

# Mobile Commerce in the New Tablet Economy

## Abstract

The rapid adoption of smartphones and tablets as well as the widespread use of mobile applications has been fueling the growth of mobile commerce around the world. This paper quantifies the economic impact of tablets in ecommerce and m-commerce markets by examining its complementary and substitution effects with two other channels – PCs and smartphones. We use archival data from the largest online and mobile commerce website in China (Taobao) and exploit a quasi-natural experiment to identify our results. Results show that the introduction of tablets enhanced the overall growth of ecommerce markets, with an annual impact of approximately US\$6.06 billion. The tablet channel acts as a substitute for the PC channel and a complement for the smartphone channel. Further, our results highlight that consumers spend more when a tablet is simultaneously used with a PC, a smartphone, or both. The most revenue generating combination of simultaneous device usage is that of a smartphone and a tablet. Consumers also purchase more distinct products when they adopt the tablet. We provide insights for retailers about how they can increase their sales volume and revenue in the emerging tablet economy.

*Keywords:* Mobile commerce, Tablet Economy, Channel Interdependence, Econometrics

## **1. Introduction**

The rapid adoption of smartphones and tablets as well as the widespread use of mobile applications has been fueling the growth of mobile commerce around the world. According to ABIresearch (2012), in 2012, the mobile commerce market doubled in size to nearly \$65 billion and in 2017 it is expected to account for 24% of overall ecommerce revenues. Consumers often use multiple devices within the same shopping session. According to Google (2012b), 65% of multi-device shoppers begin on a smartphone. Of those beginning the shopping process on a smartphone, 61% continue on a PC/laptop and 4% continue on a tablet.

Tablets now drive more ecommerce traffic than smartphones. According to Gigaom (2012a), in the first quarter of 2012, tablet traffic to ecommerce sites was 6.5 percent, overtaking smartphones (5.4 percent) for the first time. In terms of sales revenue, Forrester (2011) reported that tablets accounted for 20 percent of ecommerce sales, even though only 9 percent of shoppers own tablets. However, the rise of tablets is chipping away at the PC, which saw its share of traffic to ecommerce sites drop to 88.1 percent in the first quarter of 2012, a steep 4 percent drop in just one quarter Gigaom (2012a). The same report also predicts that PC traffic should fall below 75 percent within the next year. As tablets are increasingly growing in popularity, it becomes imperative for retailers to understand the economic impact of the tablet channel to ecommerce.

The purpose of this paper is to quantify the economic impact of tablets in the ecommerce and m-commerce markets. In particular, we examine the change in the size and growth of the market after the introduction of the iPad. We also examine whether/to what extent the tablet channel substitutes or complements existing the PC and smartphone channels. Further, we examine consumers' multi-device shopping behaviors and analyze how the simultaneous use of multiple devices affects changes in overall sales.

There are, on the one hand, several plausible reasons that could lead to a positive impact of the introduction of the tablet channel on the overall ecommerce market. Tablets provide portability, ease of access and convenience with touch screens and larger screen sizes. As smartphones, tablets, and PCs are frequently used throughout the day, the addition of a new device can allow consumers

to use their micro-moments across multiple devices to search and shop. Thus, it can help consumers to accomplish a shopping goal and generate additional sales. On the other hand, there are also plausible reasons for the introduction of the tablet channel not to have a significant impact (or even have a negative impact) on ecommerce sales. If the new tablet channel were to simply replace sales from existing PC or/and smartphone channels, it might actually reduce overall (cumulative) sales. As tablets are increasingly equipped with high-resolution screens and easy-to-use input interfaces, consumers can migrate their shopping activities from PCs or/and smartphones into tablets.

Previous research has examined the impact of introduction of online ecommerce channel. For example, prior work has found that online ecommerce markets improve consumer welfare and firms' profits through wider product selection (e.g., Brynjolfsson et al. 2003, Cachon et al. 2008). Moreover, past research has looked at the direction and magnitude of the interdependence between two sales channels (e.g., Brynjolfsson et al. 2009, Forman et al. 2009). However, the impact of the introduction of the tablet channel on consumers' ecommerce and m-commerce demand has not been explored by previous literature. In this paper, we aim to bridge this gap by exploring how the introduction of the tablet channel affects consumers' online and mobile purchases.

To examine this question, we use a large-scale archival data from the largest online and mobile commerce website in China, Taobao, and exploit a quasi-natural experiment to identify these effects. Treating the availability of the iPad channel in Taobao as an "event" in a natural experimental setting during our 4-year sampling period, we find that total sales increased by 16.7% after a consumer adopts the iPad. The annualized impact of the iPad adoption to sales in Taobao is estimated approximately US\$4.91 billion. In a similar vein, our findings show that the annualized impact of the Android tablet adoption is estimated US\$1.15 billion. Thus, the introduction of the tablet enhances the overall growth of ecommerce and m-commerce markets with its annualized impact of approximately US\$6.06 billion.

We also find that sales through the smartphone channel increased by 106.1%. However, the sales through the PC channel decreased by 11.6% after consumers adopt the iPad. This result suggests that the tablet channel acts as substitute for the PC channel while it acts as a complement

for the smartphone channel. Moreover, we find tablet adopters also purchase more frequently as well as browse more. Further, consumers tend to spend more when a tablet is used with other device(s) – a PC, a smartphone, or both – simultaneously for searching and shopping sessions. The most revenue generating combination of simultaneous device usage is that of a smartphone and a tablet. Consumers also purchase more distinct products when they adopt the tablet. To summarize, we show that while the tablet channel is a substitute for the existing PC channel and a complement for the smartphone channel, the introduction of tablets have enhanced the overall growth of ecommerce and m-commerce markets.

The rest of this paper is organized as follows. In Section 2, we provide related literature to build the theoretical framework. Section 3 provides a brief overview of the empirical setting for our archival data and a quasi-natural experimental setting. Section 4 presents the field experiment results and discusses the robustness check and additional analyses results. Section 5 discusses the implications of the results and concludes.

## **2. Prior Literature**

In this section, we discuss multiple streams of relevant literatures such as interdependence between channels and user behaviors in the mobile media.

### **2.1. Interdependence between Channels**

A long stream of literature has examined the interdependence between different channels. The outcome of such research has important managerial implications for whether a firm should invest in both channels/platforms (if there exists a synergistic effect) or in just one of the two (if there is no synergistic effect). Our paper is closely related to a stream of work in multichannel retailing. Previous studies examined cross (channel)-price elasticities or changes in product availability or geography to examine consumer substitution/ complementarity between channels (Brynjolfsson, Hu and Rahman 2009, Brynjolfsson, Hu and Smith 2003, Choi et al. 2010, Ellison and Ellison 2006, Forman et al. 2009, Goolsbee 2001, Prince 2007). For example, Forman et al. (2009) explore the competition between offline and online channels. They find that people substitute offline purchasing

from online purchasing when a store opens locally, and the disutility costs of purchasing online are substantial and that offline transportation costs matter. Our paper explores interdependence between online and mobile purchasing when a new tablet channel is introduced.

There is also an emerging stream of literature that has examined the interdependence between advertising channels. In the increasingly advertising-filled, multi-channel environment, consumers are exposed to more than one advertising message from a company before they buy the product through different channels. For example, in the literature on online advertising, Yang and Ghose (2010) find that click-throughs on organic listings have a positive interdependence with click-throughs on paid listings, and vice versa due to reinforcement effects. Lewis and Nguyen (2012) also find there exists positive interdependence between display ads and searches for advertised brands and competitors' brands due to spillover effects/externalities. Goldfarb and Tucker (2011b) find negative interdependence between targeted and highly visible ads due to privacy concerns. Goldfarb and Tucker (2011a) also find substitution patterns between online and offline advertising channels. They find that offline direct marketing substitutes for paid search advertising for legal services. Recently, Ghose et al. (2013) explore the interdependence between web and mobile advertisements. They find that implementing web and mobile ads simultaneously improves web click-through rates, mobile click through rates and web conversion rates but decreases mobile conversion rates.

## **2.2. User Behavior in Mobile Media**

Mobile content services constitute one of the fastest-growing applications on the web today. Our paper builds upon and relates to the literature on user behaviors in the mobile media. For example, as consumers are increasingly engaged in not only content usage but also content generation using their mobile phones, Ghose and Han (2011) find that there is a negative and statistically significant temporal interdependence between content generation and usage on the mobile Internet. This is because, on the mobile Internet, users not only invest time, but also incur transmission charges to generate and use content in certain countries. Ghose et al. (2012) explore how Internet browsing behavior varies between mobile-phone and PC users in a natural

experimental setting. They show that search costs are higher and the benefit of browsing for geographically close matches with retailer is higher on the mobile internet than the PC internet.

There is also an emerging literature that has discussed the role of mobile technologies in marketing. Previous studies have examined consumer perceptions and attitudes towards mobile location-based advertising (Brunner and Kumar 2007, Xu et al. 2009). Gu (2012) examines both the short-term and long-term sales effects of location-based advertising. Recently, mobile couponing and location-based advertising have gained increasing interest as a marketing tool. Dickinger and Kleijnen (2008) find that a segment of “value seekers” are more prone to mobile-coupon redemption. Molitor et al. (2012) show that the higher the discount from mobile coupons and the closer the consumers are to the physical store offering the coupon, the more likely they are to download the mobile coupons. The research on location-based advertising is still in its nascent stage. Bart et al. (2012) study mobile advertising campaigns and find that they are effective at increasing favorable attitudes and purchase intentions for higher (versus lower) involvement products, and for products that are seen as more utilitarian (versus more hedonic).

### **3. Empirical Background and Data Description**

We provide a brief overview of the empirical setting for our archival data and a quasi-natural experimental setting on the largest ecommerce website in China, Taobao.

#### **3.1. Data from Taobao**

We acquired access to a large-scale archival data of individual consumer-level purchase and browsing histories from the largest ecommerce and m-commerce firm in China, Taobao. Taobao’s B2C platform, Tmall, leads the B2C market with 56.7% market share in China. In 2012, with 564 million internet users and 75 percent of them are using mobile internet, ecommerce accounts for 7.7% of total retail sales in China. Since it was founded in May 2003, Taobao has more than 500 million registered users. In 2012, Taobao’s sales revenue exceeded 1 trillion RMB (160 billion USD), which is about 5% of total retail sales in China (Alibaba 2012). There are a PC-based online website and mobile applications for smartphones and tablets of the service. However, the products

and service features offered are the same regardless of whether a user accesses the service through a PC, a smartphone, or a tablet. There are more than 300 million users who accessed Taobao through mobile devices, and about 3.5 million users have made purchases through mobile devices (Taobao 2012).

We collected the data from the Chinese market between January 1, 2009 and December 31, 2012 (4 years) from a randomly selected 10,000 users. Our data consists of 8.14 million consumer-level transaction data encompassing 7.93 million purchases from PCs, 0.17 million purchases from smartphones, and 0.03 million purchases from tablets. The transaction data include user id, product id, transaction date and time, price, quantity, total payment, and access channel (PCs, smartphones, and tablets). The data also includes 336.06 million consumer-level browsing records (282.45 million from PCs, 48.15 million from smartphones, and 5.46 million from tablets). The browsing records include user id, browsed page URLs, product id, visit date and time, and access channel.

### **3.2. Quasi-Natural Experiment: iPad Introduction in China**

We treat the availability of the iPad channel in Taobao as an “event” in a natural experimental setting during our 4-year sampling window. We chose the iPad because it is the first tablet introduced in China and it is the most popular tablet brand with the market share of 79% in China in 2012 (UMeng 2013). There are two notable events in Taobao’s tablet commerce timeline: 1) the introduction of the iPad (hardware) and 2) the release of the iPad app for Taobao (software) during our 4-year sampling period (see Figure 1). Apple launched its first version of iPad in China on September 17, 2010. However, it was only after Taobao published its first iPad app in Apple App Store in China that consumers started making actual purchases through the iPad (Tencent 2011). This was because although one could browse Taobao’s service through a regular web browser such as Safari, one had to install extra software (i.e., plug-ins) to complete payments through the iPad. However, Taobao did not provide such plugins for the iPad at that time due to technical issues. Thus we use the release of the iPad app for Taobao as the main demand shock in our setting. And we define consumer tablet adoption in our setting as purchasing the iPad and downloading the iPad app

for Taobao. This demand shock allows us to identify causal changes in sales from PC and smartphone channels (if any) before and after the availability of iPad.

<Insert Figure 1 Here>

### **3.3. Model-Free Evidence of Economic Impact of Tablet Introduction**

We first provide “model-free” evidence that the economic impact of the introduction of the tablet channel is substantial. First, in order to explore the economic impact of the introduction of the iPad, we compare the average purchase amount per user between two groups: 1) users who accessed the Taobao service through both a PC and a smartphone and 2) users who accessed the Taobao service through all three channels including a PC, a smartphone, and a tablet. We then compare these two groups of same individual users before and after the iPad app release date. We use information on user-level access device type (a PC, a smartphone, and a tablet) and browsing records to identify each group type. Figure 2 shows that the average per-user purchase amount increases by 67% in Group 1 and by 87% (1.98/1.06) in Group 2 after the tablet channel introduction. So the introduction of the tablet channel leads to a disproportionate increase in sales from Group 2 over group 1 by about 30%. Since the difference between Group 1 and Group 2 is that only users in Group 2 have tablets, such disproportionate sales increase can be attributed to the introduction of the tablet channel. To protect the confidentiality of the sales information, in Figure 2, we re-scaled the actual sales revenue by setting the average sales revenue in Group 1 before the introduction of the iPad channel to 1.

<Insert Figure 2 Here>

Second, in order to examine how the tablet channel acts as a substitute or complement for the existing PC and smartphone channels, we compare channel (device)-specific sales share between Group 1 and Group 2 at each month during the 4-year sampling period. Figure 3 shows after the Taobao’s iPad app release (denoted as a dark vertical line) the sales share from PCs has disproportionately decreased in Group 2 over Group 1. For example, the sales shares from the PC channel at the end of our sampling period (in December 2012) are 94% in Group 1 and 80% in Group 2, respectively. In contrast, the sales shares from smartphones have disproportionately



increased in Group 2 over Group 1. For example, the sales shares from the smartphone channel in December 2012 are 6% in Group 1 and 15% in Group 2, respectively. So this result seems to suggest that the tablet channel substitutes sales from the PC channel while it complements sales from the smartphone channel.

<Insert Figure 3 Here>

#### 4. Econometric Model

A key statistical challenge we face here is to identify the causal impact of tablet adoption on changes in sales from all three channels –PCs, smartphones, and tablets. One potential concern about the model-free results in the previous section is that iPad adopters in general have more disposable income, and hence, are more likely to purchase from ecommerce and m-commerce websites. Thus when comparing the difference in sales between the tablet adopters and the non-adopters, consumers who select themselves into the tablet user group cause a biased sample, resulting in biases in estimates of the impact of the tablet adoption. To control for such a potential source of selection bias, we employ a straightforward difference-in-difference identification strategy using a matched sampling approach.

The difference-in-differences model is a quasi-experimental technique used in econometrics that measures the effect of a treatment at a given period in time both for a group that received the treatment and for a control group that did not receive the treatment (Meyer 1995). In our case, “treated” users are those who adopt the iPad and “untreated” users are those who do not adopt the iPad. Specifically, we estimate the impact of a new tablet channel on the level and share of sales from a PC and a smartphone channels, or all. For consumer  $i$  and in month  $t$ , our estimating equation is:

$$Outcome_{it} = \beta TreatmentGroups_{it} * AfterTreatment_{it} + X_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

where the outcomes are sales volume or share from a PC, a smartphone, a tablet, or all. Given this specification, we control for observed covariates such as consumer credit score (a proxy for disposable income), age, and location,  $X_{it}$ , consumer fixed effects,  $\mu_i$  and month fixed effects,  $\tau_t$ . As

such, all differences across consumers and all systematic changes over time are controlled for in the regression.

To construct a control group, we use a matched sample of untreated consumers. The idea is that each treated consumer (in our case, iPad adopter) is paired with a non-treated consumer (i.e., iPad non-adopter) that is identical to the treated consumer in terms of its propensity of being treated. This allows direct comparison of users who have similar characteristics (propensity scores) that affect tablet adoption, where one user is a tablet adopter while the other is not (see Aral et al. 2009, Carmi et al. 2012, Heckman and Ichimura 1998, Smith and Telang 2009). Thus the coefficient  $\beta$  will capture how sales volume or share in the treatment group of consumers change after they adopt the iPad compared to the control group of consumers over the same period.

Implementing this in our context, propensity scores are calculated using the standard Probit function with observed explanatory variables (age, gender, PC purchase amounts, mobile purchase amounts, digital goods purchase frequency, and mobile browsing frequency). We then created a matched sample based on propensity scores. For any given propensity score, we could find users with similar propensity scores in both treatment and control groups while preserving the global distributions over the treatment and control groups (see Figure A1 in the Appendix for propensity score distributions and Table A1 in the Appendix for the Probit result).

## **5. Empirical Results**

### **5.1. Main Results**

Table 1 shows the result of regression described in Equation (1) for log-transformed sales revenue from all three channels (a PC, a smartphone, and a tablet). We find that total sales increased by 16.7% after a consumer adopts the iPad. Figure 4 repeats the analysis in Table 1 at a finer level of detail. Given that there are approximately 10 million iPad users in Taobao, the annualized impact of the iPad adoption to sales in Taobao is estimated approximately US\$4.91 billion. Further, rather than one binary indicator variable identifying when Taobao released its iPad app, we substitute the *Treated Consumers After Adopting the iPad* variable with a sequence of dummy variables for the

months before and after Taobao's iPad app release. We find that, prior to the iPad app release, consumers in the treatment group (i.e., those who adopt the iPad) exhibit no trend towards increased sales revenue; the timing of the change in the estimated coefficient is coincident with the timing of the iPad app release.

<Insert Table 1 and Figure 4 Here>

To assess how the introduction of a new tablet channel affects sales substitution/complementarity between online and mobile channels, we re-estimated Equation (1) for sales shares and volumes from smartphone and PC channels, respectively. Table 2 presents the results. Columns (1) and (3) show that sales revenue through the smartphone channel increased by 106.1%, however, the sales revenue through the PC channel decreased by 11.6%. Columns (2) and (4) show that sales share of the smartphone channel increased by 6.1 percentage points, however, the sales share of the PC channel decreased by 10.2 percentage points after consumers adopt the iPad. The results suggest that the tablet channel acts as a substitute for the PC channel while it acts as a complement for the smartphone channel.

<Insert Table 2 Here>

## **5.2. Robustness Check Results**

To further validate our main results, we have conducted a series of robustness check analyses. In the product's life cycle, early adopters are likely to be different from late adopters (i.e., younger vs. older, more educated vs. less educated, risk-taking vs. conservative). Hence, we conducted robustness checks to only account for the people who adopted the tablet during the same stage of the product life cycle. We have selected 4 sub-samples by including matched sample observations when their first tablet use date is between Jun 2011 and Aug 2011, between Sep 2011 and Nov 2011, between Dec 2011 and Feb 2012, and between Mar 2012 and Dec 2012, respectively. Table 3 shows that the results are robust to sub-samples. Overall, our key coefficient estimates remain qualitatively the same in terms of the sign and the statistical significance.

<Insert Table 3 Here>

Table 4 shows robustness to an alternative sales measurement, which is purchase frequency. The rationale of using this sales measurement is that total sales revenue increases while the sales transaction frequency remains the same or even decreases. Column (1) shows that total purchase frequency increased by 10.1% after a consumer adopts the iPad. Columns (2) and (4) show the purchase frequency through smartphones increased by 34.5%, however, the purchase frequency through PCs decreased by 8.6%. Columns (3) and (5) show purchase frequency share of smartphones increased by 6.4 percentage points, however, the purchase frequency share of PCs decreased by 10.8 percentage points, after consumers adopt the iPad. These results remain qualitatively the same as the main results.

<Insert Table 4 Here>

iPhone users and Android phone users generally use their devices differently in terms of data consumption, app downloads, and shopping. Table 5 shows that the results are robust to additional sub-samples in which we only look at iPhone users and Android phone users, respectively. We find that total sales increased by 22.0% after an iPhone consumer adopts the iPad and total sales increased by 14.9% after an Android phone consumer adopts the iPad. These results remain qualitatively the same as the main results.

<Insert Table 5 Here>

In addition to Apple's iPad, Android tablets are also serving the Chinese tablet market with their market share of 21% in China (UMeng 2013). We treat the availability of the Android tablet channel in Taobao (the release of Android app for Taobao was on December 2010 (Tencent 2011)) as another "event" in a natural experimental setting during our 4-year sampling window. Table 6 shows that the result of regression described in Equation (1) for log-transformed sales revenue from all three channels (a PC, a smartphone, and a tablet). We find that total sales increased by 15.7% after a consumer adopts the Android tablet. Given that there are approximately 2.5 million Android tablet users in Taobao, the annualized impact of the Android tablet adoption to sales in Taobao is estimated approximately US\$1.15 billion. Figure 5 demonstrates the result in Table 6 at a finer level of detail. We find that, prior to the Android app release, consumers in the treatment group (i.e.,

those who adopt the Android tablet) exhibit no trend towards increased sales revenue; the timing of the change in the estimated coefficient is coincident with the timing of the Android app release. These results remain qualitatively the same as the main results.

<Insert Table 6 and Figure 5 Here>

### **5.3. Additional Analyses**

We have conducted a series of additional analyses. An additional ecommerce channel, tablet, can either allow popular products to become more popular or lead niche products to become popular, depending upon how people shop for a specific product category in a multi-device setting. There are 15 product categories in Taobao including automotive, beauty, clothing, digital goods, electronics, food, home & building, household appliances, household items, jewelry & watches, kids & babies, local, movies & music, shoes & bags, and sports & outdoors. We re-estimated Equation (1) using new interaction variables between the *Treated Consumers After Adopting the iPad* variable and each of the sequence of dummy variables for 15 product categories. Table 7 shows the sign and the magnitude of the economic impact of the tablet channel varies by product category. Figure 6 plots the estimates based on purchase amount rearranged by the order of sales popularity of each product category. In particular, we find overall sales for clothing (the most popular product category in our setting) increased by 28.6% after a consumer adopted the iPad. Clothing sales revenue increased by 78.6% through the smartphone channel and decreased by 8.0% through the PC channel.

Extra time arises from spontaneous usage of mobile devices, and consumers often use these micro-moments across multiple devices to search and shop (Google 2012b). First, to examine whether/to what extent people browse more after adopting the iPad, we re-estimated Equation (1) using browsing frequency volume and share as a new dependent variable. Table 8 shows that total browsing amount, measured in frequency, increased by 11.0% after a consumer adopts the iPad while the browsing frequency increased by 76.5% through smartphones and decreased by 18.1% through PCs. This result corroborates our main results by showing that the introduction of the tablet increased not only the overall sales revenue but also the overall searching and browsing amount.

Further, the tablet channel substitutes both sales and browsing amounts through the PC channel while it complements both sales and browsing amounts through the smartphone channel.

Next, to examine whether and to what extent the simultaneous usage of devices (channels) changes sales, we re-estimated Equation (1) using new interaction variables between the *Treated Consumers After Adopting the iPad* variable and each of the sequence of dummy variables for simultaneous browsing frequency between any 2 channels, between PC and smartphone, between PC and tablet, between smartphone and tablet, and among all 3 channels, respectively.

We assume that two adjacent browsing activities from different devices are simultaneous when the time interval between the two browsing records is less than 2 minutes. Our results are robust to alternative interval threshold values such as less than 1 minute or less than 30 seconds. Table 9 shows that total sales did not increase from either the simultaneous browsing between any two devices or between a PC and a smartphone after a consumer adopts the iPad. However, the total sales increased by 13.8% from the simultaneous browsing between a PC and a tablet after a consumer adopts the iPad. Importantly, the total sales increased the most by 390.2% from the simultaneous browsing between a smartphone and a tablet after the consumer adopts the tablet. These results suggest that consumers spend more when the tablet is simultaneously used with either a PC or a smartphone, or both, and the most revenue generating combination of the simultaneous device usage is that of a smartphone and a tablet.

<Insert Table 7, Table 8, Table 9, and Figure 6 Here>

Lastly, we analyze the impact of the tablet channel introduction on product diversity. Product diversity is measured by the number of distinct products purchased. Table 10 shows product diversity increased by 6.7% after a consumer adopts the iPad. This result suggests that consumers not only purchase more and frequently but also purchase more distinct products when they adopt the iPad.

<Insert Table 10 Here>

## **6. Conclusions**

Mobile commerce is taking off in a big way as mobile technologies are being used to distribute vouchers, coupons, and location-specific deals. In particular, mobile devices such as smartphones

and tablets are changing the way consumers search, shop, and keep entertained. When it comes to online shopping, consumers are turning to whichever device is at hand. While PCs and laptops are still the most widely used devices for browsing and purchasing, tablet- and smartphone-induced mobile shopping is on the rise (Zmags 2012). In today's multi-screen world, consumers are increasingly navigating the Web through multiple devices such as smartphones, tablets, laptops, and PCs to accomplish a goal. For example, one can start a task like booking a flight online using a PC, later continue the same task using a tablet, and finally make a purchase using a smartphone. This paper contributes by producing, to our knowledge, the first study that quantifies the impact of the introduction of tablets in ecommerce and m-commerce markets and examines whether and to what extent the tablet channel substitutes or complements existing PC and smartphone channels. This paper also contributes to an emerging stream of literature on economics of the mobile internet.

We use a large-scale archival data from the largest online and mobile ecommerce website in China, Taobao for 4 years. We treat the availability of the iPad channel in Taobao as an "event" in a quasi-natural experimental setting during our sampling period. Our results show that the annualized impact of the iPad adoption to sales in Taobao is estimated US\$4.91 billion. Similarly, we find the annualized impact of the Android tablet adoption is estimated US\$1.15 billion. Hence, the introduction of tablets enhances the overall growth of ecommerce and m-commerce markets in China with its annualized impact of approximately US\$6.06 billion.

Our findings also suggest that the tablet channel acts as a substitute for the PC channel and as a complement for the smartphone channel. Tablet adopters also purchase more frequently as well as browse more frequently than the non-adopters. Further, consumers spend more when a tablet is simultaneously used with other devices. The most revenue generating combination of simultaneous device usage is that of a smartphone and a tablet. Said simply, we show that the introduction of the tablet channel enhanced the overall growth of the ecommerce and m-commerce markets.

This study provides several insights for managers. First, our results can provide online retailers with insights about how they can increase their sales volume and revenue in the emerging tablet economy. Our results show total sales increase after consumers adopt tablets. However, only less

than one-third of top 100 U.S. retailers have optimized their sites for tablets (Zmags 2012). Thus, retailers need to create an engaging, even playful shopping experience on tablets, by providing powerful searching and browsing functions, generating attractive user interfaces with rich media, and building safe and convenient payment systems. Second, our results show that a tablet channel substitutes a PC channel. Tablets are in many ways performing like PCs when it comes to shopping. For example, tablets converted visits into purchases at a rate of 3.23 percent, not far behind PCs at 3.51 percent and well ahead of smartphones at 1.39 percent (Gigaom 2012b). Although tablets can do even better than PCs if tablet apps and websites start tailoring their services for tablets, most of tablet apps/websites are still oriented towards a PC experience. Thus, there are still more optimization opportunities that retailers can redesign their apps/websites to the tablet environment. Third, our results show that a tablet channel complements a smartphone channel, and that the tablet and smartphone is the most revenue generating combination of the simultaneous device usage. Thus, the prevalence and importance of simultaneous usage of multiple devices in shopping makes it imperative for retailers to provide a seamless experience across all of the user's devices. For example, retailers could provide auto-saved shopping cart function across different devices (implying that one can save and bookmark products from one device and continue on it later from another device), or the ability to email shopping progress to oneself (Google 2012a).

Data availability issues suggest that some caution is warranted in the estimation of the effect of the tablet channel. For example, our analysis focuses on the Chinese market. It is quite possible that the magnitude of the impact of the introduction of the tablet will vary across different markets, particularly the US and Europe. In addition, our data does not address iPad mini, which have somewhat smaller screens than iPad but are more mobile and less heavier. Future research can examine how the introduction of the iPad mini changes the size and growth of ecommerce market. Notwithstanding these limitations, our analyses document a substantial economic impact of the introduction of tablets on the ecommerce and m-commerce markets. To the extent that consumers are using multiple devices to search and shop, the increasing size of the tablet devices may have profound implications for the future direction of internet commerce.

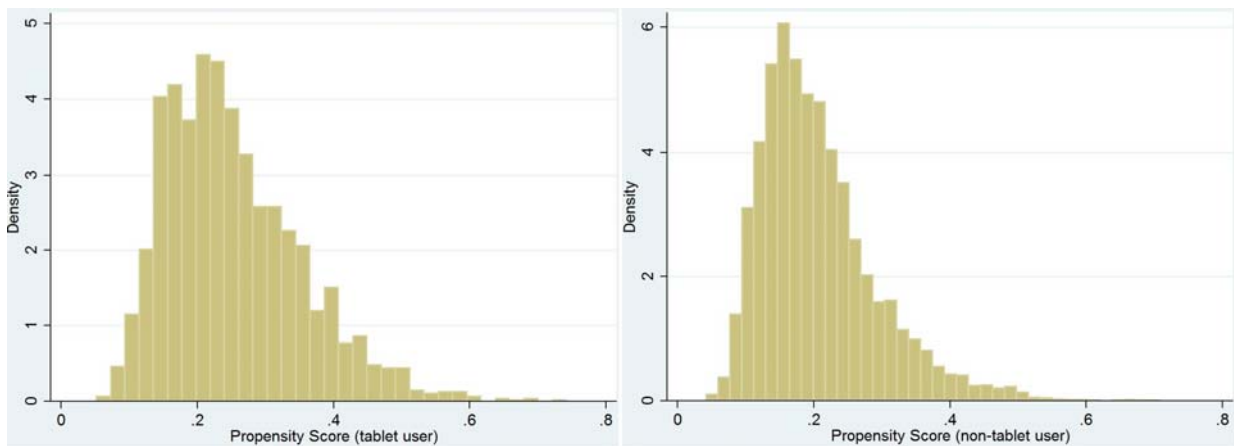


## Appendix

**Table A1 Propensity Score Estimation (Probit)**

Independent Variables	Estimate (Standard Error)
Age	-0.008*** (0.002)
Gender	0.143*** (0.036)
log(mobile purchase amounts before June 2011)	0.036*** (0.010)
log(pc purchase amounts before June 2011)	0.042*** (0.015)
log(digital goods purchase frequency before June 2011)	0.097*** (0.017)
log(mobile browsing frequency before June 2011)	0.060*** (0.006)
<i>N</i>	9983

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.



**Figure A1 Propensity Score for Adopting the iPad.**

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**Table 1 Consumers Spend “More” After Adopting the iPad**

	Log Sales Revenue from All 3 Channels (PC, Smartphone, and Tablet)
Treated Consumers After Adopting the iPad	0.167*** (0.016)
<i>N</i>	107566
<i>R</i> <sup>2</sup>	0.1970

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 2 Consumers Spend “More” Amounts through Smartphone but “Less” through PC After Adopting the iPad**

	Sales from Smartphone Only		Sales from PC Only	
	Log Sales Revenue	Sales Revenue Share in Percentage	Log Sales Revenue	Sales Revenue Share in Percentage
Treated Consumers After Adopting the iPad	1.061*** (0.020)	0.061*** (0.001)	-0.116*** (0.017)	-0.102*** (0.002)
<i>N</i>	107566	107566	107566	107566
<i>R</i> <sup>2</sup>	0.1952	0.1467	0.1524	0.1083

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 3 Robustness to Sub-samples by Tablet Adoption Date**

Cohort	Sales from All 3 Channels	Sales from Smartphone Only		Sales from PC Only	
	Log Sales Revenue	Log Sales Revenue	Sales Revenue Share in Percentage	Log Sales Revenue	Sales Revenue Share in Percentage
Jun 11–Aug 11	0.092** (0.037)	1.003*** (0.050)	0.060*** (0.004)	-0.177*** (0.042)	-0.094*** (0.004)
Sep 11–Nov 11	0.028 (0.044)	1.084*** (0.059)	0.064*** (0.004)	-0.270*** (0.049)	-0.118*** (0.005)
Dec 11–Feb 12	0.198*** (0.029)	1.043*** (0.039)	0.064*** (0.003)	-0.128*** (0.033)	-0.102*** (0.003)
Mar 12–Dec 12	0.223*** (0.025)	1.100*** (0.032)	0.058*** (0.002)	-0.030 (0.028)	-0.100*** (0.002)

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 4 Robustness to Alternative Sales Measurement (Purchase Frequency)**

	Sales from All 3 Channels	Sales from Smartphone Only		Sales from PC Only	
	Log Sales Frequency	Log Sales Frequency	Sales Frequency Shares in Percentage	Log Sales Frequency	Sales Frequency Shares in Percentage
Treated Consumers After Adopting the iPad	0.101*** (0.012)	0.345*** (0.006)	0.064*** (0.001)	-0.086*** (0.012)	-0.108*** (0.002)
$R^2$	0.2073	0.1777	0.1158	0.1781	0.1572

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 5 Robustness to iPhone and Android Phone Users**

	Sales from All 3 Channels	Sales from Smartphone Only		Sales from PC Only	
Treated Consumers After Adopting the iPad	Log Sales Revenue	Log Sales Revenue	Sales Revenue Share in Percentage	Log Sales Revenue	Sales Revenue Share in Percentage
iPhone Users	0.220*** (0.034)	1.292*** (0.049)	0.068*** (0.004)	-0.126*** (0.040)	-0.115*** (0.004)
Android Phone Users	0.149*** (0.034)	0.482*** (0.039)	0.010*** (0.003)	0.036 (0.037)	-0.056*** (0.003)

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 6 Robustness to Android Tablet Users**

	Sales from All 3 Channels	Sales from PC Only	
Treated Consumers After Adopting the Android Tablet	Log Sales Revenue	Log Sales Revenue	Sales Revenue Share in Percentage
	0.157** (0.065)	0.097 (0.069)	-0.029*** (0.005)
$R^2$	0.2364	0.2090	0.0899

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 7 Additional Analyses by Product Category**

	Sales from All 3 Channels	Sales from Smartphone Only		Sales from PC Only	
Treated Consumers After Adopting the iPad	Log Sales Revenue	Log Sales Revenue	Sales Revenue Share in Percentage	Log Sales Revenue	Sales Revenue Share in Percentage
Automotive	-0.099** (0.048)	0.200*** (0.043)	0.037*** (0.007)	-0.401*** (0.059)	-0.070*** (0.007)
Beauty	0.006 (0.023)	0.412*** (0.020)	0.062*** (0.003)	-0.461*** (0.028)	-0.106*** (0.003)
Clothing	0.286*** (0.018)	0.786*** (0.016)	0.058*** (0.003)	-0.080*** (0.022)	-0.105*** (0.003)
Digital goods	0.032 (0.023)	0.675*** (0.020)	0.112*** (0.003)	-0.598*** (0.028)	-0.140*** (0.003)
Electronics	0.072*** (0.027)	0.302*** (0.024)	0.043*** (0.004)	-0.277*** (0.033)	-0.081*** (0.004)
Food	-0.161*** (0.025)	0.329*** (0.022)	0.058*** (0.004)	-0.614*** (0.031)	-0.103*** (0.004)
Home & Building	-0.018 (0.025)	0.318*** (0.022)	0.049*** (0.004)	-0.393*** (0.031)	-0.089*** (0.004)
Household appliances	-0.034 (0.030)	0.269*** (0.027)	0.050*** (0.004)	-0.491*** (0.037)	-0.097*** (0.005)
Household items	0.106*** (0.023)	0.311*** (0.020)	0.059*** (0.003)	-0.269*** (0.028)	-0.104*** (0.003)
Jewelry & Watches	0.153*** (0.031)	0.316*** (0.027)	0.068*** (0.004)	-0.302*** (0.037)	-0.107*** (0.005)
Kids & Babies	-0.170*** (0.031)	0.437*** (0.027)	0.062*** (0.004)	-0.692*** (0.038)	-0.118*** (0.005)
Local	-0.038 (0.071)	0.250*** (0.063)	0.066*** (0.010)	-0.419*** (0.086)	-0.086*** (0.011)
Movies & Music	0.035 (0.023)	0.338*** (0.020)	0.058*** (0.003)	-0.369*** (0.028)	-0.103*** (0.003)
Shoes & Bags	0.140*** (0.021)	0.466*** (0.019)	0.061*** (0.003)	-0.333*** (0.026)	-0.110*** (0.003)
Sports & Outdoors	-0.001 (0.029)	0.302*** (0.026)	0.052*** (0.004)	-0.423*** (0.036)	-0.097*** (0.004)
$R^2$	0.2059	0.2610	0.2502	0.2013	0.2759

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 8 Consumers Browse “More” Overall and through Smartphone but “Less” through PC After Adopting the iPad**

	Browsing Frequency from All 3 Channels	Browsing Frequency from Smartphone Only		Browsing Frequency from PC Only	
	Log Browsing Frequency	Log Browsing Frequency	Browsing Freq. Shares in Percentage	Log Browsing Frequency	Browsing Freq. Shares in Percentage
Treated Consumers After Adopting the iPad	0.110*** (0.020)	0.765*** (0.045)	0.047*** (0.003)	-0.181*** (0.021)	-0.154*** (0.004)
$R^2$	0.1163	0.1451	0.0873	0.1056	0.1592

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 9 Consumers Spend More when Tablet is Simultaneously Used with Other Devices**

	Log Sales Revenue from All Channels (2 minutes)	Log Sales Revenue from All 3 Channels (1 minute)	Log Sales Revenue from All 3 Channels (30 seconds)
Treated Consumers After Adopting the iPad			
Log Simultaneous Browsing Frequency Between Any Two Devices	0.004 (0.013)	0.004 (0.013)	-0.002 (0.015)
Log Simultaneous Browsing Frequency Between a PC and a Smartphone	0.013 (0.015)	0.013 (0.015)	0.004 (0.016)
Log Simultaneous Browsing Frequency Between a PC and a Tablet	0.138*** (0.017)	0.138*** (0.017)	0.139*** (0.020)
Log Simultaneous Browsing Frequency Between a Smartphone and a Tablet	3.902*** (1.373)	3.902*** (1.373)	3.885*** (1.373)
Log Simultaneous Browsing Frequency Among Three Devices	0.386*** (0.132)	0.386*** (0.132)	0.705*** (0.252)

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.

**Table 10 Product Diversity Increases After Adopting the iPad**

	Log Number of Distinct Products Purchased
Treated Consumers After Adopting the iPad	0.067** (0.027)
$R^2$	0.9395

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.





Figure 1 Taobao’s Tablet Commerce Timeline.

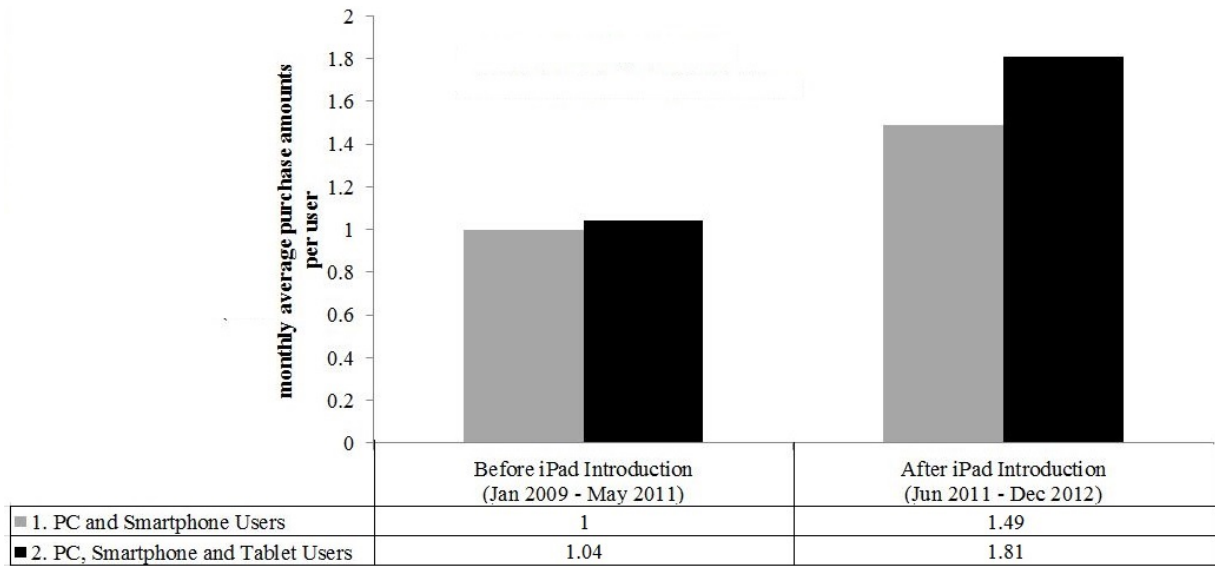
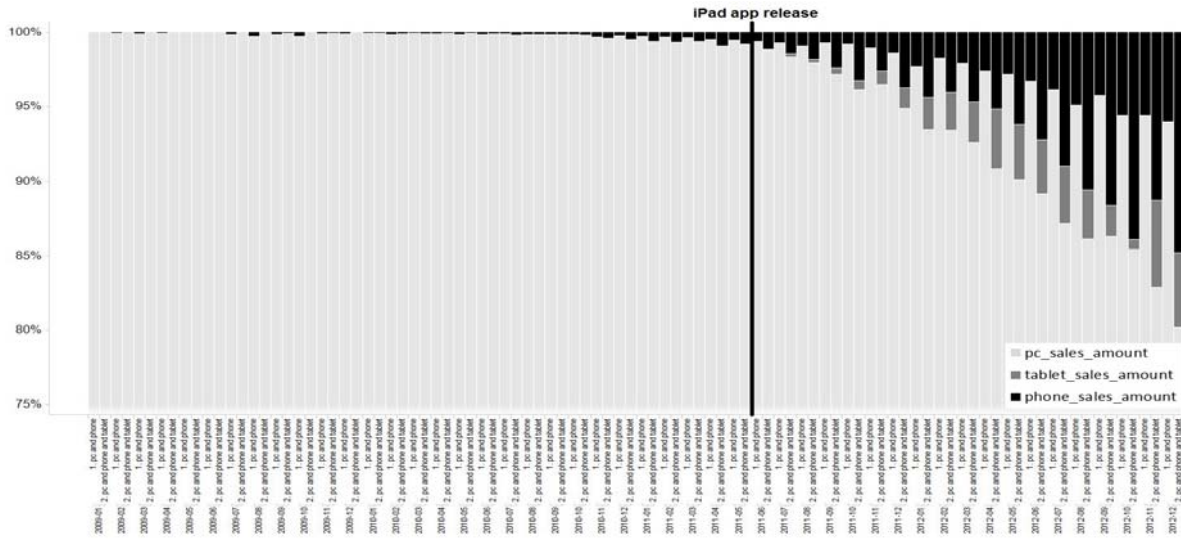
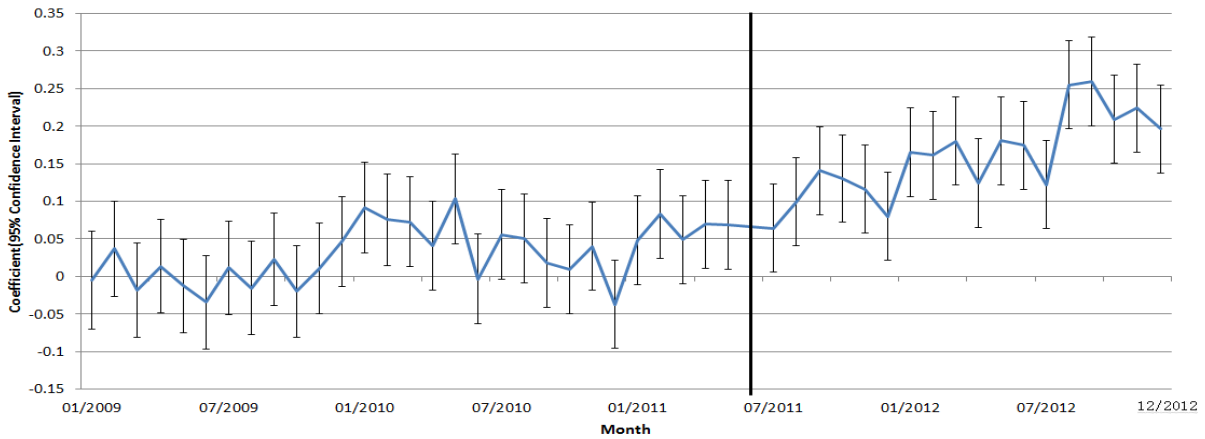


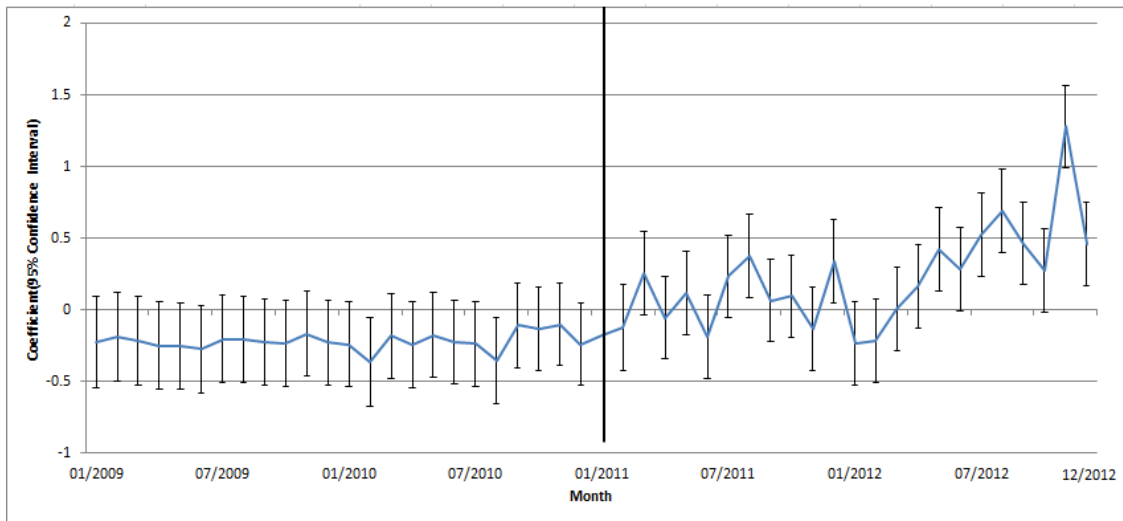
Figure 2 Do Consumers Spend More After Adopting the iPad?



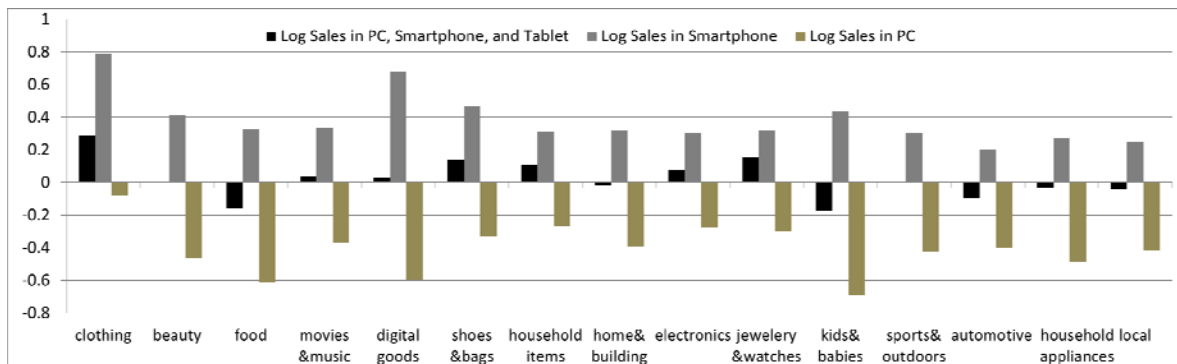
**Figure 3 Do Consumers Spend More through Smartphones After Adopting the iPad?**



**Figure 4 Coefficients of Regression of Log Sales Revenue on Being in the Treatment Group over Time.**



**Figure 5** Coefficients of Regression of Log Sales Revenue on Android Tablet Users over Time.



**Figure 6** The Economic Impact of the Tablet Channel Introduction Varies by Product Category.