

News Media Channels: Complements or Substitutes? Evidence from Mobile Phone Usage

The bulk of the work was done by a student

Jiao Xu

PhD Candidate of Information Technology Management

Georgia Institute of Technology

Chris Forman

Professor of Information Technology Management

Georgia Institute of Technology

Jun B. Kim

Assistant Professor of Marketing

Business School of Hong Kong University of Science and Technology

Koert Van Ittersum

Associate Professor of Marketing

Georgia Institute of Technology

Abstract

Media outlets have undergone a fundamental shift over the last decade as new distribution channels proliferate in an unprecedented manner. Although mobile devices in particular have been experienced rapid adoption among consumers, its broader implication is yet to be understood. In this research, we examine consumer's news consumption behaviors via mobile news web sites in response to the introduction of news apps. Data from a two-year longitudinal study (2009-2010) surprisingly reveals that the introduction of a Fox News app is associated with a significant increase in the likelihood of visiting the Fox News mobile website. This effect is higher for consumers with high valuation for concentrated news content and with less time-constraint. The results are consistent with the interpretation that adoption of a provider's news app may stimulate the corresponding mobile news web site visits by allowing consumers to sample more news content on the app. We discuss the implications of these findings to marketing practitioners and their cross-channel advertising planning decisions.

Keywords:

Online news consumption; Mobile News App; Mobile News Web site; Media Complementarity; Sampling effec

Introduction

The question of whether and how new media affect the consumption of old media has long been a concern both in the academic community and among practitioners. Since the earliest attempts to examine the interrelationships between media channels, there has been extensive research demonstrating substitution between new forms of media and old media, including radio (Lazarsfeld 1940), television (Mendelsohn 1964), and cable television (Sparkes 1983). Whether new media channels are complements or substitutes to existing channels is an important question, especially, for marketers since it is critical to more efficient and effective media planning (e.g., Athey, Calvano, and Gans 2011).

One particular question that researchers have studied in recent years is whether the introduction of new Internet-enabled media channels will complement or substitute existing media channels. One research stream has found that, because the new channels duplicate the capabilities of existing ones, new channels such as online news web sites are substitutes to existing channels such as print newspapers (e.g., Deleersnyder et al. 2002; Gentzkow 2007; Geyskens et al. 2002).¹ However, another research stream reported that new media channel can complement to existing channel if media consumption on new channel drives awareness of content on the old (e.g., Smith and Telang 2009; Chiou and Tucker 2011).

In this paper, we offer a framework and data to understand user consumption of media contents across multiple channels on mobile devices. In particular, we examine whether adoption of mobile news applications, or apps², is associated with more or less visitation of mobile news web sites on mobile devices. This allows us to make two contributions to the literature. First, building upon recent research (e.g., Avery et al. 2012), we seek to understand when complementarity or substitution is most likely to occur across channels in mobile setting. While the content and capabilities of the two channels we study are in many ways similar—leading to a potential expectation of substitution between them—we find evidence of complementarities in consumer behavior. We present a framework to describe why we observe complementarities that we believe will generalize to other digital media settings. Further, our data contains detailed

information on consumer characteristics, allowing us to identify the conditions under which complementarities or substitutions are most likely to be found. To our knowledge, there has been little research that has studied how consumer characteristics influence when we should observe complementarity or substitution.

Second, we seek to enhance our understanding on an emerging area of mobile channel and the corresponding media consumption behaviors of consumers. The main target audience of this research is marketing managers who need to understand the impact of apps on conventional mobile web sites and, if needed, shift their advertising plans. There remains relatively little research on mobile channels and, to our best knowledge no work on cross-channel behavior on mobile devices. Given the rapid growth in the use of the mobile internet in general and for media consumption in particular, we believe this is an important gap in understanding. We aim to start closing such a gap by studying whether app is a complement or substitute to conventional mobile web sites.

In our empirical analysis, we employ a novel dataset of 5,562 U.S.-based mobile smart phone users and study their media consumption on mobile news web sites and on mobile news apps. For a reason that will become clear later, we study consumer behavior on mobile devices over a period when Fox News introduced its first news app. Our main results show that, conditional on a provider, the adoption of the mobile news app complements the media consumption on mobile web site. We further find that the complementarity is stronger among consumers whose news media consumption is concentrated among a small number of other mobile web sites and among those who are less time-constrained.

Research Setting

A mobile application (or mobile app or “app”) is a software program designed to run on mobile devices such as smartphones and tablet computers. In 2011, the number of mobile app users exceeded the number of mobile browser users in the U.S., as smartphone and tablet adoption and growing app options fueled a surge in app users (comScore 2012). Given the rapid consumer adoption of apps, many marketers are trying to understand consumer behavior on this

emerging channel and its broader implications (Ahonen, 2011). For instance, one critical question for marketers, including contents providers and media planners alike, is whether emerging app ecosystems will be complements or substitutes of conventional mobile web sites. Depending on the answer to this question, marketers need to adopt appropriate strategies and coordinate their cross channel advertisements so that they can reach the target audience more effectively and efficiently.

To understand whether and why complementarity or substitution is more likely to occur, it is critical to understand whether and how news apps differ from mobile web sites. News apps and mobile web sites have different comparative advantages. Mobile news apps are more user-friendly than mobile web sites because an app can target the specific limitations and abilities of each individual mobile device much better than a mobile web site can while running inside a browser (Alang, 2010). However, mobile web sites typically offer more diverse news content than the app. An example is shown in Figure 1, which compares the home page of the Fox mobile web site against the home page for Fox News app³. Another comparative advantage of mobile web sites is that it is open in that they can be found and accessed more easily since it operates within a mobile browser. Consumers can link into stories on the web site from other sources on the web, using Twitter, social media, search engines, or news aggregators. But consumers cannot visit an app directly from other web sites since the app requires consumers first to find and download one on the mobile device.

(Insert Figure 1 here)

Apps and mobile browsers offer news providers distinct ways to engage with their audiences. A recent industry reports that a substantial percentage of the mobile consumers access content using both apps and mobile browsers by the same contents provider (comScore, 2012), highlighting the importance of both channels for mobile media consumption. Therefore, in the data, we expect to observe consumers to access both apps and mobile webs sites. However, this joint consumption is not sufficient to identify complementarities between two channels. As noted in prior literature, a central empirical challenge in evaluating the incidence of complementarities

is separating true substitution or complementarity between choices from correlation in consumer preferences (Gentzkow 2007). In our setting such correlation in choices may reflect unobserved consumer preferences; for example, some consumers may have a greater taste for a certain contents or a particular contents provider. One potential source of identification in the presence of correlated preference is panel data. If correlated unobservables such as taste for a certain contents are constant for a given consumer over time, observing repeated choices by the same consumer can allow us to separate correlation and complementarity (Gentzkow 2007).

Theoretical Framework

The effect of the introduction of new channels on the demand for existing channels is often uncertain (Gentzkow 2007). In this section, we begin by documenting the conditions that will give rise to substitution or complementarities. We next hypothesize a set of conditions when complementarity or substitution is likely to be most salient; acknowledging that our data will give us only the net effect of each of these factors on consumer behavior, we present hypotheses for both directions.

Substitution versus Complementarity between Mobile Channels

Multichannel research has found that new channels will substitute existing channels when the new channel closely duplicates capabilities of existing channels (e.g., Deleersnyder et al. 2002) or offers new ones (Alba et al. 1997). For example, research on multichannel media consumption has found that new technology-enabled media channels have consistently displaced older channels, this has been the pattern for television (Mendelsohn 1964), cable television (Sparkes 1983), and between Internet news and traditional print media (e.g. Deleersnyder et al. 2002; Gentzkow 2007; Athey et al. 2011). Displacement also occurs because individuals have a limited amount of time to spend on the media consumption category, so the introduction of new media reduces the amount of time individuals allocate to existing media.

Conditional on a provider, if apps offer similar functionality to mobile web site, adoption of a mobile news app may suppress consumption at mobile news web site. Thus, we hypothesize the following:

H1a: (Substitution) Consumer adoption of a provider's mobile news app results in a lower likelihood of visiting the provider's corresponding mobile news web site.

Multichannel research has emphasized that different channels may have varying comparative advantages. For example, direct channels like the Internet may have convenience, selection, and price (Forman, Ghose, and Goldfarb 2009) relative to traditional brick-and-mortar retail stores, while traditional stores provide instant gratification and lower transaction costs such as shipping and handling charges (Avery et al. 2012). When different channels have different comparative advantages, use of one may increase use of the other, i.e. they may complement each other. Different channels can also serve as advertisements for one another in media markets. For example, consumers who borrow or rent an access to music, television, or movies may choose later to purchase (Liebowitz 1985, Peitz and Waelbroeck 2004). Although this idea can be traced back several decades, and was originally referred to as exposure effect, it is now most frequently referred to as sampling effect (Liebowitz 1985). Samples are usually used to provide an opportunity for consumers to learn about a product at zero or low cost.

In our context, news apps and mobile web sites have different comparative advantages. As noted above, news apps typically provide a smaller number of news articles relative to the mobile news web sites conditional on the same provider (Figure 1). However, the apps are usually more user-friendly which appeals to consumers. Thus, it is likely that consumers learn about a news article initially through an app due to its superior user interface, but upon learning of the story can go to other channels to gain further information. Further, consumers may prefer channels from the same news provider if the news provider emphasizes a particular editorial or political perspective that is shared by the consumer. Under these conditions, the mobile app would serve as the “sample” for news articles offered by the news provider that may increase demand at its mobile web site.

Thus, we hypothesize the following:

H1b: (Complementarity) Consumer adoption of a provider's mobile news app results in a higher likelihood of visiting the provider's corresponding mobile news web site.

We note that substitution and complementarity effects might operate on consumer behavior simultaneously. While our data do not allow us to separately identify these two effects, we are able to identify the net effect of adopting news mobile apps on mobile web sites visits.

Moderators of Complementarity: Consumer Diversity of News Consumption

One of the most widely observed consequences of the growth in digital media is audience fragmentation. As a result of this fragmentation in the content supply, consumers show a penchant for *selective exposure*, which is the tendency to select media outlets that match one's own beliefs and predispositions (e.g. Ksiazek et al. 2010; Stroud 2008). Consider the extent to which consumers value news diversity. Consumers with narrow and focused tastes will be more likely to consume a steady diet of their preferred media outlet. For such consumers, we may expect stronger complementarity effects for their preferred provider as they will have stronger incentives to seek more information on the news provider's mobile web site after the news app from the same provider is adopted. In contrast, consumers that prefer to consume news from a variety of sources will exhibit weaker complementarity effects between existing and new channels. Thus, we hypothesize the following:

H2: Diversity in a consumer's news consumption will weaken the complementarity effects between a provider's mobile news app and web site.

Moderators of Complementarity: Consumer's Temporal Budget

Assuming that consumer's overall temporal budget—the amount of time people have to engage in activities— does not change over time, we expect more time-constrained consumers will exhibit a smaller degree of complementarity effects between mobile news app and mobile web site. This is because those consumers do not have sufficient time to seek further information from the mobile news web site after adopting the news app by the same provider. Therefore, an increase in the time constraint of consumers results in a lower incremental change in the likelihood of visiting the mobile news web site on mobile phones when the news app from the same provider was adopted. Thus, we hypothesize the following:

H3: A consumer's time constraint will weaken the complementarity effects between a provider's mobile news app and web site.

Data

We test the above hypotheses using data from comScore Mobilens. These data are constructed from detailed quarterly surveys of the mobile Internet activities of a nationally representative sample of U.S. mobile subscribers. We have quarterly data from the fourth quarter of 2009 and the second quarter of 2010. However, the survey participants in each quarter do not overlap and hence the data are longitudinal but not panel in nature.

The data contain information on news consumption from mobile web sites and mobile apps on the mobile Internet for about 5,562 smartphone mobile phone consumers in the U.S. Specifically, we know, for each quarter, whether a consumer visited a particular mobile news web site or adopted a particular news app, e.g. CNN, Yahoo, and Fox etc. We know whether a consumer visited a particular mobile news web site or adopted a news app during a quarter, but we do not know how long or how often the visits were. Thus, the focus of our analysis will be a consumer's binary decision of whether he or she visited a mobile web site in a particular quarter.

For our empirical analysis, we use a difference-in-difference regression where we study whether adoption of a news app is associated with an increase or decrease in the likelihood of visiting the corresponding mobile news web site. comScore started to measure app adoption from the second quarter of 2010. Since the apps of most major national news providers like CNN or Yahoo were introduced prior to 2010, making it impossible to measure the presence of complementarity or substitution using our estimation approach. As a result, we focus on the implications of the introduction of the mobile app of one major news media provider, Fox News, which was released in early 2010. According to Nielsen Media Research, Fox has constantly ranked as number one U.S. cable news network since 2002, with total viewership far greater than that of CNN and MSNBC combined (Fox News Press 2012). The Fox News web site is also one of the top Internet news websites with 32 million monthly unique users in 2012 (Schneider, 2012). Hence we believe that Fox is a good provider to study due to its popularity and wide reach.

The Mobilens data are not a panel of the same individuals over time, but a series of repeated cross sections. To separate correlation and complementarity by observing repeated choices by the same consumer, we construct a pseudo panel using these cross-sectional data. This approach was originally proposed by Deaton (1985), and has been developed further and applied by several subsequent papers (e.g., Verbeek and Vella 2005; Cuesta et al. 2011; Prince and Greenstein 2011) mainly in economics where available data were in the form of repeated cross sections.

Constructing a pseudo panel requires identifying a set of reliable, time-invariant criteria to construct cohorts so that the same individual remains in the same cohort over time (Prince and Greenstein 2011). We construct our cohorts using consumer demographic characteristics in the data. These include age, income, education, and location (urban versus rural), which have been adopted in prior literature (e.g., Prince and Greenstein 2011). The average number of consumers per cohort is 44 with standard deviation equal to 16.36. We have experimented with alternative cohort definitions such as including employment status in our cohort definition and our results are robust to these changes.

We compare visits to mobile news web sites between cohorts who adopted the Fox News app and those who did not adopt the app. We control for various time-varying categorical variables in our data that have been commonly used in the literature and control for their effects on consumer's news consumption behavior. Summary statistics for our variables and controls in our empirical models are shown in Table 1.

(Insert Table 1 here)

Empirical Model

We examine whether adoption of the Fox News app leads to more or less use of the Fox News mobile web site, i.e. whether there exists complementarity or substitution between two channels. The main challenge in identifying this relationship is to separate true substitutability or complementarity from correlation in consumer preferences. For example, a finding that news apps adopters consume more news at mobile web sites might be evidence that the two media

channels are complementary to each other. But it might also simply reflect the possibility that the unobservable tastes for media are correlated. Thus, a cross-sectional analysis of consumer choice between the two channels may find evidence of complementarity when in fact substitution is present (Gentzkow 2007).

We construct a pseudo panel and use a difference-in-difference approach to remove unobserved time invariant factors that are likely to influence both mobile app and web site usage. Our approach measures the temporal change in the (pseudo) panelist's visits to the app's corresponding mobile news web site (Foxnews.com) compared to the changes in visits to other mobile news web sites (e.g., CNN.com, news.google.com, news.yahoo.com, etc.) under different Fox App adoption rates. Specifically, we run a fixed-effects panel data regression model over our two sample quarters to examine the impact of Fox News app adoption. Using the cohorts defined above, we estimate the following specification for cohort i 's likelihood of visiting mobile news web site j in time t , which we represent as webvisit_{ijt}

$$(1) \text{webvisit}_{ijt} = \alpha + \gamma \text{time}_t + \beta_1 \text{FoxApp}_{it} \times \text{time}_t + \beta_2 \text{FoxWeb}_j \times \text{time}_t + \beta_3 \text{FoxApp}_{it} \times \text{FoxWeb}_j \times \text{time}_t + \theta X_{it} + \mu_{ij} + \varepsilon_{ijt}$$

The variable FoxApp_{it} measures cohort i 's the average adoption rate of the Fox News app in the second period quarter; because the Fox News app did not exist in 2009, this variable is by definition equal to zero in the first period. FoxWeb_j is an indicator variable equal to 1 if the mobile news web site j is Fox mobile web site. β_3 captures the core relationship of interest—whether adoption of the Fox News app increases the likelihood of visiting Fox mobile web site relative to other web sites—and represents a test of Hypothesis H1a and H1b. If β_3 is positive, the primary effect of adopting Fox News app is to stimulate or complement the visits to Fox mobile web site. But if β_3 is negative, the primary effect of adopting Fox News app is to suppress or substitute the visits to Fox mobile web site. We use heteroskedasticity-robust standard errors that are clustered at the cohort-web site level.

Identification of our model requires the assumption that with the adoption of the Fox News app there are no coinciding changes in unobserved factors that increase the likelihood of visiting Fox mobile web site. In a series of robustness checks below, we probe the validity of our core identification assumption.

Our use of pseudo panels also introduces measurement error into the dependent and independent variables. This measurement error comes from the differences between individual values in the cohort and cohort average values. However, the measurement error is not correlated with our explanatory variables (which are themselves within-group averages) by construction (Verbeek and Vella 2005; Prince and Greenstein 2011). Hence, this measurement error should not generate bias in our parameter estimates.

Results

In this section, we show that adoption of Fox News app has a substantial complementarity effect on visitation to Fox mobile web site.

Baseline Results

In Table 2, we use the regression model in equation (1) to examine the implications of Fox News adoption for the likelihood of visiting mobile news web sites. Columns 1 and 2 show the change in Fox mobile web site visits compared to other mobile web sites when the Fox News app is adopted. The coefficient of $FoxApp_{it} \times FoxWeb_j \times time_t$ in Column 1 suggests that the likelihood of visiting Fox mobile web site increases by 29.36 percentage points for customers who adopted the Fox News app relative to that of other mobile news web sites. The average likelihood of visiting Fox mobile web site is 18.13 % in our sample, so this translates into a 61.94% increase. From this we show that adoption of the mobile app stimulates web site visits to Fox mobile web site. The positive and statistically significant coefficient on $FoxApp_{it} \times time_t$ suggests that adoption of the Fox News app does promote visitation to other mobile web sites, but far less than to Fox web site. The coefficients for $FoxWeb_j \times time_t$ are significantly negative; suggesting that during our sample and time period there has been systematic decline in visits to Fox mobile web site compared with visits to other mobile news websites. Combined with the

sign of the coefficient of interest ($\text{FoxApp}_{it} \times \text{FoxWeb}_j \times \text{time}_t$), we interpret that although the overall visits to the conventional Fox news mobile site decreased over time, the segment who adopted the Fox app actually visited the Fox mobile web site more. The results in this section strongly support that adoption of the news app complements visitation to the mobile news web site by the same news provider, supporting H1b.

(Insert Table 2 here)

Robustness Checks

Because we use a pseudo panel, one potential concern is that cohorts that disproportionately adopted the Fox News app might also oversample individuals who prefer Fox news. The reason the cohort can be treated as a heavy Fox News app adopter might be that there is a bias in our cohort composition to simply select more individuals who preferred Fox news to be grouped into that cohort. To test the robustness of our outcomes in different cohort composition, we use a bootstrap sampling strategy to randomly resample the individuals by weights, and then group those resampled individuals into cohorts.

Each individual in our data is separately weighted by comScore to appropriately reflect independent U.S. Census estimates of the U.S. population's demographic profiles. The probability of randomly resampling an individual into a cohort can be determined by the individual's weight. We replicate the process of resampling individuals then grouping them into cohorts, and for each replication repeat the same regression analysis. Column 3 and 4 present the bootstrap regression results from 500 replications, which are consistent with our baseline results. Similar to prior studies, we construct our pseudo panel by grouping individuals into cohorts based on observed demographics such as age, education, income and location (e.g., Verbeek and Vella 2005; Cuesta et al. 2011; Prince and Greenstein 2011). Our pseudo panel results in 196 cohorts with an average of 44 observations per cohort. To further probe the robustness of our results to cohort composition, we include additional demographic variables, such as employment status (The categories of employment status are full time, part time, not employed, full time student, full time student employed, retired, and other), to group individuals into cohorts so that

the total number of cohorts becomes larger and the average observation per cohort in our sample becomes smaller. Under this alternative definition, we have 271 cohorts with an average 24 observations per cohort. Columns 5 and 6 present the regression results using smaller cohort size. We find that our results are robust to these changes.

Another critical assumption on the model identification is that coinciding with adoption of the Fox News app, there was no change in unobservables that systematically affected the visitation of Fox News mobile web site relative to other news sites. We probe the salience of this assumption through a series of falsification analyses. To that end, we examine the impact of Fox News app adoption on visits to financial news mobile web sites and weather mobile web sites. Since Fox News app does not have a separate business news category, adopting the Fox News app does not facilitate consumer sampling of business news. Therefore, adoption of the Fox News app should not increase visits to Fox mobile web site for financial news. Similarly, the adoption of the Fox News app should not stimulate visits to Fox mobile web site for weather news, since the weather content is similar across the two platforms.

In Table 3 we show the results of falsification tests that utilize visits to sites for financial and weather news. These utilize the regression model in equation (1), but the dependent variable is the likelihood of visiting mobile web sites for weather or financial news instead of general news. The mobile web sites are weather web sites of each of the news providers for column 1, and financial news web sites for column 2 (not all news providers have web sites for weather or financial news, which is the reason for the lower number of observations in Columns 1 and 2 in Table 3 when compared to Columns 1 and 2 in Table 2). As in Table 2, the coefficients for $FoxApp_{it} \times FoxWeatherWeb_j \times time_t$ ($FoxApp_{it} \times FoxFinancialWeb_j \times time_t$) measure the change in the likelihood of visiting Fox mobile web site for weather (financial) news when the Fox News app is adopted compared to visiting other weather (financial) news web sites relative to non-adopters. These coefficients are insignificant; there is no evidence to support the view that the adoption of the Fox News app increases the likelihood of visiting Fox weather or financial

mobile web sites comparing to that of visiting other providers' weather or financial news mobile web sites.

(Insert Table 3 here)

In sum, our robustness results provide additional evidence to support our hypothesis that adoption of the Fox News app indeed leads to an increase in the likelihood of visiting Fox News mobile web site in support of the hypothesis H1b.

Testing Hypothesis 2: Diversity of News Consumption and Complementarity

We next consider which types of consumers exhibit stronger or weaker complementarity between the two channels to better understand when complementarity or substitution is likely to be most salient.

In Columns 1 and 2 of Table 4, we show the results of regression model where we include additional interactions with our measures of users' diversity of news consumption.

As a measure of the diversity of mobile web sites visited ($Diversity_i$), we create a dummy for cohorts that historically had visited more mobile web sites. We use the data from the second quarter of 2009 (prior to our sample) to construct this measure. In particular, we first compute the average number of web sites visited across consumers within a cohort to compute a cohort-level measure of diversity. We define $Diversity_i = 1$ if this cohort-level measure of diversity is greater than the median diversity across all cohorts, and 0 otherwise.

Our results show that when $Diversity_i = 1$ the effects of adopting the Fox news app on visits to Fox mobile web site Foxnews.com are weakened considerably; this can be seen in the negative and significant coefficient on $FoxApp_{it} \times FoxWeb_j \times time_t \times Diversity_i$. In particular, when $Diversity_i = 0$ then adoption of the Fox news app increases the likelihood of visiting Fox mobile web site by 41.91 percentage points. In contrast, when $Diversity_i = 1$ the likelihood of visiting Fox mobile web site after Fox News app adoption decreases by 17.45 percentage points significantly. The results suggest that historical diversity in a consumer's news consumption will weaken the complementarity effects between a provider's mobile news app and web site, supporting H2.

(Insert Table 4 here)

Testing Hypothesis 3: Temporal Budget and Complementarity

Columns of 3 and 4 of Table 4 show the results of regression model where we include additional interactions of our measures with a proxy for consumers' time constraint.

As a proxy for consumers' time constraint, we use a variable in our data that indicates the employment status of the consumer, coded categorically as full employment, part-time employment, student, retired, and so on. Similar to our strategy for measuring diversity of news consumption, we create a dummy for cohorts that have a higher percentage of consumers that are fully employed, $\text{PercentFullEmploy}_i$. If the percentage of consumers who are fully employed in a cohort is greater than the median across all cohorts, the dummy variable is set to 1. It is set to 0 otherwise. Full employed consumers are more time-pressured (Gronau 1977).

Our results show that complementarities are stronger among less time constrained cohorts. The likelihood of visiting Fox mobile web site after Fox News adoption increases by 27.27 percentage points for cohorts in which $\text{PercentFullEmploy}_i=0$, while Fox News adoption increases the likelihood of visiting Fox mobile web site by only 16.49 percentage points when $\text{PercentFullEmploy}_i=1$. Therefore, an increase in a consumer's time constraint results in a lower incremental change in the likelihood of visiting the mobile news web site on smart phones when the news app from the same provider was adopted. The results suggest that customers' time constraints weaken the complementarity effects between a provider's mobile news app and web site, supporting H3.

Discussion

In this study, we analyze the impact of adopting mobile news apps on consumer visits to mobile news web sites. First we briefly summarize the empirical findings in the paper. We find robust empirical evidence that adoption of a mobile news app significantly increases the likelihood of visiting the news app's corresponding mobile web site. In addition, we find that the complementarity effect is stronger for users with high valuation for concentrated news contents and with less time constraints. As news apps and mobile web sites have some different

comparative advantages, one channel can promote visits to the other. We conduct various robustness exercises to confirm the validity of our findings.

From a theoretical standpoint, we contribute to the literature by providing a setting and evidence of complementarities across different channels within contents providers. Our results are consistent with the view that consumers sample and fully consume contents across different channels. In our setting, consumers may sample in this way because news apps have better usability but mobile web site is more content-rich.

Our findings have several important managerial and policy implications. First, from the media planner's perspective, the spillover traffic from the mobile app to the mobile web site suggests that advertisements that are placed on both mobile apps and web sites will have repeated impressions on the same target audience. Hence placing an ad on both channels serves media planners who want to achieve "persuasive" advertising than "informative" advertising. Second, our findings suggest that the greater level of complementarity exists for consumers with concentrated interest or less diversity has an important implication for better advertising targeting. That is, our finding implies that the interests of the consumers who use both channels are more likely aligned with the content's providers. Therefore, effect of repeated exposure on this segment of consumers will be stronger than average consumers who use one channel only. Third, we find little evidence of cannibalization across media channels. Since the rise of mobile computing, a recent debate expressed that if users change their ways to access online news, a mobile news app will serve as a substitute for subsequent visits to the new web sites from the same contents provider (Alang, 2010). After users adopt an app with a better format to read news on mobile phones, users may also visit the mobile web site from the same provider to search for diverse news content that not offered on the app, which might drive complementarity between these two news distribution channels. Our results suggest that the best strategy for news providers to attract more traffic on mobile phones is to manage two distribution channels differently, i.e. offering more news stories on the mobile web site compared to the app, rather than simply devoting most of their resources to apps than to the mobile web site.

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¹ For one notable exception, see Gentzkow (2007). He studies news consumption between online and offline editions of the Washington Post.² A mobile application (or mobile app) is a software application designed to run on smartphones, tablet computers and other mobile devices. In December 2011 the top 200 free iPhone apps were downloaded at a rate of 5.65 million per day (Fiksu 2011).

³ Among the seventeen providers in our sample who have mobile apps and mobile web pages: twelve of them provide more diverse content on their mobile web pages than on their applications. For the other five providers, the amount of content is the same across the two channels.

⁴ Please note that the Gross Rating Points is multiplication of reach and frequency.

Figure 1. Screen shots of Fox News mobile web site and the Fox News app

Fox News mobile web site



Fox news app



The number of top stories shown on Fox News app is around ten, but the number of top stories that can be found on Fox mobile web site is almost one hundred.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Likelihood of visiting ABC site	.1462	.1657	0	1
Likelihood of visiting AOL site	.0613	.1128	0	1
Likelihood of visiting AP site	.0601	.1220	0	1
Likelihood of visiting BBC site	.0702	.1228	0	1
Likelihood of visiting Boston Globe site	.0201	.0636	0	1
Likelihood of visiting CBS site	.0672	.1085	0	1
Likelihood of visiting Chicago Tribune site	.0194	.0500	0	0.5
Likelihood of visiting CNBC site	.0496	.0950	0	1
Likelihood of visiting CNN site	.2729	.1873	0	1
Likelihood of visiting Fox site	.1813	.1848	0	1
Likelihood of visiting Google site	.2381	.1844	0	1
Likelihood of visiting LA Times site	.0265	.0707	0	1
Likelihood of visiting MSN site	.1334	.1443	0	1
Likelihood of visiting NY Times site	.0831	.1248	0	1
Likelihood of visiting NPR site	.0307	.0777	0	1
Likelihood of visiting Reuters site	.0454	.1089	0	1
Likelihood of visiting Times site	.0301	.0746	0	1
Likelihood of visiting USA Today site	.1071	.1386	0	1
Likelihood of visiting WSJ site	.0534	.0953	0	1
Likelihood of visiting WP site	.0282	.0809	0	1
Likelihood of visiting Yahoo site	.2412	.1935	0	1
Likelihood of visiting NBC site	.0508	.1021	0	1
Fox app Adoption	.0227	.1488	0	1
Number of household members	2.9513	.5642	1	5
Length of mobile phone use (year)	3.4757	1.1578	0.5	4
Monthly cost of mobile phone service	109.63	13.56	36.67	150
First to buy new technology	5.2747	.8957	.33	10
Ask for opinion to buy new E-product	5.5660	.8966	1.4	10
Keep track of cell phone technology	5.4547	.8831	.75	10
Number of Cohorts	151			

Table 2. The likelihood of visiting the Fox News web site for increases with adoption of the Fox News app

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline Results	Baseline Results -no controls	Bootstrap Sampling (Bootstrap s.e.)	Bootstrap Sampling -no controls (Bootstrap s.e.)	Smaller Cohort Size	Smaller Cohort Size -no controls
Time dummy of 2010	-0.0046	-0.0043	-0.0042**	-0.0048**	-0.0079*	-0.0083*
	(0.0049)	(0.0046)	(0.0062)	(0.0078)	(0.0045)	(0.0044)
FoxApp x time	0.0403**	0.0315**	0.0170**	0.0186**	0.0244	0.0276
	(0.0200)	(0.0196)	(0.0126)	(0.0128)	(0.0204)	(0.0200)
FoxWeb x time	-0.0538*	-0.0538*	-0.0197*	-0.0197*	0.0019	0.0019
	(0.0302)	(0.0301)	(0.0213)	(0.0213)	(0.0284)	(0.0284)
FoxApp x FoxWeb x time	0.2936**	0.2936**	0.1824***	0.1824***	0.2746**	0.2746**
	(0.1371)	(0.1347)	(0.0304)	(0.0304)	(0.1248)	(0.1221)
Controls	Yes	No	Yes	No	Yes	No
Constant	0.1371**	0.0941***			0.0281	0.0964***
	(0.0651)	(0.0022)			(0.0487)	(0.0020)
Observations	6,644	6,644			10,208	10,208
R ²	0.6159	0.6141			0.6161	0.6073
Number of cohort	151	151			232	232

Controls: the number of persons in the household, the length of the mobile service usage, the monthly cost of the mobile service, and variables measuring the technological sophistication of users. R-squared includes the explanatory power of the fixed effects in the R-squared computation. Robust standard errors, clustered on web site-cohort level in parentheses. *** significant at 1%, ** significant at 5%, * significant at 1%

Table 3. The likelihood of visiting the Fox News web site for weather and financial news does not increase with Fox News adoption

	(1)	(2)
VARIABLES	WeatherWeb	FinancialWeb
Time dummy of 2010	0.0011	-0.0052***
	(0.0065)	(0.0017)
FoxApp x time	0.0316*	0.0204***
	(0.0206)	(0.0052)
WeatherWeb x time	0.0128	
	(0.0123)	
FoxApp x FoxWeatherWeb x time	0.0282	
	(0.0896)	
FinancialWeb x time		0.0012
		(0.0048)
FoxApp x FoxFinancialWeb x time		0.0243
		(0.0196)
Controls	Yes	Yes
Constant	0.0067	-0.0055
	(0.0815)	(0.0280)
Observations	4,832	6,040
R ²	0.6589	0.6581
Number of cohort	151	151

Controls: the number of persons in the household, the length of the mobile service usage, the monthly cost of the mobile service, and variables measuring the technological sophistication of users. R-squared includes the explanatory power of the fixed effects in the R-squared computation. Robust standard errors, clustered on web site-cohort level in parentheses. *** significant at 1%, ** significant at 5%, * significant at 10%

Table 4. Complementarities is stronger for cohorts with lower diversity of news consumption or with lower percentage of fully employment users

	(1)	(2)	(3)	(4)
	News diversity	News diversity -no controls	Full employment	Full employment -no controls
Time dummy of 2010	-0.0011	-0.0004	-0.0092	-0.0089
	(0.0056)	(0.0054)	(0.0063)	(0.0062)
FoxApp x time	0.0388*	0.0230	0.0290	0.0174
	(0.0230)	(0.0221)	(0.0268)	(0.0261)
FoxWeb x time	-0.0789**	-0.0789**	-0.0736*	-0.0736*
	(0.0350)	(0.0349)	(0.0402)	(0.0403)
FoxApp x FoxWeb x time	0.4191***	0.4191***	0.2727**	0.2727**
	(0.1547)	(0.1532)	(0.1032)	(0.0098)
time x Diversity	-0.0171*	-0.0197*		
	(0.0102)	(0.0102)		
FoxApp x time x Diversity	0.0177	0.0472		
	(0.0489)	(0.0476)		
FoxWeb x time x Diversity	0.1355**	0.1355**		
	(0.0612)	(0.0613)		
FoxApp x FoxWeb x time x Diversity	-0.5936***	-0.5936***		
	(0.2015)	(0.2000)		
time x PercentFullEmploy			0.0116	0.0108
			(0.0093)	(0.0093)
FoxApp x time x PercentFullEmploy			0.0163	0.0237
			(0.0402)	(0.0398)
FoxWeb x time x PercentFullEmploy			0.0501	0.0501
			(0.0589)	(0.0585)
FoxApp x FoxWeb x time x PercentFullEmploy			-0.1078**	-0.1078**
			(0.0535)	(0.0489)
Controls	Yes	No	Yes	No
Constant	0.1395**	0.0941***	0.1387**	0.0941***
	(0.0653)	(0.0020)	(0.0652)	(0.0020)
Observations	6,644	6,644	6,644	6,644
R ²	0.6182	0.6148	0.6128	0.6045
Number of cohort	151	151	151	151

Controls: the number of persons in the household, the length of the mobile service usage, the monthly cost of the mobile service, and variables measuring the technological sophistication of users. R-squared includes the explanatory power of the fixed effects in the R-squared computation. Robust standard errors, clustered on web site-cohort level in parentheses. *** significant at 1%, ** significant at 5%, * significant at 1%