Need For Speed: The Impact of Website Performance on Online Retailers

1. Research Problem

In 2016, total online retail sales reached $402.3 billion and were predicted to grow at an average annual rate of 9% over the next five years. Moreover, 49% of offline transactions are influenced by online channels. As the importance of online channels increased, the cost of webpage performance issues increased as well. For instance, in July 2016 Amazon went down for 20 minutes and the company reportedly lost around $3.75 million during this period. Similarly, a 5-minute outage in 2013 costed Google about $545,000.[1] Although most of the attention has focused on website outages, website slowdowns also lead to significant decreases in revenues and customer satisfaction, and are ten times more likely to occur than outages. Moreover, poor website performance can generate long-term problems in customer retention. According to Akamai's survey, 58% of the customers claimed they are less likely to visit a website that performs badly.[2]

The recent repeal of net neutrality makes the analysis of the impact of website speed on customer behavior all the more relevant. This recent regulatory change grants broadband providers a significant discretion on how they handle the data traffic. Through practices such as paid prioritization—whereby a content owner can pay a fee to the broadband provider to obtain priority in content delivery—firms can achieve a higher content speed in their commercial websites. In this environment it is paramount for companies to understand how website performance impacts customer behavior and to determine the right balance between perceived website content quality and browsing speed. In this paper, we focus on how consumer behavior is affected by the performance of retailers' website. In particular, we analyze how website speed impacts the time customers spend on the webpage, conversion rates, and online channel revenues. We also identify how this impact differs between mobile and desktop channels, as well as different geographic regions and product types. Furthermore, we observe whether slowdowns are caused by an increase in visual content and quality or due to other reasons. This enables us to understand how slowdowns originated by increases in perceived quality differ from other causes such as third party contents. Finally, we show that the impact of website performance is heterogenous across product categories and brands.

Research in operations management has long focused on analyzing the key challenge firms face between minimizing the costs of providing a fast response while ensuring customer satisfaction

[1] https://venturebeat.com/2013/08/16/3-minute-outage-costs-google-545000-in-revenue/

[2] https://www.akamai.com/jp/ja/multimedia/documents/content/akamai-performance-matters-key-consumer-insights-ebook-uk.pdf

levels are kept at a high level. This question has been extensively studied in the queueing literature. A notable example include Anand et al. (2011), who consider the trade-off between quality and speed in customer-intensive services. Call centers (Yu et al. 2016), retail stores (Lu et al. 2013), and hospitals (Batt and Terwiesch 2015) have been subject to extensive empirical analysis in this area. We contribute to this literature by analyzing the impact of delays in e-commerce services and identifying how this impact varies across devices, geographic regions, and brands. While the delays of interest for the call center setting amount to tens of seconds, they amount to minutes in retail stores and hours in a hospital setting. By contrast, in online commerce website speed differences of milliseconds can have significant impacts on online sales. In this project we identify the impact of these barely perceptible delays thanks to our granular, high-frequency website speed and online sales data.

2. Methodology

To answer our research question, we obtained proprietary datasets from multiple retailers. The retailers in our dataset are specialized in different categories such as jeanswear, sportswear, outdoor and activewear, and the average price of their products significantly differs, as they cater to different customer bases. For each retailer in our dataset, we observe daily website performance metrics such as total number of unique visitors, total online sales, conversion rate, and total page views from January 2016 to August 2017. In total we observe more than 8 million online transactions. For each online transaction, we observe the date the transaction took place, the zip-code the order originated from, as well as the SKU, price, and quantity of the items in the order.

We collaborated with a leading digital performance analytics company to obtain the website performance metrics of our focal retailers. These performance metrics are collected every 15 minutes from multiple browsers in different locations, and separately for mobile and desktop devices. The ensuing temporal and spatial granularity of the merged dataset enables us to precisely quantify customers' responsiveness to website speed. In addition, it allows us to identify the time periods and locations when website performance issues created the biggest impacts on online revenues of our focal retailers. First, we identify the impact of website speed on sales at the aggregate level leveraging the panel data structure of our dataset. The panel data approach enables us to control for time-invariant unobserved brand effects as well as brand-specific time-trends.

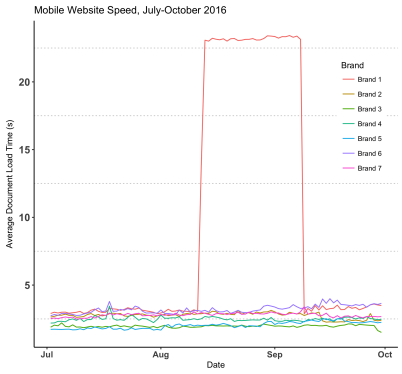
Second, we identify the time periods when one of the focal retailers experienced significant slowdowns on their website due to exogenous shocks such as slow third-party contents (See Figure 1). By comparing retailers affected by exogenous slowdowns to retailers that did not experience such a shock, we causally identify the impact of slow website on online revenues.

Table 1 Impact of Website Speed on Online Sales

	(1)	(2)	(3)
Avg.Doc.LoadTime	-0.351***	-0.137***	-0.105***
	(0.009)	(0.035)	(0.028)
$Avg.Doc.LoadTime^2$		0.011**	0.007**
		(0.003)	(0.003)
ln(visitors)	1.019***		1.020***
	(0.019)		(0.019)
_cons	0.476*	11.008***	0.587**
	(0.191)	(0.069)	(0.197)
N	5158	5158	5158
R^2	0.787	0.659	0.787

Dependent Variable : ln(Online Sales)
Average Document Load Time is used as a proxy of website speed, higher average document load times indicate slower websites

Figure 1 Mobile Website Speed July-October 2016



3. Preliminary Results

This paper makes substantive contributions to the literature on service and retail operations. First, we empirically demonstrate the impact of speed on a new emerging service area, namely online services. The estimated effects of website speed are statistically and economically significant (see Table 1). In our sample it takes 3.3 seconds, on average, for a webpage to become interactive. Decreasing this delay by blink of an eye i.e, from 3.3 to 3 seconds, leads to a 1.8% increase in online sales. The previous studies have focused on identifying the impact of service speed on customer abandonment in call centers, hospitals, and supermarkets. Customers in call centers wait for 43 to 84 seconds, on average, before abandoning or getting service, (Emadi and Swaminathan 2017) whereas these numbers are significantly higher in hospitals. By contrast, in online services customers' patience is much lower, and even delays of 100 miliseconds have significant impacts on customer abandonment. Moreover, our results strongly suggest customer intolerance to slow website speed is increasing over time, as the sensitivity of online sales to speed slowdowns is higher for 2017 than for 2016.

References

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