

Tracking the Impact of COVID-19 on the Online Economy in Real-Time

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Abstract

The online economy has been steadily increasing its share of total commerce across a host of categories, for many years. This has prompted many businesses to improve their support and experiences for purchasing different goods and services through online channels, in order to meet customer expectations and stay competitive. However, the COVID-19 pandemic has brought a cataclysmic shift to the online landscape, beginning in mid-March 2020. This shift was shaped by organizations having to maintain transaction activity and consumers needing to acquire goods in the face of shelter-in-place, lock-down, and limited store opening protocols. Using Adobe Analytics data, we analyze the effects of the pandemic manifesting in a stimulus on the online economies of retail commerce and travel, in 2020. We find that the pandemic brought an unprecedented increase in online spending and a shock to online prices. Given the magnitude of the hit to the travel industry, we also use Adobe data to track flight and hotel bookings on a daily level throughout the pandemic, identifying shifts in demand as signals of recovery and resilience of certain sectors and regions over others.

Introduction

The growth and importance of the online retail economy was recognized long before the COVID-19 pandemic began having an impact on most countries in early 2020. In February 2019, online sector sales had eclipsed general merchandise sales (Census Bureau) and while brick and mortar sales were still higher (accounting for restaurant and auto sales), most long-term forecasts pegged online share to increase at approximately 2% every year for the foreseeable future (Census Bureau). While online sales were crossing expected milestones on a predictable, annual basis, the holiday season is where online sales were asserting dominance in much more dynamic and dramatic ways. The 2019 US holiday season (November 1st - December 31st) saw online sales reach \$142.5 billion dollars (Adobe Digital Insights, Jan

2020), which was approximately 24% of online revenue generated by the US in all of 2019 (Digital Commerce).

With such a large portion of transaction activity occurring seasonally, during this period, our team has spent the last decade developing a set of models for tracking revenue and pricing trends to help enterprises, media entities and other organizations understand how spending is changing on a day-to-day basis within this sector. This real-time tracking and insights operation, along with our stress-tested methodology, would prove to be especially relevant in sizing the volatile effects of COVID-19 on consumer spending and category prices. Furthermore, leveraging the flexibility of our internal datasets and a variety of external sources, we would be able to delineate amongst the core attributes that were driving shifts in consumer spending, which were beginning to emerge.

The line between online and offline is becoming increasingly hard to draw and define. Part of the reason Adobe's online spend and product data has continued to increase in relevance over the past decade is because distinguishing between an online experience and one that's purely offline has become virtually impossible in the modern world. At least 81% of Americans already own a smartphone (Pew Research), and in an Adobe survey, 46% of consumers reported comparing prices online while shopping in store. Even before COVID lockdowns came into being, consumer usage of buy-online-pick-up-in-store (BOPIS) was growing at a rapid pace. The convenience of shorter wait times compared to traditional shipping methods and the security of avoiding package thefts drove consumers to increasingly pick this delivery option. During the height of the lockdowns, BOPIS usage was showing over +200% YoY growth. The blend of an online-driven purchase and an in-store or near-store product acquisition shows just how interconnected the digital has become with the physical. Cavallo (2016) reports that online and offline prices are identical in the US 69% of the time, and on average differ by 1%. He also reports "price

changes having similar frequencies and sizes.” In lieu of these findings, Adobe’s price data, its ease of use, its speed, and comprehensiveness becomes increasingly valuable to researchers, policy makers, businesses and consumers.

The vision and mandate that has guided our approach to data development, delivery, and analysis was informed by Einav & Levin (2013), when they posited the need for different types of high-frequency data that would complement more traditional (and lower frequency) data series on economic activity. The need to realize this vision and begin reporting day-to-day changes suddenly became a necessity as COVID-19 drove non-seasonal trends and untraditional spikes in ecommerce. This reinforced the fidelity of our core sample dataset and allowed us to leverage the model we developed for tracking daily online spend volumes during the holiday season to track the impact of COVID-19.

The data we have been using is sourced from the Adobe Analytics platform. The product boasts utilization from thousands of enterprises, including 80 of the top 100 US online retailers (Internet Retailer 2018), as well as over 100 million product SKUs, and over a trillion visits to various online properties (websites & apps). Additionally, Adobe Analytics is used by 8 out of the top 10 US airlines. The opted-in client data is aggregated to support different time-series analyses, as well as category and geo insights. This robust dataset is refreshed on a daily cadence, so that we can see early performance indicators emerge and change while they are being impacted by various phenomena.

The ability to track the shape of online spend based on the different stages of the pandemic response, along with interacting events like stimulus distribution, civil protests, and lock-down regulations has emerged as a necessary capability that our data has been able to support. Additionally, tracking online prices in contrast to demand changes has been an important initiative for us to revisit. While, in

previous years we had observed online prices across a set of key retail categories experience incremental changes in inflation and deflation, the changes paled in magnitude and volatility that online prices suddenly saw as the pandemic provoked mass online utilization. With mid-month and full-month analyses being executed across CPI categories such as groceries and apparel, we are able to quickly observe the inflationary pricing pressures that consumers are being subjected to, faster than the CPI and other released measures are able to showcase. Furthermore, with our flight and hotel travel data being representative of the larger travel sector, we were able to see how both hotel and flight bookings nose-dived as cases increased and shelter-in-place mandates were administered. More recently, however, we have been able to chart flight and hotel bookings recovering differently, with hotel bookings showing less sensitivity to rising COVID cases than flight bookings are. This paper will de-construct the methodologies that have been leveraged to track the aforementioned areas of exploration and expand on the implications of emerging the trends to the online economy.

Methodology: Online Spend

Our ecommerce model uses the aggregated and anonymized data from the opted in online merchants that use Adobe Analytics. These merchants use Adobe Analytics to get visibility into the performance of their online properties, their sales, and their marketing efforts. Adobe has the unique opportunity to aggregate the same insights across a uniquely comprehensive spectrum of retailers, which shows an accurate view of how ecommerce is doing in its entirety. Eighty out of the top 100 online retailers (Adobe analysis of Internet Retailer 2018) use Adobe Analytics for their web performance tracking. Additionally, Adobe gets a view into how ecommerce is evolving in the world of smaller retailers, using a similar dataset in the Adobe Commerce product, formerly known as Magento. The model is based on transaction data from hundreds of retailers, with visibility into location, device used, marketing channel, and other web-based metrics. This depth of data allows this dataset to answer not only to answer the

question of “how much,” but also “how” US consumers are shopping online, which changed significantly throughout the course of 2020 in unexpected ways.

We use external sources to calibrate the size of overall ecommerce and account for any growth happening outside of the Adobe sample. Our model takes in data from the census, and the Forrester yearly predictions to achieve that goal. Adobe is in the unique position of being able to use this data to track ecommerce spend in real time. During the crucial hours of Cyber Monday and Cyber Monday, the Adobe Digital Insights team reports on consumer spending by the hour. In other circumstances Adobe reports and analyzes US ecommerce trends using daily raw transactions and revenue by retailer. The daily revenue data excludes taxes and shipping. The daily trends from the entire retailer sample is then aggregated and merged in with the third-party data. We use daily spend data starting from January 2013 up to the previous day to develop a forecasting model. The model is heavily informed by flags associated with holidays, and a carefully developed one-year lag value, as well as the most recent trends in spending habits.

Methodology: Price Index

For the price index Adobe relies on the methodology developed by Goolsbee and Klenow (Goolsbee, 2018), who worked on the same data. The underlying price change from base month 0 to month 1 is calculated using the Fisher Price Index formula:

$$I_{01} = \sqrt{\frac{\sum p_1 q_0}{\sum p_0 q_0} * \frac{\sum p_1 q_1}{\sum p_0 q_1}}$$

A product is defined as a combination of SKU and retailer, and the price change formula is applied to a basket of goods of matched products that were tracked across two consecutive months. Adobe classifies the product SKUs into categories as defined in the Bureau of Labor Statistics Consumer Price Index

handbook. Given the vastness of the product data, and the speed at which new products are introduced within the ecommerce world, Adobe uses a combination of manual and machine learning based methods to classify the products. The machine learning models are based on a product description string along with a retailer-defined classification. All automated classifications undergo rigorous sampled quality control to ensure an accurate final classification. In cases where the product description is likely to cause a misclassification, Adobe has created rule-based exceptions. The quantities are tracked on a monthly level, and the prices are calculated by dividing the total revenue recorded for a product and the units sold for a given month.

Findings: The Online Spend Migration

Tracking US online spend is not a unique capability nor was Adobe the first organization to explore analysis of this sector. However, developing the in-house competency to dynamically track and project online revenue emerged as a compelling opportunity when the company looked to provide more value and differentiation for its client base and partners. The output of the online spend tracking model would be especially relevant and valuable during the holiday season, when days like Black Friday and Cyber Monday generate billions of dollars in revenue, as consumers look to take advantage of time-sensitive deals that can only be secured at certain points in the Q4 holiday season. Both the actuals tracking and forecasting models are informed by two primary data sources. The first is the opted-in, aggregated transaction data hosted in one of Adobe's flagship data products: Adobe Analytics, a product utilized by organizations to track transactions and other online actions taken by consumers across a host of web properties. The second is the base dollar growth prediction that analysts like Forrester make for the year through their surveys. The combination of both these inputs allows for the models to assume representative coverage within the parameters of the utilized online retail dataset. This is because the online retail sample, while expansive and reliable in its breadth, is still dependent on clients having their

data opted-in for analysis and remaining as a client of the Adobe Analytics product. Even though the dataset currently contains 80 of the top 100 US online retailers (list based on Internet Retailer 2018), the set is still vulnerable to clients dropping in and out of the sample¹. So, while the Adobe Analytics data source is effective at tracking the aggregated spend changes (as well as a host of other attributes like share change, devices leveraged. . .etc.) on a day-to-day basis, the models are better served by an overall dollar base number (provided by a third-party analyst) to size the scale of expected dollars spent for the year. By distributing the expected yearly dollar spend across the days within the year and using the day-to-day growth changes captured by Adobe Analytics as a multiplier, an effective and representative model for tracking online spend is realized. Furthermore, the past six years of daily data along with customized date related flags is leveraged for forecasting days when online spend is expected to reach magnitudes that are much higher than normal levels (i.e. major holidays and sales periods).

Prior to the COVID-19 pandemic, these revenue growth models were primarily being utilized for assessing and forecasting spend during major holiday shopping days and the impact of summer sales, like Prime Day, to online retail. Initially, incremental growth in ecommerce for 2020 was expected in the mid-teens of percentage points as merchants continue to transact more heavily online with consumers. The tectonic shift to online spending in the wake of the COVID-19 pandemic was not anticipated by anyone - the first demand spikes were observed in late February, when PPE items like hand sanitizers, masks, and gloves saw 817% YoY growth, spanning the first two months of the year, at the time 125,000 cases had been reported globally. Additionally, toilet paper and cold/flu products began surging in sales by 186% and 152%, respectively. However, the stocking-up behavior in those specific product areas did not push total January, February, or March e-commerce sales past their forecasted volumes for 2020 -

¹ Adobe clients can opt their data in for utilization of aggregate insights. As a result, they are also provided with custom insights that benchmark their performance against their peer set.

the inflection point occurred in mid-March, when the Federal State of Emergency was declared. The result of this declaration led to a combination of stocking-up, store closings, and retail therapy,² driving April online sales up by a staggering 59% YoY.

Online shopping continued to ramp up into May, eventually crossing the levels typically only achieved during the historically high-volume holiday season. May generated \$82.4B in revenue, surpassing the average monthly revenue volume generated during the 2020 holiday season, an unprecedented phenomenon in the ecommerce world. In turn, this unleashed havoc on the retailers as they scrambled to resolve the logistical and marketing challenges from both the influx of new consumers trying to shop online for the first time, and an overloaded US shipping network that wasn't prepared for this level of orders and packages at this time of year.

Below is a table with the ecommerce growth for the relevant months.

Month	YoY growth
February	14%
March	17%
April	59%
May	78%
June	76%
July	55%
August	41%
September	43%

² A recent survey conducted by Adobe Digital Insights found that 51% of consumers engaged in online purchasing as a form of retail therapy

April's 59% growth came in at quadruple the expected rate, with a relatively obvious step change around the mid-April mark associated with the arrival of stimulus checks, as the average US consumer saw an increase in expendable income. After the peak of the lockdowns in May and corresponding peak of demand for ecommerce, the online spend has slowly continued to drift back to the pre-COVID expected trends derived from our predictive online spend model. August year-over-year growth came in at "just" 41% as stores reopened and the extra unemployment benefits ended.

Even with the slowdown from the peak in May, the period from April to August saw a \$107B increase in online spend compared to what our model had forecast. In a world where the total online spend in the previous year came in just above \$500B, this additional revenue is noteworthy. Overall, some of the effects of the lockdowns of the US retail economy are not going to be reversed - our surveys showed a significant number of consumers reporting shopping online for the first time during the pandemic, a trend that has continued even as consumers have adapted to the "new normal." In mere months, a two- to three-year shift to online spending has been realized.

By breaking down the spend data by state, we were able to compare the increase in orders online to the lockdown status of each state. We found that the states that were reported to be "reopened" as of July 23rd by the Kaiser Family Foundation had an 8% lower increase in YoY online spend. When we collated the state ecommerce data with unemployment data we found no significant relationship, however, during the month of May, we've seen a significant increase in ecommerce activity when correlated with the political leaning of a state. Further work is required to validate this insight and account for other factors like population density, internet usage, etc.

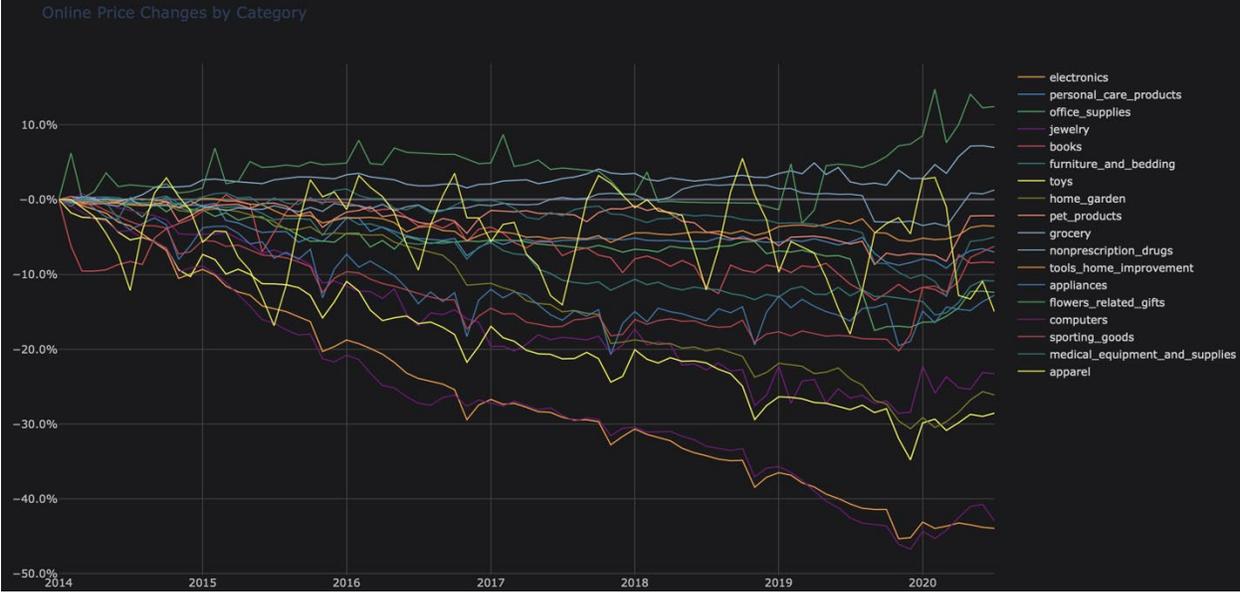
Even as stores reopen and consumers regain the ability to shop in-person safely, the habits of many consumers that were previously new to online shopping will forever be altered in favor of ecommerce. Whether it's the ability to price compare among multiple online retailers or placing your grocery order from the comfort of your couch to be picked up later in a store, a significant proportion of consumers will not go back completely to offline retail. With the holiday shopping season approaching, the thought of large crowds of people gift shopping at the mall gift is being viewed as obviously incompatible with a world that seeks social distancing. With this conundrum in mind, an unstable economy with historic unemployment will drive even more consumers to shop online, as it presents itself as the safest option for holiday shopping.



Findings: COVID-19 Impact to Online Prices

A competency to track online prices across major retail categories was driven by multiple factors that were especially salient for Adobe. The ability to observe the “best day to buy” certain types of goods online would be truly valuable for our holiday season coverage and customers. Furthermore, dynamic

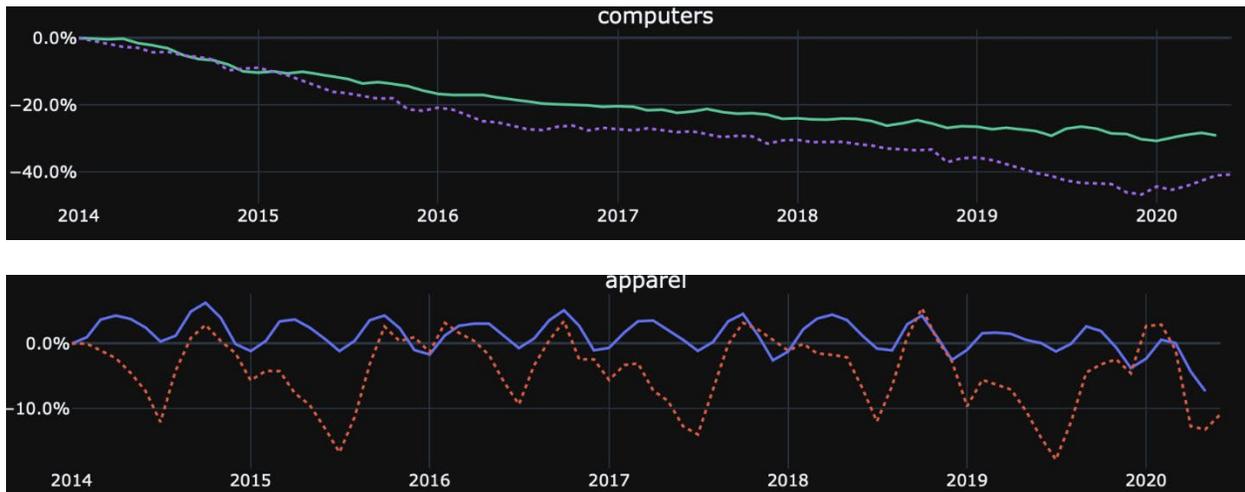
shifts in online prices would help Adobe clients understand what pricing pressures US consumers were being subjected to, and how overall price trends were grafting against their own pricing strategies. For Adobe’s economist partners, an online price index that could control for quantity (unlike the CPI) and allow for more frequent price change analyses was appealing, and established Adobe’s online price index as an ideal metric to have for measurement. The major categories that constitute most of online retail spend include apparel, electronics, and health and beauty products (Simtech). However, other categories with a smaller online presence, such as grocery, home furniture, and flowers have seen growth in online share over the past two decades. Adobe’s online price index has tracked prices across many of these major consumption categories, featured in the CPI, for the past 6 years.



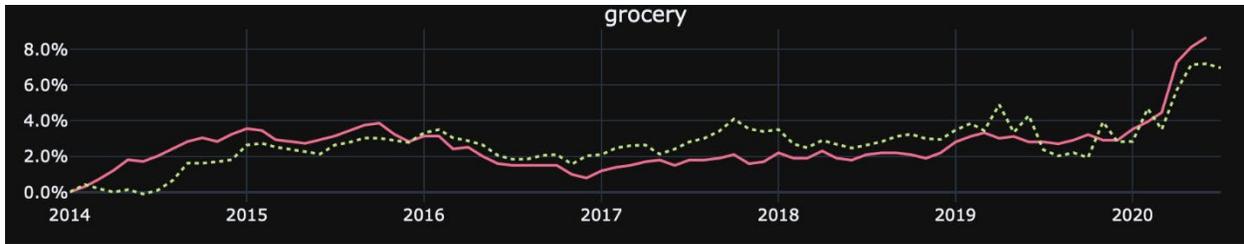
Before 2020, specific categories such as electronics, toys, and home and garden primarily experienced incremental deflation, while other categories like grocery, personal care products, and tools saw flat to mild YoY inflation. Apparel typically saw significant changes MoM due to seasonal inflation, but YoY inflationary trends remained minimal. What was apparent when observing the Adobe Online Price Index

(online prices only) vs. the CPI (online + offline prices), was that the offline marketplace was experiencing more inflated prices than its online counterpart in certain tracked retail categories, namely computers, tools and home improvement, and apparel. Comparison charts for the Online Price Index vs. CPI below.

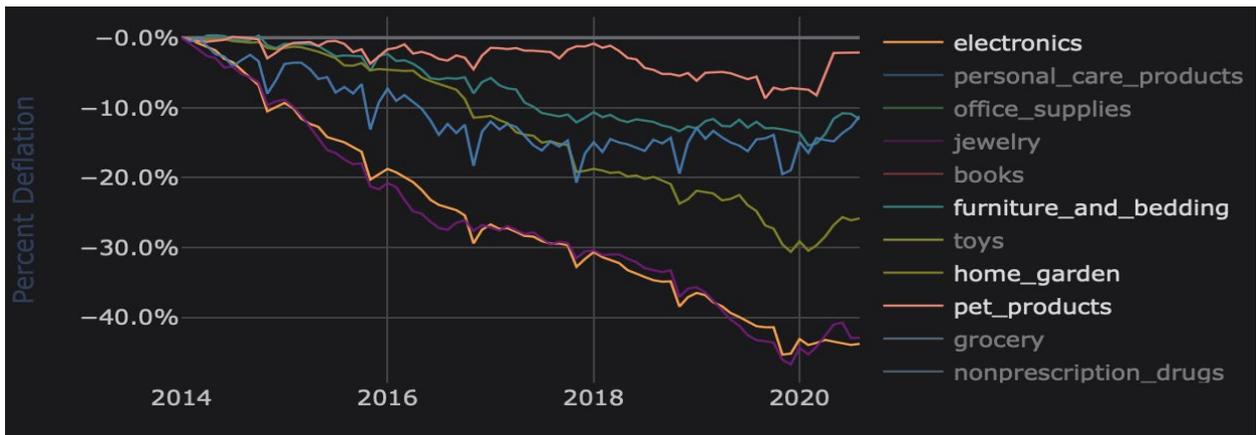
CPI = Solid Line _____. Dotted Line = Adobe Online Price Index _____



Other categories like online grocery have been tracking closely with total grocery price inflation in a manner that accommodates cautious forecasting. As seen below, in the wake of COVID we experienced online prices surging and were able to anticipate the prices plateauing and decreasing into the summer months. When the CPI reported grocery prices dropped in July by 1.1% (US News), this decrease was anticipated by Adobe's Online Price Index, which had showcased a 0.2% drop in July and a 0.04% decrease in June. This directional change was identified within weeks of entering the months that the indices were characterizing.

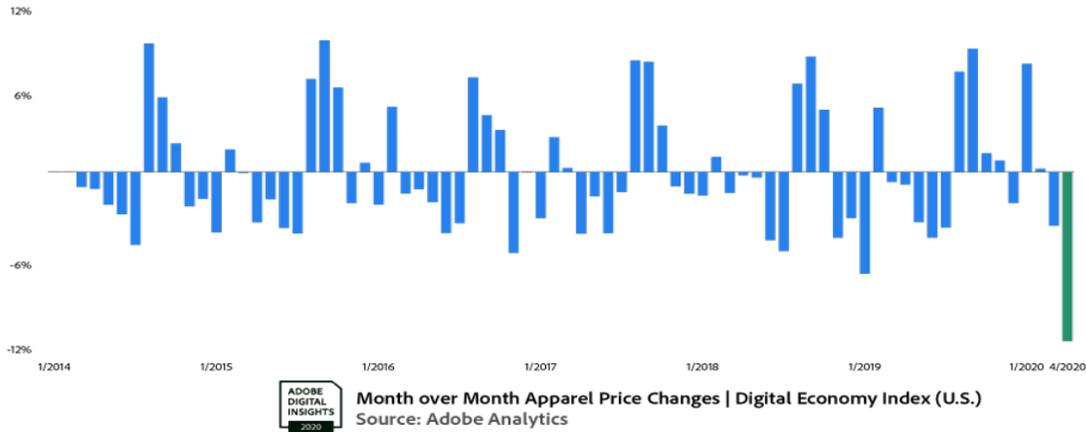


Beyond the inflation in grocery prices of 4% from January-July, the pandemic also reversed or significantly slowed the deflationary trajectories of other categories, including electronics, furniture and bedding, home and garden, and pet products. As the chart below highlights, home and garden, and computer categories saw the deflation experienced through the back half of 2019 effectively wiped out in the first six months of 2020.

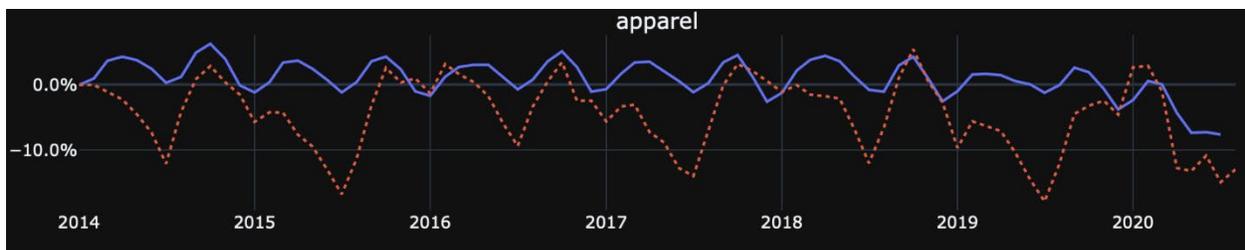


While many inflationary trends observed can be attributed to consumers suddenly purchasing these goods online and spiking up demand, some categories experienced deflationary trends as demand decreased. The impact of COVID on the online apparel category was immediate, driving significant price shifts as early as April. While some apparel items like pajamas and t-shirts saw sales increases of +143% and +67%, respectively, other apparel items experienced a decrease in demand, with pants sales dropping by -13% and jacket sales plunging an expected -33%. The monthly apparel price expressed

these demand shifts, as average price sank to historic lows. As can be seen below, online apparel saw its largest MoM price drop on record in April 2020, hitting -12% (4x the average price decrease typically seen for April).

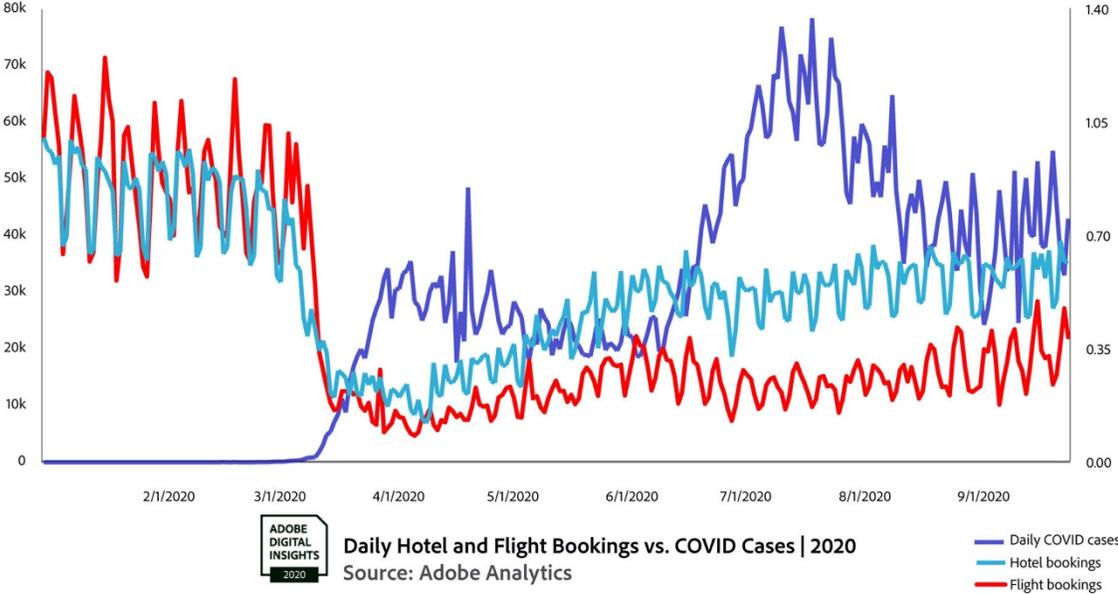


Since that massive descent, apparel prices have remained volatile in the wake of diminished need for certain types of clothing over the past 4 months. The chart below shows where the Adobe Online Price Index and CPI trends stand, as of the end of August. The online price seasonality has clearly been interrupted for apparel, with the CPI experiencing a lagged decrease in deflation as online dominant prices impact the overall online apparel category.



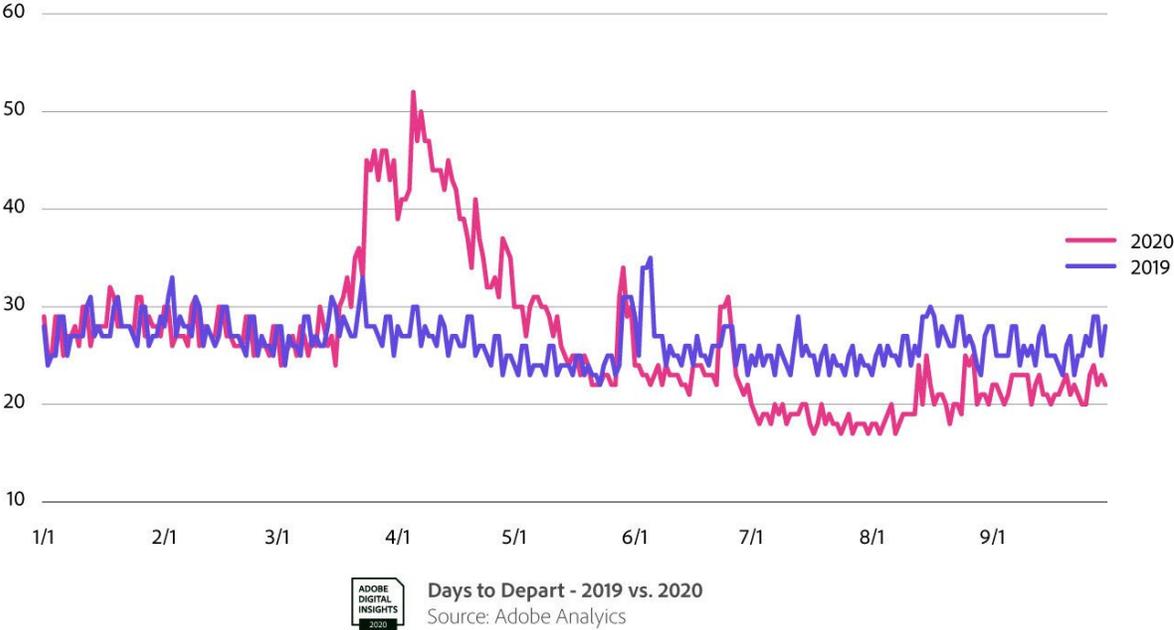
Findings: US Domestic Travel Fall & Recovery

After the National State of Emergency declaration by the US in early March 2020 in response to rising COVID-19 cases, travel plans were swiftly cancelled and future travel plans were put on hold, with flight and hotel booking volumes dropping to less than 20% of the volumes observed in January and February 2020. As airlines and hotels began to adapt to the pandemic and implemented distancing and other safety measures, travelers started booking more, although the booking patterns experienced noticeable shifts (discussed further below). When COVID-19 cases began rising once again in mid-June, traveler confidence in staying healthy while flying vs. when staying in a hotel began to diverge, with hotel bookings plateauing around 55% of the pre-COVID volumes while flight bookings again dropped down to 30% of their pre-COVID volumes. As cases began dropping in the US in July, these levels have remained constant, indicating travelers have settled into their risk tolerance levels.



Beyond the impact of COVID-19 to the overall volume of travelers, there have also been shifts around booking behaviors. One of these differences is in the time between flight ticket purchase date and departure date. On average, this booking window is typically between 25 – 30 days in advance, which

was in line with the booking behavior in January and February 2020. As uncertainty increased amid country lockdowns in an effort to control the spread of COVID, the booking window jumped sharply to between 45 – 50 days as travelers pushed their travel plans further out in hopes of being able to travel again later in the year. We’ve since seen the booking window drop below 20 days, indicating many travelers are now only choosing to travel under more urgent situations, or are making a last-minute decision to travel.



Further, in the initial days after the declaration of the National State of Emergency, one-way bookings jumped from being around 45% of total online flight bookings to closer to 65% of total online bookings as travelers hurried to the location they would be staying throughout shelter-in-place. This continued into April, but has since returned to a level more consistent with early 2020.

The COVID-19 impact to travel has big repercussions to holiday travel - we've already seen the effects on Labor Day travel with US domestic flight bookings for the holiday down 58% YoY and hotel bookings down 20% YoY. Looking forward to travelling for the holiday season in November and December, it is doubtful given the current circumstances that 2019 levels will be reached - in 2019 an estimated 68.6 million domestic passengers flew on US airlines in December, a new all-time high (Bureau of Transportation Statistics). Flight bookings so far for the week surrounding Thanksgiving are down 67% Y/Y when comparing to the same time period in 2019, and Christmas flight bookings are down 62%. However, we saw Labor Day flight bookings sharply increase much closer to the holiday than in years past, with the two weeks leading into the holiday generating 60% more bookings than the two weeks prior. In 2019 the same time period only generated 45% more bookings, so it is likely that early performance will not be representative of overall performance. Hotel bookings have not seen as drastic of an impact, but, nearly 70% of online hotel bookings for Christmas and Thanksgiving typically happen less than 30 days in advance, so the impact there is also yet to be seen.

Conclusions

The world has faced an unprecedented enemy this year. Our lives changed as we got used to catching up with family and friends over video calls. Conferences and concerts moved to the digital world. So did our shopping habits. In a reality where ecommerce was taking up share at a progressively faster rate over the past 10 years, COVID and the shutdowns related to it put the consumers, businesses and governments through a period of profound transformation. While big, fast data had already proven itself to be immensely valuable beforehand, this year's transition online and the challenges associated with collection of physical data has made these datasets invaluable. Adobe, along with other stewards of similar data, is coming forth to share the insights from its datasets to consumers, retailers and policy makers who are all facing unprecedented hardships and changes. While the virus will eventually be

defeated, the cultural ramifications from it will continue in our lives. The world of purchasing goods online and their corresponding prices as well as the habit of planning your trips online is taking up share of the overall commerce and travel. Adobe will continue to share the insights derived from the pricing and spending data, along with its travel data, in the hopes that we can profile which COVID-driven trends are persisting and dissipating, as the world marches on.

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