

How Should We Measure the Digital Economy?

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ABSTRACT

Over the past 40 years, we've seen an explosion of digital goods and services: Google, Facebook, LinkedIn, Skype, Wikipedia, online courses, maps, messaging, music, and all the other apps on your smartphone. Because many internet services are free, they largely go uncounted in official measures of economic activity such as GDP and Productivity (which is simply GDP/hours worked). If we want to understand how the internet is contributing to our economy, we need better ways to measure free services like Facebook, Google and Wikipedia. We developed techniques with Felix Eggers of University of Groningen that allow us to estimate the internet's contribution to the economy. Our research suggests that there has been a substantial increase in well-being that is missed by traditional metrics like GDP, or productivity.

The authors did not receive financial support from any firm or person for this article or from any firm or person with a financial or political interest in this article. Neither is currently an officer, director, or board member of any organization with an interest in this article.

1. Introduction

How much would we have to pay you to give up Google search for one month? \$10? \$100? \$1,000? How about Wikipedia? Perhaps you don't use Google or Wikipedia at all, and so your reply is \$0. Your answer matters tremendously, and not just to Google or Wikipedia.

We've seen an explosion of digital goods and services over the past 40 years: Google, Facebook, LinkedIn, Skype, Wikipedia, online courses, maps, messaging, music, and all the other apps on your smartphone. The average person spends three hours a day consuming these services¹.

Because so many of the internet services we each use are free, they largely go uncounted in official measures of economic activity such as GDP and Productivity (which is simply GDP/hours worked). The contribution of the Information sector as a fraction of the total GDP has barely changed over the past 40 years (hovering between 4-5% and reaching a high of only 5.5% at the end of 2018)². The reason is that GDP is based on what people pay for goods and services so if something has zero price, then it has zero weight in GDP.

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One of the most fundamental question in economics is: How are we doing? Traditionally, economists, policy makers, and journalists look at changes in GDP over time and use it as a proxy for changes in well-being. However, it is important to note that GDP measures the monetary value of all final goods *produced* in the economy. It does not measure well-being.

The split between GDP and well-being becomes even more stark as more and more of our economy becomes digital. Digital goods are often free for users and so their contributions to well-being are excluded from GDP. Therefore, it's not surprising that the share of the information sector as a percentage of GDP has remained at 4-5% for the past four decades while we can clearly see that the economy has become significantly more digital. In short, we see the benefits from the digital revolution everywhere except in the GDP statistics.

The techniques we developed in our research with Felix Eggers allow us to estimate the internet's contribution to the economy in ways that have not been possible before. They also are cheap and easy enough that many companies can adopt them for their own consumer research. Finally, they provide a path forward for policymakers and economic agencies looking to measure the overall economy and its progress. Our aim is not to replace GDP, which is incredibly useful. But too often it ends up being misused as a measure of well-being simply because no better measure existed. For services like Google search, Facebook, and Google Maps, the answer for most users is: nothing. We propose measuring how much people *benefit*. And our estimates suggest that the benefits of Facebook, email, Google Maps, and other internet services are substantial.

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1. <https://www.vox.com/2018/6/8/17441288/internet-time-spent-tv-zenith-data-media>

2. <https://apps.bea.gov/iTable/iTable.cfm?reqid=147&step=2&isuri=1>, <https://fred.stlouisfed.org/series/VAPGDPI#0>

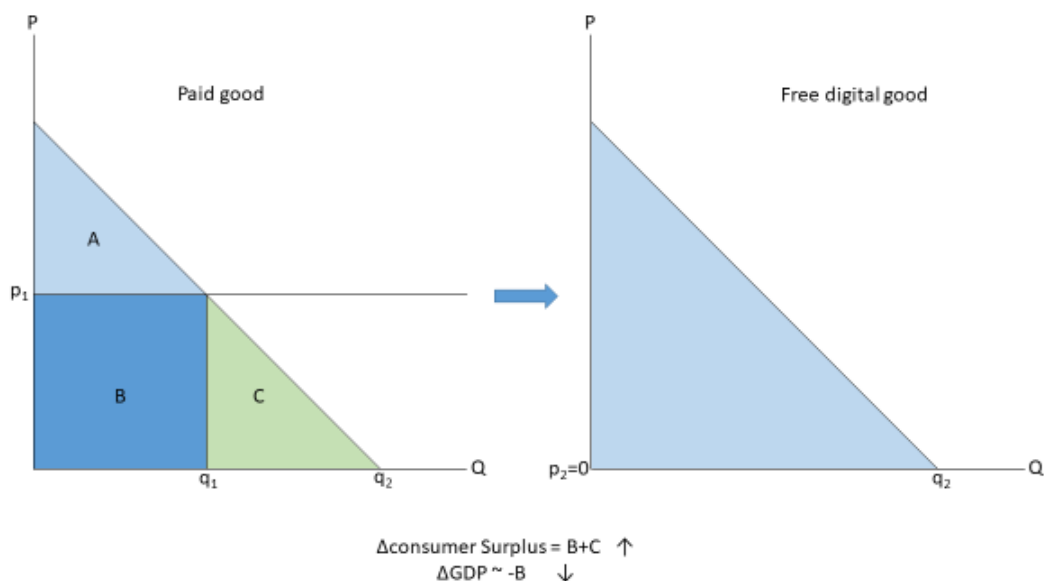
2. What GDP doesn't measure

While measuring the economies production, as GDP does, is important, we need a different approach if we want to measure our well-being. Economics provide an answer about how, at least in theory, we should do this. Specifically, the concept of consumer surplus represented that difference between what we'd be willing to pay for a good and what we actually have to pay. If we would have paid up to \$100 for a shirt but only have to pay \$40, then we have gained \$60 of consumer surplus. The difficulty is that it's hard to get reliable estimates of consumer surplus at scale. Unlike GDP, which depends on what we actually pay for goods and services and can be observed at the cash register and thus companies revenue statements, consumer surplus is not normally directly observed. But just as the digital revolution created measurement challenges, it also provides new measurement tools.

Specifically, we have been able to use online survey techniques to ask question of hundreds of thousands of consumers about their preferences and thereby get estimates of the consumer surplus for a variety of goods, including free ones that are missing from the economic statistics. In our research, we propose a way of directly measuring consumer surplus in a scalable way by asking consumers to make a choice between keeping access to a good or giving it up in exchange for monetary compensation (Brynjolfsson, Collis and Eggers 2019). To make sure that consumers reveal their true preferences, we can enforce their choices and give them the money that they ask for.

Our measure of consumer surplus is a much more direct and better measure of consumer well-being. Such a measure is especially important when previously paid physical goods transition into digital goods (see Figure 1 for illustration). Contributions to GDP might fall while consumers become clearly better off. A good example of this is encyclopedia Britannica and Wikipedia. Britannica used to cost several thousand dollars. Wikipedia is free and has more quantity and better quality of articles than Britannica ever had. If you look at GDP, you will find that the encyclopedia industry is shrinking. However, consumers are better off and obtain a tremendous amount of consumer surplus from Wikipedia. In our research, we find that the median US consumer values Wikipedia at around \$150 per year but they pay zero (Brynjolfsson, Eggers and Gannamaneni 2018).

Figure 1: Changes in GDP vs. Consumer Surplus for goods transitioning from paid to free



3. How much do we value digital goods?

To measure the consumer surplus generated by Facebook, we recruited a representative sample of US based Facebook users and asked them for the amount of money they would need to be compensated with to give Facebook up for 1 month. To make sure that they respond truthfully, some of these respondents were randomly selected and asked to give Facebook up for 1 month. At the end of the month, we verified that they indeed gave it up and gave them the cash that they asked for.

According to our research, the median Facebook user in the US would need to be paid \$48 to give up the service for one month. 20% would give it up for as little as \$1, but a significant chunk of users (20%) said that they would require more than \$1000. In total, we estimate that consumers derived \$16 billion of value on average per year from Facebook since its inception in 2004 up to 2017 (Brynjolfsson et al. 2019). None of that value showed up in GDP.

We conducted a similar study in Europe in a university laboratory and found that the median user needed a compensation of €97 to give Facebook up for 1 month. Users who have more friends value Facebook more, reflecting the fact that network effects are a key factor contributing towards this high valuation. Users of Instagram and YouTube value Facebook less, implying that they might be substitutes to Facebook. In terms of demographics, we find that women value Facebook more than men. Moreover, older people value it more than younger people. This is due to the fact that older people lack substitutes for Facebook while younger people can migrate to alternative social media platforms (e.g. Snapchat, Instagram) if they give up Facebook.

One might argue that the value generated by Facebook is reflected in its advertising revenues. However, our estimates indicate that Facebook generates over \$500 of consumer surplus per year for the average user in the US and Europe. In contrast, average revenue per user is only around \$140 per year in US and \$44 per year in Europe³. Even for one of the most skilled advertising platform, advertising revenues are only a fraction of the total consumer surplus generated by it. In general, advertising revenues and consumer surplus need not be correlated with each other (Spence and Owen 1977) since a platform might earn the same advertising revenue from 2 eyeballs while 1 eyeball might value it much higher than the other (i.e. more consumer surplus for the former user).

We conducted more studies to measure the consumer surplus generated by most popular categories of digital goods in the US (Figure 2(a)) and some popular digital goods in a controlled setting in a university laboratory in the Netherlands (Figure 2(b)). We asked our respondents for the amount of money they would need to be compensated with to give up a single good or an entire category for 1 month or 1 year. This monetary compensation is beyond what they already pay for these goods (if they are not free), hence they are an estimate for the consumer surplus generated by these goods. In laboratory studies, we gave respondents a chance to get real cash after we verified that they actually gave up the good.

Overall our results indicate that digital goods have created a tremendous amount of economic well-being as indicated by our measures of consumer surplus. Search engines are the most valued category of goods in the US with a very high valuation of over \$17,000 per year, followed by Email and Maps. These are categories which do not have offline substitutes and are essential for work or everyday life. In general, it is harder for users to give up an entire category of goods than giving up a single good and switch to a substitute, reflecting the high valuations of these categories. For example, search engines are the first stop online for work or personal browsing before we navigate to an address on the web. Video streaming and

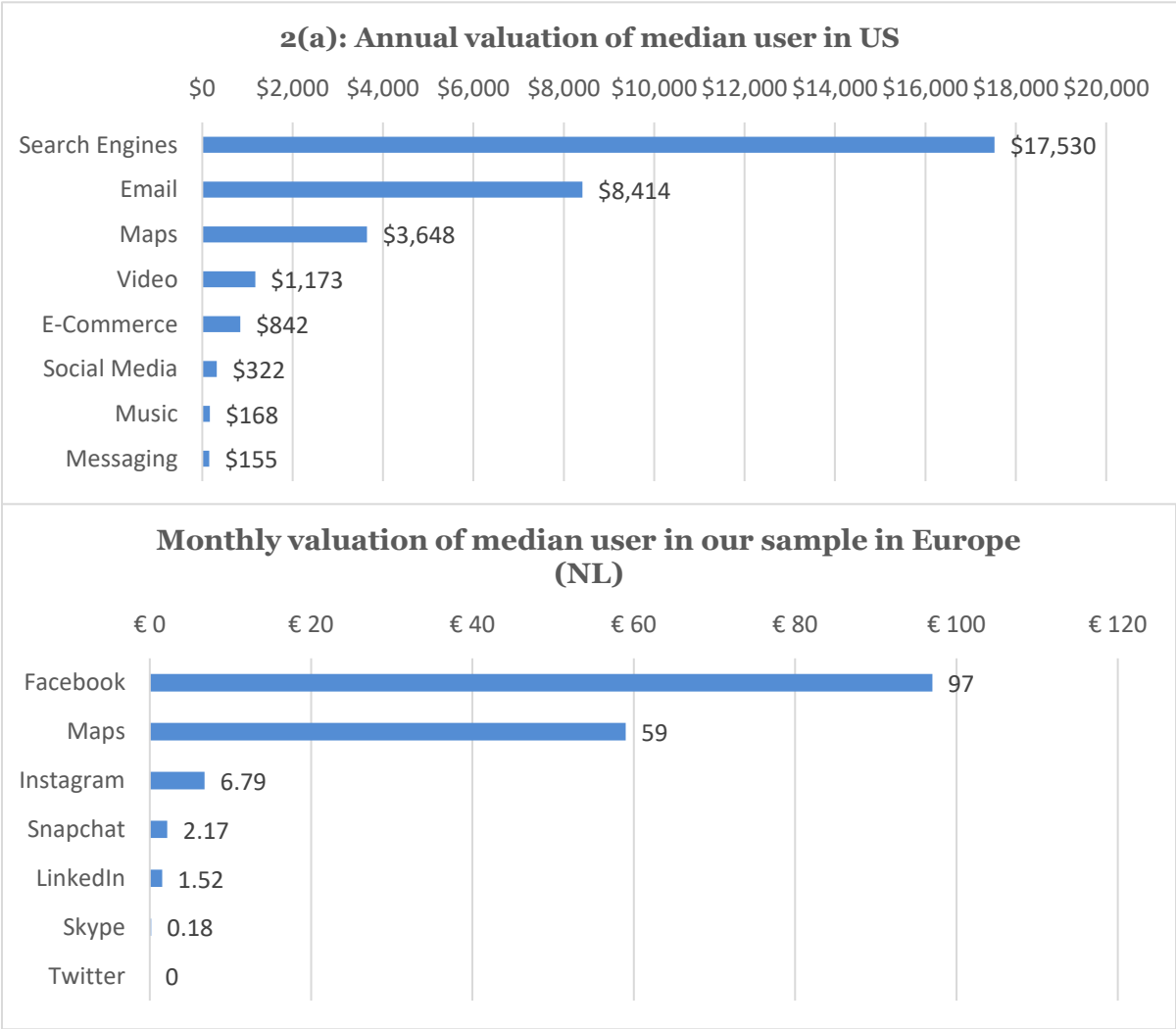
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3. <https://www.statista.com/statistics/251328/facebooks-average-revenue-per-user-by-region/>

E-commerce platforms are also highly valued by consumers. Social media, music streaming and instant messaging are not as highly valued as the other categories. Users pay to access some of these services. For example, users pay \$10-\$20 per month or \$120-\$240 per year for video streaming services (e.g. Netflix, Hulu, HBO etc.). However, the consumer surplus generated from video streaming services is a 5-10 multiple of what users pay to access them.

In Europe, WhatsApp was highly valued in our sample at over five times the valuation of Facebook. We interviewed our subjects to understand the reasons for this high valuation and found that WhatsApp is the key communication tool used to stay in touch with friends, family and co-workers. Moreover it is widely used to coordinate activities within groups, set up appointments and stay in the loop regarding meetups and events. In contrast, WhatsApp has a very low valuation in the US because most US users still use SMS as the primary instant messaging tool and are willing to give up WhatsApp for a very low amount.

Figure 2: Valuations of popular digital goods and categories of digital goods



4. Implications for managers

Although these digital goods generate a lot of consumer surplus, firms are able to capture only a small fraction of the total value generated. William Nordhaus estimated that firms were able to capture only 2.2% of the total surplus generated from technological innovations during the 20th century while the remaining 97.8% of the surplus went to consumers (Nordhaus 2004). Digital goods have a zero marginal cost (i.e. the cost to produce an extra unit of a digital good is 0) and in a perfectly competitive world firms can find it challenging to capture even a small share of the total value they generate. For example, Facebook makes money from ads but if it were to charge even \$1, users might migrate en masse to a substitute platform (either existing platforms such as Snapchat, Instagram or YouTube or a new platform might enter and offer a similar functionality for free). WhatsApp used to charge \$1/year but became totally free in 2016 and does not even have ads as of today.

However, managers can use these same methods to calculate how much value their goods create to consumers. This value is a theoretical maximum of the total value that they are creating for consumers, which has obvious implications for investment, strategy, pricing and long-term viability. Long term survival of products is more likely if they generate large amounts of consumer surplus. Keeping track of consumer valuations over time could provide managers with a more direct data driven metric of consumer well-being that can shape how they evaluate the impact of policies. These metrics can complement existing customer satisfaction metrics such as Net Promoter Score which do not look for customer value beyond promoting.

5. Implications for measuring the economy

We developed a new metric for measuring these benefits associated with the digital economy which we are formally mapping to traditional GDP. We call this new metric GDP-B because it builds upon GDP to account for the benefits (not costs) of new and free goods (Brynjolfsson et al. 2019). Working with Erwin Diewert, Felix Eggers and Kevin Fox, we developed GDP-B as a way to supplement GDP to capture the welfare gains of new and free goods. We urge policymakers and managers to track of this GDP-B metric when they want to focus on well-being of consumers rather than the production side of the economy. We find that including the benefits of Facebook would have added between 0.05 to 0.11 percentage points to GDP-B growth per year on average in the US from 2004 onwards when Facebook was launched. While our GDP-B estimates are not as precise as the GDP measures, we are at least attempting to directly measure economic well-being which is not properly inferred from GDP in the digital era.

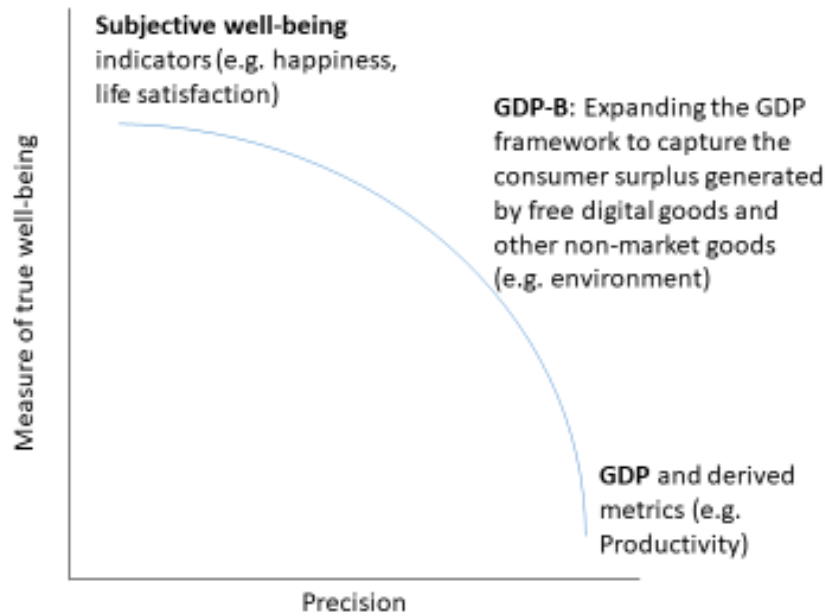
The benefits of the digital revolution do not capture some of the potential negative externalities associated with online platforms. For example, Hunt Alcott and his coauthors have explored the potential for Facebook to lead to addictive behavior and there is widespread debate about the impact of internet use and smartphones on happiness and mental health. Our GDP-B metric stays within the neoclassical framework and only captures the economic private benefits associated with the digital revolution. Other researchers have developed methods to quantify aspects of subjective well-being including happiness and life satisfaction. However, a survey of leading macroeconomists reveals that we are far away from reaching a point where these subjective well-being metrics are reliable enough to be used by policymakers⁴. On a spectrum ranging from current macroeconomic indicators such as GDP and productivity to well-being

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4. <https://voxeu.org/article/views-happiness-and-wellbeing-objectives-macroeconomic-policy>

indicators such as happiness, our GDP-B metric lies in between. It is important for policy makers to have a view of this entire spectrum and focus on the relevant metrics while implementing a particular policy.

Figure 3: Spectrum of well-being measures

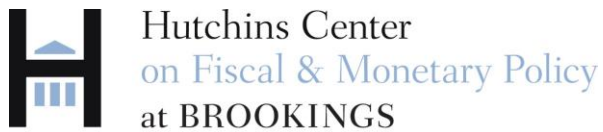


6. Conclusion

Our research suggests that there has been a substantial increase in wellbeing that is missed by traditional metrics like GDP, or productivity. It is tempting to therefore conclude that the slowdown in productivity metrics over the past decade and a half might disappear if we properly account for the benefits of the digital revolution. However, we cannot draw that conclusion because there were other important sources of consumer surplus, including free and nearly free goods like antibiotics, radio and television that were introduced in the past. Were they less important than the current wave? It's hard to say since no one did studies like ours back then. That said, if we want to compare the economic well-being of people over time we should be measuring metrics such as GDP-B moving forward. Our approach can be scaled up estimate the contributions or not only thousands of digital goods, but also convention goods from breakfast cereal to jet travel. More ambitiously, we may be able to get better estimates of the benefits associated with other non-market goods such as environment and public goods. Ultimately, if researchers in a variety of countries around the world adopt this approach, we will get meaningful estimates of how both digital and non-digital goods contribute to our well-being, and with better measurement, comes better management.

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