Current Trends in Digital Marketing

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Cite as:
Shehu Edlira, Abou Nabout Nadia (2020), Current Trends in Digital Marketing. *Proceedings of the European Marketing Academy*, 49th, (62468)

Paper from the 49th Annual EMAC Conference, Budapest, May 26-29, 2020.

Special Session on "Current Trends in Digital Marketing"

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1 The value of cursor information in predicting purchase behavior
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2 Placement disclosure in ad auctions: Evidence from a policy change
Sila Ada*, Nadia Abou Nabout (presenting author)*, Elea McDonnell Feit**
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3 Horizontal and vertical software multihoming for entertainment platforms: Impacts on hardware sales and market share
Nico Wiegand*, Yuri Peers**, Alexander Bleier (presenting author)***
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Declaration:
Each presenter has agreed to register for the conference and to present the paper, if the proposal is accepted; and none of the papers has been submitted to other conference tracks, and none have previously been presented at EMAC.

Abstract

The special session aims to discuss current trends in digital marketing. Each of the unpublished papers provides a new substantive and/or methodological contribution. Below, we briefly describe each of the papers and their respective contributions in more detail:

#1: The value of cursor information in predicting purchase behaviour (Atalay, El Kihal & Ellsaesser): Retailers are interested in predicting customers' purchase probability to target customers in real time. The authors develop a Long Short Term Memory neural network and use cursor flow data to show that purchase likelihood can be predicted very accurately using only the first 20 seconds of customer visits. A simulation study illustrates how retailers can use this model to individualize offers and considerably increase their margins.

#2 Placement disclosure in ad auctions: Evidence from a policy change (Ada, Abou Nabout & McDonnell Feit): The authors analyze how information disclosure of ad placements affects ad auction outcomes. They analyze data from a leading European ad exchange, which sells about 170M impressions weekly via real-time bidding auctions. Using data before and after a policy change, they show that average revenue per impression rose due to information disclosure. This effect was stronger for sites with thick markets.

#3 Horizontal and vertical software multihoming for entertainment platforms: Impacts on hardware sales and market share (Wiegand, Peers & Bleier): The authors analyze how horizontal and vertical multihoming strategies affect sales and market shares of different entertainment platforms. Using monthly hardware sales data and over 8,800 software releases of the leading consoles, PlayStation, Xbox, and Wii, they show positive effects of horizontal software multihoming, whereas the impact of vertical multihoming depends on the specific platform. In addition, the authors highlight specific software characteristics that influence the multihoming release effects.

#4 Understanding Multi-Channel Dynamics (Shehu & Naik): Given the highly interactive multichannel multimedia environment, firms face the challenge on how to allocate advertising budgets across multiple media, while accounting for interdependencies between sales channels. The authors propose a multimedia multichannel model, which accounts for channel specific dynamics and multichannel interdependencies. They use weekly data from a leading retailer over a period of three years, and estimate the model via Kalman filter. In addition, they analytically derive a closed-form solution for the optimal budget allocation, and demonstrate that ignoring channel dependencies leads to sub optimal managerial decisions.

The value of cursor information in predicting purchase behavior

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Most consumers visit a retailer's website and leave it without making a purchase. In our data, 99.5% of product page visits end without a purchase. If the retailer would know which product page visits will not end with a purchase, then implementing real-time interventions (such as offering price discounts) targeted at consumers with a lower purchase likelihood is a promising strategy. However, predicting purchase likelihood is a challenging task since information on consumers' decision process is usually not fully observed by the retailer.

To solve this problem, we develop a machine learning approach, using a novel source of data, namely cursor flow data. We use a software that tracks consumer's cursor movements and develop a model that predicts purchase likelihood using only the first 20 seconds of cursor flow information. We develop a Long Short Term Memory (LSTM) neural network to predict purchase likelihood and train the model on a dataset consisting of several thousand product page visits, for which micro movements of the cursor were tracked at 10 ms intervals.

Using cursor flow data for predicting purchase has several advantages. Cursor flow data is easily available to every online retailer and is inexpensive. Additionally, cursor flow data provides real-time information on consumer's decision process on a particular product page, allowing the retailer to do dynamic and targeted interventions, such as incentivising consumers with a low purchase likelihood with price discounts.

We find that cursor flow data is powerful in predicting purchases, allowing us to predict purchase likelihood with over 80% accuracy. Moreover, we find that consumers tend to move their cursor towards the "Add to Cart" button more than 5 seconds before making a purchase. This finding is in line with eye tracking research, which shows that consumers tend to drift with their eye movements towards a product or an item of choice before they have actively indicated their choice by e.g., clicking on a button (Atalay, Bodur and Rasolofoarison 2012). Finally, we demonstrate in a simulation study how retailers can use our model to individualize offers for specific customers, thereby avoiding targeting customers who would have purchased anyways. Our simulation shows that, by using cursor flow and applying our LSTM neural network, retailers can considerably increase their margins.

Placement disclosure in ad auctions: Evidence from a policy change

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Digital display is a rapidly-growing advertising medium and of major interest to many researchers (Goldfarb & Tucker 2011; Reiley et al. 2012; Johnson et al. 2017). It is also important to advertisers due to new targeting possibilities based on user demographics and online behavior as well as lower transaction costs enabled by the emergence of real-time bidding (RTB) platforms. When a user requests a page from a site, an opportunity to advertise to that user becomes available. If the site publisher wants to sell this impression on the exchange, it can submit a bid request to the ad exchange, including a cookie ID identifying the user. The ad exchange broadcasts the bid request to potential advertisers typically through intermediaries including demand side platforms (DSPs.) In response, advertisers submit bids for the impression and the exchange sells it in a second-price auction. Finally, the winning advertiser pays the bid offered by the second-highest bidder and their ad is displayed to the user. Since advertisers receive the cookie ID for the impression in the bid request, they are able to place independent bids for each impression to a specific user.

Initially, many RTB platforms did not provide advertisers with information about which site their ads will appear on. Placement information may be important to advertisers because the site where an ad is placed may have an effect on the consumer's response to the ad (Goldfarb & Tucker 2011; Bleier & Eisenbeiss 2015). In practice, the market becomes more transparent if the ad exchange provides the URL of the site that the ad will be displayed on in the bid request to the advertiser. However, our discussions with industry professionals revealed that ad exchanges are often reluctant to provide advertisers with more information about ad placements due to negative effects on revenue for certain publishers. In line with practitioners' concerns, some of the theoretical and empirical literature argues that more information about a good offered in an auction will not always generate higher selling prices (Levin & Milgrom 2010). However, providing ad buyers with site placement information allows advertisers to put a more precise valuation on each impression that they bid on. If the sites are horizontally differentiated, meaning different advertisers prefer different sites, then when advertisers bid their valuations for individual sites rather than the average valuation of the bundle, auction prices rise (Tadelis & Zettelmeyer 2015; Hummel & McAfee 2016).

While the literature primarily reports theoretical findings or counterfactual simulations, there is little direct empirical evidence on the effect of context information on ad auctions.

The data we analyze comes from a leading European ad exchange, which made a policy change in 2016. The ad exchange is a private marketplace and sells about 170M impressions per week to roughly 720 individual advertisers via real-time bidding auctions. Before the policy change, advertisers were able to bid on individual impressions based on cookie information, without knowing which specific site their ads would be displayed on. After the policy change, advertisers were given information about where each ad would be displayed for each impression. We use data before and after the policy change to determine how this change affected auction outcomes. The data consist of the number of impressions purchased and average selling price for each bidder-publisher pair in each week. The primary data set spans a period of five months in 2016 that covers four weeks before the change (March 2016), four weeks where some advertisers had access to placement information (April 2016), and twelve weeks where all advertisers received placement information (May to July 2016).

Our analysis shows that average revenue per impression rose after the policy change relative to the previous year. The increase in prices was most pronounced for the sites with a large number unique winning bidders prior to the policy change. Sites with fewer bidders (thin markets) experienced a slight drop in prices. These heterogeneous treatment effects are consistent with a scenario where advertisers prefer different sites. Such horizontally differentiated preferences lead to an increase in prices with site disclosure (Tadelis & Zettelmeyer 2015), so long as the market does not become thin (Levin & Milgrom 2010; Hummel & McAfee 2016). Under this scenario, advertisers bid higher for the sites they prefer after the policy change, which shifts the distribution of winning bids to the right.

A unique feature of the policy change we observe is that the site information was made available to one advertiser one month earlier than the other advertisers. When preferences for sites are heterogeneous across bidders and markets are thick, information disclosure to one bidder results in that bidder winning more auctions, but not paying higher prices. While we do not directly observe the auction bids in our data, a contemporaneous comparison of the bidder who was given early access to the site placement information and a synthetic control that had similar pre-treatment purchase patterns shows that the treated bidder won more auctions than they had previously (thus was bidding higher), but did not pay higher prices. While this is not a randomized treatment, the contemporaneous comparison between advertisers who did and did not have site placement information, adds evidence that the policy change had a causal effect on auction outcomes.

Horizontal and vertical software multihoming for entertainment platforms: Impacts on hardware sales and market share

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Digital platforms have taken over large parts of the entertainment industry. Today, music, television series, books, and video games are increasingly marketed as part of hardware-software or software-software systems, where a core product (the platform) serves as a physical or digital hub facilitating the consumption of compatible content (Lee & O'Connor 2003; Stremersch et al. 2007). However, as much as a platform is needed to consume content, its economic success crucially hinges on a steady supply of fresh, enticing software.

In video gaming, manufacturers of platforms (i.e., consoles) mainly depend on third party developers to source their assortment of complements (i.e., games). To obtain a competitive advantage, console manufacturers often aim to ensure that games are exclusively compatible with their own platforms (Coughlan 2004). Independent game developers, however, often follow a so-called multihoming strategy, where they produce games that are compatible with more than one platform. Such a non-exclusive approach is becoming increasingly popular and allows developers to spread the fixed costs of game development over multiple platforms and tap a larger market potential with each game (Corts & Lederman 2009).

Prior research has begun to investigate *horizontal multihoming* strategies according to which software is compatible across multiple directly competing consoles (Binken & Stremersch 2009; Landsman & Stremersch 2011). However, today, firms also market software increasingly through *vertical multihoming* strategies according to which software is compatible with indirect competitors like mobile devices, handheld devices, or consoles from the prior generation. Given these recent developments, this study aims to answer the following questions:

(1) How do horizontal and vertical multihoming strategies affect the sales and market shares of different entertainment platforms?

(2) To which extent do characteristics of the released software moderate the effects of horizontal and vertical multihoming?

To answer these questions, we draw on an extensive dataset of monthly hardware sales and over 8,800 software introductions in the seventh and eighth console generations (2005–2017), supplemented with information about software characteristics and corresponding advertising efforts. We employ an error correction modelling approach and a market share

attraction estimation to examine the impacts of horizontal and vertical software multihoming strategies on total sales and market share of the leading consoles, PlayStation, Xbox, and Wii.

Our results provide insights into the extends to which console manufacturers benefit or suffer from distinct forms of multihoming in the short-term and long-term. In particular, and contrary to previous research, our findings suggest that horizontal software multihoming may exert positive effects on platform success both in terms of absolute sales and market share. The impact of vertical multihoming, however, depends on the specific platform: Releasing console games as mobile applications benefits the sales of corresponding consoles and increases their market shares, whereas the release on predecessor console systems and handhelds seems to not have an impact. In addition, our findings highlight specific software characteristics that influence the effects of their multihomed release. While, for instance, exclusive releases increase platforms sales irrespective of software quality, multihoming is generally more effective for higher-quality software.

Our research provides important implications for both platform manufacturers and software developers. For manufacturers, we show that striking exclusive release deals might be of lower importance than previously thought and that specific forms of multihoming (horizontal and mobile multihoming) may help rather than hurt console success. In addition, our findings might motivate software developers to more strongly incorporate vertical multihoming into their strategic offerings in negotiations with platform manufacturers.

Understanding Multi-Channel Dynamics

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The current marketing environment is characterized by an increasing variety of advertising media and sales channels (Ailawadi & Ferris 2017; Verhoef et al. 2015). Due to technological advancements, firms can engage with their customers through multiple offline and online media utilizing offline and online sales channels. Given this highly interactive multichannel multimedia environment, where consumers can choose distribution channels for their purchases and utilize different media to obtain information about products, firms face the challenge on how to allocate their advertising budgets across multiple media, while accounting for interdependencies between channels (Verhoef et al. 2015).

Research analyzing interdependencies between channels has typically analyzed these

interdependencies in settings where companies add a new sales channel, and shows mixed results. Some studies show that adding a new sales channel can hurt sales of the existing one (Pauwels & Neslin 2015; Foreman et al. 2009), others show complementarity (Bell et al. 2018; Avery et al. 2017). However, after a new sales channel is established, companies need insights on whether both channels will co-exist, or one of these will dominate in the long-run. In addition, companies need to optimize their advertising budgets for an increasing number of media, based on the channel specific media effects.

Literature on dynamic media effects does typically not differentiate between sales channels (Danaher & van Heerde 2018), or does not consider cross-channel effects when using multichannel settings (e.g., Diner et al. 2014). In addition, existing research does not show how companies should allocate their budgets dynamically across different channels, while considering the dynamics in the optimization problem and the channel interdependency.

This paper proposes a multimedia multichannel model, which accounts for channel specific dynamics and multichannel interdependencies. We use weekly data from a leading retailer over a period of three years, who uses online and offline distribution channels. The retailer advertises its products through different online and offline media, online advertising, radio, TV, catalogs and calls. We estimate the model via Kalman filter.

Our results show that both carryover effects are very strong, i.e., weekly sales show a strong persistency for online (b=.704, se=.060, p<.000) and offline (b=.483, se=.137, p<.000). More interestingly, we see that offline sales cannibalize sales of the online channel (b=-.603, se=.170, p<.000), but the reverse effect does not emerge. Regarding media effects, we see that offline media, like radio and calls drive online sales, and that online advertising in turn drives offline sales. Contrary to the belief that television advertising drives online traffic, TV advertising may not have significant effects on both, online and offline sales.

Based on our model estimates, we analytically derive a closed-form solution for optimal budget allocation, as well as the optimal budget share of each advertising medium. First, we show that the actual allocation of the company is not optimal, because the retailer overspends on TV and catalogs, and underspends on radio and calls. More interestingly, we calculate the allocation if channel interdependency is not considered, and show that the differences are substantial and would lead to suboptimal managerial decisions.

This work provides novel insights regarding budget allocation of the total budget, as well as media-specific budget allocation for each of the sales channels, while considering channel interdependencies. These insights aim to augment our understanding of dynamically optimal

budgeting and allocation in multimedia multichannel setting in the presence of channel dynamics. Our results will have one important takeaway: Managers need to not only account for profits improvement in the current period due to budget re-allocation, but also consider how current re-allocation increases future trajectories of multichannel sales over time and across multiple sales channels, which, in turn, increase the cumulative profit over time.

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