

How Should We Measure the Digital Economy?

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Suppose we make you an offer. You give up access to Google search for one month, and we pay you \$10. No? How about \$100? \$1,000? What would we need to pay you to forgo access to Wikipedia? Your answer can help us understand the value of the digital economy.



In 2018, Americans spent an average of 6.3 hours a day on digital media—not just Google and Wikipedia but social networks, online courses, maps, messaging, videoconferencing, music, smartphone apps, and more. Digital media consumes a large and growing share of our waking lives, but these goods and services go largely uncounted in official measures of economic activity such as GDP and productivity (which is simply GDP per hour worked). We listen to more and better music, navigate with ease, communicate with coworkers and friends in a rich variety of ways, and enjoy myriad other benefits we couldn't have imagined 40 years ago. But if you were to look only at GDP numbers, you'd think that the digital revolution never happened. The contribution of the information sector as a share of total GDP has barely budged since the 1980s, hovering between 4% and 5% annually and reaching a high of only 5.5% in 2018. To paraphrase the economist Robert Solow, we see the digital age everywhere except in the GDP statistics.

The reason the value of digital offerings is underrepresented is that GDP is based on what people *pay* for goods and services. With few exceptions, if something has a price of zero, then it contributes zero to GDP. But most of us get more value from free digital goods such as Wikipedia and online maps than we did from their more expensive paper predecessors.

Policy makers use GDP data to make decisions about how to invest in everything from infrastructure and R&D to education and cyberdefense. Regulators use it to set policy that affects technology firms and other organizations. Because the benefits of digitization are dramatically underestimated, those decisions and policies are being made with a poor understanding of reality.

Effective management of the digital economy depends on our ability to accurately assess the value of free digital goods and services. That's why we developed a new technique to measure not only how much consumers pay for digital products but how much they benefit from them. And that uncounted benefit is substantial. For example, our research with Felix Eggers, of the University of Groningen, found that Facebook alone has created more than \$225 billion worth of uncounted value for consumers since 2004.

Gross domestic product (GDP), developed in the 1930s, is rightly heralded as one of the greatest inventions of the 20th century. It measures the monetary value of all final goods produced in an economy. It is widely used as a proxy for well-being; however, Simon Kuznets, the leader of the team that created it, warned that "the welfare of a nation can scarcely be inferred" from GDP, nor was that its purpose when it was created.

Among its weaknesses is that it fails to capture negative externalities associated with growth, such as pollution or congestion. Moreover, nonmarket activities—such as household production (when people do unpaid tasks for themselves at home)—are not included in GDP.

Since its conception, GDP has been updated, revised, and extended a number of times. For instance, better measures of computer prices and software investments were introduced in 1999. "Satellite" accounts were introduced in 1993 to track particular aspects of economic activity, such as household production and R&D. Our new metric, GDP-B, is a step toward providing a more complete dashboard of economic indicators.

Capturing the unmeasured benefit of free goods is not a new problem: Think of earlier waves of innovation that produced free and nearly free offerings like antibiotics, radio, and television, which clearly delivered significant value to the consumer. Given the exceptionally rapid growth of digital goods and services in our economy, it's past time to solve this problem.

What GDP Doesn't Measure

GDP is often used as a proxy for how the economy is doing. It's a relatively precise number that signals every quarter whether the economy is growing or shrinking. However, GDP captures only the monetary value of all *final goods produced* in the economy. Because it measures only how much we pay for things, not how much we benefit, consumer's economic well-being may not be correlated with GDP. In fact, it sometimes falls when GDP goes up, and vice versa.

GDP can be a misleading proxy for economic well-being.

The good news is that economics does provide a way, at least in theory, to measure consumer well-being. That measure is called consumer surplus, which is the difference between the maximum a consumer would be willing to pay for a good or service and its price. If you would have spent as much as \$100 for a shirt but paid only \$40, then you have a \$60 consumer surplus.

To understand why GDP can be a misleading proxy for economic well-being, consider Encyclopedia Britannica and Wikipedia. *Britannica* used to cost several thousand dollars, meaning its customers considered it to be worth at least that amount. Wikipedia, a free service, has far more articles, at comparable quality, than *Britannica* ever did. Measured by consumer spending, the industry is shrinking (the print encyclopedia went out of business in 2012 as consumers abandoned it). But measured by benefits, consumers have never been better off. Our research found that the median value that U.S. consumers place on Wikipedia is about \$150 a year—but the cost is \$0. That translates into roughly \$42 billion in consumer surplus that isn't reflected in the U.S. GDP.

Consumer spending—the basis for GDP—can be counted at the cash register and shows up on companies' revenue statements. In contrast, consumer surplus cannot be directly observed, which is one reason it hasn't been used much for measuring the economy. Fortunately, the digital revolution has created not only tough measurement challenges but also powerful new measurement tools. In our research, we use digital survey techniques to run massive online choice experiments examining the preferences of hundreds of thousands of consumers. The results allow us to estimate the consumer surplus for a great variety of goods, including free ones that are missing from GDP statistics. We start by asking participants to make choices. In some cases, we ask them to choose between various goods (for example, "Would you rather lose access to Wikipedia or to Facebook for one month?"). In others, they choose between keeping access to a digital good or giving it up in exchange for monetary compensation ("Would you give up Wikipedia for a month for \$10?"). To make sure that people have revealed their true preferences, we follow up with experiments in which participants actually must give up a service before they can receive compensation.

Here's an example of how this works. To measure the consumer surplus generated by Facebook, we recruited a representative sample of the platform's U.S.-based users and offered them varying amounts of money to give it up for a month. To verify the responses, some participants were randomly selected to actually receive payments and forgo the service for the month. We temporarily added them as Facebook friends—with their permission, of course—to confirm that they didn't log in for that month.

Since GDP is a flawed proxy for consumer well-being, several alternative measures have been developed to provide a more comprehensive understanding. The United Nations' Human Development Index (HDI) is composed of life expectancy, education level, and income per capita. Stanford's Chad Jones and Pete Klenow have developed a summary measure of consumer welfare consisting of consumption, leisure, mortality, and inequality. Several countries, including the UK and Bhutan, quantify subjective well-being

by surveying citizens on questions related to happiness and life satisfaction. The OECD Better Life Index is an interactive tool that allows users to compare countries across 11 dimensions of well-being, including the environment, health, and life satisfaction. Michael Porter and Scott Stern's Social Progress Index comprises 54 indicators measuring the extent to which countries provide for the needs of their citizens (including basic human needs and needs related to well-being and opportunity).

Some 20% of the users agreed to stop using the service for as little as \$1; an equal proportion refused to give it up for less than \$1,000. The median compensation our Facebook users were willing to accept to give up the service for one month was \$48. On the basis of the survey and the follow-up experiment, we estimate that U.S. consumers have derived \$231 billion in value from Facebook since its inception in 2004.

We conducted a similar study in Europe and found that the median compensation participants required to give Facebook up for one month was even higher, about €97. We also found that users with more friends place a higher value on the site, reflecting the fact that network effects are a key factor in consumer valuation. People who also use Instagram and YouTube value Facebook less, suggesting that those are substitutes for Facebook. Women, on average, value Facebook more than men, and older people value it more than younger people—perhaps because older users are less likely to migrate to alternative social media platforms (such as Snapchat and Instagram).

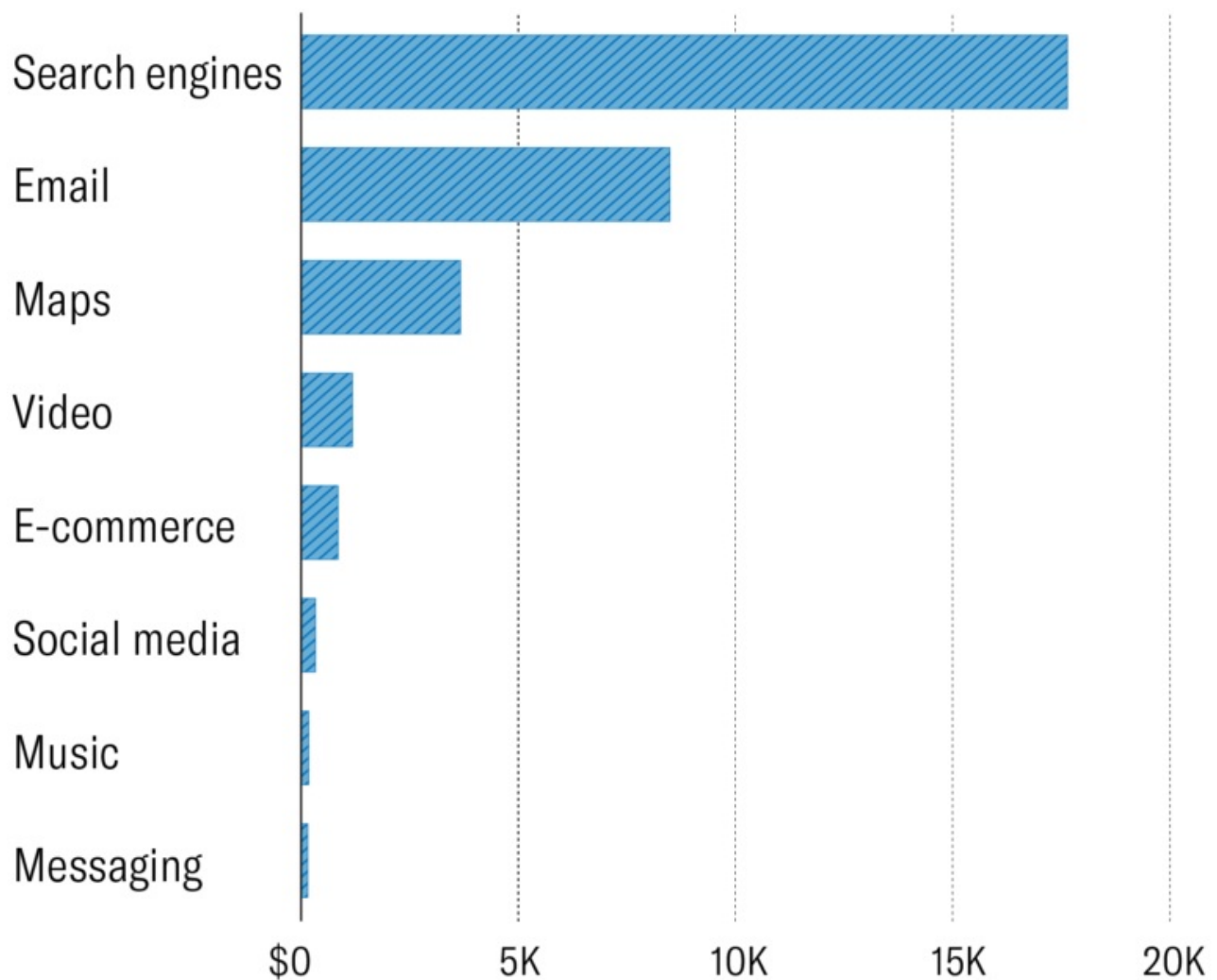
One might think that the value generated by Facebook is accounted for in GDP through its advertising revenues. However, our estimates indicate that the platform generates a median consumer surplus of about \$500 per person annually in the United States, and at least that much for users in Europe. In contrast, average revenue per user is only around \$140 per year in United States and \$44 per year in Europe. In other words, Facebook operates one of the most advanced advertising platforms, yet its ad revenues represent only a fraction of the total consumer surplus it generates. This reinforces research by NYU Stern School's Michael Spence and Stanford's Bruce Owen that shows that advertising revenues and consumer surplus are not always correlated: People can get a lot of value from content that doesn't generate much advertising, such as Wikipedia or email. So it is a mistake to use advertising revenues as a substitute for consumer surplus.

It's a similar story for digital goods that generate revenue from user fees and subscriptions. For example, users pay \$120 to \$240 a year for video-streaming services such as Netflix, Hulu, and HBO. However, the consumer surplus generated from those services is five to 10 times what users pay to access them, our surveys suggest.

The effect of consumer surplus is even stronger when you look at categories of digital goods. We conducted studies to measure it for the most popular categories in the United States and found that search is the most valued category (with a median valuation of more than \$17,000 a year), followed by email and maps. These categories do not have comparable off-line substitutes, and many people consider them essential for work and everyday life. When we asked participants how much they would need to be

compensated to give up an entire category of digital goods, we found that the amount was higher than the sum of the value of individual applications in it. That makes sense, since goods within a category are often substitutes for one another.

Consumers value some digital categories more than others. Search engines, email, and maps, for example, have no comparable off-line substitutes, propelling them to the top of the list.



From: "How Should We Measure the Digital Economy?" by Erik Brynjolfsson and Avinash Collis, November–December 2019

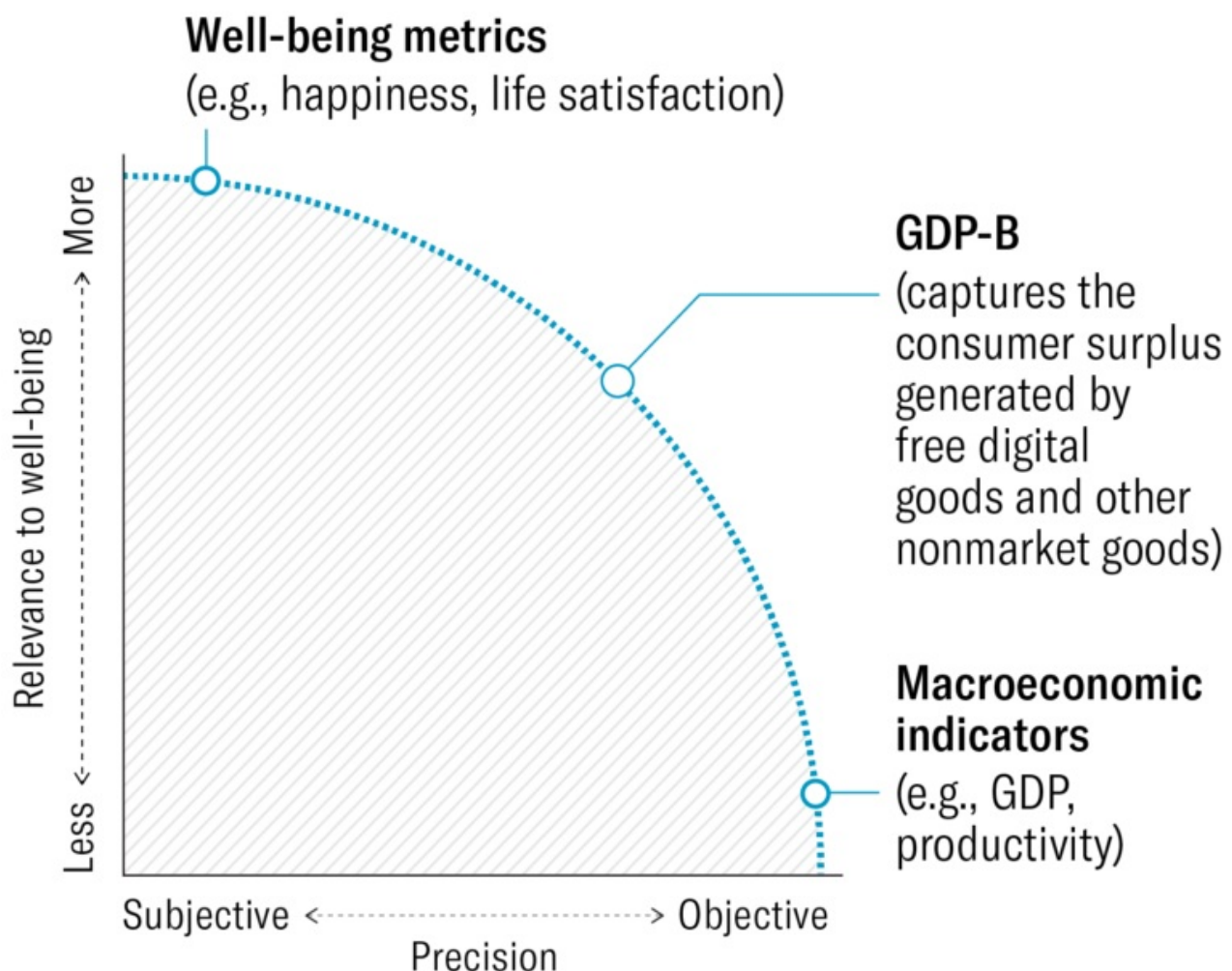


Getting the Numbers Right

To put the economic contributions of digital goods in perspective, we find that including the consumer surplus value of just one digital good—Facebook—in GDP would have added an average of 0.11 percentage points a year to U.S. GDP growth from 2004 through 2017. During this period, GDP rose by an average of 1.83% a year. Clearly, GDP has been substantially underestimated over that time.

Working with the Canadian economist Erwin Diewert, Felix Eggers, and University of British Columbia's Kevin Fox, we developed a method for measuring the benefits associated with the digital economy. GDP-B is an alternative metric that supplements the traditional GDP framework by quantifying contributions to consumer well-being from free goods. Policy makers, managers, and economists can estimate these contributions using the relatively inexpensive method we described earlier: Conduct large-scale surveys asking respondents how much they'd need to be paid to give up a given good for a certain period of time and then validate those results by running smaller-scale studies with real monetary incentives. With a bit of additional data gathering, changes in GDP-B could be estimated regularly and released alongside quarterly or annual GDP updates.

Macroeconomic indicators can be precisely measured, but they tell only part of the story. Well-being metrics convey a truer picture of how consumers are doing, but they are more subjective. By considering an array of measures, including our GDP-B metric, policy makers, regulators, and investors can establish a better foundation for decision making.



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Our method has two important limitations. First, our GDP-B estimates are still far from

Second, like traditional GDP, our measure does not capture some of the potential negative externalities associated with goods and services, including online platforms. Several studies suggest that social media platforms can lead to addictive behavior and that internet use and smartphones may have a negative impact on happiness and mental health. Others have argued that some digital goods are damaging to social cohesion or political discourse or impose costs on consumers in the form of lost privacy. For now, our GDP-B metric captures only the personal benefits and costs associated with goods, as assessed (perhaps imperfectly) by the participants in our online choice experiments, not the social costs and benefits. We are working on addressing those limitations, as are others. For example, researchers have developed a range of useful methods to quantify subjective aspects of well-being, including happiness and life satisfaction. Although a survey of leading macroeconomists suggests that such metrics are not yet as precise, comparable, or reliable as “hard” metrics such as GDP are, it’s a step in the right direction.

About the art: To understand and quantify the “priceless” value of art and the colossal sums pieces sometimes sell for, artist Nick Smith reinterprets famous works of art using color swatches, each bearing a number that holds a proportional value of the piece’s final sale price.

On a spectrum ranging from traditional macroeconomic indicators such as GDP and productivity, which tend to be very precise, to well-being indicators such as happiness, which are often coarser, our GDP-B metric lies somewhere in the middle. GDP has a very specific definition and value, but it doesn’t capture the consumer surplus generated by the digital economy; happiness assessments have the opposite problem. GDP-B strikes a balance between those extremes. As such, it represents a useful improvement for policy makers and regulators, who require a full understanding of how technology affects the economy in order to make sound decisions.

CONCLUSION

The answers to questions concerning how to regulate tech, how much to subsidize digital infrastructure, and even what sorts of new digital offerings entrepreneurs ought to create depend on understanding the true benefits derived from the digital economy. Our approach can also help us better quantify the benefits we get from conventional goods, from breakfast cereal to jet travel. More ambitiously, it could help generate more-accurate estimates of the benefits associated with changes in nonmarket and public goods such as air quality, health care, and infrastructure. Ultimately, as governments, managers, and researchers around the world adopt this approach, our assessments of how both digital and nondigital goods contribute to our well-being will improve, and with better measurement comes better management.