other hand, outdated categories can be excluded quickly and easily whenever necessary.

The estimation of digital trade is basically carried out as a two-step procedure: In a first step, sales are researched and assessed individually per category. This was done by the identification of gross consumer spending for each category and/or sub-category since 2013. In a second step, those sales of relevance to the balance of payments and national accounts were determined by adjusting for resident service providers. In some special cases a third step was necessary in which figures were further manually adjusted due to various reasons such as double-counting or stationary sales.

In the following, the main data sources for each segment as well as a step-by-step guide are presented in more detail.

3.1 Video-on-demand

Video-on-demand (VoD) is a system that allows viewers to request immediate access to video content of their choice and watch it at a convenient time on any device suitable for playing videos such as PCs, TVs or smartphones and tablets etc. VoD provides a wide menu of available videos including feature films, sports, entertainment, and educational programmes from which to choose. Typically, user access is provided by a subscription to basic content as well as the ability to purchase additional premium viewing. VoD essentially encompasses three different business models:

- **Subscription Video-on-Demand (SVoD)** - access is granted through the purchase of a periodic subscription
- **Transactional Video-on-Demand** (transaction-based VoD or TVoD) - providers grant paid access to video content that is limited by time or number of views
- **Electronic Sell-Through (EST)** - users pay a one-time fee to download a video or for on-demand access with no limits on time or number of views, similar to the purchase of a DVD or blu-ray.

Estimates for this market segment are based on a study carried out by the market research institution Gesellschaft für Konsumforschung (GfK) on behalf of the German Federal Film Board (FFA) (Bundesverband Audiovisuelle Medien e. V. (2016)). The questionnaire was completed in writing (around 80 % online, around 20 % paper and pencil), in the form of a diary kept by panel participants. As the sample size was surprisingly high for digital formats (n=28,903), the results are considered to be reliable. Further, it is expected that a potential recall bias should be less pronounced as people are probably more likely to remember video-on-demand consumption than other

micro-transaction such as in-app purchases. The study puts total sales for video on demand services at around €0.77 billion in 2017.

As the video-on-demand segment is home to both resident and non-resident enterprises, an adjustment for transactions incurred in business with domestic enterprises is necessary. In this context, a useful data source was a study conducted by Goldmedia, a German strategic consultancy firm in the field of media and telecommunications. The survey has a sample size of n=2058 (Goldmedia, 2016) and provides information about the video portals used by German households where only paid film and series on demand providers were assessed (data as at April 2016). In Germany, the VoD market is (still) slightly dominated by resident VoD providers. The share of German paid VoD providers comes to roughly 62%. This considerably large proportion is due to the fact that in addition to "traditional" German providers well known foreign providers established German branches. In consequence, transactions with them have to be considered as resident-to-resident transactions and are thus not relevant for the balance of payments.

Due to the lack of detailed information, the share of resident paid VoD providers is assumed to remain steady over time. This is admittedly an ambitious assumption for what is still an emerging market - Netflix, for instance, has only existed since 2015, while other foreign providers have vanished from the market (e.g. Lovefilm and Watchever). Hence, the share of resident VoD providers should be observed continuously and should be adjusted as new information become available.

Given a market volume of €0.77 billion in 2017 and taking into account that 62% of sales within this segment are generated by resident VoD providers lead to sales of €0.29 billion that are relevant to the balance of payments. The calculated time series from 2013 to 2017 before and after the adjustment for resident service providers is shown in table 1.

Adjusted and non-adjusted sales in the VoD segment from 2013 to 2017.

In € bn.

Table 1

	Sales, according to GfK study	Sales, non-resident
2013	0.120	0.046
2014	0.150	0.057
2015	0.423	0.161
2016	0.545	0.207
2017	0.768	0.292

3.2 Digital audio content

The digital audio content segment is very heterogeneous in terms of both how products are consumed (downloads of tracks, albums, music videos or audio streaming) and who provides them. Hence, it is worth basing the estimates on user behaviour. A paper prepared by the federal music industry association (Bundesverband der Musikindustrie, 2017) shows in detail how music industry sales evolved from 1984 up to 2016. This paper is itself based on a study carried out by GfK Entertainment.

This survey puts digital music sales at €0.604 billion for 2016. Price Waterhouse Coopers (PwC) forecasts (on the basis of the above mentioned study) a figure of €0.741 billion for 2017 (Price Waterhouse Coopers, 2018). Alongside traditional music downloads, this number also includes audio streaming, real tones and digital audio books.

In terms of market structure, the digital audio content segment deviates significantly from the video-on-demand segment discussed in the previous section. In contrast to the aforementioned segment, it is dominated by non-resident service providers. Resident providers only play a minor role when it comes to services of digital audio content. Information on the share of resident providers for which the total sales need to be adjusted comes from a study carried out by Statista. Statista is a German online portal for statistics, that provides access to data collected by market and research institutes or derived from the economic sector and official statistics. Based on a 2017 survey, only around 10% of sales from digital audio content are generated by German providers (Statista, 2017). Though the sample size (respondents who have paid for digital audio content over the past 12 months) is relatively small at n=642, the results do indicate the dispersion across providers and countries. In Germany, there exist only two resident digital audio content service providers, the above estimate appears therefore to be dependable.⁷ In summary, around 90% of the sales calculated for 2017 are relevant for the balance of payments, equating to a figure of around €0.637 billion. Time series estimates are taken from the GfK survey mentioned above, from which information is available on how digital audio content purchases have evolved since 2008. The study results are adjusted for sales by domestic providers. Again, it is assumed that the share of resident providers remains steady over time. Once better data become available, a time-variant share should be assumed as the assumption made here is quite restrictive.

In summary, 90% of the sales calculated for 2017 (€0.741 billion) are relevant to the balance of payments, equating to a figure of around €0.667 billion.

3.3 Buying and using software

Buying and using software is a market segment that involves a wide range of different services that need to be considered by balance of payments and national accounts compilers. Hence, from a practical point of view it is appropriate to separate it into two subcategories.⁸

1. Mobile applications (incl. games for smartphones and tablets);
2. Video games for PC / games consoles as well as online browser games

This differentiation constitutes a simplified way to deal with the variety of digital services included in this segment.

⁷ A list of digital audio content providers operating can be found here: <http://www.musikstreaming-dienste.net>

⁸ It must be mentioned here that a third category, "system and office software" needs to be identified. The model will be updated once data for this category become available.

3.3.1 Mobile applications (incl. games) for smartphones and tablets

Mobile applications, most commonly referred to as apps, are built to run on a mobile device such as a smartphone or tablet for a specific platform, e.g. iOS for Apple's iPhones or Android for various other smartphone providers. They serve to provide users with downloadable application software similar to services accessed on PCs. Purchases of mobile apps via smartphones or tablets by households are typically micro-transactions that are neglected in external statistics due to high reporting thresholds. However, they can be estimated based on sales in the relevant app stores. According to Gartner, Inc., which has established itself as a market leader in the field of research and advisory engagements (Gartner, Inc., 2018), the only operating systems of relevance to smartphones and tablets are iOS and Android.⁹

Data for the mobile applications segment come from App Annie, an app market data provider. Only freely available data published on their homepage were used. By knowing the 2017 global gross consumer spending in the Apple App Store, which was US \$41 billion, in the Google Play Store as well as in third-party Android stores (e.g. Amazon App Store), which was US \$40 billion, global market shares were calculated for the Apple App Store on the one hand and all Android Stores in total on the other hand (App Annie, 2018a).¹⁰ Thus, Apple's App Store accounts for a global market share of 50.6%, whereas Android Stores make up for 49.4% of global app market sales.

Sales on the German app market were also taken from an App Annie market study. They are given as US\$ 1.4 billion for 2017 or €1.17 billion (App Annie, 2018b). But as detailed information on German market shares of Apple and Android in Germany are not available, it is assumed that the global market shares of both app stores are equivalent to their market shares in Germany. The distinction between operating systems is crucial as both Android stores and the Apple App Store offer third-party apps. This refers to apps that are not developed and marketed directly by, e.g., Google or Apple, but are produced by publishers that merely offer their apps for sale in the respective stores.

Payments are generally made to the store operator regardless of whether the app being purchased is a third-party app or not. The store operator will then pay these revenues minus their commission (commonly known as the transaction fee) to the publisher.

In a first constellation (own store/own app), the contractual relationship is clear, as the contractual party is always the App store provider. But things are different for third-party apps (own store/third-party app), whose publishers use the app stores as a sales platform. Neither Google (Google, 2019) (as the biggest app store platform operator under Android) nor Apple (Apple, 2019) unambiguously clarify the contractual relationship in their terms of use. However, the general consensus is that purchasing a third-party app gives rise to a contractual relationship between the end consumer and the third-party provider in the Google Play Store (by assumption, this

⁹ The Microsoft Store creates a degree of opacity. It can be accessed both via a desktop computer or a notebook as well as via a Windows phone. However, the Windows operating system is of virtually no relevance to 2017.

¹⁰ These figures include the prices of the apps as well as subscriptions for media streaming, news and dating apps, which are routed through the app stores' sales channel. They also include in-app purchases.

also applies to the other Android app stores such as Amazon). As such, app stores can therefore be regarded as sales platforms and third-party publishers could be resident publishers. When it comes to Apple, this general consensus in terms of third-party apps does not apply. This is because Apple, by checking and releasing any apps it offers, has material control over all content, advertising and technical content and thus becomes the contractual party regardless of which app was purchased by a resident household.¹¹

That being said, it must be clarified what percentage of app revenues generated in the Android Stores is relevant to external statistics by establishing the share of resident app publishers. According to a list of the top 20 Android app publishers in Germany in 2015, some 7% of revenues are generated by German publishers.¹² In contrast, statistics on the most successful publishers of games in the Google Play Store of September 2018, show that around 5% of revenues are generated by German providers (Statista, 2018a). It is assumed, that those shares most probably will underestimate the true values as all studies focus on the most successful publishers. For lack of a better estimator, the percentage of German publishers in Android stores in Germany is initially estimated to be 10%.

Thus, the estimated €1.17 billion must consequently be corrected by €0.0578 billion. For 2017, this sub-category shall be estimated to have generated sales of €1.11 billion.

To capture developments in sales over time, we use information on sales via app stores coming from a Bitkom study (Bitkom, 2018).¹³ As this data source includes information on sales for advertisements, it diverges from data provided by App Annie. Thus, only the growth rates as per the Bitkom study are applied to the sales figure calculated above. This is possible as the assumption is made that the percentage of German publishers in the app market remains constant over time.

After the adjustment for resident services providers, a further adjustment in the mobile applications segment is needed. This next step is crucial in order to avoid double counting of services that were purchased on mobile devices and whose sales were routed and billed via Android Stores or the Apple App Store.

If, for example a video-on-demand subscription is concluded via an app store, revenues are booked via the store and are part of the revenue figures for mobile applications for smartphones and tablets calculated here in the mobile applications segment. However, they are also included in the video-on-demand segment data. Hence, a decision must be made as to where the corresponding sales should be included.

Within the balance of payments, spending on this subscription should, however, be exclusively booked under video-on-demand. This is because it seems more reasonable to remove the corresponding transactions in the mobile application segment where they are considered to be in-app purchases and to leave them in the video-on-demand segments where their true nature as a video-on-demand service is taken

¹¹ <https://rickert.net/blog/vertragliche-beziehungen-beim-kauf-von-apps>

¹² <https://omr.com/de/app-publisher-umsatz-ranking>

¹³ The market research company research2guidance was entrusted with this study on behalf of Bitkom.

into account. The adjustments made are specific to all three video-on-demand business models described in section 3.1.

In the case of TVoD or EST, then, these are films which can be hired or ordered directly in an app on a smartphone or tablet. As for SVoD, these are subscriptions which are taken out and paid for directly in an app (Netflix, for example, can be subscribed to via a number of channels.¹⁴) As these transactions can constitute both, video-on-demand services as well as digital audio content services, corrections in the mobile applications segment for both market segments are necessary.¹⁵

Since the information needed for a robust estimation is lacking, just a very rough estimate can be made using the only data that are available. Indications are provided by a number of monthly statements published on Statista, which have been calculated by Priori Data, a provider of app market data (Statista, 2008b-c). These monthly statements show the top 10 grossing apps in Germany in each app store. In the Google Play Store (which we consider representative for all Android stores) there were no video-on-demand providers in the top 10 list in October 2018, which implies that a video-on-demand provider must have grossed less than US \$1.1 million monthly. This equates to roughly €0.92 million.¹⁶ In the Apple App Store, Netflix shows up in the top 10, once with a figure of €1.42 million for October 2018 and with €0.92 million for January 2018. From this information, average monthly sales are calculated that are grossed up to annual sales.

Netflix, as the only video streaming subscription service which could be bought and paid for directly in the smartphone app before January 2019, will probably have registered average monthly sales across both app stores in 2018 of €1.08 million, which equates to annual sales of €13 million. Measured in terms of total sales of video-on-demand services (i.e. EST + TVoD + SVoD) relevant to the balance of payments, in the amount of €0.29 billion, this represents an adjustment of around 4.5% for the SVoD segment. The exact calculation is shown below in more detail for all three video-on-demand business models.

$$\text{correction business model } i = \frac{\text{annual sales of business model } i \text{ routed through app stores (€ bn)}}{\text{total annual sales in video-on-demand in (€ bn)}}$$

with $i = \text{SVoD, EST + TVoD}$.

The correction factors for EST and TVoD need to be determined as well. Sales relevant for the balance of payments for 2017 are made up of roughly 35% from individual sales (EST) and time-limited hires (TVoD), and 65% from streaming service subscriptions (SVoD). It is assumed that those shares are also equivalent to the video-on-demand sales that are paid for exclusively via the app stores. In this case, the calculated annual sales figure of €13 million for SVoD equates to 65%. This means that corrections still need to be made for 35% of sales (TVoD and EST), i.e. by an amount of €7 million, corresponding to roughly 2.4% of video-on-demand sales that are relevant to the balance of payments.

¹⁴ Since January 2019 the subscription to Netflix and Spotify (Music on demand) is no longer possible via Apples App store. Thus, this adjustment will not be necessary in future data updates.

¹⁵ Corrections for the audio content services will be included in the next data update.

¹⁶ Exchange rate series from the Deutsche Bundesbank database: BBEX3.M.USD.EUR.BB.AC.A01

In total, then, the sales included in the "mobile applications (including games) for smartphones and tablets" segment that are relevant to the balance of payments are reduced by 4.5% for SVoD and 2.4% for EST and TVoD to avoid double counting due to sales already included in the video-on-demand segment.

A time series for the necessary corrections is estimated based on information from the GfK study cited in 3.1. This study publishes sales generated with digital formats since 2013. The results are adjusted for sales by resident providers (62%). Data on subscriptions to video streaming services have only been collected since 2015. Therefore, the corrections in the mobile applications segment up until 2015 comes to 2.4% (individual sales and hires of moving image content billed via one of the two app stores), whereas the addition corrections for SVoD of 4.5% are made as of 2015.

3.3.2 Video games for PC/games consoles as well as online or browser games

A suitable source for determining which sales of video games for PC and games consoles as well as online and browser games are of relevance to the balance of payments is the association of the German games industry (game – Verband der deutschen Games-Branche)¹⁷. The figures it publishes are based on the GfK Consumer Panel, in which a sample of 25,000 persons are asked about their spending habits.

Overall, spending on video games amounted to around €2.4 billion in 2017. Purchases of games for mobile phones, smartphones and /or tablets are described as micro transactions in which the individual transactions generate only minimal revenues, but these add up to significant sales in aggregate. The same holds for in-app purchases. As sales for apps and in-app purchases (where relevant to the balance of payments) were calculated in section 3.3.1, in-app purchases must now be deducted from the sales figures for this category. It is assumed that the sales data on the purchase of apps and in-app purchases to the tune of some €14.1 million as published by game underestimate actual turnover. This is due, in particular, to the fact that those sales only represent one specific genre of apps, namely game apps, whereas data in the mobile applications apps encompass all genres in total. Further, it is expected that there might be a pronounced recall bias in this category of games. Eliminating in-app purchases is largely unproblematic for the years 2014 to 2017, as game publishes the relevant data in its annual reports.

Sales of video games for PC and games consoles as well as online and browser games excluding the purchase of apps or in-app purchases are listed in the following table. It shows that sales in the German games market rose from €1.6 billion in 2014 to around €1.9 billion in 2017.

¹⁷ www.game.de

Sales in the German games market

In € bn

Table 2

	2014	2015	2016	2017
Sales	1.63	1.68	1.72	1.89

Sources: game – Verband der deutschen Games-Branche (2018)

Following the procedure in the other market segments, those sales need to be identified that represent a transaction between residents and non-residents and are therefore relevant to the balance of payments. As before, only games provided digitally will be considered, not those acquired on physical data carriers. The following table shows the percentage of downloads.

Share of downloads in German game sales

In percent

Table 3

	2012	2013	2014	2015	2016	2017
Share of downloads	9%	11%	19%	21%	27%	29%

Sources: game – Verband der deutschen Games-Branche (2018)

According to the game association's annual report, German games developments made up a share of sales of $\pi=5.4\%$ in 2017.

Share of sales from German games developments

In percent

Table 4

	2014	2015	2016	2017
Share of sales π	6.9%	6.5%	6.4%	5.4%

Sources: game – Verband der deutschen Games-Branche (2018)

Sales of relevance to the balance of payments, i.e. sales of international games developments on the German games market and therefore spending by German consumers on international video games, can now be calculated using the following formula:

Sales of international games developments on German games market = Sales in the Germany games market $\times (1-\pi)$

This yields the following data in terms of games market sales of relevance to the balance of payments.

Sales in the games segment of relevance to the balance of payments

In € m

Table 5

	2014	2015	2016	2017
Sales in BOP	589	690	812	995

Sources: game – Verband der deutschen Games-Branche (2018)

4. Gambling

Since 2014 the state governments' gambling supervisory authorities publish annual reports that include benchmark figures for the German gambling market, private online sports and horse racing betting, online casino games, online poker and online secondary lotteries.

Gross gambling revenues of non-resident providers from German customers

In € m

Table 6

	2012	2013	2014	2015	2016	2017
Sales	418	1,673	1,746	2,270	2,558	3,284

Sources: State governments' gambling supervisory authorities annual reports

Data for 2013-2016 on gross gambling revenues with non-residents, calculated as gross stakes minus winnings paid out, which corresponds to German expenditure on gambling, was taken from the annual report (Glückspielaufsichtsbehörden der Länder (2018)). The figures for 2017 are calculated by projecting the 2016 figure at the rate of change in tax revenues from bettings and lotteries, as shown in the statistics on tax revenues provided by the Federal Statistical Office. The time series begins with the second half of 2012, thus the figure for 2012 is estimated to be 1/4 of the annual figure for 2013. This explains the significant rise in values from 2012 to 2013.

Since the gross gambling revenues already represent sales by non-resident providers to German customers, they are generally relevant to the balance of payments. However, gross gambling revenues also include a portion of sales that is generated not online but at a gambling outlet (particularly in the case of sports and horse racing betting). As the annual reports indicate, this share was around 23% in 2014, around 19% in 2015, and around 20% in 2016. The annual share of sales generated in gambling outlets is assumed to remain relatively constant, including in the years in which it is not known. The mean of the 2014, 2015 and 2016 figures (21%) is therefore shown used. This results in the amounts shown in table 7.

Gross gambling revenues in the gambling segment relevant to the balance of payments

In € m

Table 7

	Gross gambling revenues gambling outlets and online	Share at gambling outlets in %	Gross gambling revenues online only
2012	418	21%	330
2013	1,673	21%	1,322
2014	1,746	23%	1,344
2015	2,270	19%	1,839
2016	2,558	20%	2,046
2017	3,284	21%	2,594

Sources: State governments' gambling supervisory authorities annual reports

5. Cloud services

Cloud services are typically offered globally by a service provider to multiple customers through the internet. They include a wide range of IT services that traditionally are hosted in-house, e.g. storage space or accessing software and applications directly from the web without the need of a prior installation.

Not only enterprises but also households purchase IT storage space in clouds for hosting websites or for back-up data on a variety of devices. However, in most cases, households get a certain amount of free storage space free of charge from their internet provider. Only those requiring more storage capacities usually have to pay.

To calculate household purchases of storage space, a model was developed based on quarterly data from the survey on the private use of information and communication technologies ICT survey carried out by the Federal Statistical Office (2018). This survey collects data on the private facilities and use of state-of-the-art information and communication technologies, in particular on computers and the internet and also on cloud users. From this data source the number of internet users and the share of German cloud users were used. As the ICT survey only provides information on the number of internet users for the first quarter of each year, figures were allocated to the other quarters by interpolation. In a next step, they were multiplied by the share of cloud users to calculate the number of German cloud users as shown in table 8 exemplarily for the years 2016-2017.

For the share of cloud users, only information between 2016 and 2017 was available. Thus, it was assumed that the share was following a constant positive trend.

Number of internet and cloud users in Germany

In thous. Table 8

	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q 2017
Number of internet users	61,970	62,311	62,140	62,651	62,651	63,094	63,538	63,981
Share of cloud users in %	23%	24%	26%	27%	28%	29%	30%	31%
Number of cloud users	14,253	15,069	15,889	16,714	17,542	18,297	19,061	19,834

Sources: Federal Statistical Office (2018)

Research has discovered two things: first, storage capacities of different sizes are free of charge, depending on the provider; and second, many internet providers are domiciled in Germany. This is why it is assumed that around 5% of cloud users do indeed purchase storage space from abroad. Prices for storage space as shown in table 9 were calculated by analysing cloud service providers' websites .

Quarterly average prices for cloud services in Germany

In € Table 9

	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q 2017
Price per quarter	61	61	61	61	60	60	60	59

Sources: Federal Statistical Office (2018) / own calculations

All in all, this volume/price model produces the following time series:

Results of volume/price model on purchases of cloud services by German customers

In € m Table 10

	Q1 2016	Q2 2016	Q3 2016	Q4 2016	Q1 2017	Q2 2017	Q3 2017	Q4 2017
Cloud purchases abroad	43	45	47	49	52	54	56	58

Sources: Federal Statistical Office (2018) / own calculations

6. Final results

All researched sales figures from the previous sections are summarised in table 11. For 2018 and 2019 the figures shown are calculated based on the year-on-year growth rate from 2016/2017. This is an appropriate way in light of the current spell

of growth in digital trade and the market segments under observation. However, if the market became saturated in the future, this straightforward approach would result in the figures being overstated. This is why the sales figures should be revisited and adjusted as necessary in the future.

Sales in all market segments of relevance to the balance of payments

In € bn Table 11

	2014	2015	2016	2017	2018	2019
Mobile Applications	0.674	0.946	1.070	1.104	1.139	1.174
Video-Games	0.589	0.690	0.812	0.995	1.219	1.443
Video-on-demand	0.057	0.161	0.207	0.295	0.412	0.532
Digital Audio Content	0.317	0.416	0.516	0.634	0.779	0.924
Gambling	1.344	1.839	2.016	2.594	2.824	3.055
Cloud Services	0.123	0.155	0.184	0.218	0.258	0.299
TOTAL	3.104	4.207	4.835	5.837	6.632	7.427

The 2018 and 2019 sales relevant to the balance of payments are calculated as in the following:

$$\text{Sales}_{2018/2019} = \text{Sales}_{2017} \times \frac{\text{Sales}_{2017} - \text{Sales}_{2016}}{\text{Sales}_{2016}} + \text{Sales}_{2017} .$$

This formula disregards very strong past growth rates. For the time being, only the growth from 2016 to 2017 is carried over to 2017 - 2018 and to 2018 - 2019. For the gambling segment, the 2017 figure is already an estimate by the Federal Statistical Office, which is why the growth from 2015 to 2016 is carried over to 2017 - 2018.

7. Conclusions

Increasing sales in international digital purchases have made it necessary to fill potential data gaps that occur in external statistics due to high national reporting thresholds. In this paper, it is shown how the digital market in Germany is classified into several market segments, which data sources are used to estimate yearly sales, and which adjustments were necessary to compile a supplementary estimate of private households' digital purchases for the balance of payments. The following conclusions and recommendations are made as a result of the study:

First, a bottom-up approach delivers a proxy for service debits of households which are provided via the internet. The figures obtained using this method provide an initial indication of the scale and dynamics. As the market for digital services might be very heterogeneous across countries, this procedure seems to be sufficiently flexible to account for any country specifics.

Second, the estimation model is easily expandable, as the implementation of further categories or subcategories such as platform fees or e-learning services can be realised as soon as reliable information is available. Likewise, outdated categories can be excluded when appropriate.

Third, extensive research has identified the main data sources for the first five most relevant market segments in Germany, which very much simplifies data updates in the future.

A further way to proceed forward is to give up the assumptions of time invariance that were taken advantage of in many market segments. This step would increase considerably the quality of the estimates described.

The advantage of using freely available internet data is that data gaps in the official statistics can be closed quickly and cost-effectively. However, there are also a number of disadvantages. For instance, there is a risk that the data provider in question will stop producing the data or stop making them available to the public. In addition, checking the quality of internet data is not necessarily a simple process, since most of the information is taken from the results of surveys that were not carried out by official bodies. Besides this, some of the information is only available with a time lag of several years, meaning that the data need to be extrapolated to the current end.

Added to this is the fact that the data that are freely available at present do not meet all the requirements of the balance of payments. They are not broken down by country, for example. Initial analyses show that a country structure of digital purchases cannot be identified on the basis of the current data sets. For this reason, the estimated sales are shown under the item "countries not identified". Developing an appropriate method for breaking digital purchases down by country is a task that still needs to be tackled.

This project should be seen as a first step to better measure internet induced micro-transactions in the balance of payments. It forms one piece of work to provide data on digital trade according to the definitions of the OECD, WTO and IMF handbook. It should therefore be clear, if digital trade statistics encounter growing interest from users, a cooperation with the data providers will play a key role in overcoming these challenges.

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