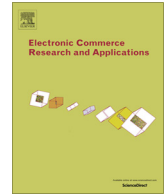




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Competition, cooperation, and regulation: Understanding the evolution of the mobile payments technology ecosystem



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ABSTRACT

The past twenty years have been a time of many new technological developments, changing business practices, and interesting innovations in the financial information system (IS) and technology landscape. They have led to the increasing use of prior innovations that have supported e-commerce, and that are now being brought into financial services to support different kinds of improvements to core business processes. This research examines recent changes in the payment sector in financial services, specifically related to mobile payments (m-payments) that enable new channels for consumer payments for goods and services purchases, and other forms of economic exchange. We extend recent research on technology ecosystems and paths of influence analysis for how industry-centered technology innovations arise and evolve. We explore the extent to which they can be understood through the lens of several simple building blocks, including technology components, technology-based services, and the technology-supported infrastructures that provide foundations for the related digital businesses. Our extension of the prior research focuses on two key elements: (1) modeling the impacts of competition and cooperation on different forms of innovations in the aforementioned building blocks; and (2) representing the role that regulatory forces play in driving or delaying innovation in the larger scope of our modeling approach. To assess the efficacy of our approach, we use it to retrospectively analyze the past two decades of innovations in the m-payments space. Our results identify the industry-specific patterns of innovation that have occurred, suggest how they have been affected by competition, cooperation and regulation, and point out some more universal patterns of technology innovations that offer insights into the development of e-commerce.

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1. Introduction

The history of the financial services industry has witnessed several waves of innovations for services delivery that have changed the ways that customers and banks interact. Advances in *information communication and technology* (ICT) have played an important role in initiating, driving and shaping these innovations (Hatzakis et al. 2010).

1.1. Understanding technology-led financial services and payments industry transformation

In some niche markets, the impacts of technology-based business innovation have been transformational and far-reaching (Callado-Munoz et al. 2012; Steiner and Teixeira 1989; Wriston

1988, 2007). Some of them include the emergence of computer-assisted program trading in the 1980s, the e-brokerage boom in the 1990s, and the elimination of floor trading at the exchanges (Gastineau 1991). Some others are: the introduction of value-at-risk (VAR) and risk-adjusted return on capital (RAROC), which were incorporated in financial risk management systems after the stock market crash of 1987 (Fama 1998, Saita 2007); and the widespread adoption of Internet banking in the 2000s. More recently, mobile payments (m-payments), high-frequency trading (HFT), Bitcoin, and crowdfunding have been shaping the new high-tech landscape of financial services in the late 2000s up to the present (Aldridge 2013).

Various kinds of mechanisms for consumers to make payments have had elements of mobility for many years. For example, in 1946, the National Bank of Brooklyn, New York, issued a “Charge-It” card program that allowed customers to access bank credit at local stores (Bellis 2015). Then in 1950, Frank McNamara, Ralph Schneider and Matty Simmons created a credit card company, the Diners Club, as a means of allowing a customer

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to pay for lunch or dinner at a participating restaurant without having cash (Diners Club International 2015). The card required payment in full, month by month, for its use, and this “mobile credit” service grew rapidly through the mid-1960s in the restaurant, travel, hospitality and entertainment sectors (Ma 2014). In 1958, the Bank of America introduced the BankAmericard, which became the first all-purpose and general-use credit card in payments history (Simon 2007). In the early 1970s, the Bank of America relinquished control of BankAmericard issuance to other organizations in the U.S., which created National BankAmericard Inc. (NBI), and its licensing activities expanded to other countries (Stearns 2007). Then in 1975, NBI and some of its affiliates created an independent organization called VISA, which we know today as one of the leading credit card associations and transaction processors, and a provider of branded credit, debit and prepaid card products to financial institutions.

The past twenty years from 1994 to 2014 have been a period of high innovation in the development of payments technologies and solutions. The first big wave of innovations emerged when Microsoft attempted to acquire Intuit to enter the Internet banking sector in 1994 (Fisher 1994). There was an intense period of experimentation that occurred in parallel with Microsoft’s and other firms’ investigation of electronic bill payment and presentment, and these things supported the growth of industry-wide interest in online payments. The subsequent rise of the online payment services provider, PayPal, and the emergence of online brokers further stimulated the growth of non-cash payments. The growth of money market funds and other investment vehicles in the *shadow banking system* – non-bank financial intermediaries that do not operate subject to the regulations of depository institutions – along with other problems with asset-backed securities, derivatives and ineffective accounting practices contributed to the financial crash in 2008 and the subsequent global financial crisis. After the market downturn years of 2008–2011, companies such as Square, Softcard, Google, PayPal, and Apple Pay expanded their efforts to create and bring m-payments technology and service innovations to the marketplace.

A more formal definition of an *m-payment* is any payment in which some kind of a mobile device is used to initiate, authorize and confirm an exchange of financial value in return for goods and services (Karnouskos 2004). Conceptually, an *m-payment* is a new form of value transfer, similar to other payment instruments that consumers can use, but that relies more on the advanced features of mobile phones and the tokenization of a consumer’s financial credentials (Pandy and Crowe 2014). According to a recent Mobile Payments Industry Workgroup (MPIW) discussion document made available through the Federal Reserve Bank in the U.S. (Pandy and Crowe 2014, pp. 2–3):

A token is a randomly generated substitute value used to replace sensitive information through a process called tokenization. When used for financial transactions, tokens replace payment credentials, such as bank account and credit/debit card numbers. The ability to remove actual payment credentials from the transaction flow can improve the security of the payment and is a key benefit of tokenization. ... The key goal of tokenization is to protect the Primary Account Number, or PAN. A PAN is a 13 to 19-digit number embossed on a plastic bank or credit card and encoded on the card’s magnetic strip. The PAN identifies the card issuer in the first six digits, known as the Bank Identification Number (BIN), as well as the individual cardholder account (generally the final four digits), and includes a check digit for authentication. Tokenization eliminates the need for merchants to store the full PAN on their network systems for exception processing or to resolve disputes. Replacing PANs with tokens can reduce the financial impact resulting from data compromise, theft, or unintended disclosure during

disposal. While data breach prevention is the key to reducing the risk of compromise, tokenization has the benefit of making the compromised data less valuable.

1.2. Research questions, perspectives and analysis approach for m-payments innovations

In this research, we retrospectively analyze the evolution of mobile payments technology innovations in the past two decades with respect to technological changes relative to market competition and cooperation, and government regulation. Financial services professionals and analysts have a difficult time to predict the arrival of new technological developments, estimate the extent of their impacts, and forecast their future status. Hence, there is a strong need to understand how highly impactful technology-based financial innovations were initiated and developed, and then evolved over time.

We address two fundamental research questions. What are the major forces that drive the evolution of technology-based innovations, such as mobile payments, in financial services? What are the roles played by market competition, cooperation, and regulation in shaping the observed paths of evolution and the changing pace of technological transitions?

1.2.1. Technology ecosystems and paths of influence

To answer these questions, we propose a financial information system (IS) and technology ecosystem approach that extends Adomavicius et al.’s (2008a) *technology ecosystem paths of influence model*.¹ We consider the issues that financial services decision-makers and analysts face, as they think through what will drive the major changes in the technology ecosystem in the financial IS and technology landscape. We categorize innovations in three levels: the *technology component level*, the *technology-based service level*, and the *technology-supported business infrastructure level*.² The technology ecosystem perspective only considers technology supply-side forces for innovations though. In this research, we offer an extended view that incorporates market-side competition, cooperation and regulation among a range of stakeholders in financial services as important forces that jointly shape the evolution of technology-based financial innovations.

1.2.2. Supporting theoretical perspectives

Historical events and trends inspired some of our thinking in this research, as did some of the well-known conjectures about how technology performance improves and the alternative interpretations of how changes arise in technology evolution. On the technology side, Moore’s Law suggests that technologies double in performance every eighteen months, a 60% improvement per annum (Moore 1965), but its prediction has been debated due to subsequent empirical assessments (e.g., Tuomi 2002). In addition,

¹ We presented these ideas in multiple conferences in the past, where we obtained useful comments as the basis for earlier and much less complete versions of the current work. They include an article that explored decision-making under certainty for mobile payments (Kauffman et al. 2012, 2013a), followed by a more recent journal article that proposes a new approach for continuous-time stochastic valuation modeling for IT investment under uncertainty that incorporates a mean reversion process to capture cost and benefit flow variations over time (Kauffman et al. 2015b). In addition, we have given presentations about the technology ecosystem view in articles on high-frequency trading (Kauffman et al. 2015a) and mobile payments (Kauffman et al. 2013b, Liu et al. 2014) that are a basis for the present research article. The present article is a unique piece of research, with new ideas on competition, cooperation, and regulation contextual analysis that go beyond our prior work.

² Adomavicius et al. (2007, 2008a, 2008b) constructed three key building blocks, including components, products and applications, and infrastructures, and focused on the general IT landscape rather than the financial services sector, as we do here. We adapt their approach to emphasize the services innovation perspective instead of the product innovation perspective.

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