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Special Commentary

Sarah House, Economist
sarah.house@wellsfargo.com • (704) 410-3282
Ariana Vaisey, Economic Analyst
ariana.b.vaisey@wellsfargo.com • (704) 410-1309

The Weight of the World (Wide Web) on Inflation

Executive Summary

Persistently low inflation over the current expansion has generated a reevaluation of the forces that are driving price changes in the economy. One dynamic that has gained attention is the influence of e-commerce. The wide-scale use of the internet has been pointed to as a disinflationary force since businesses can lower overhead costs and sell directly to consumers. At the same time, the internet generates greater price transparency, leading to increased competition between businesses.

The extent to which e-commerce is holding down overall inflation, however, currently appears small. Online commerce has made the greatest inroads into the retail sector, but goods account for less than one-third of the Consumer Price Index (CPI). Moreover, some of the most heavily weighted categories of goods, such as food, gasoline and autos, still have some of the smallest penetration rates of e-commerce. In the services sector, the biggest disruptions from internet-based platforms are occurring in the travel and public transportation industries, which together account for about 2 percent of the overall CPI.

E-commerce is having only a small effect on overall inflation.

For e-commerce to bear down further on inflation, online business will need to take a growing share of sales. That is because while the level of prices are on average lower online, research shows that online and "offline" prices tend to change by about the same amount. For many industries, this will not be hard. In retail for example, e-commerce still accounts for only about 10 percent of total sales. However, there may be offsets to the future disinflationary force of e-commerce, including delivery costs, a convenience premium for ordering online and increased industry concentration among U.S. firms more broadly that helps firms' maintain pricing power.

Under Pressure

E-commerce has erupted since the turn of the century, transforming the way in which consumers shop and businesses deliver their products. In 2000, online orders accounted for less than one percent of retail sales, but that share has grown nearly 10-fold as of last year. The explosive growth of e-commerce has been pointed to as a disinflationary force in the economy since online prices are typically lower.

E-commerce lowers prices directly and indirectly.

E-commerce lowers prices through two main channels. First is the direct effect on prices. Companies selling online face lower overhead costs than their traditional peers. Without rent to pay for a storefront or office space, businesses can pass on those cost savings to their customers. The cost of changing prices is also minimal compared to physical outlets, which need to update displayed prices. Shipping costs still need to be accounted for, but using products on Amazon as a proxy for online prices, recent research has shown that online prices are 6 percent lower than "offline" prices on average.[1]

[1] **Alberto Cavallo, "Are Online and Offline Prices Similar?"** ***American Economic Review*** **107, no. 1 (2017): 238-303.**

This report is available on wellsfargo.com/economics and on Bloomberg WFRE.

Second, e-commerce puts downward pressure on prices indirectly by spurring competition between sellers. Consumers have access to sellers well outside their local market. To compete with online outlets, traditional stores are driven to lower prices to maintain their market share. According to a Pew Research Center survey, 65 percent of shoppers report that they typically compare online and in-store prices before making purchases.[2] Price competition between brick-and-mortar stores is also intensified by the internet as consumers no longer need to drive across town to compare prices. Such price transparency makes it more difficult for businesses to raise prices, all else equal.

Ch-ch-ch-ch-changes: More Than Just the Price Level

The shift to e-commerce has been accelerating.

It is worth remembering that inflation is a measure of the *change* in prices, not the absolute *level*. In order for e-commerce to be a persistent drag on inflation, online sales would need to account for a growing share of commerce and/or see slower price growth than their brick-and-mortar peers. The first of these, an increased share of sales, is clearly taking place. As shown in Figure 1, the portion of sales occurring online has grown continuously since the Census Bureau first began keeping track in late 1999. What's more, the shift to e-commerce has been accelerating. As is more clearly shown in Figure 2, online sales have made faster inroads in recent years. Whereas the share of e-commerce sales was growing by about half a point or less a year up through 2013, online sales captured nearly an additional full point of total sales over the past year.

Figure 1

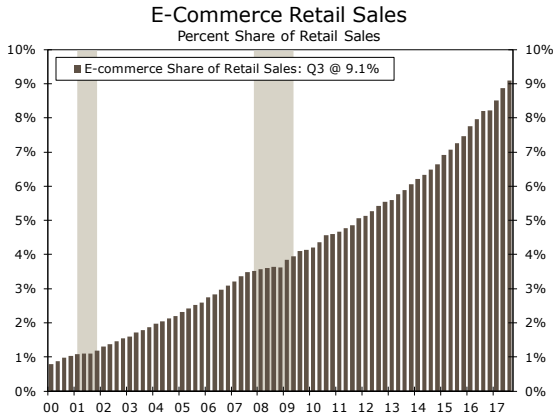
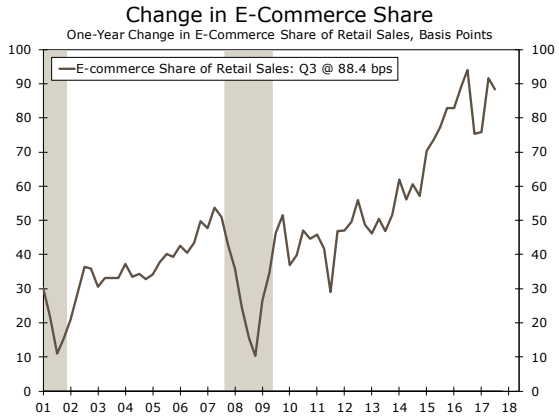


Figure 2



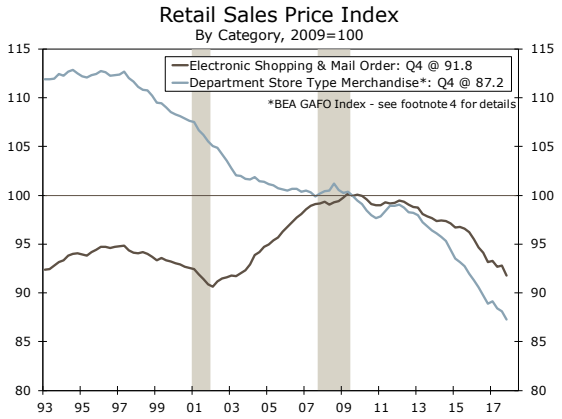
Source: U.S. Department of Commerce and Wells Fargo Securities

Prices at brick-and-mortar stores have been falling faster than at online retailers.

But are prices online growing more slowly than at traditional stores? One way to look at this is to compare the price indices calculated by the Bureau of Economic Analysis for nonstore retailers and retail items more typically bought online. It is worth pointing out that nonstore retailers not only include internet-only retailers such as Amazon, but the e-commerce units of traditional retailers.[3] According to these measures, both online and offline prices have been falling since 2009; however, prices at brick-and-mortar stores have fallen faster, implying some convergence (Figure 3).[4]

[2] Aaron Smith and Monica Anderson, "Online Shopping and E-Commerce," Pew Research Center, (2016).
[3] If companies have online divisions, they are considered a different establishment of the firm and therefore classified as "nonstore." Not all retailers with online sales may have separate e-commerce units, or report such sales separately to the BEA. This leads to "nonstore retailers" accounting for the lion's share (87 percent) of e-commerce sales.
[4] The GAFO represents stores which specialize in department store types of merchandise including furniture & home furnishings; electronics & appliances; clothing & accessories; sporting goods, hobby, book & music; general merchandise; and office supply, stationary & gift stores.

Figure 3



Source: U.S. Department of Commerce and Wells Fargo Securities

Evidence So Far: E-Commerce Having Little Effect on Overall Inflation

Online and offline prices tend to change by roughly the same amount.

So how much is e-commerce holding down inflation? Research on the topic is still in the early stage and somewhat mixed. The use of "big data," however, is helping researchers tackle the challenge by collecting online prices. The Billion Prices Project at MIT finds that online prices in the United States have moved closely in line with the Consumer Price Index, and that when the online and official index diverge, differences tend to be small and temporary.[5] Additional research finds that online and offline shops adjust their prices by roughly the same amount.[6] This would suggest that measurement errors in official price indices due to surveys not adequately sampling online outlets are small. In contrast, using Adobe's Digital Price Index (DPI) shows inflation to be about one percentage point lower than the CPI for a basket equivalent to 19 percent of the CPI.[7]

Adding e-commerce as a variable into a simple OLS model of CPI inflation shows that faster growth in the market share of e-commerce is associated with a statistically significant decline in inflation.[8] However, the relationship appears to be driven by the market share of online sales growing at a slower rate during the past recession while gasoline prices, and consequently inflation, spiked. Taking out this period and looking at the previous and current expansion shows that faster growth in the share of e-commerce is negatively associated with inflation, but the relationship is not statistically significant. Looking at core CPI generates the same results.

Mixed Maturity of E-Commerce by Industry

Why is the relationship between e-commerce and inflation not clear cut given the direct cost savings of e-commerce and the competitive pressures they incite? First, it's not just online-only stores whose sales account for "e-commerce." Many traditional brick-and-mortar stores also sell online, and prices for products at these "multi-channel" retailers are found to be only 1 percent lower online on average and to change by similar sizes and frequencies.[9]

Second, e-commerce still accounts for a fairly small fraction of sales. Just under 10 percent of retail sales are placed over the internet. Most retail spending still occurs in categories where e-commerce is more impractical or the online market is much less mature. Groceries, gasoline, autos and building material sales account for more than half of retail sales (Figure 4). The large share of

[5] Alberto Cavallo and Roberto Rigobon, "The Billion Prices Project: Using Online Prices for Measurement and Research," *Journal of Economic Perspectives* 30, no. 2 (2016): 151-178.
[6] Yuriy Gorodnichenko, Viacheslav Sheremirov and Oleksandr Talavera, "Price Setting in Online Markets: Does It Click?" NBER Working Paper Series, no. 20819 (2014).
[7] Goldsbee, Austan and Pete Klennow, "Internet Rising, Prices Falling." (presentation, ASSA Annual Meeting, January 2018). https://www.aeaweb.org/conference/2018/preliminary/powerpoint/dr5BAaE6
[8] All econometric results available upon request.
[9] Cavello, "Are Online and Offline Prices Similar?"

spending devoted to these categories means that their prices have greater importance in official measures of inflation.

Categories with the largest share of online sales account for only a small portion of the CPI.

Categories with the largest online sales penetration account for a relatively small portion of consumer spending and carry only a small weight in inflation indices (Figure 5). Apparel, home furnishings, electronics, hobby goods and other items more likely to be purchased online account for only about 8 percent of the CPI index.[10]

Figure 4

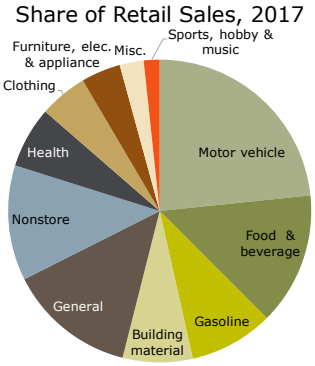
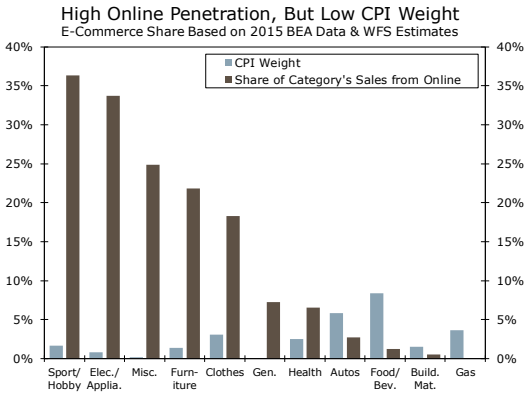


Figure 5



Source: U.S. Department of Commerce, U.S. Department of Labor and Wells Fargo Securities

Services: 65 Percent of the Equation

New internet-based platforms have added to competition in the services sector.

The retail categories more commonly associated with online spending account for such a small portion of official price indices since the vast majority of consumer purchases are on services. Services account for 65 percent of the Consumer Price Index and 75 percent of the core CPI. Similar to Amazon in the goods sector, new internet-based platforms have added to competition in the services sector by making it easier to compare prices and/or competing directly with established players.

In the shelter category (the largest component of the CPI at 34 percent), internet listing websites are already frequently used to find homes and compare prices. According to Zillow, 87 percent of homebuyers and 84 percent of renters use online resources to assist in their home search.[11] This high penetration means that the initial benefit from more transparent pricing has already flowed through to inflation. Also, at the end of the day, most homebuyers still use realtors, so the impact of online listing on the home search process is somewhat limited.

In a disruption that is still playing out, companies such as Airbnb and Uber are reducing barriers to entry in the lodging and transportation services sectors by creating platforms to easily connect individual buyers and sellers virtually. While the resulting added supply of rooms and taxis should put downward pressure on prices, lodging away from home and public transportation have a small (2 percent combined) weight in the overall CPI. Slightly lower prices in these sectors will not meaningfully move headline inflation, especially if there are offsetting effects. For example, researchers have shown a link between a high density of Airbnb listings and increased rents.[12] This would be consistent with people choosing to list their homes for short-term stays on Airbnb (at higher rates) instead of making them available to long-term tenants.

[10] More specifically, 8.4 percent of the CPI is weighted toward the categories of: household furnishings and supplies; apparel; recreation commodities; and education and communication commodities. See Table 2 of the release for additional details on what these categories include.
[11] Zillow, "Consumer Housing Trends Report 2016"
[12] Kyle Barron, Edward Kung and David Proserpio, "The Sharing Economy and Housing Affordability: Evidence from Airbnb," *SSRN*, (2017).

The internet also increases competition and reduces delivery costs in the services sector by making it easier to provide services at a distance. The services sector has historically been more isolated from competition because of the need or preference for proximity between consumer and producer. However, more services are being provided virtually, often at lower prices. For instance, many health plans now cover virtual doctor's visits ("telehealth"). A telehealth visit costs $79 on average, versus $149 for an office visit. [13] The effect on prices will depend on the share of people who elect to consume virtual services, and whether these replace services otherwise provided in person. In the case of healthcare, a recent study shows that most telehealth visits represent new utilization, so this would actually lead to higher health care spending overall.[14] Many services (e.g., childcare, food preparation) also remain difficult to provide virtually.

More services are being provided virtually, often at lower prices.

Trade in services makes up a greater share of GDP in countries with higher internet penetration, in part because the internet reduces the cost of sending services cross-border (Figure 6). Since the largest portion of U.S. services imports are business services (not typically bought directly by consumers), the potential effect on consumer prices is primarily indirect (Figure 7). Insofar as imported services are priced lower than would be available domestically, increased services imports (made possible by internet marketplaces) allow companies to produce goods and services more cheaply and could feed into lower CPI inflation. However, given widespread internet access in the United States, companies are likely already outsourcing services where practical. In addition, regulations (e.g., licensing requirements) prevent some professional services from being imported, limiting how far outsourcing can extend.

Figure 6

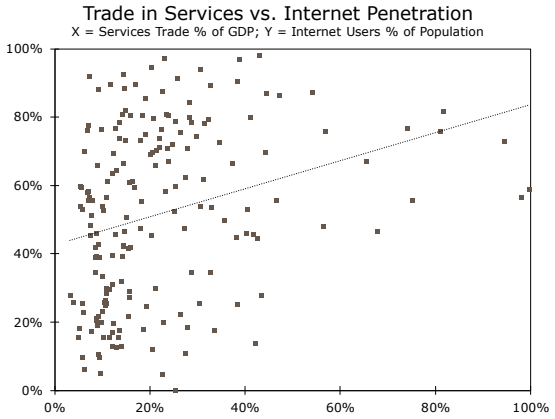
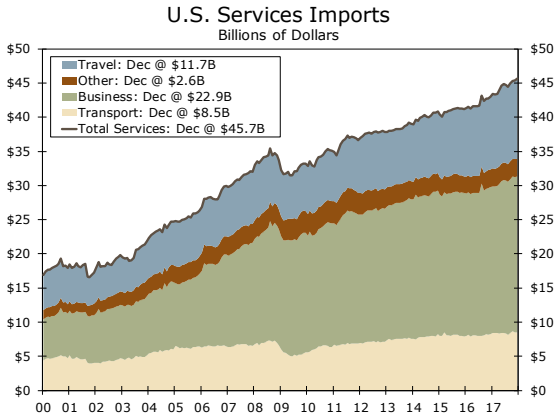


Figure 7



Source: U.S. Department of Commerce, World Bank and Wells Fargo Securities

Outlook: Disinflation Forces to Persist, but So Are Some Offsets

The fact that much of consumer spending is devoted to categories where e-commerce is still immature leaves scope for disinflationary pressures brought on by the use of the internet for businesses to intensify in the years ahead. Only a sliver of groceries, one of the most frequent purchases for households, occurs online. At the same time, the use of the internet to deliver major purchases like cars and healthcare more directly to consumers remains at an early stage.

On the other hand, there are factors to offset some of the disinflation stemming from e-commerce. Some sectors of the economy like real estate and travel services already look to be close to saturation in terms of consumers using the internet to research and buy products. Goods still need to be delivered to the customer. If the delivery service capabilities of companies cannot keep pace with

There is scope for disinflation from e-commerce to intensify, but not without some offsets.

[13] J. Scott Ashwood, Ateev Mehrotra, David Cowling and Lori Uscher-Pines, "Direct-To-Consumer Telehealth May Increase Access to Care But Does Not Decrease Spending," *Health Affairs* 36, no. 3 (2017): 485-491.
[14] Ibid.

the rapid rise in online ordering, prices stand to rise and/or disappointed customers stand to go back to the store.

Even if the delivery logistics keep pace with e-commerce, internet sellers might start to charge for the convenience of buying online, as customers become attached to the ease of ordering from anywhere. Fourteen percent of all online shoppers report they would typically buy online without looking at in-store prices, but that share jumps to 28 percent among the most frequent online shoppers.[15] Leverage for companies to add a convenience premium could stem from greater industry concentration with fewer big players. While e-commerce might be spurring more competition in the retail sector and to a lesser extent the services sector, there is evidence that on the whole, the U.S. economy is becoming more concentrated.[16] This generates more pricing power for firms and would help to protect margins even if the internet on its own is increasing competition.

The historically weak sales environment—not just technology—has pressured prices.

Without clear-cut evidence of the degree to which e-commerce is lowering inflation, we would not expect the FOMC to give much weight to this dynamic, at least in isolation. Technology might be generating greater price transparency, but the historically weak sales environment of the current expansion has also likely contributed to companies using price to battle for market share. From at least the perspective of the official price indices to which monetary policy is benchmarked, e-commerce still appears to be having little direct effect on inflation. That said, with PCE inflation falling short of the Fed's target for all but two months over the past five years, the FOMC needs every bit of inflation it can get.

[15] Smith and Anderson, "Online Shopping and E-Commerce"
[16] Council of Economic Advisers, "Benefits of Competition and Indicators of Market Power," Council of Economic Advisers Issue Brief. Washington: CEA, April 2016.

Wells Fargo Securities Economics Group

Diane Schumaker-Krieg	Global Head of Research, Economics & Strategy	(704) 410-1801 (212) 214-5070	diane.schumaker@wellsfargo.com
John E. Silvia, Ph.D.	Chief Economist	(704) 410-3275	john.silvia@wellsfargo.com
Mark Vitner	Senior Economist	(704) 410-3277	mark.vitner@wellsfargo.com
Jay H. Bryson, Ph.D.	Global Economist	(704) 410-3274	jay.bryson@wellsfargo.com
Sam Bullard	Senior Economist	(704) 410-3280	sam.bullard@wellsfargo.com
Nick Bennenbroek	Currency Strategist	(212) 214-5636	nicholas.bennenbroek@wellsfargo.com
Eugenio J. Alemán, Ph.D.	Senior Economist	(704) 410-3273	eugenio.j.aleman@wellsfargo.com
Azhar Iqbal	Econometrician	(704) 410-3270	azhar.iqbal@wellsfargo.com
Tim Quinlan	Senior Economist	(704) 410-3283	tim.quinlan@wellsfargo.com
Eric Viloria, CFA	Currency Strategist	(212) 214-5637	eric.viloria@wellsfargo.com
Sarah House	Economist	(704) 410-3282	sarah.house@wellsfargo.com
Michael A. Brown	Economist	(704) 410-3278	michael.a.brown@wellsfargo.com
Jamie Feik	Economist	(704) 410-3291	jamie.feik@wellsfargo.com
Erik Nelson	Currency Strategist	(212) 214-5652	erik.f.nelson@wellsfargo.com
Michael Pugliese	Economic Analyst	(704) 410-3156	michael.d.pugliese@wellsfargo.com
Harry Pershing	Economic Analyst	(704) 410-3034	harry.pershing@wellsfargo.com
Hank Carmichael	Economic Analyst	(704) 410-3059	john.h.carmichael@wellsfargo.com
Ariana Vaisey	Economic Analyst	(704) 410-1309	ariana.b.vaisey@wellsfargo.com
Abigail Kinnaman	Economic Analyst	(704) 410-1570	abigail.kinnaman@wellsfargo.com
Shannon Seery	Economic Analyst	(704) 410-1681	shannon.seery@wellsfargo.com
Donna LaFleur	Executive Assistant	(704) 410-3279	donna.lafleur@wellsfargo.com
Dawne Howes	Administrative Assistant	(704) 410-3272	dawne.howes@wellsfargo.com

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