Free goods and economic welfare[1]

Diane Coyle[2] and David Nguyen[3]
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Abstract

This paper uses surveys representative of the UK online population to assess the welfare value of online and offline goods with a zero price. Through pilot studies and two surveys conducted before and during the Covid19 lockdown, we ascertain consumers' willingness to accept the loss of a range of 'free' online and offline goods, as well as some substitutes with a positive market price. The average value assigned to free goods was generally high, particularly when benchmarked against revenue figures for the services. The ratio of stated valuations to average revenues is higher for free than for non-zero price goods. We also present demand curves and explore the distributional effect of free goods as between different demographic groups. The surveys suggest that absolute valuations are not tightly anchored, but indicate clear rankings among goods. The natural experiment of the Covid19 lockdown brought about changes in valuations that were significant for some goods and have plausible sign and scale. We also discuss the limitations of the contingent valuation approach to estimate the aggregate effect of such goods on economic welfare, in particular questions of distribution, the meaning of the gap between willingness to accept and willingness to pay, and the absence of an adding up constraint for aggregate measurement.

Keywords: digital, free goods, contingent valuation, economic welfare

JEL classification: D12, D60, I31, C43

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[2] University of Cambridge and ESCoE.

[3] National Institute of Economic and Social Research and ESCoE.

1. Introduction

There has been growing interest in the use of survey methods to estimate the value of 'free' digital goods, as one possible approach to incorporating zero monetary price goods in a measure of aggregate economic activity. In contrast to other suggestions – for example treating the data and monetary transactions involved in the provision of advertising-supported free-to-consumer digital goods as a barter arrangement (Nakamura et al 2017) – contingent valuation methods can provide a direct estimate of consumer welfare additional to the marketed activity included in GDP (Brynjolfsson et al 2019a, 2019b). This approach addresses the question of whether there is an increasing digital wedge between GDP and different elements of consumer welfare (Heys, Martin & Mkandwire 2019). These initial estimates of the welfare increment from free digital goods indicated that consumers place a high value on using them. The suggestion is that this could be added to total GDP to give a welfare-augmented aggregate measure.

For this approach to be useful, measures calculated using contingent valuation surveys would need to be reliable (across time and samples, for example) and consistent with fundamental economic measurement principles. In this paper we calibrate such valuations by comparing them to other free goods, such as access to parks, and to paid-for substitutes, such as newspapers, and assessing the characteristics of the results. We use surveys representative of the UK online population (the YouGov online panel), both a series of pilots to test valuation ranges and which goods to include, conducted in 2019, and full-scale surveys in February 2020 and again in May 2020, taking advantage of the natural experiment provided by the UK Covid-19 lockdown. We consider the economic implications of the stated valuations, and also use the size and representative character of our sample to explore socio-demographic differences.

Our results indicate that users place a high value on free digital goods, with mean valuations strongly correlated with usage (i.e. the proportion of respondents using them). There were large changes in both usage and valuations between the two main surveys. Comparing online goods and offline substitutes, the online valuations are considerably higher, suggesting that there are perhaps aspects of online use such as convenience, choice or time-saving that deliver considerable consumer value. The changes in ranking of the willingness-to-accept (WTA) for different goods seem plausible. The 'elasticity' of WTA in response to usage varies widely between different goods. The stated WTA values for 12 months typically are less than 12 times higher than the valuations for one month. We are able to identify large differences in valuations along different demographic dimensions. We did not test willingness-to-pay (WTP) for specific goods, but consistent with the contingent valuation literature find WTA values for free goods that are much larger than actual revenues per user or comparable prices for marketed goods.

In the absence of other methods for estimating the consumer surplus value of free digital goods, the stated value approach gives valuable insights. However, there are a number of issues requiring further consideration before the estimates can be used for aggregate measurement of economic welfare. The series of pilots and surveys we carried out suggest stated values are large but not tightly anchored, and have large standard errors. More significantly, it is not clear how to define and partition the universe of goods to survey. For example, stated values for social media do not add to the sum of stated values for each social media platform named separately. The large distributional differences in usage and values would also need to be taken into account for an economic welfare aggregate. Finally, it is not obvious how to impose an adding-up constraint in terms of the time spent using free digital goods and other goods, whereas with paid-for goods this constraint is provided by actual monetary expenditures.

2. Previous literature

There is a large literature on the use of contingent valuation (CV) methods in environmental economics and cultural economics (see Carson, Flores & Meade 2001 and McFadden & Train 2017 for surveys). The approach is contested for several reasons, including the potential for strategic responses, the consistent finding of wide gaps between willingness to pay (WTP) and willingness to accept (WTA) results for non-marketed goods, and whether or not results are consistent with plausible income and substitution effects or adding up constraints. Some economists (e.g. Hausman 2013) have concluded the method is hopeless whereas others (e.g. Blinder 1991) strongly defend the need to use interview or survey techniques in contexts where economics is unable to provide any preferred method for empirical estimation – as is the case with many non-monetary public goods. While there are alternative approaches worth exploring, either hedonic methods relying on revealed preference or household production function approaches using available measures such as time spent and travel costs, the Blinder argument has some weight in the context of digital goods and services for which users do not have to pay a direct monetary price. Survey methods would also be appropriate for statistical production, as conventional economic statistics are already often survey-based, whereas the alternative approaches would require econometric methods.

Carson et al (2001) noted that some of the criticisms of CV methods are based on intuitions about responses to marginal price changes for marketed goods whereas the context of (often non-marginal) quantity changes for public goods implies intuitions far more in line with the results in the CV literature. For example, one common criticism is that implied demand curves

for goods in CV studies have implausibly low elasticities; but the standard income elasticity of demand refers to the change in quantity demanded when income increases, whereas the elasticity of a stated valuation reflects how much WTP/WTA for a fixed quantity of a good changes as income rises. There will be a shadow price of the implicitly rationed good, such that the latter 'income elasticity' is likely to be lower than the conventional one. There have also been methodological advances in terms of ensuring incentive compatibility when people face hypothetical questions. However, some key issues remain, notably anchoring effects from survey questions on the size of respondents' valuations, the WTP-WTA gap (which also sometimes manifests itself with some marketed goods, such as large bid-ask spreads in options markets), and the question of an adding-up constraint on valuations when people are surveyed about goods individually.

Widely used in environmental economics, more recently there are examples of the CV approach being applied in the context of digital goods and services for which there is no direct market price, or where there are likely to be significant externalities including network effects (Brynjolfsson et al 2019a, b). This has been part of a debate about whether and how these 'free ' goods should be accounted for in aggregate economic measurement (Ahmad & Schreyer 2016, Nakamura et al 2017), if their omission in effect understates welfare-relevant economic activity.

In their early contribution applying contingent valuation methods, Brynjolfsson, Collis & Eggers (2019a) used large-scale online choice experiments to elicit valuations of consumer surplus and concluded that the welfare value was large. For instance, in their incentive-compatible discrete choice experiments, the median US Facebook user needed around $37 to give it up for a month (although just $322 to give up 'all social media' for one year). Others have reported a range of median valuations – a lower (annual) figure of $59 willingness-to-accept and a median $1 willingness-to-pay in Sunstein (2018) to over $1,000 a year in Corrigan et al (2018). The method was extended by Brynjolfsson et al (2019b) to calculate an extended GDP, GDP-B, who used estimates of consumer welfare elicited from online discrete choice experiments for a number of goods to calculate growth in the wider measure compared to conventional GDP, concluding that it would add 0.05 to 0.11 percentage points a year to US growth. Brynjolfsson and co-authors (2020) also suggest using the method as a means of measuring real consumption of the goods.

In another recent study Allcott et al (2020) found median annual valuations for Facebook of around $100 using similar methods, but queried aspects of the methodology. For example, some studies they consider did not require users to actually deactivate their social media accounts. In

particular, though, they find that willingness-to-accept valuations are not firmly anchored, and furthermore changed after users in their experiment had actually gone without Facebook: "*We find that four weeks without Facebook improves subjective well-being and substantially reduces post-experiment demand*." (p.672). This result, if confirmed, raises some fundamental questions about the nature of consumer preferences, which both conventional and CV methods take to be well-determined and stable. However, Collis & Eggers (2019) do not find any impact of social media usage on well-being.

3. The surveys

The literature applying stated preference methods to 'free 'digital goods remains limited and has not to date been applied to many countries other than the US. In this paper we test the approach in the UK and discuss its advantages and limitations in the light of our findings. For the pilots and full surveys we used YouGov's nationally representative online panel. We chose a survey representative of the UK's (online) population, rather than more costly incentive-compatible laboratory experiments, in order to test a method scalable for regular estimation. One of the concerns in the contingent valuation literature is whether respondents will be honest, or alternatively have strategic reasons to misstate their 'true 'valuations. Although our approach is not incentive compatible in the sense of actually withdrawing the goods included in the survey in return for payment, there does not seem to be a strong rationale for strategic misstatement in this context.[4] In addition, we supplemented the main survey with some 'best-worst' scaling (BWS) questions as a test for the consistency of preference rankings in a forced choice context.

Initially, we ran a number of pilots to test questions and whether to select valuation bands. Fuller results from the pilot surveys are set out in Appendix 1. A total of four pilots of approximately 1,600 adults each ran between March 2018 and November 2019. We tested:

- Open-ended questions versus using a menu of bands
- Different time periods (week, month, 3 months, 6 months, 12 months)
- Categories versus specific goods (e.g. "All social media" versus "Facebook")
- Usage intensity

[4] The survey of 30 questions takes around 15 minutes to complete and participants are not directly paid for their time. YouGov does offer a minimal compensation using a points-based system, however, but people need to take part in a considerable number of surveys to reach the first payout.

We drew on the pilots to select an approach for use in the main survey in Feb-March 2020 and the supplementary Covid-19 survey in May 2020: we used specific names for a few well-known and intensively used digital services, and selected the price bands that elicited a distribution of stated values, for one month and 12 month periods. Where specific goods have high usage rates among the population (e.g. Facebook) we opted to ask about them specifically rather than at the category level (i.e. all social media). Asking about categories is more useful where there are many competing providers (e.g. ride-hailing services); however it is possible that people might not consider the full ramifications of giving up access (i.e. no substitutes) when compared to individual goods.

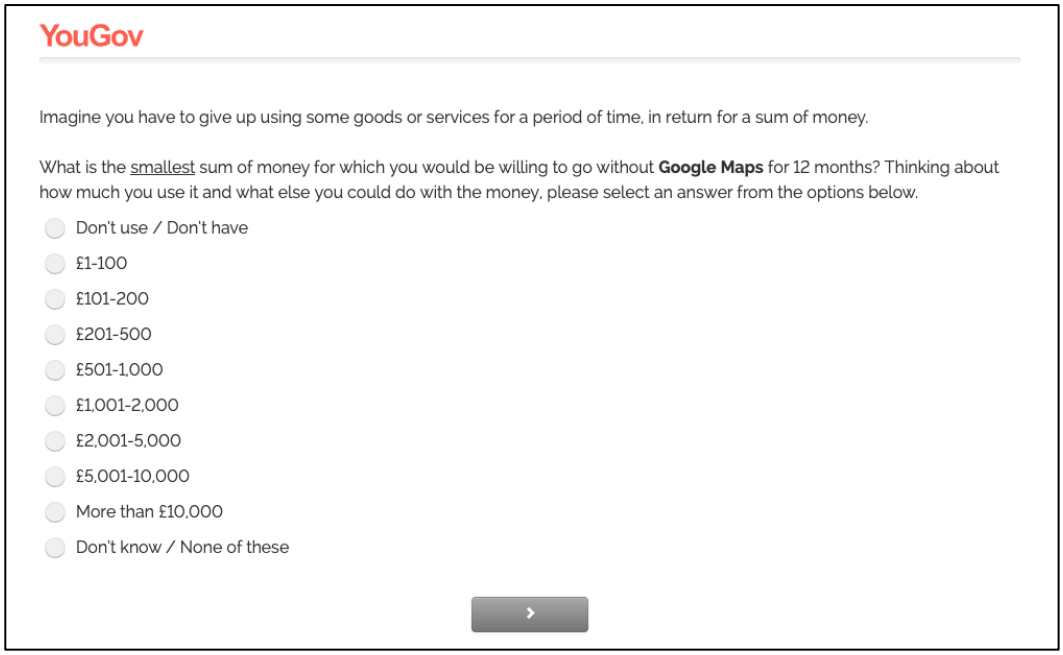
The main survey with a sample size of 10,500 adults ran between 27 February and 3 March 2020 and a smaller follow-up with a sample size of 1,600 ran from 14 -15 May 2020 (see Appendix 2 for further detail).[5] Taking into account the pilot results, we selected 30 goods for the survey, based on 1) number of users and time spent on them; 2) goods used in the previous literature, to allow for some comparisons; 3) a wider coverage of categories than prior studies (for example including banking, gaming, news, some non-digital free and some non-digital goods that are potential marketed substitutes).

Survey participants were asked about their willingness to accept giving up access to 30 different goods for a specified period of time. The order in which the goods were presented to participants was randomised. Participants were asked to choose a sum of money based on pre-determined valuation bands shown in Figure 1. A key advantage of using pre-defined bands is that our results are less likely to be influenced by the extreme values that we observed when testing open boxes. For the main survey, half of participants were asked to give up access for a period of one month, while the other half was asked to consider twelve months (none were asked about both). In the follow-up May 2020 survey, we asked only about the twelve-month valuations. Both the surveys were representative of the UK population in terms of socio-economic factors including age, gender, income, education and region. However, considering that 13% of households in the UK do not have access to the internet (Ofcom, 2019) our findings likely only hold for the UK's online population.[6]

[5] The first Covid-19 death in the UK occurred on 5th March and the country officially went into lockdown on 23rd March. The first steps in easing lockdown restrictions in the UK occurred on 13th May. More details on the survey, including summary statistics can be found in Appendix 2.

[6] In 2019, 10% of the UK adult population were internet non-users, lowest in London and highest in N Ireland. More than half the non-users were women and the great majority over 65. https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/articles/exploringtheuksdigitaldivide/2019-03-04

Figure 1. Typical survey question



4. Results

4.1. Usage

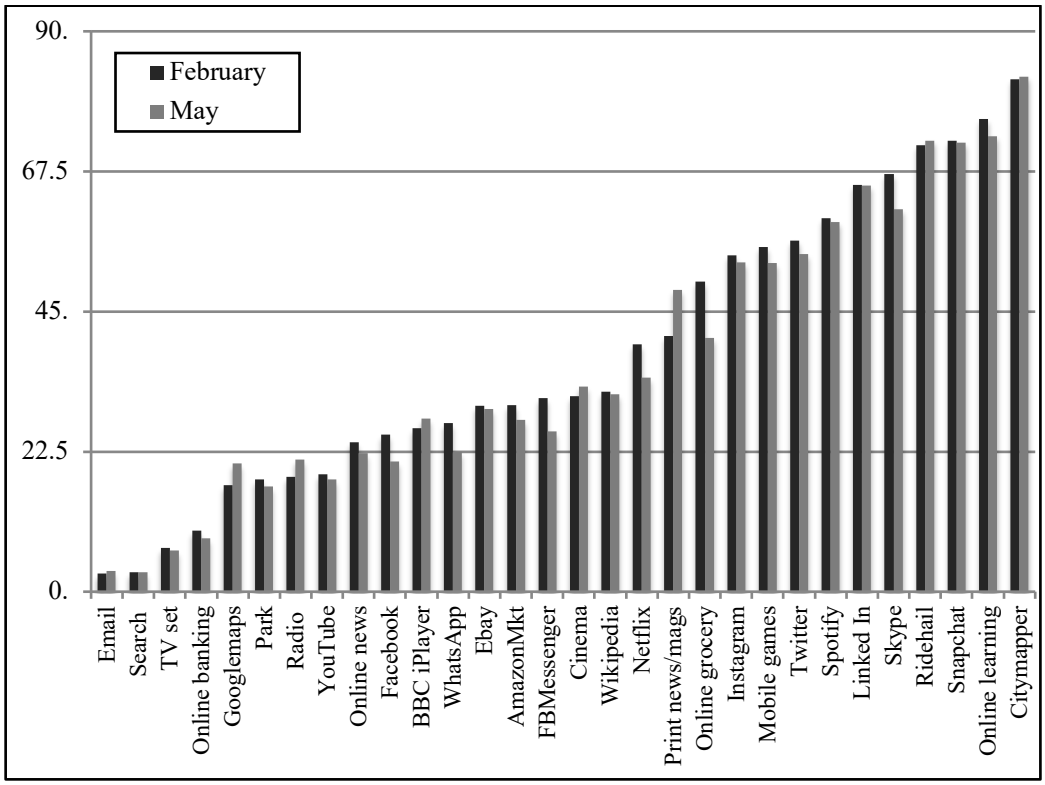
Unsurprisingly, there are significant differences in the extent to which the different goods and services are used, ranging from almost universally for personal email and search to minority usage of categories such as online learning (of most use to households with children) or Snapchat (aimed at a specific demographic) (Figure 2). As the two survey waves were only 10 weeks apart and people were asked to consider the next 12 months, one might not usually expect large changes in (stated) usage rates; but we also found significant usage changes in some categories before and during lockdown (Table 1). Again, these were not surprising in the circumstances. While in February around 50% reported that they do not shop online for groceries, this had declined to 40% in May. The share of people not using Skype, Facebook Messenger, Netflix and WhatsApp also decreased by around 5 percentage points. Other goods that saw an increase in usage (decline in non-usage rates) were Facebook, online learning, mobile games, Amazon Marketplace and Twitter. On the other hand, the usage of various others declined. In February around 41% reported they do not use newspapers, and this increased to 48.5% in mid-May. Reported use of Google Maps, Radio, BBC iPlayer and cinemas also decreased somewhat.[7]

[7] Cinemas were closed at that point, but the question asked about 12 month usage.

*Table 1: Changes in usage: % who **do not use**, ranked by February-May change (in percentage points)*

Item	February	May	Change
Online groceries	49.84	40.76	-9.1%
Skype	67.10	61.47	-5.6%
Messenger	31.10	25.71	-5.4%
Netflix	39.69	34.37	-5.3%
WhatsApp	27.09	22.48	-4.6%
Facebook	25.26	20.89	-4.4%
Online learning	75.92	73.19	-2.7%
Mobile games	55.36	52.76	-2.6%
Amazon	29.99	27.64	-2.4%
Twitter	56.37	54.20	-2.2%
Online news	24.04	22.27	-1.8%
Online banking	9.80	8.53	-1.3%
Instagram	54.01	52.90	-1.1%
Public park	17.99	16.94	-1.1%
YouTube	18.81	18.03	-0.8%
Spotify	59.97	59.38	-0.6%
eBay	29.89	29.38	-0.5%
TV set	7.08	6.66	-0.4%
Wikipedia	32.14	31.75	-0.4%
Snapchat	72.41	72.09	-0.3%
LinkedIn	65.34	65.19	-0.2%
Online search	3.11	3.16	+0.1%
Citymapper	82.29	82.67	+0.4%
Personal email	2.94	3.37	+0.4%
Online ride hailing	71.67	72.38	+0.7%
Cinema	31.44	32.93	+1.5%
BBC iPlayer	26.28	27.78	+1.5%
Radio	18.43	21.24	+2.8%
Google maps	17.07	20.62	+3.6%
Printed newspapers	41.05	48.50	+7.5%

*Figure 2: Proportion (%) who **do not use** specified goods*



4.2. Valuations – February 2020

Table 3 shows the mean and survey and median valuations (and confidence intervals) in February 2020.

*Table 2 February 2020 12-month valuations (ranked by % who **do not use**) £*

	CI Low	Valuation (mean)	CI High	Non-usage	Valuation (median band)
Citymapper	142	174	207	82.3%	0
Online learning	208	247	285	75.9%	0
Snapchat	304	350	396	72.4%	0
Online ride hailing	204	240	277	71.7%	0
Skype	290	335	379	67.1%	0
LinkedIn	201	238	275	65.3%	0
Spotify	633	696	759	60.0%	0
Twitter	501	556	612	56.4%	0

Mobile games	534	592	650	55.4%	0
Instagram	597	657	717	54.0%	0
Online groceries	656	720	783	49.8%	0
Printed newspapers	510	566	621	41.1%	1-100
Netflix	1185	1267	1349	39.7%	1-100
Wikipedia	633	694	756	32.1%	1-100
Cinema	657	719	780	31.4%	1-100
Messenger	1011	1088	1166	31.1%	1-100
Amazon	968	1044	1119	30.0%	1-100
Ebay	723	787	852	29.9%	1-100
WhatsApp	1496	1588	1680	27.1%	101-200
BBC iPlayer	757	821	885	26.3%	1-100
Facebook	1195	1278	1360	25.3%	101-200
Online news	1170	1253	1336	24.0%	101-200
YouTube	1313	1399	1485	18.8%	101-200
Radio	1617	1713	1809	18.4%	101-200
Public park	1848	1951	2053	18.0%	201-500
Google maps	1224	1307	1390	17.1%	101-200
Online banking	2674	2790	2906	9.8%	1001-2000
TV set	3182	3300	3419	7.1%	1001-2000
Online search	2977	3095	3214	3.1%	1001-2000
Personal email	3282	3402	3522	2.9%	2001-5000

Valuations are strongly positively correlated with usage, with a February correlation coefficient of 0.84. Indeed, the relationship between usage and valuation seems non-linear, with higher valuations than would be indicated by a linear relationship for the four most used goods, online banking, physical TVs, online search and personal email.

Looking at the ratio between those aged 18-24 to those aged 65 or over, the difference in valuations in this case is most pronounced in the case of Snapchat (valued about 50 times more by the younger people), Instagram and Spotify (15 times), online learning and Twitter (10

times). The differences are less pronounced but still large when splitting respondents at the age of 50. As might be expected, however, older people tend to value non-digital services more than the younger people. For instance, valuations of printed newspapers, radio, and a physical TV set were twice as high for those above 65 than for those aged 18-24. In the case of Amazon, personal email, online banking, eBay and BBC iPlayer there appear to be no significant difference in valuations between younger and older age groups.

There are also some striking gender differences (Table 3).

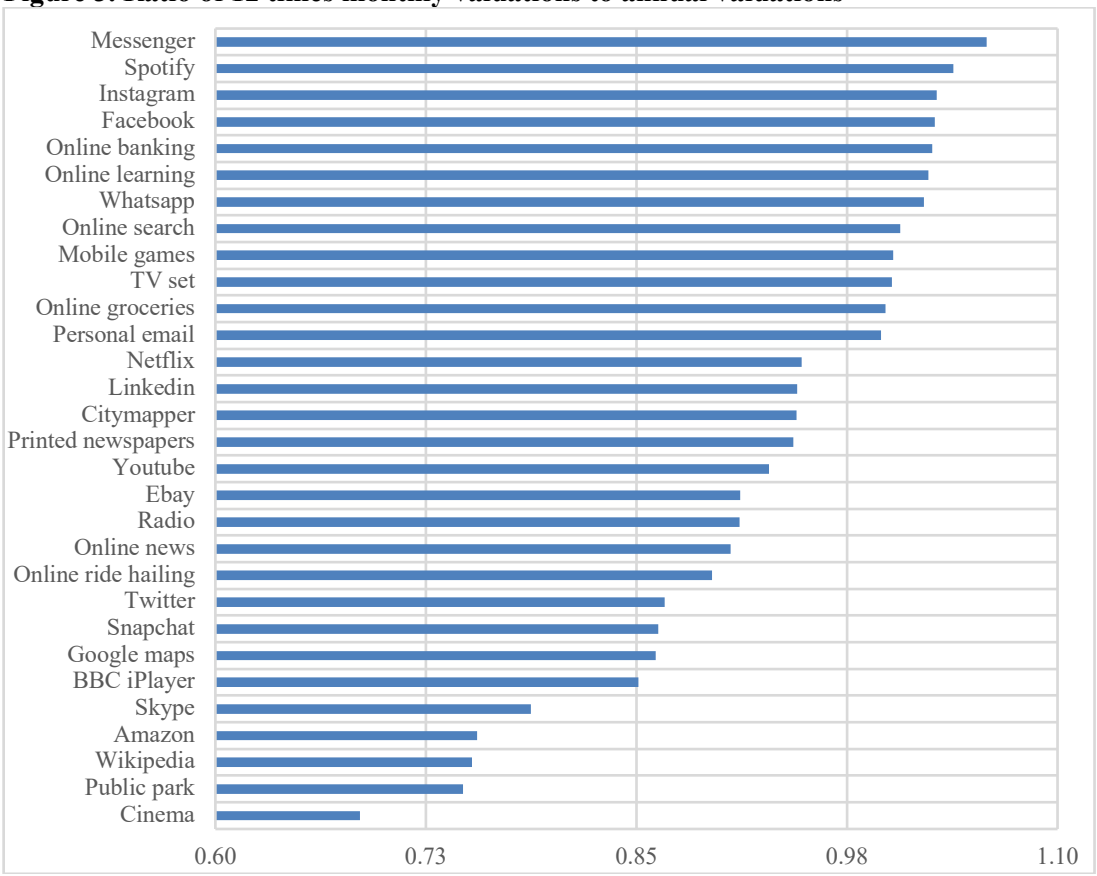
Table 3: Gender skews: ratio of M to F valuations, Feb 2020

	Skew F			Skew M
Instagram	0.615		TV set	1.002
Messenger	0.669		Online banking	1.009
Facebook	0.717		Personal email	1.016
Whatsapp	0.724		Radio	1.037
Online Groceries	0.736		Cinema	1.075
Netflix	0.788		Snapchat	1.108
Mobile Games	0.833		Citymapper	1.109
BBC iPlayer	0.889		Spotify	1.122
Google maps	0.949		Skype	1.131
Public park	0.964		Online ride hailing	1.150
Amazon	0.985		eBay	1.154
Online search	0.992		Printed newspapers	1.241
			Online news	1.284
			YouTube	1.374
			LinkedIn	1.419
			Twitter	1.466
			Wikipedia	1.493
			Online learning	1.729

The stated WTA values for 12 months typically are less than 12 times higher than the valuations for one month (see Figure 3), implying either 'overvaluation' of short periods or 'undervaluation' of longer periods.[8] This would be consistent with the frequent finding in behavioural economics that some form of hyperbolic discounting of the future is common (Frederick et al 2002). Other explanations are also possible including the thought process that the respondent would switch to another service if one specific good were withdrawn.

However, there is a small number of goods whose annual valuations are greater than 12 times the monthly valuations (ie. 12 times the monthly figure exceeds the annual valuations). This is the case for some messaging services (Facebook Messenger, WhatsApp), social media (Instagram, Facebook) and others (online banking, online learning). For another set of goods. The ratio of annual to 12 times monthly valuations is almost one. Interestingly, this includes online search, personal email and physical TV sets, the three most widely used and most valued of the 30 goods. This seems to suggest that the time discounting is more accurate whenever goods are integrated into people's daily lives and used frequently, often more than once per day.

Figure 3. Ratio of 12 times monthly valuations to annual valuations



[8] As stated above, half of survey respondents were asked to consider giving up access for 12 months and the other half for 1 month. None were asked to consider both.

We did not ask willingness-to-pay questions, but the WTA results could be benchmarked against average revenues per user (ARPU) for the free service providers; the two measures are unrelated but ARPU could be a starting point for how a service provider might think about pricing the service if it were a subscription offer. Ofcom (2019) estimates per capita revenues for various online services in the UK in 2018.[9] For example, ARPU for online search was estimated to be £101, £45 for social media, £27 for free video streaming, £11 for online news, £1,094 for online shopping, £47 for online entertainment, and £63 for online gaming. For almost all of these (the exception being online grocery shopping in February), the stated valuations in our surveys exceed these revenue per user figures by a large margin. This is consistent with findings of a large gap between willingness-to-accept and willingness-to-pay valuations both in this context and more broadly in the contingent valuation literature (Sunstein 2019).

We can also compare the valuations with others in the literature. Although the context differs between countries, this could highlight some interesting differences. Our mean Facebook WTA valuation of £1278 for 12 months compares with the range of $48 (for the median user) to $1000 in the US literature – in other words it is even higher than the top of this range - whereas the median band selected was a more comparable £101-200. The mean-median difference in our results indicates that some users state very high values, a distributional pattern evident with a number of the goods.

4.3. Changes February to May 2020

Table 4 shows the May 2020 valuations, and the percentage and absolute change in valuations between February and May.[10] There were significant increases in valuations of (i.e. outside the February upper confidence band) in the case of six goods (online groceries, online learning, WhatsApp, Netflix, Facebook, public parks, and TV sets). There were significant decreases in valuations for nine goods, such as online services related to mobility and inaccessible services such as cinemas.

[9] Based on estimates of UK market share in total global revenues, averaged across UK population rather than actual users. ARPU per user will be somewhat higher.

[10] These are minimum valuations, as we are using the lower end of the valuation bands offered, shown in Figure 1 (i.e. £1, £101, £201, etc). While there is no obvious way to decide which value to choose, we err on the side of caution.

Table 4 May 2020 valuations, £, and changes Feb-May, % and £

	CI Low	Valuation (mean)	CI High	Valuation (median)	Change Feb-May (in %)	Change Feb-May (in £)
Citymapper	90	141*	192	0	-19.0%	-33
Online learning	230	309*	388	0	25.30%	62
Snapchat	255	337	419	0	-3.6%	-13
Online ride	147	206	266	0	-14.1%	-34
Skype	251	334	416	0	-0.3%	-1
Linkedin	155	220	284	0	-7.8%	-18
Spotify	499	604*	709	0	-13.3%	-92
Twitter	322	408*	494	0	-26.7%	-148
Mobile games	506	614	721	0	3.7%	22
Instagram	569	681	792	0	3.6%	24
Online groceries	918	1059*	1199	1-100(+)	47.1%	339
Printed news	342	430*	518	0(-)	-23.9%	-136
Netflix	1219	1373*	1528	1-100	8.4%	106
Wikipedia	-5.40	657	767	1-100	-5.4%	-37
Cinema	486	589*	693	1-100	-18.0%	-130
Messenger	987	1131	1275	1-100	3.9%	43
Amazon	908	1046	1185	1-100	0.3%	2
Ebay	696	819	943	1-100	4.0%	32
Whatsapp	1599	1774*	1950	201-500(+)	11.8%	186
BBC iPlayer	677	795	914	1-100	-3.2%	-26
Facebook	1202	1358	1514	101-200	6.3%	80
Online news	1092	1243	1393	101-200	-0.8%	-10
YouTube	1234	1390	1546	101-200	-0.6%	-9
Radio	1350	1520*	1689	101-200	-11.3%	-202
Public park	1869	2063*	2258	201-500	5.8%	112
Google maps	889	1027*	1164	101-200	-21.4%	-280
Online banking	2455	2664*	2874	1001-2000	-4.5%	-126
TV set	3226	3449*	3673	2001-5000(+)	4.5%	149
Online search	2777	2998	3219	1001-2000	-3.1%	-97
Personal email	2958	3181*	3404	2001-5000	-6.5%	-221

*Note: * indicates significantly different from February valuation. (+/-) indicates whether median has in- or decreased.*

These changes in valuations were strongly positively correlated with changes in usage, with a correlation coefficient of 0.74. It is striking how large some of these changes are, in just 10 weeks, but this reflects the extraordinary circumstances and in general the changes are intuitive. For example, there is a very large positive change in the value stated for online shopping with the biggest increases being among women (£826 to £1426) and the oldest age categories (£476 to £1083 among over-65s).

Changes in valuations by age group, February to May

Changes in valuations differed across age groups. For example, while valuations of Facebook decreased by 2% to 4% for those aged 25-65, it increased by 26% for those aged 18-24 and by 38% for those aged above 65. There were also stark differences in the case of online grocery shopping, which increased in value for all age groups apart from those aged 18-24. The value that people aged 65 and above attached to this increased by 127%, while for people between 25-64 it increased by 37%. Wikipedia was another interesting contrast. For those aged 18-49 the value decreased by 13-16%, while for those aged 50 and above valuations increased by 14%. Online learning increased in stated value by between 20-40% for all age groups below 65, while its value decreased by 20% for those 65 and above. The value that different age groups attached to public parks increased markedly for those aged 18-24 (+25%) and 25-49 (+13%), while it appeared to have decreased for the groups of 50-64 (-3%) and over 65 (-13%).

Gender differences

There were some large changes between February and May. In February around 51% of men and 49% of women did not use online grocery shopping. Over the lockdown period these proportions decreased to 44% for men and 38% for women. Valuation for online grocery shopping thus increased relatively more for women (+51%) than for men (+41.5%). We also found large difference in changes in valuations in the case of Skype (women -15%, men +14%), online news (women +15%, men -14%), online learning (women +62%, men +4%), LinkedIn (women +21%, men -30%), online ride hailing (women +25%, men -50%), mobile gaming (women +16%, men -12%), printed newspapers (women -2%, men -43%), and WhatsApp (women +18%, men +2%).

Changes in valuations by social group

Looking at the changes in valuations by six socio-economic grades,[11] we find in most cases the changes in valuations have different signs across the social gradient. The valuations increased

[11] The NRS six social grades are: A-High managerial, administrative or professional; B-Intermediate managerial, administrative or professional; C1-Supervisory, clerical and junior managerial,

for all groups (online grocery shopping) or decreased for all (cinema) for few goods. Interestingly, the valuations for LinkedIn and online learning decreased for grades A to C2, but increased considerably for grades D and E. For example, in the case of online learning the WTA loss of access increased by more than 400% for semi-, unskilled and manual workers (grade D). For people in grade A (*High managerial, administrative or professional*) valuations decreased for most goods and by the most for mobility apps (online ride hailing, Google Maps, and Citymapper). Apart from online grocery shopping valuations of Grade A only markedly increased for YouTube (+17%). Valuations for people in grade B (*Intermediate managerial, administrative or professional*) decreased the most for printed news, Skype and Snapchat, but increased for eBay, Facebook and online grocery shopping. Valuations for grade C1 (*Supervisory, clerical and junior managerial, administrative or professional*) decreased considerably for Twitter, and printed newspapers, and increased significantly only for online grocery shopping. For C2 (*Skilled manual workers*) valuations increased for online groceries and Amazon and to a lesser degree Netflix, Facebook, WhatsApp and a TV set at home. Their stated values went down considerably for Skype and cinemas and also Twitter, LinkedIn, Spotify and YouTube. People in grade E (*State pensioners, casual or lowest grade workers, unemployed with state benefits only*) reported a large decrease in valuations for Spotify, Google maps and Snapchat as well as Wikipedia and Twitter. Apart from online groceries they stated an increase in the value of LinkedIn (+32%).

4.4. Demand Curves and Consumer Surplus

As the valuations of free goods increase, the associated consumer surplus will increase as well. Considering it has been proposed that the welfare contribution from free goods should be added to GDP, it is important to look at the associated changes in consumer well-being.

In the absence of a market price and reliable data or metrics on consumer demand it is difficult to calculate consumer surplus. Some studies have tried to capture the consumer surplus of free digital goods by looking at the time users spend using them (Goolsbee & Klenow, 2006; Brynjolffson & Oh, 2012). Other approaches have looked at advertising revenue (Nakamura et al., 2017); based on search time savings Varian (2011) estimates that the consumer surplus of Google is around 2-4 times its advertising revenue of $36 billion per year in 2011. Both approaches have the drawback that consumer surplus could be very high for some products

administrative or professional; C2-Skilled manual workers; D-Semi and unskilled manual workers; E-State pensioners, casual or lowest grade workers, unemployed with state benefits only. The social grades refer to the chief income earner in a household.

despite users spending little time on them (e.g. online banking), or their having little associated advertising revenue (e.g. Wikipedia, or niche products with a dedicated user base).

We can use our results to construct implied demand curves for the various products. In the case of Facebook, for example, 28% of our respondents reported that they do not use it. In other words, even at a zero price their marginal utility from using Facebook is zero, while it is positive for 72% at a £0 WTA.[12] Similarly, we find that 21% of respondents require between £1-100 to give up access to Facebook for 12 months. If we subtract those from the group that would rather keep access, we can see that for an expected payment of maximum £100 around 51% in our sample would choose to consume Facebook, and 49% would give up access. This is because those who would give up access for £1 would also do so for £100 (we asked for the "lowest amount" people would be willing to accept to forego access). Compared to this when offered £100 only 18% of respondents would give up access to personal email. Continuing this calculation, we arrive at less than 9% of respondents willing to keep access to Facebook when offered between £5,001-10,000. Log-linear demand curves for a selected number of products in February and May 2020 constructed in this way are shown in Figure 4 (digital products) and Figure 5 (non-digital products).[13] It is clear that the minimum quantity and the 'elasticities' are highly variable between products.

But note that the intuition differs from standard demand curves showing price and quantity for market goods. These curves show the proportion of people who would choose to give up access at different 'prices' (i.e. WTA). As quantity accessed varies, a steeper curve indicates a bigger change in the WTA amount required and hence a more elastic response. For example, based on our findings this implies that cinema and newspaper demand are rather (quantity-)elastic while personal email and search or TV set demand is inelastic in this sense.

We can also analyse shifts and changes in slope before and during the UK-wide lockdown. For example, the demand for Facebook, WhatsApp and YouTube appears to have become more

[12] While we know whether a consumer uses a certain product (e.g. Facebook, public parks), we do not know anything with regards to quantity or quality of usage (e.g. time spent, condition of local park). In addition, there are entry costs to using free digital products, including mobile devices such as smartphones and tablets, and internet access. However, while these costs can be high, especially for some groups of people, they are likely to be stable or decreasing over time. This is supported by the fact that the average smartphone penetration and monthly usage of mobile broadband has been increasing steadily over time. On average UK households spent £77.50 on all telecoms services in 2019, a 6% decline from the previous year; Ofcom 2020 https://www.ofcom.org.uk/__data/assets/pdf_file/0026/203759/cmr-2020.pdf.

[13] Demand curves for all 30 products are shown in Appendix 3.

inelastic, while demand for Google Maps and printed newspapers and magazines became more elastic.

Figure 4. Demand curves for selected digital products, February & May 2020

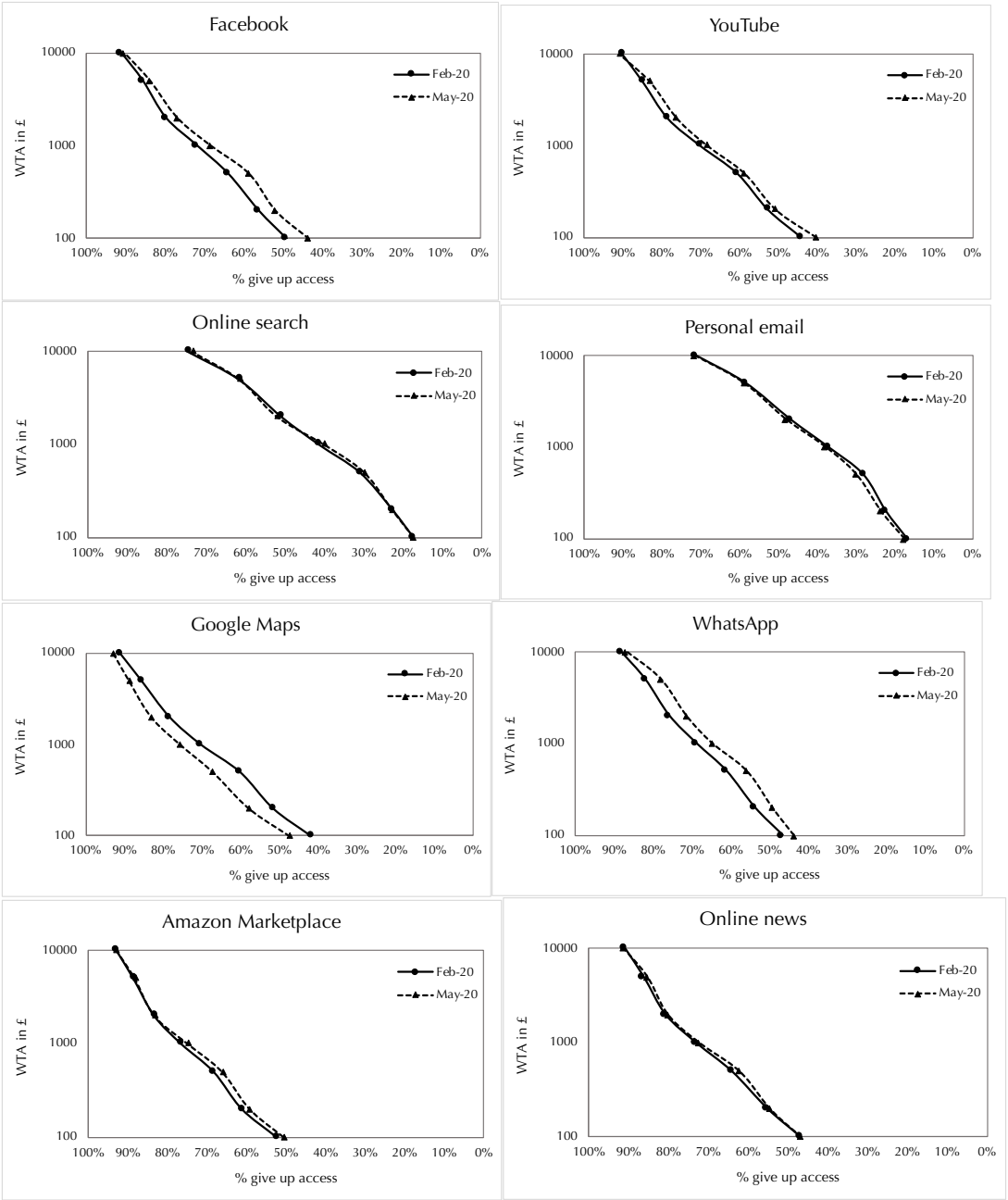
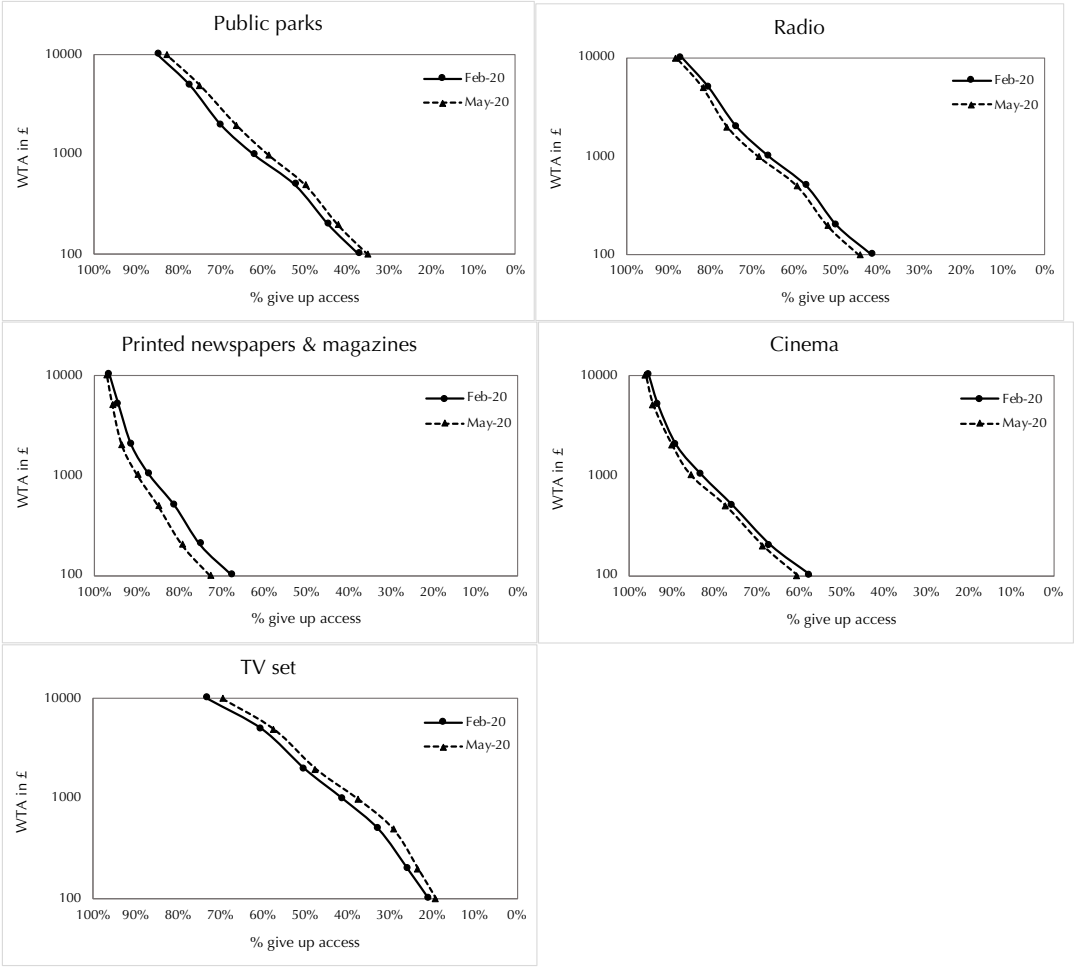


Figure 5. Demand curves for selected non-digital products, February & May 2020



A corollary of the fact that the thought experiment behind these demand curve differs from that behind the standard price-quantity relationships in marketed goods implies that caution is needed before using the aggregate consumer surplus indicated by these relationships to GDP.

4.5. Regression results

To summarise conveniently the multivariate relationships between valuations and the socio-demographic characteristics of interest, we regressed valuations on these variables (gender, education, age and region, choosing as reference categories: male, no degree, 25-49, and London). We also generated a variable 'low income 'for those with incomes below £20,000 a year and included a dummy variable for respondents using a mobile phone or tablet to complete the survey (as opposed to a laptop/desktop). The coefficients in the table can be interpreted as the valuation in pounds for the period.[14]

[14] We use a standard Ordinary Least Square model to estimate how individual-level factors are related to valuations. While this allows us to control for several socioeconomic characteristics simultaneously and show broad correlations, we do not claim any statistical relationship to be of causal nature.

For example, in Table 5 we present the results for the 12-month valuations for Facebook. Recall that the mean and median valuations for Facebook for 12 months were £1278 and £101-200, respectively, with 75% of respondents using it. Women responded that they would require a 40% higher monetary amount than men to give up use of Facebook for 12 months, reflected in the highly significant coefficients on the Female variable here. Regional dummies were insignificant. More educated users assign lower valuations; not having a degree may be correlated with greater likelihood of using a mobile (rather than laptop or desktop computer) to answer the survey.

Table 5 Facebook, regressions using 12-month valuations

	(1)	(2)	(3)	(4)	(5)	(6)
Female	531.6***	527.9***	468.1***	500.2***	485.6***	490.8***
	(6.42)	(6.37)	(5.59)	(5.81)	(5.67)	(5.72)
Low income		104.1	144.0	97.50	156.4	152.8
		(1.03)	(1.42)	(0.92)	(1.48)	(1.44)
Mobile device			383.8***	412.4***	232.1*	229.5*
			(4.55)	(4.76)	(2.56)	(2.52)
GCSE				-271.4	-360.3	-354.3
				(-1.30)	(-1.73)	(-1.70)
A Level				-323.7	-472.4*	-469.9*
				(-1.59)	(-2.28)	(-2.26)
Degree				-447.0*	-688.2***	-676.6***
				(-2.30)	(-3.49)	(-3.43)
Other				-309.9	-404.4*	-401.0*
				(-1.62)	(-2.12)	(-2.10)
18-24					-442.4**	-438.8**
					(-2.80)	(-2.77)
50-64					-515.9***	-519.8***
					(-4.67)	(-4.70)
65+					-760.1***	-758.4***
					(-6.66)	(-6.62)
Constant	1085.1***	1065.8***	867.2***	1184.2***	1799.1***	1633.3***
	(17.36)	(16.33)	(11.06)	(6.24)	(8.62)	(6.52)
Region dummies	YES	YES	YES	YES	YES	YES
Observations	4850	4850	4850	4650	4650	4650

The regression results capture the socio-demographic skews for other goods similarly. For example, public parks are most valued by the reference age group 20-49, and in this case there are significantly lower valuations outside London. Online search – which has high mean and median valuation across the whole sample – is most valued by more educated and younger groups, and least by the 50 and over age groups. Interestingly, by contrast Brynjolfsson et al. (2019a) found that in the US search was valued more by people above 55. Twitter skews male, mobile user and young while Instagram skews female, mobile user and young. Snapchat skews young but strongly toward those who do not have a degree. For online news there is a strong

skew toward male, highly educated respondents, and some degree of skew towards London users, while the oldest age group is significantly less likely to value online news. Printed news on the other hand skews female and older.

While these results are not surprising, they serve to underline an important point about using such valuations for constructing aggregate welfare measures. It means that the selection of goods to include in any aggregate total will have significant distributional implications, which ought to be taken into account if the aim is an estimate of total welfare. We return to this point in the discussion below.

4.6. Best Worst Scaling questions

At the end of the survey we presented respondents with a best-worst-scaling (BWS) question. Among a set of choices, participants had to pick the one they were most or least willing to give up (see Appendix 4 for details). The seven choices were Facebook, personal email, WhatsApp, online search, Wikipedia, public parks, and 'earning less' (with an amount of annual income reduction drawn randomly from five options).

The proportion of respondents opting to 'earn less 'as their 'least willing 'option was lower for higher amounts. In other words, the smaller the hypothetical reduction in income, the smaller the proportion of respondents stating it to be their 'least willing' choice. For example, while 40% say they would be least willing to accept earning less when facing a decrease in annual income of £10,000, the proportion was 20% in the case of earning £500 less per annum and 9% when earning £100 less. This intuitive result supports the case that the stated values reported above reflect consistent consumer choices.

Second, the proportion of respondents least willing to give up access to personal email or online search, as compared to a reduction in income, was higher for smaller income reductions. For example, the proportion stating they would be least willing to give up personal email was very similar when the alternative was an income loss of either £5,000 or £10,000 a year (around 21-22%). However, at an income loss of only £100-500 a considerably higher proportion (29-32%) said they would be least willing to give up email. There was an equally pronounced trade-off in the case of online search. When the alternative was an income loss of £10,000 or £5,000 8-11% opted for access to online search as the good they were least willing to give up, but this proportion increases to 15-20% when faced with a loss in annual income of £100-500. A broadly similar pattern can be observed for access to public parks (12-14% in case of £5,000-10,000 income loss as compared to 18% in case of £100-500 income loss).

Other categories displayed a less pronounced trade-off between access and loss of income. For example, no matter the amount of hypothetical decrease in income as their alternative choice, around 5-6% of respondents were always least willing to give up access to Facebook. Similarly, 7-10% were least willing to give up access to WhatsApp. The share of respondents opting for Wikipedia as the good they are least willing to give up is also relatively unchanged at around 0.5-1% no matter the amount of income loss as the alternative.

Thus, a proportion of respondents appear to always be least willing to give up access to some goods such as Facebook or WhatsApp, at least for the earnings decreases offered in our survey. These results suggest that for this proportion, individual demand is highly inelastic and consumer surplus large. This tallies with the distribution of stated valuations noted above, with a proportion of respondents stating high values. An avenue for future research would be to explore these individual characteristics across a full choice set.

4.7. The value of reading the news

Our selection of goods means we are able to compare stated values for online goods and physical substitutes. One of the pairs is online news and printed newspapers. In recent years there has been progressive substitution from print to online formats: Ofcom figures show daily newspaper circulation in the UK has declined from 21.9m in 2010 to 9.3m on 2019.[15]

In our February 2020 sample, 73% of respondents stated that they read news online and on average required £1,253 to give up access to online news for 12 months.[16] In comparison, around 55% of respondents say they read printed newspapers and on average placed a WTA valuation on this of £566 for the same time period.

There are interesting differences in terms of usage rates and WTA across age groups (see Table 6). Reading printed newspapers appears to be negatively associated with age, while online news is most widely used by people age 50-64. Readership of online news is the lowest (65%) among those aged 65+, as are annual valuations (£832). At the same time this age group has the highest share of reading printed newspapers (66%) with the highest average valuation (£895).

[15] https://www.ofcom.org.uk/__data/assets/pdf_file/0013/201316/news-consumption-2020-report.pdf
[16] Calculated based respondents that did not reply "Don't know/None", which in this case was almost 10%. Questionnaire did not specify whether online news was paid-for or free.

Valuations on online news are the highest for respondents aged 18-24 (£1,685) and twice as high as for people aged 65+.

Over the period of 10 weeks between end of February and mid-May usage of printed newspapers declined from 55% to 47%, while use of online news increased from 73% to 75%. At the same time average valuations of printed news decreased by 24% from £566 to £430, while the valuation of online news decreased minimally from £1,253 to £1,243.

Changes in valuations exhibited considerable differences across social grades. For example, valuations of online news decreased for all grades and most for C2 (-21%); however, they in increased by 19% for grade C1 (from £1,290 to £1,539) and thus converging towards the highest valuations found in grade A (£1,667). Valuations of printed newspapers decreased across all social grades, but markedly more for grades A, B and C1. In the case of grade C1 valuations dropped the most (-39%) and reached the lowest among all social grades (£314).

Overall our results are consistent with other surveys indicating that all groups are now more likely to read the news online, but particularly younger people. The new insight from the comparison is that WTA valuations for online news (which is either cheaper than print subscriptions or free to access) are on average more than twice as high as those for printed newspapers (for which users have to pay). The average WTA for printed newspapers of £566 compares to an annual print subscription of £468 for The Times (whose digital subscriptions are £180-£312 a year), for example, or £144 for a subscription to £820 at newsstands a year for The Guardian in print (and zero-£144 for tiers of its online access). The prices charged for print newspaper subscriptions could be interpreted as an estimate of WTP. The WTA/WTP gap is smaller for the paid-for good than for the online version, which seems to confirm the finding of a large WTA/WTP gap for free goods so commonly found in contingent valuation studies. The implication of this finding is that the economic welfare gap between GDP, as a measure of marketed activity, and total welfare including consumer surplus will grow the more substitution there is to online goods with a zero monetary price.

Table 6. Valuations and usage of reading news online and offline, February 2020

		All	18-24	25-49	50-64	65+
Online news	% usage	73	79	77	89	64
	WTA £	1,253	1,685	1,406	1,195	832
	% usage	55	48	51	56	66

Printed news	WTA £	566	554	374	589	895

For the other goods in our survey for which there are offline comparators, one could compare the mean or median valuation to actual average expenditure – for example, Google maps compared to average spending on road atlases and maps, and navigation devices. There are, though, services in the survey whose valuation seems to represent a 'pure 'welfare gain in terms of time saved, convenience or increased choice or control. For instance, online banking is highly valued (mean WTA in February was £2,790 for 12 months) yet the outcomes – transactions people need to carry out – are the same whether online or offline. Another example is the BBC iPlayer, which allows users to access all BBC programmes when they like rather than when broadcast; the mean WTA (around £800 for 12 months) is high, and considerably higher than the BBC licence fee of £157.50 a year. The time saved or convenience/choice gained through online services is an under-explored source of consumer welfare (Coyle 2019, Coyle & Nakamura 2019).

5. Discussion

Although the stated values we report are not tightly anchored to a particular level, the results are plausibly related to stated usage, are consistent as between time periods with some forms of discounting, can identify clear rankings among goods, and demonstrate plausible relative changes in response to events.

We consider the method is a useful way to assess changes in valuations absent a price. During the lockdown, we observed rapid changes in the contributions different goods and services make to consumer welfare, with some significant differences by age group and gender. In this sense the lockdown has acted as a natural experiment testing for the extent to which digital goods and physical goods are substitutes. As many of the goods we considered are free to use, these valuation changes give useful insights into economic welfare and activity that are not captured by changes in market prices. They act as a forward-look at which services are most valuable in a post-pandemic world where more activity takes place online, compared with the recent past. They also provide important, policy-relevant insights into distributional questions as between men and women and different age and socio-economic groups.

However, there are significant hurdles before this approach could be used for aggregate measurement of economic welfare. Notwithstanding some recent work constructing distributional GDP measures (eg Aitken & Weale 2020, BEA 2020), distribution is not taken into account in GDP, yet it would be odd to think about constructing an explicit aggregate welfare metric without consideration for distribution. Our results show significant differences in the valuation of different goods by gender, age and social grade, and a skewed distribution of values, with a proportion of respondents assigning very high values to certain goods. An aggregate measure could nevertheless give all individuals equal weight. But in that case the definition of the universe of free goods to be included in an aggregate welfare measure, and how it is to be partitioned among specific and general categories, would affect the aggregate. There is no reason to expect the stated value for 'all social media' would be equal to the sum of values for each social media platform, for example, as some of the free goods can be substitutes. And indeed, there is a significant 'new goods' problem; we did not include TikTok, for example, which was far less prominent even before the first survey was conducted. The selection of individual platforms would also have welfare implications depending on the demographic skews in the stated values. For instance, certain selections might tilt toward platforms valued more highly by men or by young adults.

Another significant issue is the absence of an adding up constraint. For marketed goods, the monetary budget constraint, and consumer expenditure within that limit, ensures that the estimated total does not exceed the money available. However, in their usage of any goods but particularly the free digital ones we are considering here, people are constrained by time. But in their assignment of valuations to free goods, they face neither a monetary nor a time budget constraint.

As the literature on application of contingent valuation methods to free digital goods grows, some important insights are emerging. One is that people do assign generally high median and mean values to these goods. An avenue for further research is whether, as compared to offline versions, these high values reflect other attributes such as convenience and time saving, or greater choice. The results are also broadly consistent with intuitions from economic theory. However, some significant questions remain to be addressed before the method is applied to the estimation of an aggregate economic welfare measure.

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Appendix 1 – Pilot survey, further details and results

A sample question from the first (March 2018) pilot, presenting an open box for the answer is: *Imagine you had to give up access to some goods or services for a period of time, in return for a sum of money. For what sum of money would you be willing to go without access to social media for one [month/week]? This would include all social networking sites like Facebook, Twitter or Snapchat, and all video sharing sites like YouTube. Please write the amount in the box below. If you would not be willing to do thisfor any amount of money, please write '0'.*

Results are shown in Table 1.

Table 1: Median values from 1st pilot, March 2018

	1 week	1 month
All social media	£50	£100
Personal email	£100	£200
Physical TV	£100	£250
Mobile phone	£100	£400
Personal internet access	£200	£600

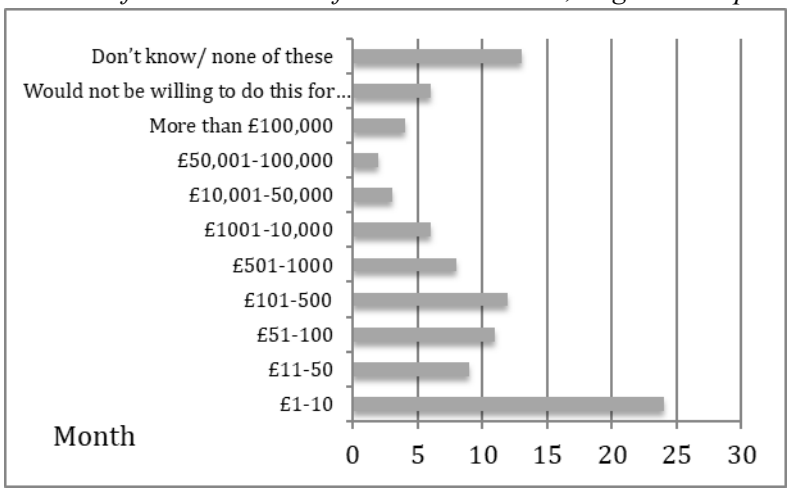
We next tested a menu card of pre-defined price bands, and also added a question about the intensity with which people used each good/service (on a scale from 'several times a day' to 'never'). The question format was: *Imagine you had to give up access to some goods or services for a period of time, in return for a sum of money. What is the lowest sum of money for which you would be willing to go without access to all forms of social media for one week/month/year? Please select an answer from the options below.*

£1-10
£11-50
£51-100
£101-500
£501-1000
£1001-10,000
£10,001-50,000

£50,001-100,000
More than £100,000
Would not be willing to do this for any sum of money
Don't know/ none of these

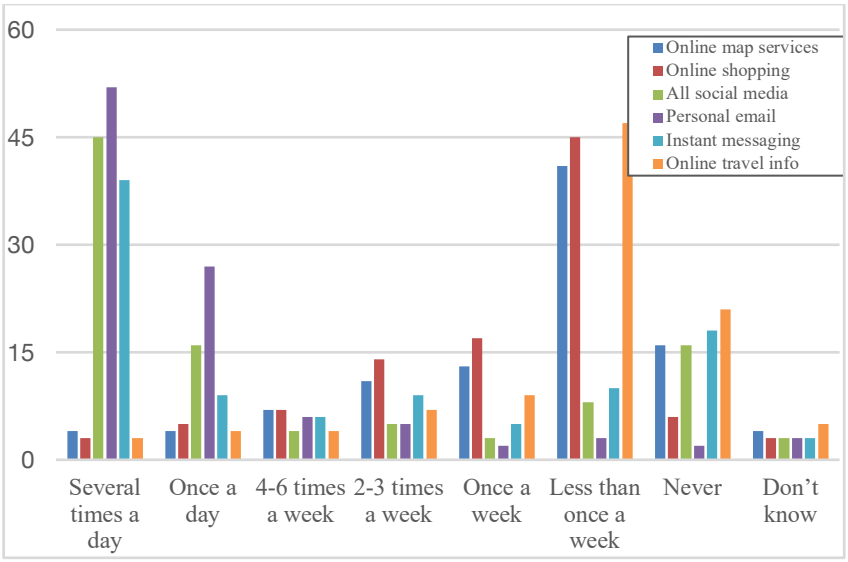
Figure 1 shows the one-month results for 'all social media'. The profile was similar for week and year, but as with the first pilot the values over the different time periods were not wholly internally consistent, with some evidence of annual valuations being 'understated' relative to shorter period valuations. We also identified some socio-demographic differences in responses to explore in the full survey, age, gender and social class.

Figure 1: Distribution of WTA valuations for all social media, August 2018 pilot.



Additionally, we found greatest intensity of use of personal email, social media and instant messaging, and least usage of online shopping, mapping, and travel information services (see Figure 2).

Figure 2: Usage of digital products in the UK, August 2018



In the September 2019 pilot, having added a question about usage, we asked about only three different categories of digital services but tested three different answer sets per question and two time periods (week and month). The categories were: All forms of social media; Online instant messaging (e.g. Snapchat, WhatsApp, Instagram, Facebook Messenger, WeChat etc); Personal email accounts (but NOT including email use needed for work).

The answer categories were:

- Open box, i.e. no price bands (N=1,600)
- Pre-defined price band 1 (N=850), see below
- Pre-defined price band 2 (N=850), see below

Pre-defined price band 1	**Pre-defined price band 2:**
Less than £1	Less than £1
£1-3	£1-5
£4-8	£6-10
£9-12	£11-20
£13-20	£21-50
£21-50	£51-100
More than £50	More than £100
Would not be willing to do this for any sum of money	Would not be willing to do this for any sum of money
Don't know	Don't know

We were mainly worried that changing the options bands per se would alter responses. In other words, when respondents would see options going up to £100 (price band 2) instead of just £50 (price band 1) they would be more inclined to opt for higher valuations). To test this, we randomly provided respondents with either price band 1 or price band 2, but never both. Table 2 compares the results from this exercise, and we are confident that there is no huge bias arising from this. For instance, around 6-7% opt for "less than £1" in both samples and 39-42% choose "more than £50". There is some indication that providing respondents with more answer options (e.g. four options in the range £1-20 in price band 1 as opposed to three in price band 2) could entice more respondents to choose one of them. However, we need to keep in mind that sample sizes are relatively small so we would not generalise this point. More testing in this regard would certainly be useful to consider in future research.

Table 2. Comparison of price bands

	Band 1	Band 2
Less than £1	7	6
£1-20	16	13
£21-50	8	12
More than £50	42	39
Would not be willing to do this for any sum of money	16	18
Don't know	10	13

The results led us to test in November 2019 four categories of specifically named services (Facebook, Google search, personal email, WhatsApp) and four time periods (1/3/6/12 months) to understand better the 'time inconsistency' and whether there were differences between specific and generic descriptions. This time we used one set of price band options, adjusted in the light of earlier pilot results suggesting an extended scale and less division in the low bands would be appropriate:

£1-10
£11-20
£21-50
£51-100
£101-200
£201-500
£501-1,000
More than £1000

I do not use Facebook
I would not be willing to do this for any sum of money
Don’t know

For all four services there was a U-shaped WTA profile, with the highest proportions selecting either the lowest of highest price band options. Furthermore, and in line with our expectations, moving from 1 month to 12 months, the share of respondents opting for £1-10 decreases (e.g. from 22 to 13% for Facebook), while the share choosing £1,000+ increases (from 6 to 16%). This pattern holds for all four services we considered.

Appendix 2 – Main survey, further details

- Wave 1: 27 Feb – 3 March 2020 N = 10,500 UK adults
- Wave 2: 14 – 15 May 2020 N = 1,600 UK adults

Sample:

The full survey (February 2020) contains data for 10,500 individuals, randomly split in half to provide valuations for one month and 12 months periods. None of the survey participants answered questions on both, monthly and annual valuations. This means we have around 5,250 responses for the annual valuations, which are used also in the regression analysis.

Our sample is weighted and representative of GB adult population (18+) by age, gender, education level, social grade, region, and political attention (see YouGov website for further details on sample representativeness). The average age in our sample is 49.9 years, with a median of 51. 42.6% of respondents are male, and 27.6% hold a university degree of any kind. Overall 26.6% of our sample falls within a high-income group, which we define as those with an average gross household income of more than £40,000. Similarly, 20.8% fall into a low-income group of below £20,000. Around 8.1% are captured by a "London" dummy. Finally, we include a dummy which captures the fact that 58.4% of respondents took the survey on a mobile device or tablet.

Correlation matrix

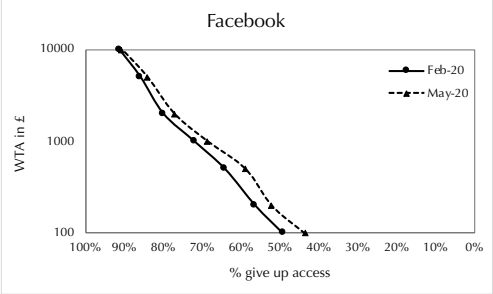
	Female	Age	Mobile	Degree	London	High inc
Female	1.0000					
Age	-0.1042	1.0000				
Mobile	0.1567	-0.3386	1.0000			
Degree	-0.0057	-0.1628	0.0131	1.0000		
London	-0.0102	-0.0789	0.0113	0.0722	1.0000	
High inc	-0.0680	-0.1738	0.0802	0.1621	0.0617	1.0000

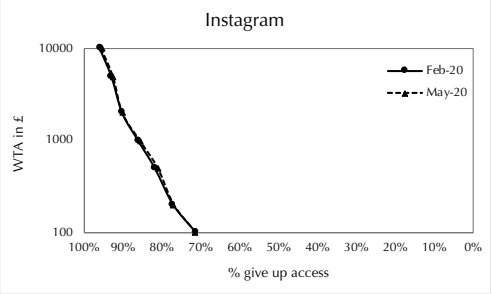
We selected the following goods:

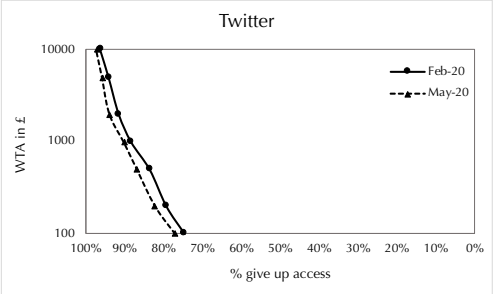
- **Social media**: Facebook, Messenger, Instagram, WhatsApp, LinkedIn, Snapchat, Twitter
- **Offline versus online "substitutes"**:
  - TV, cinema & Radio vs iPlayer, Netflix, YouTube & Spotify
  - Printed newspapers vs online news
  - Public parks
- **Online substitutes**: Skype, online groceries, eBay, Amazon, online banking, Wikipedia, personal email, online search, online learning, gaming
- **Mobility**: Google Maps, CityMapper, ride-hailing

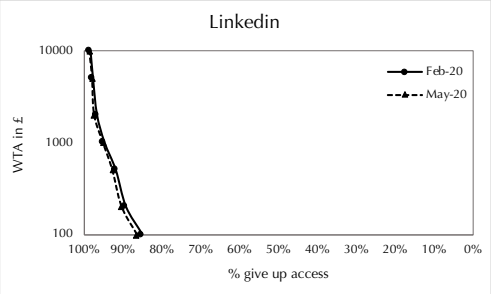
Appendix 3 – Demand Curves, further details

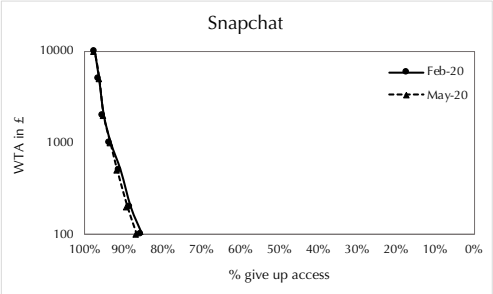
Demand curves for selected social media products



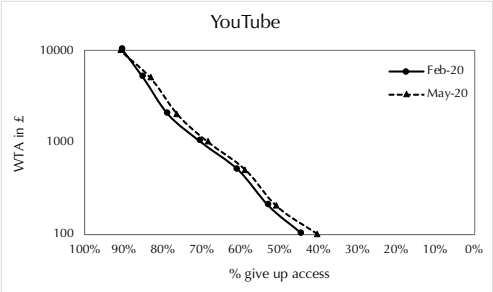


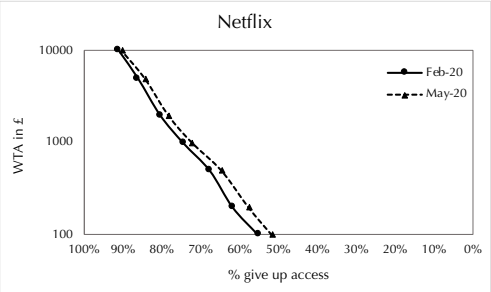


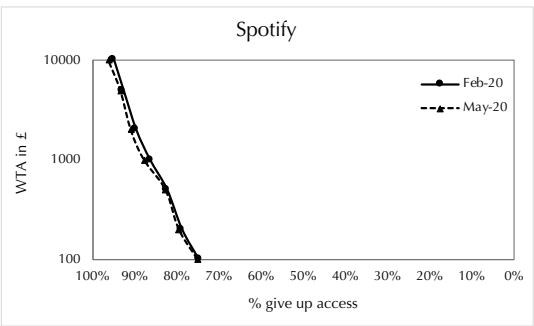


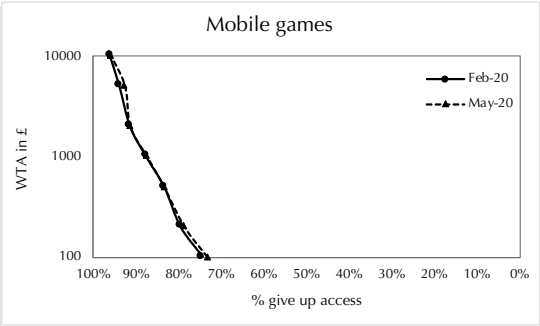


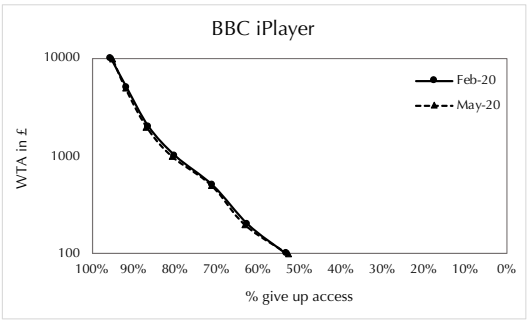
Demand curves for selected digital entertainment products



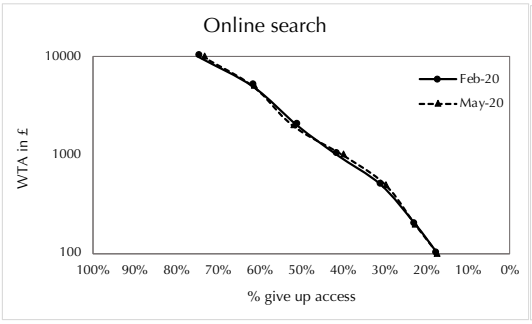


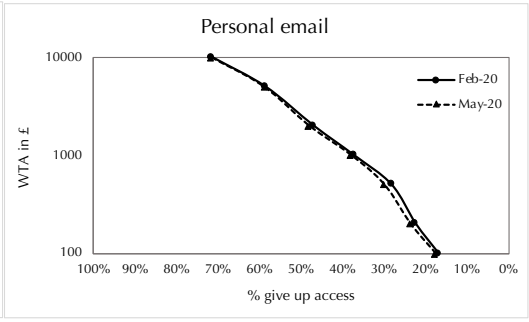


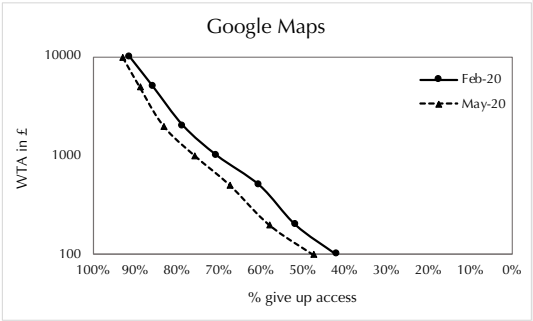


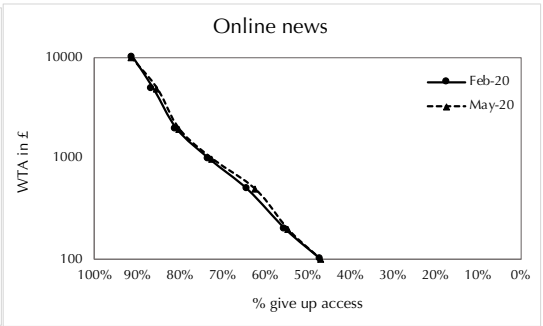


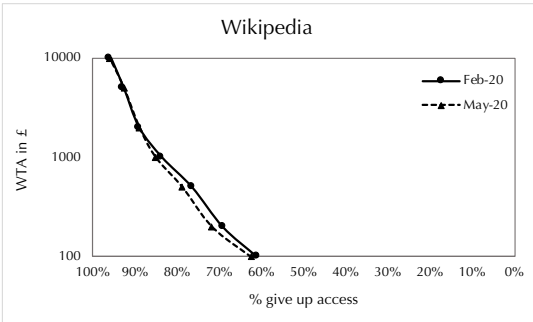
Demand curves for selected digital productivity products

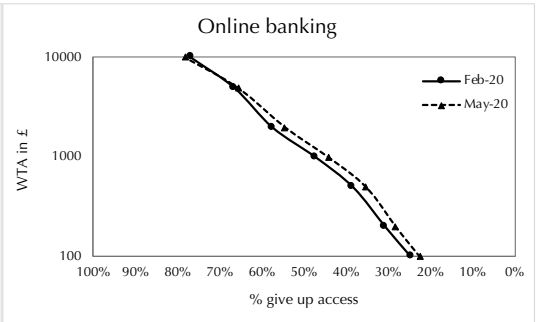




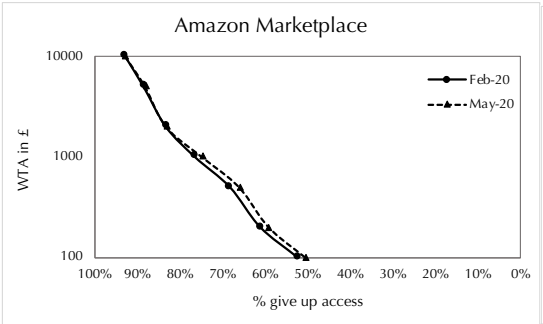


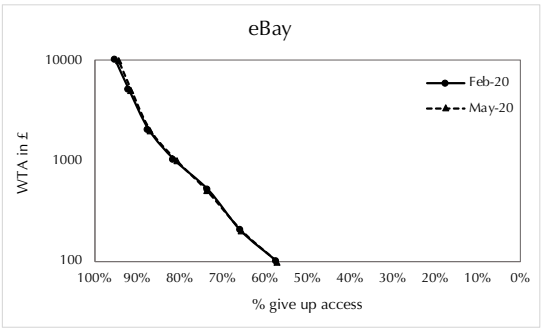




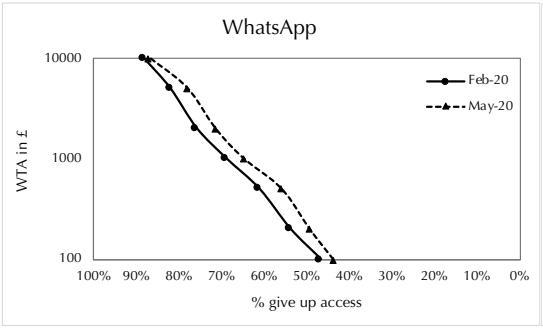


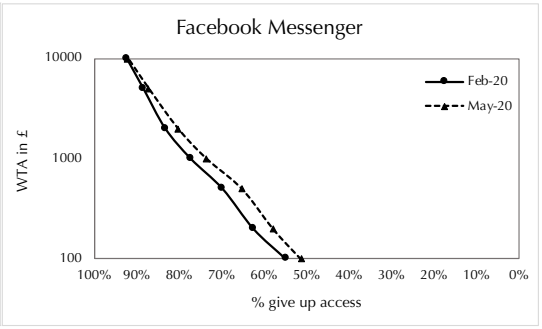
Demand curves for selected online shopping products

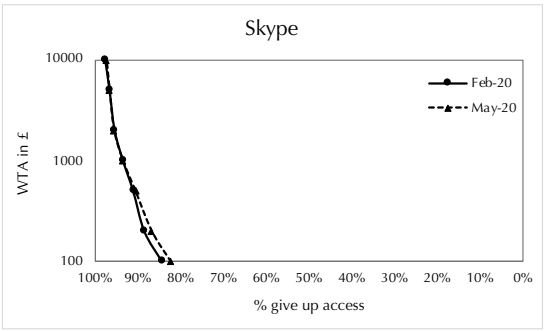




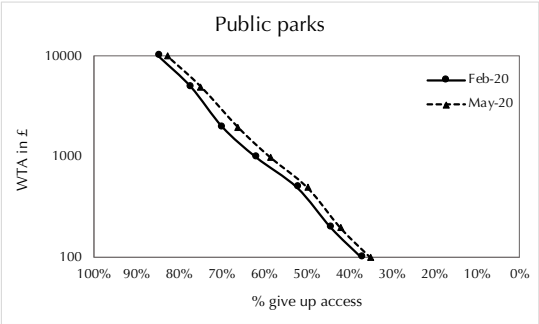
Demand curves for digital messaging products

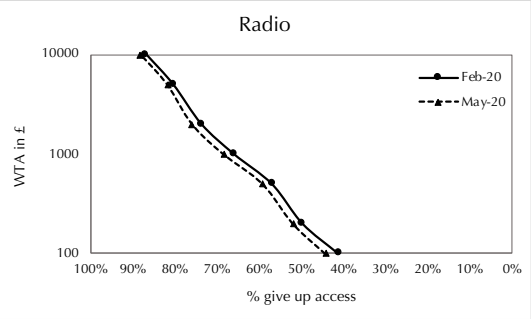


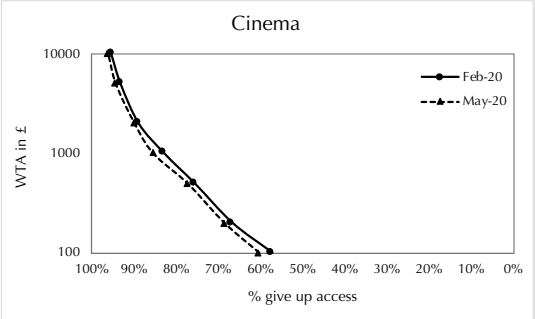


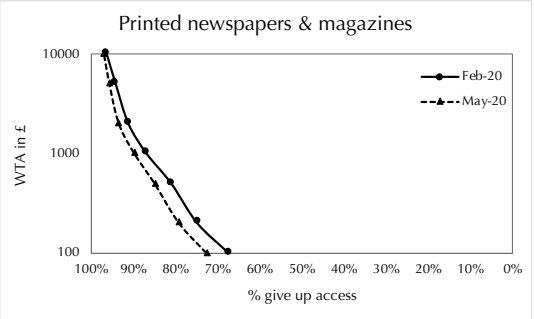


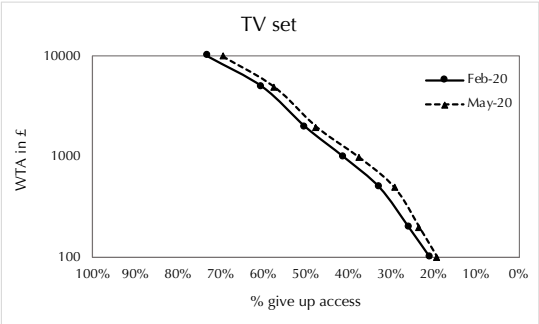
Demand curves for offline products











Appendix 4 –Best-Worst-Scaling, further details

At the end of the main February 2020 survey we asked the following question: "Now imagine you have a choice of giving up all but one of the following for [1 month/12 months]. From the following options, select which one would be the "best" and which the "worst" to give up for you." Half of respondents were randomly asked to consider 1 month and the other half 1 year.

We provided participants with the following seven goods:

1. Facebook
2. Personal email
3. WhatsApp
4. Online search engines, e.g. Google search
5. Wikipedia
6. Earning [x] less for the [month/year]
7. Access to any public park

Earnings were randomly drawn from five options for 1 month / 12 months respectively:

- £1,000 / £10,000
- £500 / £5,000
- £100 / £1,000
- £50 / £500
- £10 / £100

Participants were first asked to choose which option from the seven they were *most* and *least* willing to give up. Following this, we asked them the same question but now only presenting them with the remaining five options. In the third step they were given the final three options. We thus obtained the individual set of preferences among seven options for all respondents.

In the first stage, we obtained the following choices for 1 and 12 months:

	1 month		12 months	
	Most willing	Least willing	Most willing	Least willing
Facebook	31.26%	6.64%	32.87%	5.43%
Personal email	1.23%	31.51%	1.32%	25.76%
WhatsApp	13.97%	10.48%	14.22%	8.25%
Online search engines, e.g. Google search	1.35%	15.51%	1.18%	13.88%
Wikipedia	27.62%	0.89%	28.62%	0.77%
Earning [x] less for the [month/year]	6.53%	16.89%	5.17%	25.93%
Access to any public park	13.8%	13.84%	12.47%	15.81%
	4.23%	4.23%	4.16%	4.16%

We can also break down the share of participants choosing one of the seven options depending on the size of the decrease in earnings presented to them. In the 1 month case, the choices stated were:

Loss of earnings:	Facebook	Email	WhatsApp	Search	Wiki	Earn less	Park
£1,000	5.53%	25.74%	8.48%	12.49%	1.05%	31.94%	10.77%
£500	6.62%	29.11%	10.30%	11.34%	0.57%	24.67%	12.76%
£100	5.82%	33.56%	10.86%	17.07%	1.07%	12.03%	15.62%
£50	7.07%	33.58%	11.26%	16.47%	0.84%	10.88%	15.16%
£10	8.15%	35.55%	11.47%	20.19%	0.95%	5.02%	14.88%

In the 12-month case, the stated choices were:

Loss of earnings	Facebook	Email	WhatsApp	Search	Wiki	Earn less	Park
£10,000	5.52%	20.95%	8.33%	8.14%	0.75%	40.60%	11.60%
£5,000	4.97%	21.75%	7.65%	10.53%	0.79%	36.74%	13.60%
£1,000	4.53%	23.74%	8.87%	14.98%	0.49%	24.83%	17.04%
£500	5.98%	29.25%	6.81%	15.00%	0.83%	20.15%	18.31%
£100	6.05%	32.28%	9.56%	20.18%	0.96%	9.12%	18.25%