Stanford | Institute for Economic Policy Research (SIEPR)

How valuable is e-commerce?

By Pete Klenow

KEY TAKEAWAYS

- Online purchases reached about 8 percent of all spending in 2017.

- The typical household gains about 1 percent of consumption — or over $1,000 per year — in extra buying power from accessing merchants online.

- Gross domestic product (GDP) — the standard yardstick of an economy's size —does not incorporate the full gains from online shopping.

- Research estimates a nearly 4 percent decline in spending at brick-and-mortar stores because of the rise of e-commerce.

According to the U.S. Census Bureau, e-commerce spending doubled as a share of retail sales from 2007 to 2017, reaching 10 percent of overall retail sales.[1] In addition to large online-only megastores, many traditional brick-and-mortar retailers have launched online entities that sell the same products available in the retailers' physical stores.

For consumers, shopping online differs in important ways from visiting a brick-and-mortar store. Because online retailers are less constrained by physical space, they can offer a wider variety of products. E-commerce also enables consumers to access stores that do not have a physical location near them. And people can purchase a product online that they may have previously purchased at a brick-and-mortar store without making a shopping trip. I refer to the first two as variety gains and the last as a convenience gain.

In research with Paul Dolfen, Liran Einav, Ben Klopack, and Jon Levin of Stanford, plus Larry Levin and Wayne Best of Visa, Inc., we attempt to quantify these benefits for consumers from the rise of online shopping.[2] We leverage a large and detailed dataset of consumer purchases: the universe of Visa credit and debit card transactions between 2007 and 2017. In an average year, the Visa data cover 380 million cards, 36 billion transactions, and almost $2 trillion in sales.

Our research has several policy implications, which are outlined later in this policy brief. But one important consideration is that online sales are not being fully captured by current measures of the U.S. economy. To the extent consumers benefit from e-commerce by more than what they spend online, growth in national income is understated. This matters because such growth is a yardstick used to evaluate the success of government policies.

---

1 *https://www.census.gov/retail/ecommerce/historic_releases.html*

2 "Assessing the Gains from E-Commerce," by Paul Dolfen, Liran Einav, Peter J. Klenow, Benjamin Klopack, Jonathan D. Levin, Laurence Levin, and Wayne Best, NBER Working Paper No. 25610, February 2019.

In 2017, roughly 22 percent of all consumption in the U.S. flowed through Visa. The Visa data include detailed information on each transaction, including whether the transaction was conducted in person at a brick-and-mortar store, by phone or mail, as a recurring payment, or through the internet. We consider the latter as e-commerce.

Table 1 reports the categories we count as containing e-commerce. E-commerce is sometimes defined as *retail* e-commerce, so we break the categories into retail versus non-retail categories. The non-retail ones are all travel-related (online booking of air travel, rental cars, hotels, and ground transportation). We exclude telecommunications spending (e.g., smartphone bills) from our definition of e-commerce.

Table 1: E-commerce categories

| Retail categories	Example
Non-Store Retailers	Amazon
Clothing	Nordstrom
Miscellaneous Retail	Staples
General Merchandise	Walmart
Electronics	Best Buy
Building Material, Garden Supplies	Home Depot
Furniture	Bed Bath & Beyond
Sporting Goods, Hobby	Nike
Health, Personal Care	CVS
Food	Safeway
Car Parts	AutoZone
Non-Retail categories	**Examples**
Admin. Support Services	Expedia Travel
Air Transportation	American Airlines
Accommodation	Marriott
Ground Transportation	Uber
Rental Services	Hertz Rent-a-Car

The rising share of e-commerce

Figure 1 documents the rising share of online spending within Visa in selected categories. The online share was already quite high in 2007 in some categories, such as air transport. And in some categories, such as food, the online share remained low in 2017. The share of e-commerce rose most notably for clothing.

To estimate the share of online spending in *all* U.S. consumption, we first scale up Visa e-commerce spending by the inverse of Visa's share in national credit and debit card spending. This assumes Visa spending is representative of all card spending in terms of its online share and that all spending online occurs through debit and credit cards. Finally, we divide by overall U.S. consumption of goods and services (including the service flow from housing).
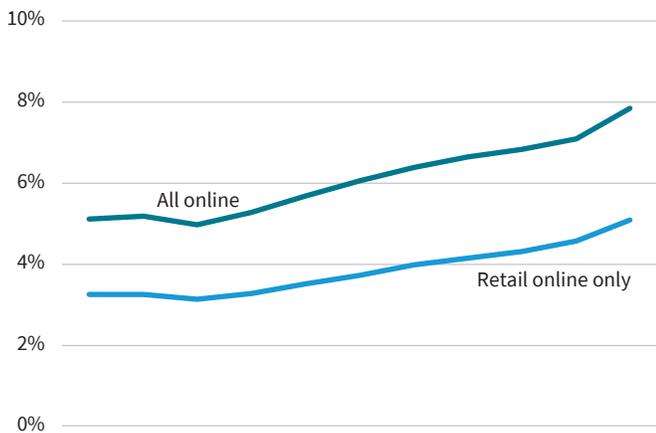
Figure 2 shows our estimates of the share of online spending in all consumption from 2007 and 2017, growing from about 5 percent of spending in 2007 to almost 8 percent in 2017. Defined more narrowly using retail categories, the online share rose from about 3.5 percent in 2007 to 5 percent in 2017.

Figure 1: Share of Visa spending online, select industries
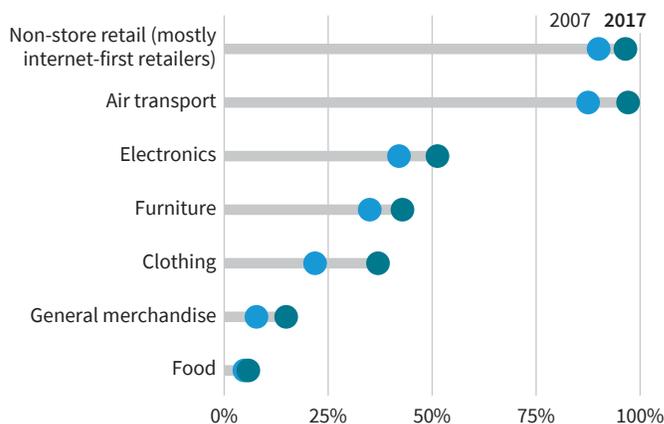
Source: Dolfen, et al, via National Bureau of Economic Research
Image credit: *The Washington Post.*

Figure 2: Estimated share of online spending in the U.S.

We estimate an e-commerce share of 3.4 percent of consumption for households with 2017 incomes of $50,000 and below in 2017 and 9.7 percent of consumption for households with incomes above $50,000.

If we sort counties by 2010 Census population density, denser counties have a population-weighted average online share of 9.1 percent of consumption, whereas less dense counties have an average online share of 6.4 percent. This is perhaps surprising because the density of brick-and-mortar retailers is increasing in population density.

Figure 3 displays our online share estimates for all U.S. counties in 2017. Online penetration is distinctly higher in the Northeast and in the West and Mountain regions than in the South or Midwest.

Heterogeneity by income and population density

There are two primary channels by which consumers likely benefit from e-commerce: convenience and availability. From a convenience perspective, e-commerce allows consumers to avoid the trip to the offline store and the potential time and hassle costs associated with parking, transacting, and carrying home the purchased items. It seems plausible that these convenience benefits are largest for more affluent consumers.

The availability benefits might be particularly important for consumers who live in more rural areas and smaller cities, where there are fewer offline merchants. E-commerce is essentially available to everyone everywhere, thus making many more merchants available to consumers.
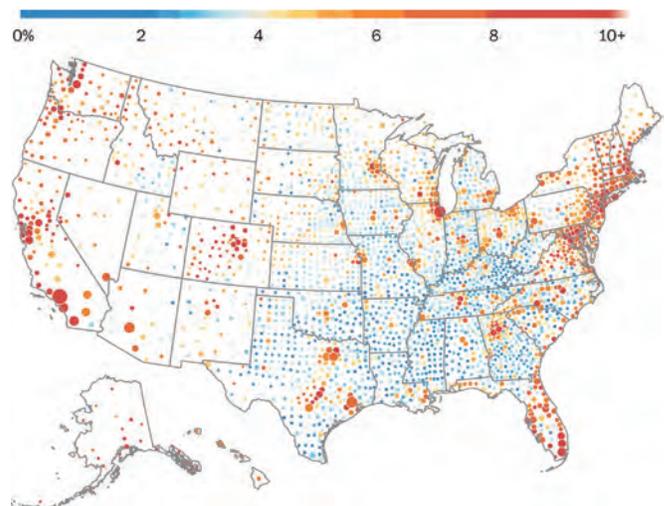
We observe (estimated) income for about one-half of Visa credit cardholders in 2016 and 2017 through a credit bureau, but not all households have credit or debit cards. To adjust for the card-less, we scale down the Visa e-commerce share by the ratio of Visa cards to the number of IRS tax return filers and dependents in the corresponding county and income bracket/bin, relative to the national average ratio of Visa cards per tax filer.

Figure 3: Online shares by county in 2017

Note: Circles sized by each county's 2017 population to distinguish between urban and rural areas.
Sources: Vis via Dolfen et al (commerce); Census Bureau (population).
Image credit: *The Washington Post.*

Stanford | Institute for Economic Policy Research (SIEPR)   John A. and Cynthia Fry Gunn Building
366 Galvez Street, Stanford, CA 94305-6015   siepr.stanford.edu
@siepr facebook.com/SIEPR/   **3**

Convenience benefits

A specific gain from e-commerce is avoiding travel to a physical store by buying the same basket of goods from the merchant's e-commerce channel. To quantify these convenience gains, we examine how the share of transactions online for a given merchant (say Gap.com) varies with distance to the nearest physical store of the same merchant (the Gap in this example). Comparing cases where the offline store is nearby to cases where the offline store is 30 to 50 miles away, the online share roughly triples, from approximately 14 percent to 45 percent.

Based on consumers shopping online rather than at the closet store of the same merchant, we obtain an average convenience gain of 11.3 miles (round-trip) per transaction. To monetize miles, we assume that each mile costs $0.80 in time costs and $0.79 in direct costs, for a total of $1.59 for each one-way mile and $3.18 for each round-trip mile between the consumer and the store. The convenience gain per transaction comes to $36 dollars. Applying this to all transactions, we estimate total convenience gains as a share of Visa spending of about 2.2 percent, or roughly 0.4 percent of all consumption.

Variety gains

The set of merchants that consumers visit online and offline are largely different. In the Visa data, 88 percent of online spending occurs at merchants that the card never transacts at offline. This suggests cross-merchant substitution may be the main source of consumer surplus from e-commerce.

The rising share of e-commerce transactions, in turn, may reflect a rising number, quality, and affordability of products online vs. offline. To estimate how much consumers benefit, we need to know how substitutable products are offline versus online. The closer substitutes they are, the less consumers gain from any given shift in their spending from offline to online.

To estimate substitutability, we again exploit the physical distance between each cardholder and each brick-and-mortar merchant. For each cardholder, we look at online as well as offline purchases made within 20 miles of the cardholder's location. For each category, we calculate the share of combined trips for each pair of competing merchants that were made online as opposed to at the brick-and-mortar merchant. In Figure 4, we show this fraction of combined purchases made online as a function of card distance to each physical store.

Figure 4: Percent of transactions online vs. distance to a physical store
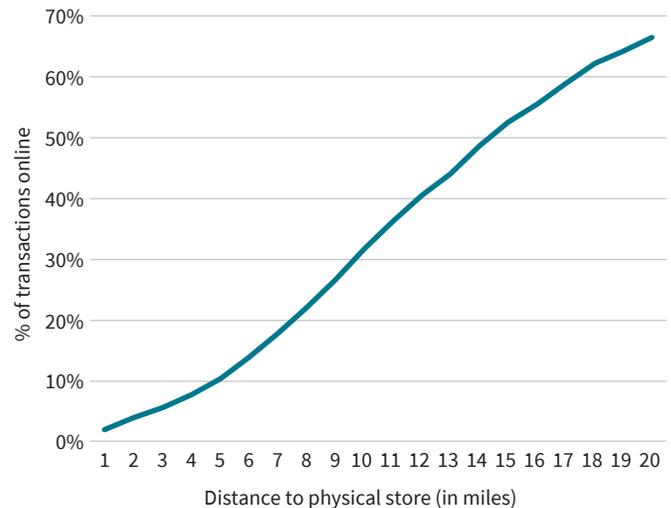
As in the convenience analysis, we can convert distance into effective price variation. We add $3.18 in round-trip travel costs to the average ticket size of Visa transactions in the pair of merchants. This gives us the relative price of the total bundle — Visa ticket size plus travel costs — for going to the closer store (or shopping online) vs. the farther store (or the brick-and-mortar store).

Taking into account substitutability, we estimate the typical household gains about 1 percent of consumption, or over $1,000 per year, in extra buying power from accessing merchants online. Cardholders with income of $50,000 or less enjoyed gains equivalent to 0.45 percent of their consumption from online shopping. Richer households enjoyed more than twice the gains at

1.3 percent of their consumption. The gains were also increasing in population density, rising from 0.85 percent for the sparsest counties to 1.2 percent for the most densely populated counties.

We also estimate the impact of rising e-commerce spending on the number of merchants available offline. We estimate a 3.7 percent decline in spending at brick-and- mortar stores, with a 1.6 percent decline in spending per surviving physical store and 2.1 percent decline in the number of physical stores. This impact may seem modest, but is more dramatic in the retail sectors in which it is concentrated.

Policy implications

Our results have a number of potential policy implications.

First, the consumer e-commerce gains we estimate from convenience (0.4 percent of consumption) and variety (another 0.6 percent of consumption) are over and above those captured directly by official statistics on consumption and income. Accurate measurement of economic growth is important for assessing the welfare consequences of government policies.

Second, the unequal gains from e-commerce so far highlight the remaining digital divide between rich and poor and between urban and rural consumers. Government policies to improve access in poor and/ or rural areas might yield important benefits for these populations.

Finally, the negative impact of rising e-commerce on brick-and-mortar retailers could leave consumers facing fewer local options, thereby enduring higher travel costs and/or fewer shopping options if they do not go online. Though economists are reluctant to advocate policies that slow creative destruction, this underscores that governments might pursue ways to broaden access to e-commerce.

Pete Klenow is the Gordon Moore Senior Fellow at SIEPR and the Landau Professor in Economic Policy. He specializes in macroeconomics, with emphasis on prices, productivity and economic growth.

The Stanford Institute for Economic Policy Research (SIEPR) catalyzes and promotes evidence-based knowledge about pressing economic issues, leading to better-informed policy solutions for generations to come. We are a nonpartisan research institute, and SIEPR Policy Briefs reflect the views and ideas of the author only.