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Third-party apps (TPAs) and software platform performance: The moderating role of competitive entry

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ABSTRACT

Noting the increasing importance of software platform, this article examines the effects of third-party apps (TPAs) on platform performance (PP) and how such effects differ before versus after competitive entry. The authors validate the hypotheses using data from the web browser market. The results show that the quantity of new TPAs leads to higher PP before than after competitive entry, whereas the quantity of TPA updates contributes a higher PP after than before competitive entry. In addition, the quality is more important and diversity is less important to PP after than before competitive entry.

1. Introduction

Software built on different platforms is used in a variety of industries such as mobile systems (e.g., Apple App Store), web browsing (e.g., Firefox, Chrome), video games (e.g., Xbox, PlayStation), and social media (e.g., Facebook) [1–3], leading more researchers to emphasize the importance of platform-based strategies for establishing a firm's competitive advantage and performance (e.g., [4]. Unlike traditional, nonplatform-based markets, software platforms extend product boundaries by encouraging diverse, complementary third-party apps (TPAs) to join them to help satisfy the needs of heterogeneous users [5,6]. For example, Apple's App Store launched in early 2007 with approximately 500 TPAs; by 2015, this quantity had increased to 1.5 million TPAs, ranging across varied domains such as education, entertainment, games, health, productivity, and sports. Google Android, a competing smartphone platform, featured 1.6 million TPAs in 2015.

To make the software platform more appealing to customers, a platform can devise strategies for new TPAs to join it [1,7]. A platform, for example, can offer development guidelines or standard development kits for TPAs [8]. To have successful TPAs such as Angry Birds, the platform might also impose screening criteria on TPAs before making them available [9]. At the same time, a platform can encourage or incentivize existing TPAs to upgrade, which is to leave core functionality intact, and to release with more features and better performance [10]. For example, with the encouragement from web browser platform, Adblock Plus, a TPA that helps end users block annoying ads, has upgraded its versions 62 times since its initial launching. However, these TPAs represent a double-edged sword for the platform [1,11]: On the one hand, a wide portfolio of complementary TPAs makes the platform more attractive, but on the other hand, managing a wide range of TPAs can be challenging in terms of both performance risks and end-user acceptance [5]. Therefore, it is both practically and theoretically important to understand the value implications of TPAs to software platform performance (PP). However, we still know little about how TPAs contribute to PP, leaving a significant research gap that this paper attempts to address.

In addition, the effects of new TPAs and TPA updates on PP may be different with the entry of competing platforms, as many platform-based markets experience competitive entries. If the incumbent platform and new entrant use similar business models and are developed for the same end users, they are positioned in direct competition and the new entrant can be considered as competitive [12]. For example, in the video game market, Sony's incumbent PlayStation platform experienced competition from Microsoft's Xbox consoles. In the online group buying industry, the incumbent Groupon faced intense rivalry from the new entrant LivingSocial. The market share of the new, competitive platform has the potential to reach certain threshold that could affect the incumbent platforms. Competing platforms may even affect the survival of the incumbent platforms [13,12]. However, we know little about the impact of TPAs on PP under distinct market conditions (e.g., before and after competitive entry). The entry of a competitive platform might alter the behaviors of end users and TPAs, as well as their interplay [3], and thus the different aspects of TPAs on PP before and after competitive entry may be quite different.

Therefore, this paper explicitly examines two key questions: (1) *What are the effects of new TPAs and TPA updates on platform performance?* and (2) *How do such effects differ before and after competitive entry?* In particular, we focus on three aspects of new TPAs and TPA

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updates: *quantity, quality,* and *diversity*. The quantity relates to the number of new TPAs and TPA updates on the platform, quality is about the performance attributes of these new TPAs and TPA updates perceived by end users, and diversity refers to the extent to which these TPAs span across multiple subject domains. Empirically, we study the competition between two platform-based open web browsers: the early mover Mozilla Firefox and the later entrant Google Chrome. Firefox, introduced in November 2004, differed from traditional browsers such as Internet Explorer (IE), in that it operated with a platform ecosystem model that provided a development kit and application programming interface (API) to encourage TPAs (i.e., add-on applications by third-party developers to enrich Firefox's performance). In December 2009, Google developed its Chrome browser and entered the market using a similar platform strategy. This entry provides an ideal setting to assess the effects of TPAs on the Firefox platform's performance both before and after the competitive entry by Chrome.

Longitudinal weekly data, collected between 2008 and 2013, revealed the TPAs, PP, and competitive entry; by adopting vector autoregression with the exogenous variable (VARX) method, we incorporate dynamic and network effects between TPA and PP. In turn, we obtain several important insights.

(1) The quantity of new TPAs leads to higher PP before than after competitive entry, whereas the quantity of TPA updates contributes a higher PP after than before competitive entry.
(2) The quality of new TPAs and TPA updates is more important to PP after than before competitive entry.
(3) Before competitive entry, a diversified portfolio of new TPAs contributes more to PP, whereas after competitive entry, a concentrated portfolio contributes more to PP.

These findings accordingly contribute to extant literature in several important ways. First, our theoretical framework and empirical results suggest that assessing the value of complementary TPAs to the platform requires noting their unique characteristics and fit with market conditions (before and after competitive entry). Second, the literature of competitive entry in information system, strategic management, and economics mainly focused on the order-of-entry effect and market shares achieved by a new entrant or retained by an incumbent (e.g., [14,15], and disagreement exists about whether an entrant platform can gain or retain market share when it competes with an incumbent platform (e.g., [12]; we provide initial evidence on how an incumbent platform can use TPA strategies to respond appropriately. Finally, our empirical evidence implies that, when facing the entry of a competing platform, platform owners should shift their focus from new to existing TPAs and focus more on TPA quality. Therefore, the platform should balance control over and contributions by TPAs.

2. Related literature

The importance of platform strategies has prompted growing literature to focus on the determinants of PP, as summarized briefly in Appendix A. According to the constituents of platform ecosystem, the determinants of PP can be categorized as platform-related and supply- and demand-side factors. The former emphasizes how a platform can design appropriate strategies to improve its performance, while the latter two focuses on how end user and TPA characteristics may affect PP. Among the platform-related factors, prior studies have examined issues such as pricing, openness, and control. For example, some studies show that it is often profit maximizing for a platform to undercut its price below cost on one side of the market to attract more consumers on that side and increase consumers' willingness to pay (e.g., [16–19]. Furthermore, Maurer and Tiwana [9] found that tight development control is a double-edged sword that promotes knowledge integration on one hand but inhibits platform differentiation on the other. In addition, some theoretical studies suggest that selecting the appropriate levels of openness is crucial for platform success (e.g., [20–22]. Among demand-side factors, Chen and Xie [23] found that, unlike traditional market where higher consumer loyalty generally leads to higher profits, in platform market, where effect of cross-market network exists, a medium level of customer loyalty may lead to lower profits than a low level of loyalty. In addition, Hagiu and Halaburda [24] further examined end users' expectations and found that different mechanisms of expectation formation have distinct influences on platform benefits.

Surprisingly, existing studies have largely ignored the supply-side factors and their impact on PP. Thus far, only Cenamor et al.'s [25] study showed that end users' adoption of platform is driven by the availability of complementary products on the platform, but their study did not explore how different characteristics of TPAs may differentially contribute to PP. Furthermore, prior studies largely ignored the potential entry of competing platforms, even though many platform-based markets experience competitive entries. The emergence of a competing platform is an environmental shock exogenous to an incumbent ecosystem. Although the relationship between environmental dynamics and platform evolution has received some attention in the theoretical literature (e.g., [3], it has received little empirical attention.

3. Theory and hypothesis development

3.1. Two-sided markets in platform ecosystem

The software platform organizes as an ecosystem that encompasses several distinct roles (refer to Fig. 1): (1) demand-side platform users, commonly called "end users"; (2) supply-side TPAs, which are adopted by demand-side users in tandem with the core platform and can be viewed as add-on products; and (3) the core platform, which serves as the primary point of contact for demand-side users and supply-side TPAs [26,27]. The performance of the core platform depends on the demand-side users, supply-side TPAs, and their interactions [21,3].

The software platform inherently operates as a two-sided market and exhibits a special form of cross-side network effects because of the interdependence between end-user demands for platforms and demands for their associated TPAs [7,28]. TPAs usually complement and add functionality to the core platform. The benefit that an end user derives for the use of the platform depends on the availability of TPAs. More TPAs on a platform lead to greater demand for that platform; at the same time, a larger installed base of consumers leads to a larger supply of TPAs [12,29]. In the presence of cross-side network effects, a size advantage on the TPA side normally leads to dominance on the user side, which is then fed back to the opposite side in an escalating fashion. Thus, a platform that has small lead on both sides of the market is likely to attract more users and more TPAs, and thus over time, it could take over the entire market [30,31].

In many cases, TPAs play a significant role in platform innovation and serve as the basis for platform leadership [5]. As a result, the focus of platform owners has shifted from in-house innovation to providing resources that support the development of TPAs [32,33], with the goal of offering future end users greater benefits. For example, platforms are providing some base functionality on which developers can build their

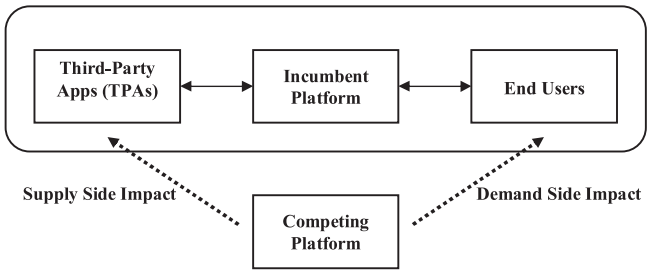

Fig. 1. Impact of Competitive Entry on Platform Ecosystem.