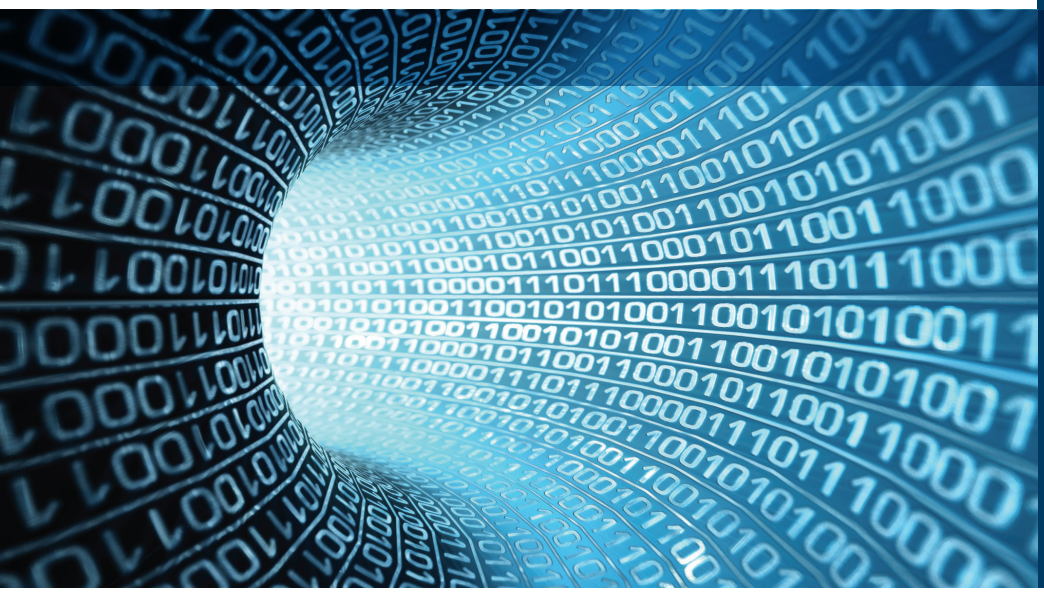

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Beyond Goods and Services:

The (Unmeasured) Rise of the Data-Driven Economy

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OCTOBER 2012

INTRODUCTION

We live in a world where 'data-driven economic activities'—the production, distribution and use of digital information of all types—are the leading edge of economic growth. Mobile broadband, increasingly available even in poor countries, is fostering a fundamental technological and social transformation. Big data—the storage, manipulation, and analysis of huge data sets—is changing the way that businesses and governments make decisions. And torrents of data ceaselessly flow back and forth across national borders, keeping the global economy linked.

Yet paradoxically, economic and regulatory policymakers around the world are not getting the data they need to understand the importance of data for the economy. Consider this: The Bureau of Economic Analysis, the U.S. agency which estimates economic growth, will tell you how much Americans increased their consumption of jewelry and watches in 2011, but offers no information about the growing use of mobile apps. Eurostat, the European statistical agency, reports how much European businesses invested in buildings and equipment in 2010, but not how much those same businesses spent on consumer or business databases. And the World Trade Organization publishes figures on the flow of clothing from Asia to the United States, but no official agency tracks the very valuable flow of data back and forth across the Pacific.

The problem is that data-driven economic activities do not fit naturally into the traditional economic categories. Since the modern concept of economic growth was developed in the 1930s, economists have been systematically trained to think of the economy as being divided into two big categories: 'Goods' and 'services'.

Goods are physical commodities, like clothes and steel beams, while services include everything else from healthcare to accounting to haircuts to

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restaurants. Goods are tangible and can be easily stored for future use, while services are intangible, and cannot be stockpiled for future use. In theory, a statistician could estimate the output of a country by counting the number of cars and the bushels of corn coming out of the country's factories and farms, and by watching workers in the service sector and counting the number of haircuts performed and the number of meals served.

But data is neither a good or service. Data is intangible, like a service, but can easily be stored and delivered far from its original production point, like a good. What's more, the statistical techniques that have been traditionally used to track goods and services don't work well for data-driven economic activities. The implication is that the key statistics watched by policymakers—economic growth, consumption, investment, and trade—dramatically understate the importance of data for the economy. In turn, these misleading statistics distort government policy.

SUMMARY

In this policy brief we will show that government economic statistics, stuck in the 20th century, are missing most of the data boom. To remedy this problem, it is time to expand our economic statistics to add data as a primary economic category, just like goods and services. Until we do this, policymakers and regulators won't have the information they need to make good decisions.

This policy brief is organized around four major arguments:

1. **We explain why data is becoming important enough to get its own statistical category.** Individuals can consume data, just like they can consume soda (a good) or haircuts (a service). Businesses can invest in databases, just like they invest in buildings and equipment. And countries can export and import data, just like they export and import goods and services.

   As a result, instead of breaking down the economy into goods and services, statisticians need to be thinking about goods, services, and data. Adding data as a primary economic category can give policymakers a much more accurate picture of economic growth, consumption, investment, employment, and trade.

2. **We show how the official economic statistics dramatically undercount the growth of data-driven activities.** To give a real-life example, we focus on the consumption of data by Americans. According to statistics from the Bureau of Economic Analysis, real consumption of 'internet access' has been falling since the second quarter of 2011.

   In other words, according to official U.S. government figures, consumer access to the Internet—including mobile—has supposedly been a drag on economic growth for the past year. This is simply absurd. As a result, the official statistics are missing such important trends as the increasing adoption of smartphones and tablets, the growth of mobile broadband, and the enormous surge of usage of services like Gmail, Dropbox, Facebook, and Twitter.

3. **We adjust the official U.S. statistics to account for unmeasured data consumption by individuals. Based on our estimates, we show that real GDP rose at a 2.3% rate in the first half of 2012, compared to the 1.7% official rate** (**Figure 1**)**.** In other words, the impact of the data-driven economy on overall economic growth is being substantially underestimated.[1] Based on these figures, the growth in data consumption in the United States accounts for roughly one-quarter of adjusted GDP growth in the first half of 2012, making data consumption by individuals one of the largest contributors to U.S. economic growth in this period.

4. **We assess the link between economic growth and future government privacy and data regulatory policy in the 21st century data-driven economy.** Given that we have shown that data powers growth, correctly measured, we discuss the possibility that excessive privacy and data regulation can inadvertently harm future growth prospects.

To put it another way, restrictive and prescriptive regulation of the Internet and the movement and uses of data could have the effect not only of constraining Internet freedom but also Internet free trade. Such regulation could become the trade barriers of the data-driven economy, "balkanizing" access to information and innovative data-driven products and services and constraining global economic growth. That's a highly undesirable outcome for everyone.

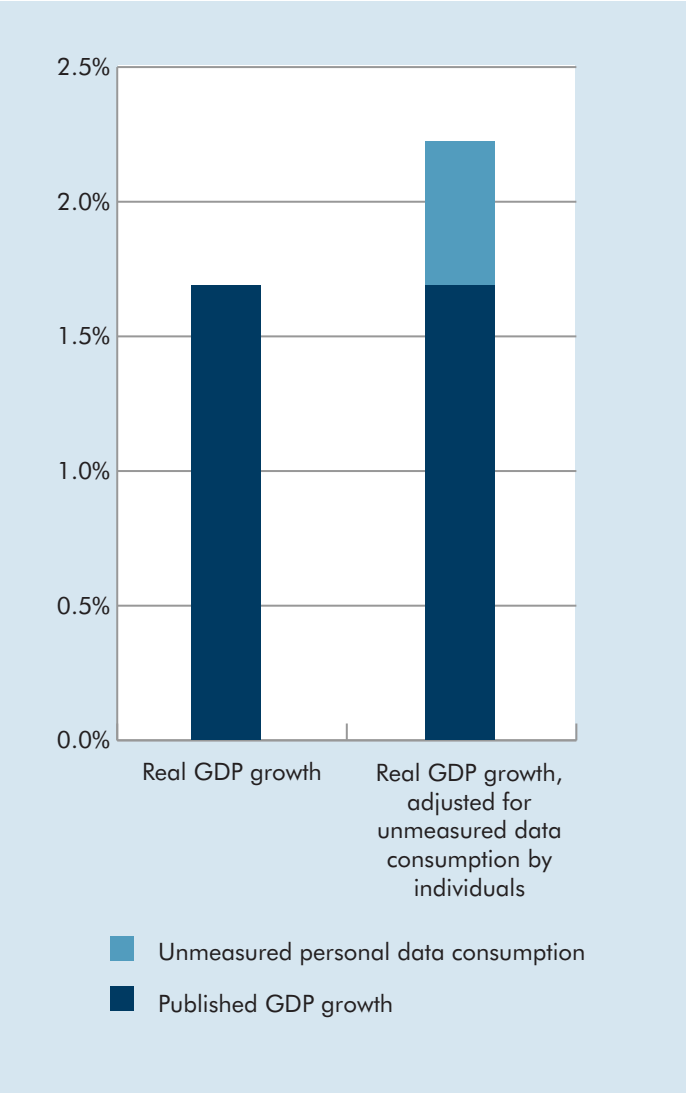
THE BASICS OF GOODS AND SERVICES

Economists still think of the economy as being divided into goods and services. Manufacturing, agriculture, and mining are goods-producing industries, while consulting, finance and healthcare are service-producing industries. An automobile is a good, auto repair is a service. Food is a good, being served a meal in a restaurant is a service. A telephone is a good, the actual telephone connection is a service.

The distinction between goods and services pervades all of the economic statistics available on both the national and global levels. For example, the consumer inflation figures published each month by the U.S. Bureau of Labor Statistics divide consumer spending into commodities (goods) and services. The World Trade Organization publishes global trade statistics covering merchandise trade (goods) and commercial services. And Eurostat, the statistical arm of the European Union, uses a classification scheme that explicitly separates output into goods and services. That classification of economic activities, published in 2008, defines an economic activity as "characterised by an input of resources, a production process and an output of products (goods or services)."[2] This emphasis on goods and services as the two main classifications of economic activity is embedded in global (United Nations), regional (European Union), and national (United States) economic statistics.

What is the difference between goods and services? Broadly speaking, goods are tangible, can be stored, and can be consumed or used well after the original production. By contrast, services are intangible, difficult to store or inventory, and must be usually consumed or used at the time of the original production.

FIGURE 1: REAL U.S. GDP GROWTH, WITH AND WITHOUT UNMEASURED DATA CONSUMPTION (FIRST TWO QUARTERS OF 2012, ANNUAL RATES)



Data: Bureau of Economic Analysis, Progressive Policy Institute (data as of 8/10/12)

Take healthcare, for example. Pharmaceuticals are goods—they are physical products that are made in a factory and can sit on your shelf, sometimes for years at a time. Nursing is a service—it is provided by personnel of varying levels of skills and training, and cannot be bottled and stored for future use. Healthcare equipment, such as CAT

scanners, count as goods when they are purchased by a hospital. But when patients are given a CAT scan that counts as a service because it requires preparation and a technician, and the patient does not walk away with the scanning machine afterwards.

WHY DATA IS DIFFERENT

Data only shows up indirectly in the current system of economic statistics. The United States statistical agencies use an industrial classification which includes an information sector, comprised of a broad range of data-related industries, such as "Internet Publishing and Broadcasting and Web Search Portals," "Wireless Telecommunications Carriers (except Satellite)," and "Cable and Other Subscription Programming."[3]

> Economists still think of the economy as being divided into goods and services.

However, in practice, the government does not actually measure consumption of data or investment in data. Instead, it very imprecisely measures the access to the data. For example, the price of a data subscription on a smartphone is picked up by government statistics. But the amount of data used is not reported.

Similarly, the comprehensive *OECD Guide to Measuring the Information Society 2011* does not discuss business investment in databases. Nor does it even discuss how to measure the volume of data that individuals or businesses consume. Instead, it is primarily concerned with measuring access.[4]

Here's an analogy to make the problem clearer. Suppose we want to estimate the amount of clothing Americans are buying. Now let's suppose that the only thing we know is which stores shoppers are going into, but not much they spent or what they bought. We might guess that they are buying clothing if they go into a clothing store. But we wouldn't know how much they bought, or whether they were just browsing. And if the shoppers went into a department store or a discounter such as Wal-Mart, we wouldn't know whether the shoppers were buying clothing, electronics, or food.

When it comes to data, we have much the same problem. We know that people are paying to use their smartphone or their home Internet connection, but we don't know how much data is being consumed, or how valuable it is.

SERVICES VS DATA

Economists generally treat data-driven activities as if they were part of the service sector. The provision of free email by companies such as Microsoft, Yahoo, or Google is considered a service.

Yet classifying data-driven activities as services doesn't capture the true value or essence of data in today's economy. Yes, data are intangible, like services. But data can be stored, processed, and used separate from their original production and collection, much like goods. Indeed, data are even easier to ship and store than goods are.

In fact, we are increasingly seeing traditional services transformed into data-driven activities, with very different characteristics. One example is retailing. Traditional retailing involved—and still involves—a large number of low-skilled workers personally stocking shelves and ringing up sales to customers.

By contrast, online retailing, as practiced by Amazon and others, requires far fewer workers. The ordering process is typically handled electronically, and even the distribution warehouses are on the way to becoming automated as well.[5]

But that's not the only differences between retailing-as-service and retailing-as-data. Traditional retailing cannot be exported—instead, a new store has to be opened in a different country. When retailing is turned into a data-driven activity, it immediately becomes much easier to export. The same IT infrastructure

TABLE 1: HOW DATA IS DIFFERENT

Goods	Services	Data
Tangible	Intangible	Intangible
Can be stored	No storage possible	Can be stored
Consumption is usually separated from production	Consumption often happens at the same moment as production	Consumption is usually separated from production

can support websites aimed towards different countries and different languages.

In addition, online retailers such as Amazon provide customers with a wide range of data, such as product reviews and suggestions for other purchases. In effect, the online retailer is offering two 'products': The purchase of a physical product, plus access to related data on the product. That data is valuable to the customer, whether or not he or she makes a purchase at the original website. This value is not counted by the government statisticians.

The personal financial management industry—which includes tax return preparation—offers another example of the difference between services and data. At one time, many Americans either paid accountants to do their tax returns, or used tax preparation consultants at companies such as H&R Block. These were classic services—intangible services performed by workers—bringing in billions of dollars that were counted in GDP.

Then tax preparation shifted, as more people used software provided by companies such as Intuit to do their taxes themselves. These software programs obviously reduced the number of workers needed to do tax preparation, boosting productivity in this industry.

Now things have changed again. Increasingly, people with low incomes and simple returns are using the free online versions of these tax preparation packages to do their returns. In effect, tax preparation has shifted from service to data.[6]

Paradoxically, because data is not counted as output by the government, the shift to free online versions of tax preparation software has the effect of reducing gross domestic product. So if Americans save $1 billion by shifting from paid preparers to tax preparation software to free online programs, it looks like GDP has fallen in the process. In reality, however, taxpayers are getting the same results as before, only cheaper.

UNMEASURED DATA CONSUMPTION

In today's data-driven economy, there is a variety of ways that data can be used or consumed by individuals (Table 2). Clearly this data consumption is valued by consumers, or else they wouldn't be spending time with these products. However, many of them are provided without money cost. How can the value of this data be incorporated into the consumption figures published by the Bureau of Economic Analysis in the United States, and by

TABLE 2: DATA CONSUMPTION BY INDIVIDUALS

APPS (Apple, Google, Amazon, RIM, Microsoft, Facebook)
EMAIL (Google, Yahoo, Microsoft, AOL, Facebook)
GAMES (Zynga, PerBlue)
MAPS AND NAVIGATION (Google, Microsoft, Apple, Mapquest, Yahoo)
SEARCH (Google, Microsoft, DuckDuckGo, Blekko)
SOCIAL MEDIA (Facebook, Twitter, LinkedIn, Pinterest, Foursquare)
STORAGE (Dropbox, Google, Apple, Amazon)
TRANSMISSION (AT&T, Verizon, T-Mobile, Comcast, Sprint, Time-Warner Cable)
VIDEO (Youtube, Vimeo, Hulu, Netflix, Amazon, itunes)

various statistical agencies in other countries? It turns out that economists are developing a variety of techniques for measuring the consumption of data. For example, in a paper written well before he joined President Obama's Council of Economic Advisors, Austan Goolsbee and co-author Peter Klenow estimated the value of the Internet to consumers.[7] Shane Greenstein

> Clearly data consumption is valued by consumers, or else they wouldn't be spending time with these products.

and Ryan McDevitt estimated the 'broadband bonus' for different countries—the economic value created by broadband Internet, which is not being picked up in the conventional GDP statistics.[8] And in a new unpublished paper, Erik Brynjolfsson and JooHee Oh of the MIT Center for Digital Business estimate the value of free goods and services on the Internet.[9]

UNMEASURED INVESTMENT IN DATA

Economists usually think of investment as companies spending on machinery and buildings, and governments spending on infrastructure such as highways. But treating data as investment is not as far-fetched as it might sound. Over the past 15 years, economists have been giving increased importance to investment in 'intangibles' such as software, R&D and human capital. In 1999, for example, the Bureau of Economic Analysis introduced software into GDP as an investment 'good'. It was easier at that time to think of software as an investment good because prepackaged software was sold in boxes, just like detergent. But the software category also includes custom software, which is closer to a service. And software investment also includes "own-account" software, which is the software that a company creates for itself. Investment in "own-account" software totaled roughly $100 billion in 2010.

In 2006 U.S. economists Carol Corrado, Charles Hulten, and Daniel Sichel published a groundbreaking paper analyzing a whole range of intangible investments.[10] They even include the value of investment in "computerized databases", which they pegged at a very low $3 billion per year.[11]

Currently the BEA is proposing to include research and development—another intangible—in U.S. national income accounts in 2013.[13] The BEA is also proposing to expand the definition of investment to 'artistic originals' such as motion pictures, television programs, music compositions and recordings, and books.

In fact, the proposal calls for separating nonresidential investment into three categories, structures, equipment and intellectual property products. This last one, a new category, would include:

- Software (currently included with equipment)
- Research and development
- Entertainment, literary, and artistic originals

We suggest that any accumulation of data in a useful form should be treated investment. As a rule of thumb, investment is any spending which generates an asset with a productive lifetime of more than one year. So flight data that is used to track airplanes is investment if it is stored and analyzed in a way that gives insight into the best ways to arrange airline routes or logistics

How is investment in data different from investment in the software used to construct the database? We can use the analogy of a building versus the tools and equipment required to construct the building. A construction company will spend money on the cranes, bulldozers, and riveters necessary to construct a building. But the actual construction—which includes other materials and the time of the construction workers—is counted separately from the cost of the tools and equipment.

TABLE 3: INVESTMENT IN DATA

GENOMIC DATABASES (National Center for Biotechnology Information, Ensembl, MaizeDB)
FINANCIAL DATABASES (Bloomberg, Thomson, CRSP, Global Financial Data)
SOCIAL MEDIA DATABASES (Facebook, Twitter)
CONSUMER TRANSACTION DATABASES (Amazon, Wal-Mart, MasterCard, Visa, American Express)
HEALTH TRANSACTION DATABASES (CVS Caremark)
CLIMATE DATABASES (National Climatic Data Center, European Climate Assessment & Dataset)

Similarly, building a database—especially 'big data' databases—requires expertise, algorithms, and time separate from the cost of the software. In this paper we have not analyzed the impact of investment in data. However, the growth of enormous databases is contributing enormous value to the economy. Table 3 lists some examples.

MEASURING GROWTH IN DATA CONSUMPTION

So far we've made the argument that data deserves to be added to goods and services as a primary economic category. It would be helpful, though, to get some idea of the magnitude. Would adding data make a big difference to the current economic statistics?

A full assessment of the contribution of data to economic growth is beyond the scope of this initial policy brief. Instead we will focus here on one aspect of data, the growth in the consumption of data by individuals. We will also focus on the United States, though a similar analysis would be possible for Europe and Asia.

The first step is to see how much of data consumption growth is already being picked up by the official statistics. The Bureau of Economic Analysis publishes figures on several categories of consumer services that are related in some way to data (the figures in parentheses refer to consumer spending in the second quarter of 2012, at annual rates): [13]

- Cellular telephone services ($110 billion)
- Cable and satellite television and radio services ($86 billion)
- Internet access ($55 billion)
- Local landline ($47 billion)
- Long distance landline ($16 billion)

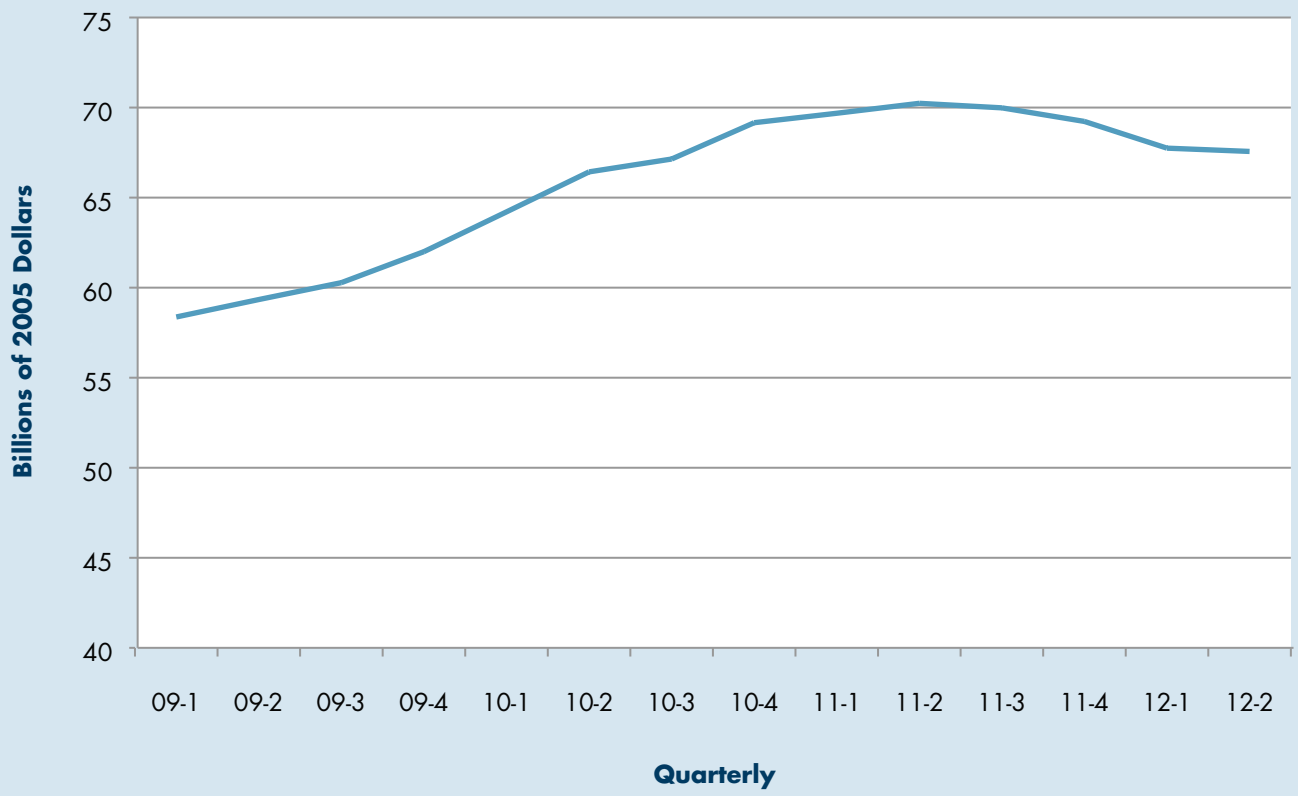
In total, nominal spending on these services in the second quarter of 2012 summed to roughly $314 billion in the United States (at an annual rate).

The big problem, though, comes when we look at the real growth rates for these categories. Remember that real growth represents the change in quantities consumed, after stripping out the effect of price changes. It's this real growth rate that feeds into the overall economic growth numbers.

> According to official U.S. government figures, consumer access to the Internet—including mobile—has been a drag on economic growth for the past year

It turns out that the government's numbers clearly underestimate, by a wide margin, the growth of data consumption by individuals in the United States. Let's start with the figures for Internet access. Internet access lies at the heart of the data-driven economy, and our experience in the real world tell us that Americans are consuming more and more of it. According to one survey, the average number of minutes spent on mobile devices rose 30% over the past year. [14]

FIGURE 2: REAL PERSONAL CONSUMPTION EXPENDITURES FOR INTERNET ACCESS (BILLIONS OF 2005 DOLLARS)



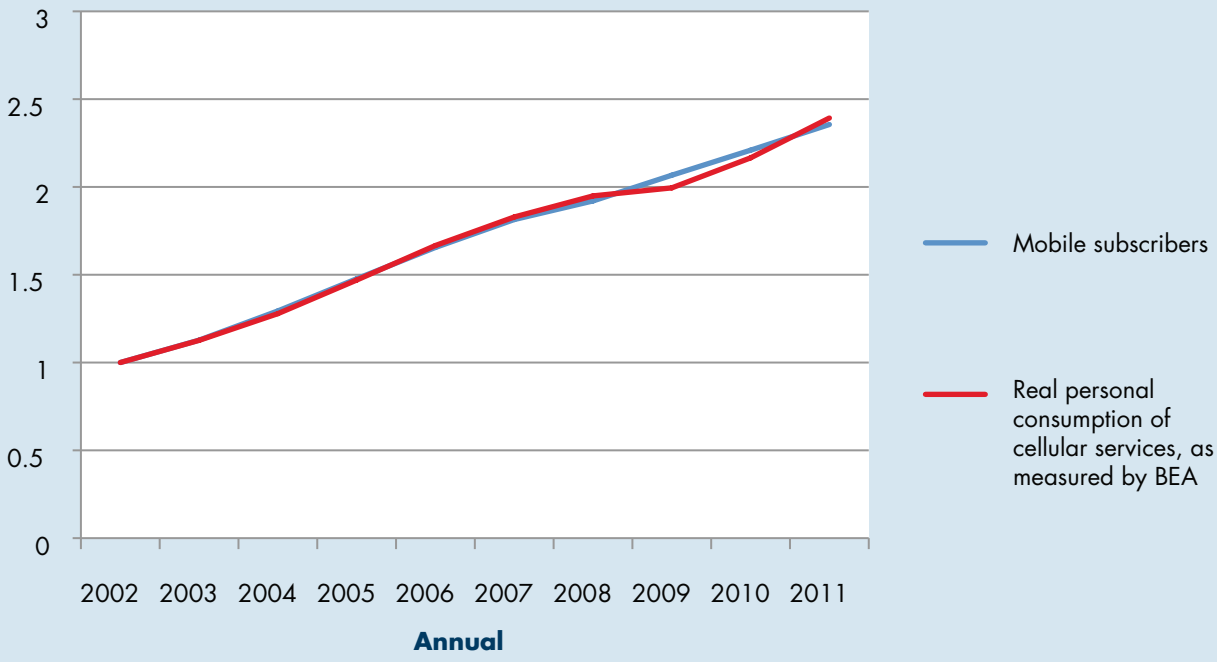
Data: Bureau of Economic Analysis (data as of 8/10/2012)

However, according to the BEA, real personal consumption expenditures on internet access in the United States peaked in the second quarter of 2011, and has been falling since then (Figure 2). This would imply that Americans are "buying" less Internet access, after adjusting for prices, in the same way that a fall in real purchases of gasoline would be interpreted as saying that Americans are buying less gasoline, after adjusting for prices.

In other words, **according to official U.S. government figures, consumer access to the Internet—including mobile—has been a drag on economic growth for the past year.** This is simply absurd. According to this figure, American consumers are getting no additional benefit from the tens of billions spent by companies such as Apple, Google, Rim, and Microsoft to create mobile operating systems, or the hundreds of billions spent by companies such as AT&T, Verizon, and Sprint to build out broadband networks in the United States, and the hundreds of thousands of apps now available f or smart phones.

Let's take this a step further. If the fruits of the data revolution are not showing up in the category "internet access," perhaps the BEA is reporting the gains in "cellular telephone services" or "cable and satellite television and radio services." After all, many Americans are connected to the Internet either through cable modems or through wireless broadband

FIGURE 3: NUMBER OF U.S. MOBILE SUBSCRIBERS VERSUS MEASURED REAL CONSUMPTION OF CELLULAR SERVICES (2002=1)



Data: CTIA, Bureau of Economic Analysis (data as of 8/10/12)

But in fact, the BEA's figures for cellular and cable clearly are not picking up the data-driven revolution either. We plotted the number of American mobile subscribers against the BEA's measure of real personal consumption expenditures on cellular telephone services.[15] We found that since 2002, the two lines are almost identical (see figure 3). That means the BEA's measure of the growth in mobile PCE **only** reflects the change in the number of subscribers. The implication: The BEA's figures for cellular telephone services do not account for the tremendous growth of mobile broadband, one of the biggest technological changes in the past 50 years. **In other words, the BEA figures for cellular telephone services greatly underestimate the contribution of wireless to economic growth.**

Finally, according to BEA figures, real consumption of "cable, and satellite television and radio" peaked in the third quarter of 2011 and has fallen by about 1% since then. So the fast-rising use of smartphones, mobile, apps, and data in general by consumers does not show up anywhere in the economic growth data published by the BEA. Indeed, according to the BEA's figures, it's as if data-driven activities are holding back growth. As measured by the BEA, data-related services—cable, Internet access, cellular, landlines—actually shrunk in the first half of 2012, as table 4 below shows.

Here's another way to put it. Over the past year, consumer data services, as measured by the BEA, have grown slower than overall consumption of services. That's astonishing.

ESTIMATING THE REAL GROWTH OF DATA CONSUMPTION BY INDIVIDUALS

In the previous section, we laid out the general problems with the growth figures. In the world

TABLE 4: REAL CONSUMER SPENDING ON DATA SERVICES (AS MEANSURED BY THE BEA)

	Change in real consumer spending 2001 IV - 2012 II At annual rates
Internet access	4.8%
Cable and satellite TV and radio	-1.4%
Cellular telephone services	4.5%
Local landline	-4.8%
Long-distance landline	-4.8%
Total consumer data services (as measured by the BEA)	**-0.7%**

Data: BEA, PPI

that we live in, a decline in data consumption in the United States makes no sense. If anything we should be seeing an explosion in data consumption by American households, given that the number of smartphones in use rises every month.

Because the U.S. government is reporting a decline in consumer data consumption in the first half of 2012, it's as if the data-driven economy was a drag on GDP growth, not a boost. How do we properly account for the data boom within the context of the gross domestic product figures? In this section we do a simple back of the envelope calculation that gets us closer to the right answer.

The first step is to note that all the anecdotal and survey data suggests that data usage is rising at a rapid pace. For example, the number of Americans who own smartphones is 45% higher than a year ago.[16] The Apple App store contained more than 625,000 active apps as of April 2012, up by 75% over a year earlier, while Android apps have doubled over the same period. The amount of data transmitted via mobile connections is expected to rise by about 120% in 2012 compared to 2011.[17] The amount of high-definition video delivered by cable and other non-Internet pipes is expected to rise by roughly one-third over the same period.

True, there's been some disappointment with the performance of social media and gaming stocks, such as Facebook and Zynga. However, the underlying real growth in social media continues. In its earnings release for the second quarter of 2012, Facebook reported its monthly active users had increased by 29% over a year earlier. Unique visitors to LinkedIn in the second quarter increased by 30% over the previous year.[18] Zynga reported that monthly active users were up 34% in the second quarter of 2012 compared to a year earlier.

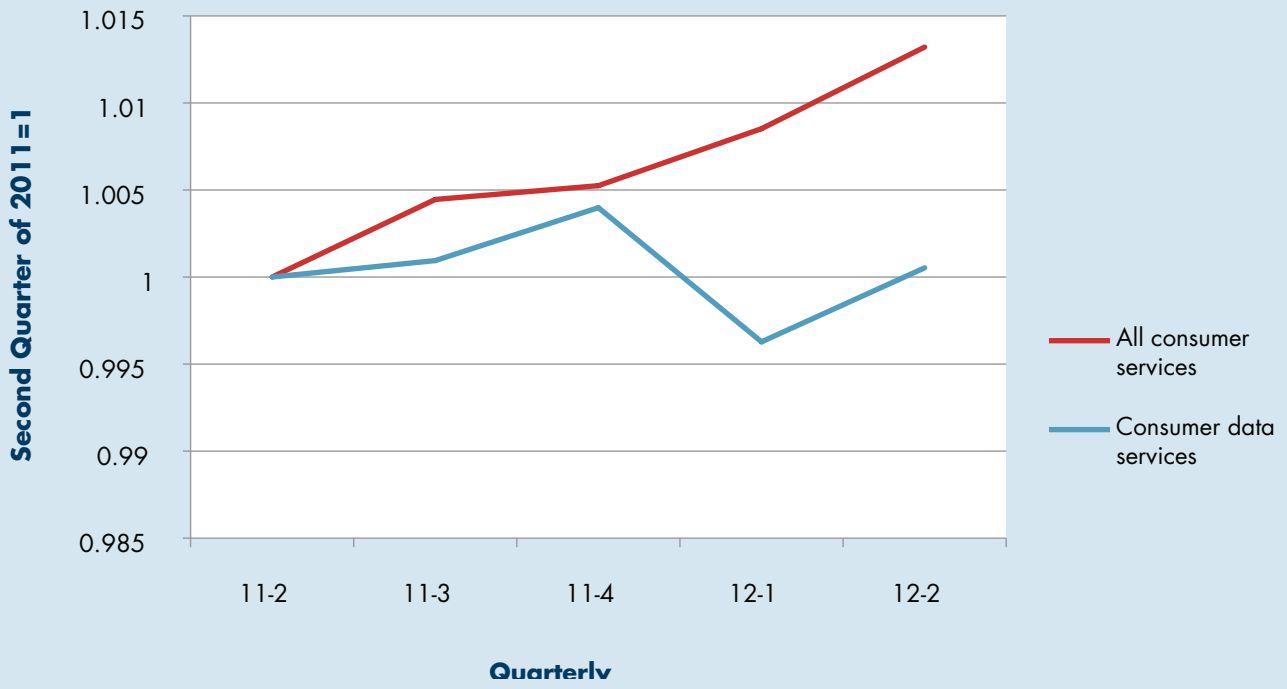
All of these indicators, coming from a variety of different data sources and calculated in a variety of different ways, appear to point in the same direction—that data consumption by individuals has been rising at an annual rate of 30%, as opposed to shrinking at an 0.7% rate as the official numbers show.

As a rough estimate, if the U.S. has roughly $300 billion in data-related services, growing at 30% per year that would add $90 billion to gross domestic product over the course of a year. Since U.S. GDP is roughly $15.5 billion, that would boost GDP growth by roughly 0.5-0.6 percentage points over the course of a year.

> The BEA's figures for cellular telephone services do not account for the tremendous growth of mobile broadband, one of the biggest technological changes in the past 50 years.

The actual calculation is more complicated, to duplicate the 'chain-weighted' methodology used by the BEA to calculate economic growth. We find that once we include the unmeasured data consumption, economic growth in the first half of 2012 increases to a rate of 2.3%, compared to the published 1.7% (as of August 10, 2012).

FIGURE 4: REAL CONSUMPTION OF CONSUMER DATA SERVICES IN THE UNITED STATES HAS BARELY GROWN OVER PAST YEAR, ACCORDING TO OFFICIAL STATISTICS (SECOND QUARTER OF 2011 = 1)



Data: Bureau of Economic Analysis, Progressive Policy Institute (data as of 8/10/12)

Based on these figures, the growth in data consumption by individuals accounts for roughly one-quarter of adjusted GDP growth in the first half of 2012. From this perspective, data consumption by individuals is one of the largest contributors to U.S. economic growth.

Obviously these results are illustrative rather than conclusive. We have focused on the consumption of data by consumers, which is only one aspect of the data-driven economy. A more complete treatment would include investment in databases by business and government, as well as trade in data.

We have also done this calculation only for the United States so far. A similar procedure could be used to adjust economic growth estimates for the European Union. We would use a combination of government and nontraditional information to estimate the rate at which the consumption of data by Europeans is growing, and then fold the results into the existing economic growth numbers. We suspect that there are some countries where data-driven activities are quite economically important.

IMPLICATIONS FOR FUTURE PRIVACY AND DATA REGULATORY POLICY

The 20th century was about the industrial economy, followed by the service economy. So far, however, the 21st century is about the data-driven economy.

This study shows the importance of data-driven economic growth in today's world. Data is low-cost, decentralized, and crosses national borders easily. As a result, the data-driven economy has the potential to deliver economic growth and raise global living standards.

In the short run, data-driven growth has the ability to propel the economies of developed

countries, despite the headwinds of financial crisis. For example, our calculations show that the unmeasured contribution of data-driven activities adds more than half a percentage point to U.S. economic growth in the first half.

The powerful push from the data-driven economy may help explain why the U.S. unemployment rate has fallen over the past year, despite a comparatively slow rate of measured GDP growth. There are more than 500,000 jobs in the App Economy across the United States, as a forthcoming paper shows, and the number continues to rise.

> The growth in data consumption by individuals accounts for roughly one-quarter of adjusted GDP growth in the first half of 2012

The data-driven economy has the potential to help other regions of the world as well. European economies, with their core of highly educated workers, can become leaders in the 21st century data-driven world, just as they were once leaders in the industrial economy.

This process is not painless, of course. As technology develops new capabilities, new concerns arise that never mattered before. In this case, people have some very real worries about privacy and appropriate use of data by both large and small companies. What's more, the list of potential problems gets longer every day.

We need to ask, then, what type of regulation can best address the real concerns about privacy and data usage, while still fostering data-driven growth. Historically, the first choice of regulators, when faced with a problem, is to adopt a 'command-and-control' approach, specifying not only the outcome, but the actions that companies must take to achieve that result. In the environmental area, for example, a command-and-control approach would involve specifying the technologies that companies must use to reduce pollution. Similarly, a command-and-control approach to privacy would lay out a precise set of rules, say, for safeguarding health data.

However, the 'command-and-control' approach fails miserably when dealing with a highly innovative industry. What looks like a 'good' solution may be sadly out of date within a year, outmoded by fast-changing technologies. For example, as more and more health monitoring is done by mobile devices, overly-rigid regulations on health data might have the effect of slowing down innovation, costing lives and raising costs.

Similarly, a key question is the location of data infrastructure. Mandating where data may be hosted may seem straightforward, but potentially functions as a barrier to international trade, just like tariffs and quotas did for physical goods and services. There's no reason to return to that past era.

Another issue in data regulation is the 'pebble in the stream' effect. If you thrown a single pebble into a stream, nothing happens to the flow of water. A second pebble might not have an effect either. But throw a hundred pebbles into the stream, and suddenly the water stops flowing. Similarly, layering on a series of apparently narrow data regulations can have the effect of slowing down innovation, even if each regulation individually seems innocuous.[19]

So what would 21st century regulatory policy look like, to go along with a 21st century data driven economy? One possibility is collaborative regulation, where industry and government work together to establish best practices. Under President Obama, the United States has embarked on a multi-stakeholder process on data and privacy that has the potential to work well.

Second, the increasing importance of data for growth may suggest that government policy should be oriented towards encouraging rather than discouraging data-driven activities. In effect, privacy, security, consumer protection and other types of regulatory policies risk becoming the new

global trade barriers of the 21st century data-driven economy. Unless policies are developed thoughtfully and carefully, they could stifle innovation and economic growth.

For example, it's essential to develop standards for privacy for mobile apps that are acceptable to consumers. However, excessive tight privacy regulations could make it more difficult and expensive to develop innovative apps. And that, in turn, will have a dampening effect on small startups that have limited resources, which in turn will slow growth and job creation.

In the end, prosperity depends on regulators balancing two objectives: economy growth and consumer protection. In a period when the U.S. and Europe are worried about slipping back into recession, policymakers should lean towards boosting the data-driven economy rather than holding it back.

ENDNOTES

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