CREATING AND CAPTURING VALUE FROM FREEMIUM BUSINESS MODELS: A DEMAND-SIDE PERSPECTIVE

Joost Rietveld
Rotterdam School of Management, Erasmus University
Burgemeester Oudlaan 50
Mandeville (T) Building, Room 7-41
3062 PA Rotterdam, the Netherlands
+31 (0)10 408 1996
rietveld@rsm.nl

October 30, 2017

Research summary:
This paper takes a demand-side perspective on business models as a source of performance heterogeneity. It is argued that business models create and capture value when the elements that compose a business model improve how consumers perceive a firm's products and better enable heterogeneous consumers to act on their willingness-to-pay. Hypotheses are centered on the competition between freemium and premium business models and are tested in the market for digital PC games. Results show that freemium games are played less and generate less revenues than premium games. Results further show that greater variety in games' menu of paid items is associated with higher revenues. These findings contribute to our understanding of how firms compete through their business models and hold strategic implications for entrepreneurs.

Managerial summary:
Freemium business models are increasingly prevalent in the digital economy, yet we know very little about how freemium affects consumers' perception of value and their willingness-to-pay. This paper studies how the freemium business model competes with the premium business model in the market for digital PC games. Results show that freemium games are played less and generate less revenues than premium games. The findings further show that greater variety in games' menu of paid items is associated with higher revenues. This implies that in order to achieve competitive parity with firms operating the premium business model, firms operating the freemium business model need to create more value (e.g., through improved product quality, income from advertisements, or unlocking network externalities) or operate at lower costs.

Keywords:
Business models, demand-side view, value creation, value capture, freemium, video games.
Running head:
Creating and capturing value from freemium business models

INTRODUCTION

Over the past two decades the business model construct has become recognized as a novel and relevant unit of analysis in the fields of strategic management, entrepreneurship, and technology and innovation management (Massa, Tucci, and Afuah, 2016; Zott, Amit, and Massa, 2011). Complementing existing theories in strategic management and entrepreneurship, the business model is market-centric, as it looks downstream to the product market as a strategic element for value creation and value capture (Chesbrough and Rosenbloom, 2002; Demil *et al.*, 2015; Priem, Butler, and Li, 2013; Teece, 2010). The business model, defined by Amit and Zott (2001: 511) as 'the content, structure, and governance of transactions so as to create value through the exploitation of business opportunities,' essentially describes how a firm creates value for its customers and the mechanisms it deploys to capture that value.[1]

Beyond the business model's descriptive power, it has been argued that firms can compete through their business model and that business models play a key role in explaining heterogeneity in firm performance (Amit and Zott, 2001, 2012; Casadesus-Masanell and Ricart, 2010; Markides and Charitou, 2004). Netflix's DVD mail-order business model, for example, disrupted the DVD rental market, and Ryanair was able to enter the highly competitive airline industry through its 'no frills' value proposition. While recent studies have importantly validated the business model as a driver of firm performance (Kim and Min, 2015; Zott and Amit, 2007, 2008), there have been few studies to investigate how the business model interacts with the firm's products in shaping the firm's value proposition to consumers. Specifically, we know very little about how the business model influences consumers' perceptions about the firm's products and services and how these perceptions affect the firm's value creation and value capture.

[1] The term customers is used here to denote all downstream, B2B buyers of a vertical chain's products; the term consumers is used to denote the final, B2C buyers of a vertical chain's products (see Priem, 2007, for a discussion).

This paper addresses this gap by taking a demand-side perspective on business models as a source of value creation and value capture. The central premises of the demand-side view are that value needs to be created before it can be captured and that consumers are the final arbiters of value (Gans and Ryall, 2017; Priem, 2007). The demand-side view further posits that firms can achieve competitive advantage without having access to uniquely valuable resources, by devising strategies that exploit consumer heterogeneity in downstream markets (Priem *et al.*, 2013; Ye, Priem, and Alshwer, 2012). Building on this, the two main arguments put forward in this paper are that (1) business models create value when they increase the benefits that consumers perceive from consuming a firm's products and services, and (2) business models facilitate value capture when they enable heterogeneous consumers to act on their willingness-to-pay (WTP). Business models are a source of competitive advantage when their elements improve how consumers perceive a firm's products and/or better enable heterogeneous consumers to act on their WTP, resulting in superior revenue generation vis-a-vis a focal firm's rivals.

To test these arguments, in this paper I analyze the value created and captured from products brought to market through the freemium business model. Freemium business models are increasingly popular in many markets for digital goods, including mobile applications, social networking services, and video games.[2] Contrary to the premium business model, where consumers pay a price before they experience any of the benefits a product offers, transactions in the freemium business model are temporally decoupled such that (initial) consumption precedes consumer payment(s). Additionally, transactions in digital goods are often decomposed into a menu of various add-on features or services. The video-chat and voice-call application Skype,

[2] While the elements of a freemium business model that are most visible to consumers are contained in the revenue model, the firm's implications of operating a freemium business model are more consequential and require distinct capabilities such as involved customer engagements and active monitoring of a product's user-base (Kumar, 2014).

for example, lets users connect with other Skype users for free but charges for calling landlines and mobile phones. The video game Candy Crush Saga, another example, offers players a menu of add-on features allowing them to accelerate their progress, access extra content, or boost their skills. I conduct two studies in the market for digital PC games to analyze how these elements of temporal transaction decoupling and product bundle transaction decomposition affect the amount of time consumers spend on a digital game and the revenues these games generate.

Consistent with arguments put forward by prospect theory and mental accounting (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991; Thaler, 1980, 1985, 1999), I hypothesize that temporal transaction decoupling negatively affects consumers' perceived benefits resulting in lower WTP for freemium products than for premium products. I further argue that temporal transaction decoupling results in subpar revenue generation from freemium products (vs. premium products). Looking at product bundle transaction decomposition, I argue that greater variety (vs. less variety) in a product's menu of paid items allows heterogeneous consumers to self-select into a combination of options that matches their WTP, increasing a product bundle's overall revenue generation. The implications of these conjectures are that products brought to market through the freemium business model will be used less and generate less revenues than premium products (keeping all else constant). Firms can partially offset of this revenue loss by embedding greater variety in freemium products' menu of paid items. Support for these arguments is found in a randomized controlled trial of 246 subjects and in a real market sample of 343 digital PC games released in 2014 on the online Steam platform.

This study aims to make three contributions to the literature. First, the paper responds to recent calls for research linking demand-side thinking with the literature on business models (Demil *et al.*, 2015; Massa *et al.*, 2016; Priem *et al.*, 2013; Priem, Wenzel, and Koch, 2017).

Relating these emerging streams in management is particularly fruitful given that both perspectives are market-centric because they emphasize the relevance of addressing and satisfying customer needs as a prerequisite for firm performance (Baden-Fuller and Haefliger, 2013; Casadesus-Masanell and Ricart, 2010; Hienerth, Keinz, and Lettl, 2011; Priem, 2007). In taking a demand-side perspective, this paper demonstrates that by looking downstream to the product market we can develop new theoretical mechanisms for *how* business models create and capture value and may ultimately be a source of competitive advantage.

Second, an oft-heard critique of business model research is that it tends to reside in the conceptual domain and lacks much-needed empirical validation (e.g., Arend, 2013). Empirical papers mostly rely on single-case studies, and systematic inquiries and rigorous testing are ‘relatively rare’ (Demil *et al.*, 2015: 2). Exceptions to this reproach include Kim and Min (2015), who looked at revenues generated by large U.S. retailers, and Zott and Amit (2007, 2008) who estimated the stock value of publicly listed European and U.S. entrepreneurial firms. This paper adds to these empirical studies by taking a contextualized approach to investigating the effect of two competing business models and their design elements on product-level outcomes in two studies, both with relatively large samples. Taking a contextualized approach allows meaningful comparison of competing business models; having a large sample improves external validity and enhances the generalizability of the reported findings.

Third, this paper contributes to a small but burgeoning area of research on freemium business models. Freemium has become widespread in many markets and is often mentioned as a key example of how the Internet changed the way firms do business (Amit and Han, 2017; Mahadevan, 2000; McGrath, 2010; Teece, 2010). Despite its impact on the entrepreneurial landscape, however, we know very little about how the freemium business model affects firms’ value creation and value capture, or how it competes with other business models in the digital economy. This paper links with studies in the fields of marketing (Arora, ter Hostede, and Mahajan, 2017; Lee, Kumar, and Gupta, 2015; Pauwels and Weiss, 2008) and information systems (Jiang and Sarkar, 2009; Liu, Au, and Choi, 2014; Runge *et al.*, 2016; Voigt and Hinz, 2016; Wagner, Benlian, and Hess, 2014) on the micro-dynamics of the freemium business model. It adds to these bodies of work by analyzing the freemium business model through a competitive dynamics lens. By contrasting freemium and premium business models, managers gain better insights into how the freemium business model affects the way consumers engage with their products and under which conditions it may be an ideal choice.

BUSINESS MODELS AS SOURCE OF PERFORMANCE HETEROGENEITY

The business model construct was introduced in the late 1990s to describe how the Internet changed the way firms do business (Timmers, 1998). Business conducted over the Internet facilitates the generation of novel revenue streams while dramatically reducing the (marginal) costs of production (Mahadevan, 2000). This has shifted firms' focus from one predominantly centered on capturing value vis-a-vis other firms in the vertical chain, to one centered on creating value for consumers and devising new architectures for revenue generation (Chesbrough and Rosenbloom, 2002). In their seminal paper, Amit and Zott (2001) concluded that none of the extant management and entrepreneurship theories is fully equipped to explain the value creation potential of firms operating in the era of the Internet. They therefore proposed the business model as a new unit of analysis that describes how a firm creates value and the mechanisms it deploys to capture a portion of this value.[3]

[3] Some (e.g., Arend, 2013) have criticized the business model construct for not being distinctively different from the concept of strategy. Business model scholars note that the two concepts are rather complementary (Zott *et al.*, 2011),

Key to the business model literature is the notion that the business model itself can be a source of performance heterogeneity (Amit and Zott, 2001, 2012; Casadesus-Masanell and Ricart, 2010; Markides and Charitou, 2004). Firms can compete through their business model when the value creation potential of the business model and the firm's ability to capture this value are superior to the business models employed by its rivals. Amit and Zott (2001) identified four drivers of value that business models can unlock: (1) efficiency, (2) complementarities, (3) lock-in effects, and (4) novelty. They noted that these drivers can be mutually reinforcing, and Casadesus-Masanell and Ricart (2010) developed this notion further by proposing that the business model is a source of sustained performance when its elements work together to create virtuous feedback loops that are difficult to reverse or imitate. In this light, Teece (2010) pointed out that even though the business model can be a source of performance heterogeneity, it is unlikely that a business model alone will assure a sustained competitive advantage given that its elements are generally visible to actors outside the firm and therefore easily imitable.

Despite the business model's strategic relevance, few studies have investigated *how* firms compete through their business model. Exceptions to this reproach include Zott and Amit's (2007, 2008) studies of the effect of business model design on stock market performance of European and U.S.-based entrepreneurial firms. Nevertheless, these studies are shareholder focused and shed little light on how the business model creates *value for consumers*. Given the central role of consumers in the business model, it has been suggested that a demand-side perspective would arrive at a more balanced view of how firms compete through their business

---

and that the business model is different from strategy in at least three ways (Massa *et al.*, 2016): (1) where strategy emphasizes the division of value between firms in the vertical chain, the business model emphasizes customer value creation as a prerequisite for value capture; (2) strategy is concerned with creating value for shareholders, while the business model is concerned with creating value for customers, end-users, and other exchange partners; and (3) where strategy assumes the firm to hold complete and unbiased knowledge, the business model assumes knowledge to be cognitively limited and points to experimentation and innovation as important managerial tasks.

models (Priem *et al.*, 2013, 2017). A first step was taken by Kim and Min (2015), who studied how firms' complementary asset positions affect the revenues generated from adding online retailing by U.S.-store-based retailers. Still, to gain a more fine-grained understanding of how the business model influences consumers' perceptions about the firm's products and services and how these perceptions affect the firm's value creation and value capture, we need to look downstream at the product-market and develop theory that is consumer-centric.

A demand-side perspective on business models

The demand-side perspective looks downstream to the product market and defines value creation as the consumer benefits offered by the vertical chain as a whole (Brandenburger and Stuart, 1996, 2007). Consumer evaluations of benefits, however, are imperfect given that it is often unclear, prior to consumption, which needs or wants a product precisely satisfies. This is particularly true for experience and credence goods, such as movies or educational programs, whose product characteristics are hard to compare and whose benefits cannot easily be assessed, even after consumption. Product evaluations are further obscured by the fact that it may be unclear to consumers what costs were incurred and which resources were deployed by the firm(s) in the vertical chain (Bowman and Ambrosini, 2000; Priem and Butler, 2001). Consumers therefore often rely on lower-level attributes in forming perceptions about the expected benefits offered by a good or service (Boatwright, Kalra, and Zhang, 2008; Zeithaml, 1988). Among these attributes are brand name, reputation, expert reviews, advertising, and, as argued in more detail below, the business model through which a product was brought to market.

Value can be captured by firms when a consumer's WTP is higher than or equal to the price charged by the utmost downstream firm in the vertical chain. When this condition is met, consumers pay for the expected future benefits, and monetary value is transferred back into the vertical chain (Bowman and Ambrosini, 2000; Brandenburger and Stuart, 1996, 2007). Put differently, value captured can be equated with the cumulative revenues generated by the firm(s) in the vertical chain, minus their combined costs (Bowman, 2001).[4] Value capture only imperfectly correlates with consumers' WTP, as some consumers will retain part of their WTP in the form of consumer surplus while others will forgo purchasing a product because their WTP is less than the price charged (Bowman and Ambrosini, 2000; Priem, 2007). This discrepancy arises because firms generally cannot engage in perfect price discrimination, yet consumer perceptions of benefits are 'highly personal and idiosyncratic' (Zeithaml, 1988: 13). Creating consumer value therefore is a necessary but insufficient condition for value capture. Without the right appropriation mechanisms, firms 'leave money on the table' by ceding value to paying consumers or by forgoing revenues from untapped consumers.

Exploiting consumer heterogeneity is at the heart of demand-side thinking (Priem, 2007; Priem *et al.*, 2013). Firm strategies that either increase the expected benefits for a wide range of consumers or maximize revenues by increasing the number of consumers willing to pay for a product increase the 'size of the pie.' From a demand-side perspective, firms therefore do not necessarily require uniquely valuable resources to create superior value. Everyday resources that give focused consideration to consumers' heterogeneous needs can be a source of competitive advantage if they increase consumers' perceptions of value and/or allow more consumers to act on their WTP, relative to a focal firm's rivals in the product market (Ye *et al.*, 2012).

[4] The division of revenues among firms in the vertical chain is the domain of the resource-based view of the firm and is a function of each firm's contribution, or their value added, and firms' respective bargaining power vis-à-vis other firms in the vertical chain (Bowman and Ambrosini, 2000; Brandenburger and Stuart, 1996, 2007; Lepak, Smith, and Taylor, 2007). This paper focuses on how a firm's business model can be a source of value capture by enhancing the total revenues generated. Nevertheless, given that bargaining power can be a function of many different factors, it is possible that the business model can also contribute to the amount of value that an individual firm captures by improving its relative standing in the vertical chain.

From this it follows that business models can be a source of performance heterogeneity when one or both of the following conditions are met: First, the business model enhances a firm's value creation potential when the elements composing the business model increase the expected benefits that consumers perceive from consuming the firm's products. Second, the business model enhances a firm's ability to capture value when the elements composing the business model (1) increase the number of consumers willing to pay for the firm's products, and/or (2) increase the amount of revenues extracted from paying consumers. Consequently, the business model contributes to a firm's competitive advantage when these conditions result in superior revenue generation relative to the focal firm's rivals in the product market.

CREATING AND CAPTURING VALUE FROM FREEMIUM BUSINESS MODELS

In this section I develop demand-side theory on how freemium business models affect value creation and value capture relative to premium business models. Contrary to premium business models, where consumers pay a price before they can experience any benefits, transactions in freemium business models are temporally decoupled such that initial consumption precedes the generation of revenues. Furthermore, transactions in a freemium product bundle are often decomposed into separately priced features or services. Although this decomposition is integral to freemium goods, it is not an exclusive feature as many premium goods also offer paid extras. I develop hypotheses for how these elements of temporal transaction decoupling and product bundle transaction decomposition affect consumers' perceptions of value as well as firms' ability to generate revenues. Given the demand-side view's consumer-centric and perceptual focus, I draw from prospect theory and mental accounting for hypotheses development.

Creating value from the freemium business model

Prospect theory departs from normative economic theories and assumes that consumers are boundedly rational (Simon, 1957). Specifically, prospect theory posits that consumers are *reference dependent* (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991): that 'the perceived attributes of a focal stimulus reflect the contrast between that stimulus and a context of prior and concurrent stimuli' (Kahneman, 2003: 1454). Consumers form preferences based on gains and losses derived relative to a reference point. Put differently, a key feature of prospect theory is that the carriers of value are changes in wealth, rather than absolute states of wealth. In evaluating benefits, consumers perceive outcomes along a *value function* that exhibits three distinct features (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991): (1) the value function is concave in the domain of gains, favoring risk aversion; (2) it is convex in the domain of losses, favoring risk seeking; and, (3) it is sharply kinked at the reference point, such that it is steeper for losses than for gains, thus favoring overall loss aversion (see Figure 1).

--- INSERT FIGURE 1 ABOUT HERE ---

Contrary to economic theories of utility, the shape of the value function implies that historical costs—which are sunk and rationally irrelevant—influence consumers' perceptions of gains and losses. Consistent with this, Thaler (1980, 1985, 1999) argued that consumers use mental accounting wherein previously incurred costs inform current decisions. When consumers have paid for a product, they begin a mental account that is closed only when the costs incurred have been associated with, or linked to, the benefits experienced from consuming said product (Prelec and Loewenstein, 1998). In the absence of a positive consumption experience, the costs incurred for a product are perceived as a loss, and further spending is justified until all benefits are completely internalized (Garland and Newport, 1991). The implications of this *sunk cost* *effect* are twofold: (1) the rate at which consumers use a product is higher when they first spend money on it (rather than receiving the product as a gift or obtaining it through a free trial period), and (2) consumers are more likely to spend additional money on a product or service they have previously invested money in.[5]

The effects of the value function on consumers' perceptions were famously demonstrated by Arkes and Blumer (1985). They conducted a field study of 60 purchasers of season tickets to the Ohio University Theater whom they randomly allocated into one of three price brackets. They found that consumers who paid more for their season tickets, and thus moved further down the value function in the domain of losses, attended significantly more plays than consumers who paid less for their tickets. Additionally, in her study of 'buy now, pay later transactions,' Siemens (2007) showed that individuals were more content with transactions for which the costs incurred and the benefits offered were joined in time. Satisfaction was considerably lower for transactions where a time delay was imposed such that individuals were first offered certain benefits and had to pay for them later. This is a cognitive process that Gourville and Soman (1998) referred to as the benefit depreciation effect. Support for the benefit depreciation effect was recently found in a study of subscribers to a digital television provider. Datta, Foubert, and van Heerde (2015) found that consumers who joined the service through a free trial promotion used the service less than those who joined without first enjoying such a free trial period.

The first implication of the sunk cost effect is that the business model's transaction structure affects how consumers perceive the benefits offered by a good or service. Prospect

[5] While it was initially assumed that both monetary costs and time spent are perceived as investments (Arkes and Blumer, 1985; Garland and Newport, 1991), recent research established that the sunk cost effect pertains to monetary costs exclusively. Soman (2001) found that consumers act seemingly rational when investments are expressed in units of time, a finding later echoed by Abdellaoui and Kemel (2013). It has been suggested that the reason for this 'pseudo-rationality' is that consumers lack the ability to mentally account for time in the same way they do for money (Soman, 2001). The consumption experience as reflected by the time consumers spend using a product is therefore not a contributing factor to their position on the value function; it is much rather a consequence.

theory suggests that business models that require consumers to pay before they can experience (part of) the expected benefits positively affect consumers' perceptions of value. When transactions are temporally decoupled, consumers do not shift their reference point downward in the domain of losses and are therefore less inclined to use a product and perceive fewer benefits from consuming that product. I therefore argue that, keeping all else equal, products brought to market through freemium business models will create less value for consumers than products brought to market through premium business models:

H1: Products brought to market through freemium business models will have lower use rates than products brought to market through premium business models.

Capturing value from the freemium business model

The sunk cost effect also establishes that consumers are more likely to invest additional money in goods or services in which they made prior investments (Thaler, 1985, 1999). Once a consumer begins a mental account, they will perceive the price paid for a product as a loss until they fully experience the benefits the product offers. Moreover, withdrawing from consuming a product in the face of residual gains will result in perceiving (part of) the price paid as a certain loss.[6] Finally, diminishing sensitivity to additional costs due to the value function's convexity in the domain of losses (as depicted in Figure 1), and the fact that losses weigh heavier than gains, increases consumers' willingness to spend additional money until all the benefits a product offers are fully internalized and the mental account is closed.

[6] The magnitude of the loss perceived depends on the degree to which the benefits offered are fully experienced as well as on the time since the initial investment, as both factors depreciate a consumer's perception of sunk costs (Gourville and Soman, 1998; Soman and Gourville, 2001).

This tendency to 'throw good money after bad' has been illustrated on many accounts. In management research it has most notably been documented in the escalation of commitment literature, where investors have repeatedly proved to make irrational and risky investment decisions (e.g., Brockner, 1992; Staw, 1976). For example, through a series of experiments, Thaler and Johnson (1990) demonstrated that in the presence of prior losses, subjects sought greater risks in their investment decisions, especially if these decisions increased their chances of eventually breaking even. In the marketing literature, Datta *et al.* (2015) showed that the average lifetime subscription value of consumers of a digital television service who joined after a free trial period was 59 percent lower than that of consumers who joined without first enjoying a free trial period. Similarly, Pauwels and Weiss (2008) documented that digital services experience difficulties in upgrading their consumers from free to paid subscription plans.

The second implication of prospect theory's sunk cost effect is that the business model's transaction structure affects not only the benefits consumers perceive but also the value a firm can capture. Business models that lock consumers in by temporally joining initial consumption benefits with payments are in a better position to generate additional revenues from paid extras than business models that decouple consumer transactions. In the absence of prior payments, not only will consumers not have incurred any investments, concavity of the value function in the domain of gains suggests that any additional benefits beyond the freely offered benefits will yield marginally diminishing WTP. I therefore argue that:

H2: Products brought to market through freemium business models will generate less revenue from paid items than products brought to market through premium business models.

Previous research established that consumers differ in the shape of their value function and in the extent to which they are risk averse in the domain of gains and risk seeking in the domain of losses (Gonzalez and Wu, 1999). This implies that business models that can accommodate this demand heterogeneity are better positioned to capture value. In evaluating any priced items (i.e., complete products or parts thereof), consumers will be influenced not only by their reference point but also by the degree to which the price asked for a consumption experience is less than or equal to the expected future benefits. Decomposing product bundles into re-combinatory components effectively renders a product a modular system (Henderson and Clark, 1990). Modularity is particularly valuable when demand is heterogeneous, as modular product bundles let consumers mix and match a combination of components that closely reflects their WTP (Langlois and Robertson, 1992; Schilling, 2000). Greater decomposition of a product into paid components increases the number of configurations that a consumer can possibly make, and thus the likelihood that the firm will capture value from its products.

A product's price menu consists of all the paid items that are available for purchase. These items can be functional (e.g., extended search functionality in LinkedIn) or otiose (e.g., character outfits in a video game) and vary in price. As argued above, greater decomposition of the product bundle into a varied menu of priced items allows heterogeneous consumers to self-select into a combination of items that matches their WTP. This decreases any excess consumer surplus not captured by the firm and increases the number of consumers who are willing to pay for any of the available options. I therefore argue that greater (vs. less) price-menu variety positively affects the revenues generated from both freemium and paid goods:

H3: Products brought to market with greater price-menu variety will generate more revenue from paid items than products brought to market with less price-menu variety.

--- INSERT TABLE 1 ABOUT HERE ---

Table 1 summarizes the paper's theoretical framework. Freemium goods are characterized by temporal transaction decoupling. The digital version of the technology and innovation magazine Wired, for example, lets users read one or a few articles per issue for free and charges readers for unlocking the full issue. This decoupling of benefits from consumer payments negatively affects the perception of value leading to lower use rates than for products where payments and benefits are joined in time. Moreover, lack of prior monetary investments and concavity of the value function in the domain of gains results in less WTP for such goods. The second dimension concerns products' price menu and the extent to which it is decomposed into a multifarious bundle of components. While some products have one or a few paid items, others have many, often in a wide range of prices. The productivity app Duet Display, for example, lets users extend their Mac and PC displays onto their iPad, and, with one additional payment, unlock pencil and drawing functionality. The photo- and video-editing application Photo Lab PRO, on the other hand, offers many paid extras, including various filters and editing techniques. Greater product bundle decomposability facilitates heterogeneous users in self-selecting into a combination of items that matches their WTP. It follows, then, that premium goods with varied price menus are optimally positioned, whereas freemium products with fewer items are in the worst position to create and capture value.

EMPIRICAL SETTING AND METHODOLOGY

I test the hypotheses in the context of the computer game industry and Steam, a platform for digitally distributed games for PC and Mac, in particular. The computer game industry gained popularity in the early 1980s after the home video game console industry crashed and hobbyist game developers began creating games for computer platforms such as the Commodore 64 and the IBM PC (Izushi and Aoyama, 2006). The computer game industry differs from the console video game industry in that there are no platform sponsors with consolidated power who exert control over market entry for software or set technological standards for hardware. As a result, the market for computer games is characterized by greater technological fragmentation on the hardware side and lower prices and greater diversity and innovation on the software side. During the late 1980s and 1990s, video game consoles regained mass popularity as Nintendo reestablished consumer trust through tight quality-control policies, upon which game developers returned to creating console video games, many treating computer games as an afterthought (Rietveld, 2014; Tschang, 2007). In the mid-2000s, however, the PC and Mac made a comeback when digital distribution platforms such as Steam and GamersGate made it easier for game developers to reach consumers and commercialize innovative video game content.

Steam is the market-leading distribution platform for digital PC games and holds over 75 percent ($3.5 billion) of global market share for digital PC games.[7] Steam was founded in 2003 by publisher Valve, initially as a platform for distribution and support of its internally created games Counterstrike and Half-Life 2. Shortly after Steam launched, Valve began developing tools for outside game developers to offer third-party content on the platform. Valve admitted the first externally developed video games in 2005, and entry by game developers has increased exponentially since. By February 2015 there were 4,500 games on the platform.[8] On the user side, Steam also enjoyed notable successes. Initially the platform was exclusive to users of Microsoft's Windows operating system, but Valve added support for Mac and Linux users in

[7] https://www.bloomberg.com/news/articles/2013-11-04/valve-lines-up-console-partners-in-challenge-to-microsoft-sony (accessed June 2017).
[8] http://www.anandtech.com/show/9003/valve-to-showcase-steamvr-hardware-steam-machines-more-at-gdc-2015 (accessed June 2017).

2010 and 2012, respectively. As of March 2015, there were over 125 million registered users on the platform, and concurrent use peaked at 9 million users.

Steam is a fitting setting to test the effects of freemium business models on consumers' perception of value. Unlike home video game consoles that rely mostly on premium content, or mobile operating systems where applications developers often include sponsor-based elements in their freemium applications (Casadesus-Masanell and Zhu, 2013), game developers on Steam operate either a pure freemium or a premium business model, and there is no peripheral income from advertisements, as these are banned by the platform.[9] Freemium games are labeled 'free-to-play' and can be downloaded and played free of charge. Both free-to-play and pay-to-play games on Steam can offer paid extras known as downloadable content, or DLC. Common items offered as DLC include additional levels, character outfits, and extra game modes.

To identify the effects of free-to-play and price menu variety on value creation and value capture, I conduct two studies, each with its own strengths and weaknesses (Miller *et al.*, 2011). In the first study I conduct a randomized controlled trial with 246 subjects. Subjects are exposed to a single video game released on the Steam platform and then treated with two manipulations: free-to-play/pay-to-play and low-/high-variety price menu. The randomized trial allows me to control for user and content heterogeneity and provides a controlled test of the hypotheses. Specifically, by randomly allocating subjects either to a free-to-play or to a pay-to-play condition and asking them about their willingness to pay and play, I do not have to be concerned about the heterogeneous preferences of the users of freemium and paid video games. A similar argument applies to the supply side, as developers of freemium games may differ from developers of paid games, and these differences may affect consumers' perceptions of value beyond the choice of

[9] https://www.gamespot.com/articles/heres-why-valve-wont-put-ads-on-steam/1100-6431454/ (accessed June 2017).

business model. In the second study, I estimate use and revenue statistics for 343 games on Steam. Using market data helps to assess the external validity of the experimental results and provides meaningful estimates. The Steam data allow me to estimate the effects of free-to-play on consumers' average use rates and on games' cumulative revenues while controlling for product characteristics such as genre and game quality.

STUDY 1: RANDOMIZED CONTROLLED TRIAL

To create an experiment that is both realistic and reflective of real games, I contacted a game developer with several games released on the Steam platform. The Dutch game developer Two Tribes released its game Toki Tori in 2010 on Steam as a pay-to-play game selling over 400,000 copies. Although the game had a €10.00 price tag and offered no downloadable extras, its developer agreed to produce a number of visual assets for use in an experimental setting. In choosing downloadable extras, common items for games on Steam were chosen that also matched with the game's design. The experiment was administered to 263 undergraduate business students at a Western European business school who were randomly assigned to one of four conditions across two manipulations. Data were collected in an online environment designed in Qualtrics. Nine subjects were excluded from analysis because of missing data, and another eight subjects were excluded because they had prior knowledge of Toki Tori.

Results for Study 1

In the first manipulation, subjects were assigned to either a free-to-play condition (n = 125) or a pay-to-play condition (n = 121). In the free-to-play condition, subjects were presented with information about the game, including its genre, quality as assessed by expert critics and prior consumers, gameplay mechanics, and several images portraying the game and its main character (see Appendix 1 for examples). Both the images and the accompanying text clearly communicated that the game was free to play and could be downloaded free of charge. The same information was presented to subjects in the pay-to-play condition except that the game was presented with a price tag of €10.00. After being exposed to this information, subjects were asked "How much would you be willing to pay for this game?" The average WTP for subjects in the free-to-play condition was €0.48, and the average WTP for subjects in the pay-to-play condition was €2.91. The mean difference in WTP of €2.43 is significant at $p < 0.01$ in a two-tailed t-test with equal variances assumed. Subjects were then asked about their willingness to spend time on the game: "Assume that you have downloaded this game and that it takes approximately six hours to complete this game; how many hours would you play this game?" Subjects' average willingness to play in the free-to-play condition was 2.46 hours; subjects' willingness to play in the pay-to-play condition was 3.65 hours. The mean difference in willingness to play of 1.19 hours is significant at $p < 0.01$.

Subjects were also asked about their willingness to purchase downloadable extras for the video game. Upon being presented an overview of several downloadable items with prices ranging from €1.00 to €7.50 (explained in more detail below), subjects were asked "Assume you have downloaded this game and that you have completed its main contents in approximately six hours; would you buy any of the downloadable extras for this game?" Of the subjects in the free-to-play condition, 8.80 percent adopted one of the downloadable extras (rather than choosing the baseline option of not purchasing any downloadable extra); in the pay-to-play condition, 27.27 percent of the subjects adopted one of the paid extras. The mean difference of 18.47 percent is significant at $p < 0.01$. Furthermore, the revenues generated per subject averaged €0.34 per downloadable extra in the free-to-play condition and €1.17 for the pay-to-play condition. The difference in average revenues of €0.82 per subject is significant at $p < 0.01$.

In the second manipulation, subjects were assigned to either a low-variety price menu condition (n = 120) or a high-variety price menu condition (n = 126). In the low-variety price menu condition, subjects were presented with one downloadable extra, a level editor in which players can create, play, and share their own levels for €5.00 (see Appendix 1). In the high-variety price menu condition, subjects were presented with four downloadable options: an outfit pack for the game's main character (€1.00); a level pack with 20 additional levels set in a new game world (€3.00); a level editor allowing players to create, play, and share their own levels (€5.00); and a complete pack containing all the above downloadable options (€7.50). Subjects were asked, "Assume you have downloaded this game and that you have completed its main contents in approximately six hours; would you buy any of the downloadable extras for this game?" Of the subjects in the low-variety price menu condition, 10.00 percent adopted one of the downloadable extras; of the subjects in the high-variety price menu condition, 25.40 percent adopted one of the downloadable extras. The mean difference of 15.40 percent is significant at $p < 0.01$. Furthermore, the average revenues per subject were €0.50 per downloadable extra in the low-variety price menu condition and €0.98 in the high-variety price menu condition. The difference in average revenues per subject of €0.48 is significant at $p < 0.05$.

In line with H1, these findings show that subjects in the free-to-play condition had lower WTP and spent less time playing the game than subjects in the pay-to-play condition. Consistent with H2, the findings also show that subjects in the free-to-play condition were less likely to adopt any downloadable extras and that the revenues generated from these extras were lower than in the pay-to-play condition. Finally, supporting H3, I found that when subjects were presented with a greater variety of downloadable items, they were more likely to adopt any of these paid items and that the revenues from these items were also higher.

--- INSERT TABLE 2 ABOUT HERE ---

Table 2 combines the two manipulations into four randomized subsamples. The table documents subjects’ average willingness to adopt downloadable extras and the average revenues generated from these extras. In line with the theoretical framework, the results show that subjects in the pay-to-play and high-variety price menu subsample had the highest willingness to adopt downloadable extras and spent the most money on these items. Subjects in the free-to-play and low-variety price menu subsample were least likely to adopt any paid extras and spent the least amount of money on these items. All results presented here are robust to multivariate regression analyses controlling for various demographics such as whether subjects used their computer for playing video games, age, and gender (see Appendix 2 for results).

STUDY 2: STEAM VIDEO GAME MARKET DATA

In the second study I assessed the external validity of the trial results on a sample of games released on Steam in 2014. Data on 343 games released by 238 firms were collected from various sources. The core dataset containing information on games’ release dates, cumulative downloads, usage statistics, and firm information was made available by Steam. Data on games’ hardware requirements, price, genre, business model, user review scores, and firm type were hand-collected from games’ product pages on Steam. Revenue data (in USD) for 222 games were partly derived by combining games’ pricing and download information and partly provided directly by games’ developers.[10] Data on video game quality as assessed by expert critics were

[10] Data on 46 games were provided directly by games’ developers, and data on the 176 remaining games were derived using a straightforward formula combining pricing and download information, correcting for any price

retrieved from Metacritic.com, which collects and aggregates expert review scores from over 300 online and offline publications and transforms these into color-coded, weighted ‘Metascores’ ranging from 0 to 100.

Dependent and independent variables

These data were used to estimate the effects of the business model on games’ use rates and their cumulative revenues. The first outcome measure I estimated is the average time (in hours) spent per user of a game. *Time spent on game* was calculated by dividing the cumulative time spent by all users of a game by the number of users who downloaded and played the game at least once. I log-transformed this measure to account for the skewness in its distribution. The second outcome measure is the cumulative *revenues generated* by a focal game. Here, too, I took the log-transformation to correct for the measure’s skewness. The business model with which a game was brought to market is measured by a dummy variable that takes the value of 1 if a game is *free-to-play* and 0 when a game is *pay-to-pay*. These variables allowed me to test H1 and H2, respectively. Since I only have cumulative revenue data at the game level but no revenue data broken out by initial payments in the case of pay-to-play games and payments generated by downloadable extras, I could not conduct a convincing test of H3 using this dataset.

Control variables

In the empirical models, I controlled for a number of factors that may be correlated with the outcome variables. First, I controlled for the type of firm a game was released by. Independent studios typically are small game developers that focus on releasing creative and innovative

---

discounts, the duration of price discounts, and the standard Steam royalty rate of 30 percent. The reported results are robust to estimating the models on the subset of 46 games for which revenue data were directly provided.

games, while incumbent publishers such as Electronic Arts tend to have bigger budgets and to deploy a more exploitative strategy by focusing on sequels and media tie-ins. *Independent studio* is a dummy variable that takes the value of 1 if a game was published by an independent game developer. Second, I controlled for how games were rated by users and expert critics as proxies for quality. *User review score* measures the ratio of positive user review scores to all user review scores for a game. The measure is proportional, ranging from 0 to 1; a score of 1 indicates a perfectly positive user evaluation. Information on expert critics' quality evaluations comes from Metacritic. Following Metacritic's colored-coded grading schema, I created a vector of dummies indicating whether a game had a *high expert score* (a Metascore ranging from 75 to 100), a *medium expert score* (ranging from 50 to 74), or a *low expert score* (ranging from 0 to 49).[11] Games with missing Metascores are the base category. Not only is this categorical measure coherent with Metacritic's color-coded grading schema, it is also consistent with the incentive structures of many publishers who reward financial bonuses to creative staff if their games surpass a certain threshold score on Metacritic. Third, I controlled for heterogeneity across product categories by including nine *genre dummies*. Genre classifications were obtained from Steam and include action, adventure, casual, massive multiplayer, racing, role playing, simulation, sports, and strategy. Fourth, I included 11 *month of release dummies* to control for seasonality, which is prevalent in most markets for entertainment goods. These dummies also provide a good proxy for a video game's age given that all games were released in 2014.

[11] http://www.metacritic.com/about-metascores (accessed June 2017).

Results for Study 2

Table 3 lists descriptive statistics and pairwise correlations for the estimation sample of 343 video games. The untransformed summaries of the outcome variables show that users spent on average 10 hours playing a game and that games generated average cumulative revenues of $1.4 million. As expected, the time that users spent on a game and the game's cumulative revenues are positively correlated. I note that 16 percent of all games in the sample are free-to-play, and that this variable negatively correlates with both outcome variables, which is directionally consistent with H1 and H2. Games by independent studios have lower use rates and generate less revenues than games by incumbent publishers, while games with high expert review scores are positively correlated with both outcome variables. Variance inflation factor (VIF) statistics obtained from unreported analyses indicate that VIFs are well below conventional thresholds.

--- INSERT TABLES 3 AND 4 ABOUT HERE ---

Models 1 and 2 of Table 4 report results from an ordinary least squares regression with robust standard errors clustered on the firm. Model 1 estimates the average time that a user spends on a game, and Model 2 estimates games' cumulative revenues. Both models display good fit, with R^2 coefficients of 0.47 and 0.40, respectively. Model 1 lends support to H1, as the coefficient for free-to-play is negative and significant at $p < 0.05$. Exponentiating the coefficient provides insight into the effect size: users spent 34 percent less time playing free-to-play games than playing pay-to-play games. This effect size is directionally consistent with the results obtained from the randomized trial, where subjects spent 77 percent less time if the game was free-to-play. H2 is also supported, as the coefficient for free-to-play in Model 2 is negative and significant at $p < 0.01$. Exponentiating the effect size shows that the revenues generated by free-to-play games were 92 percent less than the revenues by pay-to-play games. This effect is also consistent with the results obtained from the experiment, where subjects indicated 84 percent less WTP for the game when it was free-to-play rather than pay-to-play. The control variables load as expected: games by independent studios were played less and generated less revenues, while positive user reviews and high expert scores positively correlate with both outcomes.

Alternative explanations and robustness tests

The reported results may be driven by unobserved factors that are correlated with the free-to-play variable and with the outcome variables. For example, developers that create games as a hobby may be less attuned to their business models and more focused on having their games played and building a community of fans. Games by such developers are more likely to be free-to-play while also generating less revenue than those by more exploitative developers. To control for this potential source of endogeneity, I estimated an endogenous treatment effects model (Wooldridge, 2010). This model first estimates nonrandom selection into a binary treatment variable (i.e., free-to-play) and then controls for this selection in the outcome equation. One advantage over Heckman selection models and instrumental variable regressions is that the exclusion restriction assumption is relaxed in the endogenous treatment effects model (Guo and Fraser, 2014). I estimated the probability of a game being free-to-play based on a number of firm- and game-level attributes. At the firm level, I controlled for firm type by including the independent studio dummy. I also included a game's technological requirements as measured by the minimum required random access memory (in GB) to play a game and the minimum required amount of hard drive space (in GB) to download and install a game. I also included a game's genre as a predictor. The full model was estimated in Stata 14.1 using the command *etregress*.

--- INSERT TABLE 5 ABOUT HERE ---

Table 5 provides results for the selection equation estimating free-to-play via probit regression. Models 3 and 4 in Table 4 provide results for the selection-corrected outcome equations. Results from the selection equation show that independent studios were less likely to develop free-to-play games ($p < 0.05$) and that free-to-play games were technologically less complex, as they required less RAM ($p < 0.10$) and less hard drive space ($p < 0.01$) to download and install. Combined, these results suggest that free-to-play games were generally commercialized by incumbent publishers who target a nonspecialist audience with fairly technologically simple games. Results further show that massive multiplayer games were more likely to use the free-to-play model ($p < 0.01$), whereas racing and simulation games were less likely to use the free-to-play model ($p < 0.05$).[12] The results for the outcome equation remain supported, as free-to-play games still negatively correlate with the average time users spent ($p < 0.01$) and with the cumulative revenues generated ($p < 0.05$). The effect size of free-to-play on time spent doubles, as users spent 64 percent less time on free-to-play games in the treatment effects model. The effect size on cumulative revenues is lightly dampened, as free-to-play games generated 79 percent less revenues than pay-to-play games in this alternative specification.

The results were subjected to a number of robustness tests. First, the reported findings are robust to various alternative measures of expert review scores, including a continuous measure and a continuous measure with mean-imputation while controlling for games with missing quality scores. Second, the findings are robust to the inclusion of the number of days that a game was on sale during the data collection period, weighted by the price discount. Third, the revenue models are robust to estimating results on a restricted sample of 46 games for which revenue data

[12] Note that not all genres are included, as some predict selection perfectly. Action is excluded as a base genre.

were directly reported by games' publishers. Fourth, the results are further robust to models including the number of downloads as an additional control variable.

DISCUSSION

Despite the business model's market-centric orientation and its emphasis on value creation (Chesbrough and Rosenbloom, 2002; Demil *et al.*, 2015), there have been few studies to investigate how business models interact with the firm's products in shaping the firm's value proposition to consumers. Addressing this gap, in this paper I take a demand-side perspective on business models as a source of performance heterogeneity. I argue that firms' business models create value when they increase consumers' perceived benefits from consuming a firm's products and that business models can enhance a firm's ability to capture value when the elements that compose a business model (1) increase the number of consumers who are willing to pay for a firm's products, and/or (2) increase the revenues generated from paying consumers. I empirically test these arguments by analyzing the competition between freemium and premium business models in the context of digital PC games. Consistent with the demand-side theory put forward in this paper, the results show that video games commercialized through the freemium business model are played less and also generate less revenues than video games commercialized through the premium business model. Results further show that greater variety in games' menu of paid items is associated with higher revenues for both freemium and premium video games.

This paper contributes to the literature by documenting that business model design influences how consumers perceive the firm's products and services and that these perceptions affect the firm's value creation and value capture. In order to better understand the consequences of business model design, it is therefore suggested that we need to extend the notion of bounded rationality in the business model literature to include individuals outside of the firm (Martins, Rindova, and Greenbaum, 2015; Tripsas and Gavetti, 2000). Indeed, it is not only organizational members who are boundedly rational, but also the consumers of firms' products (Simon, 1957). Consistent with arguments put forward by prospect theory and mental accounting, the findings of this paper show that the elements that compose a business model can affect the value that consumers perceive in a firm's products, even when the product itself is kept constant in an experimental setting. I find that temporal decoupling of a product's benefits from its transactions negatively affected consumers' perception of value and WTP, whereas greater decomposition of a product's benefits into a varied menu of paid items positively affected consumers' WTP. In moving forward, there is merit in exploring additional mechanisms for how business models create and capture value in the product market. Future studies may draw from other theories of boundedly rational decision making for theory development. Future research will also have to address the extent to which consumer advantages can be sustained over the long run.

A second contribution of the paper is that it bridges the literatures on business models and demand-side perspectives (Priem *et al.*, 2017). Complementing traditional perspectives in management research such as the resource-based view and dynamic capabilities, the demand-side perspective looks downstream to the product market and treats value creation as an endogenous factor that firms can and must manipulate to reap profits (Priem and Butler, 2001). A key insight from this perspective is that firms do not necessarily need heterogeneous and imperfectly mobile assets to create and capture value. Firms can attain competitive advantage when (the combination of) ordinary resources increase(s) consumers' perceptions of value and facilitate(s) heterogeneous consumers in their WTP (Priem *et al.*, 2013). This paper is among the first to empirically assess this proposition and provides an example in the form of the business model as an everyday resource capable of creating and capturing value. In doing so, the paper adds to Ye *et al.* (2012), who showed that demand-side synergies from combining mundane services can lead to superior value creation. Much business model research from the demand-side view remains to be done. Two fruitful areas for future research are the sustainability of superior performance stemming from demand-side advantages and the conditions under which business model design improve a focal firm's relative standing in the vertical chain.

The study further contributes to our understanding of the freemium business model. Despite the business model's growing relevance in the digital economy, extant research in management has largely ignored the freemium business model. One of the paper's main conclusions is that firms operating the freemium business model must create more value (or operate at lower costs) to achieve competitive parity with firms operating the premium business model. I argue and find that the freemium model harms consumers' perceptions of value and that the model's temporally decoupled transaction structure reduces consumers' WTP for priced items such as added functionality or extra content. These findings add a competitive lens to studies in marketing and information systems, which mostly focused on converting free users to paying consumers through products' design features (Lee *et al.*, 2015; Pauwels and Weiss, 2008; Runge *et al.*, 2016; Voigt and Hinz, 2016; Wagner *et al.*, 2014), freemium as a driver of adoption (Arora *et al.*, 2017; Liu *et al.*, 2014), and the effect of freemium on network externalities (Jiang and Sarkar, 2009). Knowing how the freemium business model competes with other digital business models clearly holds managerial relevance, as firms do not operate in a vacuum.

That said, there still exist ample opportunities for future research on freemium business models. First, scholars may explore additional drivers of value creation and value capture. For example, freemium goods often include sponsor-based elements in the form of advertisements as a way to compensate for lost revenues from consumers (Casadesus-Masanell and Zhu, 2013). While advertisements provide an additional revenue stream for the firm, they may be perceived as a nuisance by consumers of freemium goods (see Ghose and Han, 2014). This suggests a careful balancing act that new product development teams ought to consider: when does the inclusion of advertisements in freemium goods offset the loss of revenues from consumers, and when does it result in even greater competitive disadvantage compared to premium goods? Second, scholars may look at the role of lock-in effects and network externalities in the context of freemium and premium products. Due to their low barriers to adoption, freemium business models are particularly well-suited for triggering network externalities and lock-in mechanisms (such as the massive multiplayer games in this study's empirical context). Since the size of a product's network can be an additional driver of value, future studies may explore the moderating effect of these factors on the revenues generated from otherwise comparable freemium and premium products. Third, greater insight is needed into which firms and which product designs optimally benefit from freemium business models. Some of the empirical analyses in this paper show that incumbent firms were more likely to operate the freemium business model when releasing games in certain genres. This ultimately raises a question of fit: are certain firms in certain product market segments more likely to enjoy superior performance from operating the freemium business model, and if so, why? A final suggestion is about the design of price menus for premium products. Research in mental accounting showed that the passage of time depreciates consumers' perceptions of costs (Arkes and Blumer, 1985; Gourville and Soman, 1998). This suggests that premium products can benefit from offering paid extras early in the consumption experience rather than later. Greater insight into these dynamics not only is of scholarly interest but also holds significant managerial relevance.

The research in this paper has some important limitations which hold implications for the findings' generalizability and the paper's contributions. First, hypotheses were tested in a single industry setting. Although freemium business models are widespread in the market for digitally distributed PC games, it remains to be seen how the findings hold in settings beyond video games, such as mobile software applications or social networking services. More generally, given the stated assumption that consumers experience difficulties in evaluating products, it will be worthwhile to explore how the paper's findings apply to markets for search goods, where evaluations tend to be more straightforward. Another important limitation is that the effect of product bundle transaction decomposition was only tested in the randomized controlled trial, due to data limitations. Future research should assess the external validity of this finding and establish boundary conditions for when the decomposition hypothesis holds or is rejected. An important consideration in this regard is the degree of decomposition, such that more variety may not always be better: at a certain number of paid items consumers may experience choice overload (see Scheibehenne, Greifeneder, and Todd, 2010). Last, a key limitation is that the product market data in this study were cross-sectional, limiting the ability to assess issues of causation or product lifecycle dynamics. To further expand our knowledge of the freemium business model and its impact on value creation and value capture, future research should collect longitudinal datasets tracking freemium products over sustained periods of time.

ACKNOWLEDGEMENTS

I thank Cristiano Bellavitis, JP Eggers, Douglas Hannah, Dylan Minor, David Nieborg, Evan Rawley, Melissa Schilling, Dmitry Sharapov, and Arun Sundararajan for their valuable input and feedback. The paper benefitted from comments by seminar participants at the University of

Groningen, the Rotterdam School of Management, and the KIN Research Digital Innovation Workshop. This paper was presented at the 76th annual meeting of the Academy of Management, the 10th Ratio Colloquium for Young Social Scientists, and the 36th Annual SMS Conference. A shorter and earlier version of this paper was published in the best paper proceedings of the 76th annual meeting of the Academy of Management. I thank the editor and two anonymous reviewers for their helpful guidance. All mistakes are my own.

REFERENCES

Abdellaoui M, Kemel E. 2013. Eliciting prospect theory when consequences are measured in time units: ‘Time is not money.’ Management Science, 60(7), 1844-1859.

Amit R, Han, X. 2017. Value creation through novel resource configurations in a digitally enabled world. Strategic Entrepreneurship Journal. In press.

Amit R, Zott C. 2001. Value creation in e-business. Strategic Management Journal, 22(6-7), 493-520.

Amit R, Zott C. 2012. Creating value through business model innovation. MIT Sloan Management Review, 53(3), 41.

Arend RJ. 2013. The business model: Present and future—beyond a skeumorph. Strategic Organization, 11(4), 390-402.

Arkes HR, Blumer C. 1985. The psychology of sunk cost. Organizational behavior and human decision processes, 35(1), 124-140.

Arora S, ter Hofstede F, Mahajan V. 2017. To free, or not to free: The implications of offering free versions for the performance of paid mobile apps. Journal of Marketing. In press.

Baden-Fuller C, Haefliger S. 2013. Business models and technological innovation. Long Range Planning, 46(6), 419-426.

Boatwright P, Kalra A, Zhang W. 2008. Research note—should consumers use the halo to form product evaluations? Management Science, 54(1), 217-223.

Bowman C, Ambrosini V. 2000. Value creation versus value capture: towards a coherent definition of value in strategy. British Journal of Management, 11(1), 1-15.

Bowman C. 2001. ‘Value’ in the resource-based view of the firm: A contribution to the debate. The Academy of Management Review, 26(4), 501.

Brandenburger AM, Stuart HW. 1996. Value-based business strategy. Journal of Economics & Management Strategy, 5(1), 5-24.

Brandenburger AM., Stuart HW. 2007. Biform games. Management Science, 53(4), 537-549.

Brockner J. 1992. The escalation of commitment to a failing course of action: Toward theoretical progress. Academy of Management Review, 17(1), 39-61.

Casadesus-Masanell R, Ricart JE. 2010. From strategy to business models and onto tactics. Long Range Planning, 43(2), 195-215.

Casadesus-Masanell R, Zhu F. 2013. Business model innovation and competitive imitation: The case of sponsor-based business models. Strategic Management Journal, 34(4), 464-482.

Chesbrough H, Rosenbloom RS. 2002. The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. Industrial and Corporate Change, 11(3), 529-555.

Datta H, Foubert B, Van Heerde HJ. 2015. The challenge of retaining customers acquired with free trials. Journal of Marketing Research, 52(2), 217-234.

Demil B, Lecocq X, Ricart JE, Zott C. 2015. Introduction to the SEJ special issue on business models: business models within the domain of strategic entrepreneurship. Strategic Entrepreneurship Journal, 9(1), 1-11.

Gans J, Ryall MD. 2017. Value capture theory: A strategic management review. Strategic Management Journal, 38(1), 17-41.

Garland H, Newport S. 1991. Effects of absolute and relative sunk costs on the decision to persist with a course of action. Organizational Behavior and Human Decision Processes, 48(1), 55-69.

Ghose A, Han SP. 2014. Estimating demand for mobile applications in the new economy. Management Science, 60(6), 1470-1488.

Gonzalez R, Wu G. 1999. On the shape of the probability weighting function. Cognitive Psychology, 38(1), 129-166.

Gourville JT, Soman D. 1998. Payment depreciation: The behavioral effects of temporally separating payments from consumption. Journal of Consumer Research, 25(2), 160-174.

Guo S, Fraser MW. 2014. Propensity score analysis: Statistical methods and applications (Vol. 11). Sage Publications.

Henderson RM, Clark KB. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly, 9-30.

Hienerth C, Keinz P, Lettl C. 2011. Exploring the nature and implementation process of user-centric business models. Long Range Planning, 44(5), 344-374.

Izushi H, Aoyama Y. 2006. Industry evolution and cross-sectoral skill transfers: a comparative analysis of the video game industry in Japan, the United States, and the United Kingdom. Environment and Planning A, 38(10), 1843-1861.

Jiang Z, Sarkar S. 2009. Speed matters: The role of free software offer in software diffusion. Journal of Management Information Systems, 26(3), 207-240.

Kahneman D, Tversky A. 1979. Prospect theory: An analysis of decision under risk. Econometrica: Journal of the Econometric Society, 263-291.

Kahneman D. 2003. A perspective on judgment and choice: mapping bounded rationality. American Psychologist, 58(9), 697.

Kim SK, Min S. 2015. Business model innovation performance: When does adding a new business model benefit an incumbent? Strategic Entrepreneurship Journal, 9(1), 34-57.

Kumar V, 2014. Making "freemium" work. Harvard Business Review, 92(5), 27-29.

Langlois RN, Robertson PL. 1992. Networks and innovation in a modular system: Lessons from the microcomputer and stereo component industries. Research Policy, 21(4), 297-313.

Lee C, Kumar V, Gupta S. 2015. Designing freemium: Balancing growth and monetization strategies. SSRN Working Paper.

Lepak DP, Smith KG, Taylor MS. 2007. Value creation and value capture: a multilevel perspective. Academy of Management Review, 32(1), 180-194.

Liu CZ, Au YA, Choi HS. 2014. Effects of freemium strategy in the mobile app market: an empirical study of Google play. Journal of Management Information Systems, 31(3), 326-354.

Mahadevan B. 2000. Business models for Internet-based e-commerce: An anatomy. California Management Review, 42(4), 55-69.

Markides C, Charitou CD. 2004. Competing with dual business models: A contingency approach. Academy of Management Executive, 18(3), 22-36.

Martins LL, Rindova VP, Greenbaum BE. 2015. Unlocking the hidden value of concepts: a cognitive approach to business model innovation. Strategic Entrepreneurship Journal, 9(1), 99-117.

Massa L, Tucci C, Afuah A. 2016. A critical assessment of business model research. Academy of Management Annals.

McGrath RG. 2010. Business models: A discovery driven approach. Long Range Planning, 43(2), 247-261.

Miller KM, Hofstetter R, Krohmer H, Zhang ZJ. 2011. How should consumers' willingness to pay be measured? An empirical comparison of state-of-the-art approaches. Journal of Marketing Research, 48(1), 172-184.

Pauwels K, Weiss A. 2008. Moving from free to fee: How online firms market to change their business model successfully. Journal of Marketing, 72(3), 14-31.

Prelec D, Loewenstein G. 1998. The red and the black: Mental accounting of savings and debt. Marketing Science, 17(1), 4-28.

Priem RL, Butler J E. 2001. Is the resource-based 'view' a useful perspective for strategic management research? Academy of Management Review, 26(1), 22-40.

Priem RL. 2007. A consumer perspective on value creation. Academy of Management Review, 32(1), 219-235.

Priem RL, Butler JE, Li S. 2013. Toward reimagining strategy research: retrospection and prospection on the 2011 AMR decade award article. Academy of Management Review, 38(4), 471-489.

Priem RL, Wenzel M, Koch J. 2017. Demand-side strategy and business models: Putting value creation for consumers center stage. Long Range Planning. In press.

Rietveld J. 2014 Nintendo: Fighting the video game console wars, in Mintzberg H et al. The Strategy Process, Fifth Edition, FT Press.

Runge J, Wagner S, Claussen J, Klapper D. 2016. Freemium pricing: Evidence from a large-scale field experiment. SSRN Working Paper.

Scheibehenne B, Greifeneder R, Todd PM. 2010. Can there ever be too many options? A meta-analytic review of choice overload. Journal of Consumer Research, 37(3), 409-425.

Schilling MA. 2000. Toward a general modular systems theory and its application to interfirm product modularity. Academy of Management Review, 25(2), 312-334.

Siemens JC. 2007. When consumption benefits precede costs: towards an understanding of 'buy now, pay later' transactions. Journal of Behavioral Decision Making, 20(5), 521-531.

Simon HA. 1957. Models of man; social and rational.

Soman D. 2001. The mental accounting of sunk time costs: Why time is not like money. Journal of Behavioral Decision Making, 14(3), 169-185.

Soman D, Gourville JT. 2001. Transaction decoupling: How price bundling affects the decision to consume. Journal of Marketing Research, 38(1), 30-44.

Staw BM. 1976. Knee-deep in the big muddy: A study of escalating commitment to a chosen course of action. Organizational Behavior and Human Performance, 16(1), 27-44.
Teece DJ. 2010. Business models, business strategy and innovation. Long Range Planning, 43(2), 172-194.
Thaler RH, Johnson EJ. 1990. Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. Management Science, 36(6), 643-660.
Thaler RH. 1980. Toward a positive theory of consumer choice. Journal of Economic Behavior & Organization, 1(1), 39-60.
Thaler RH. 1985. Mental accounting and consumer choice. Marketing Science, 4(3), 199-214.
Thaler RH. 1999. Mental accounting matters. Journal of Behavioral Decision Making, 12(3), 183.
Timmers P. 1998. Business models for electronic markets. Electronic Markets, 8(2), 3-8.
Tripsas M, Gavetti G. 2000. Capabilities, cognition, and inertia: Evidence from digital imaging. Strategic Management Journal, 1147-1161.
Tschang FT. 2007. Balancing the tensions between rationalization and creativity in the video games industry. Organization Science, 18(6), 989-1005.
Tversky A, Kahneman D. 1991. Loss aversion in riskless choice: A reference-dependent model. The Quarterly Journal of Economics, 106(4), 1039-1061.
Voigt DWIS, Hinz O. 2016. Making digital freemium business models a success: Predicting customers' lifetime value via initial purchase information. Business & Information Systems Engineering, 58(2), 107-118.
Wagner TM, Benlian A, Hess T. 2014. Converting freemium customers from free to premium—the role of the perceived premium fit in the case of music as a service. Electronic Markets, 24(4), 259-268.
Wooldridge JM. 2010. Econometric analysis of cross section and panel data. MIT press.
Ye G, Priem RL, Alshwer AA. 2012. Achieving demand-side synergy from strategic diversification: How combining mundane assets can leverage consumer utilities. Organization Science, 23(1), 207-224.
Zeithaml VA. 1988. Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. The Journal of Marketing, 2-22.
Zott C, Amit R. 2007. Business model design and the performance of entrepreneurial firms. Organization Science, 18(2), 181-199.
Zott C, Amit R. 2008. The fit between product market strategy and business model: implications for firm performance. Strategic Management Journal, 29(1), 1-26.
Zott C, Amit R, Massa L. 2011. The business model: recent developments and future research. Journal of Management, 37(4), 1019-1042.

TABLES AND FIGURES

Table 1. Theoretical framework

		Temporal transaction decoupling	
		No	**Yes**
Product bundle transaction decomposition	**High**	Pay before consumption with many paid extras Examples: *Photo Lab PRO*; *Minecraft Pocket Edition* Consumer usage: +, revenue generation: +/+	Free initial consumption with many paid items Examples: *LinkedIn*; *Clash Royale* Consumer usage: -, revenue generation: -/+
	Low	Pay before consumption with few or no paid extras Examples: *Duet Display*; *Grand Theft Auto: San Andreas* Consumer usage: +, revenue generation: +/-	Free initial consumption with one or few paid items Examples: *Wired*; *Super Mario Run* Consumer usage: -, revenue generation: -/-

Note: the (+) and (-) signs reflect the directional effects stated in H1 (consumer usage) and H2 and H3 (revenue generation), respectively.

Table 2. Subjects' willingness to adopt downloadable extras

	Pay-to-play	**Free-to-play**
High-variety price menu	Willingness to adopt extras = 38.33% Revenues from extras = €1.52 n = 60	Willingness to adopt extras = 13.64% Revenues from extras = €0.50 n = 66
Low-variety price menu	Willingness to adopt extras = 16.39% Revenues from extras = €0.82 n = 61	Willingness to adopt extras = 3.39% Revenues from extras = €0.17 n = 59

Table 3. Descriptive statistics and pairwise correlations

Variable	N	Mean	St Dev	Min	Max	1	2	3	5	6	7	8
1. ln(Time spent on game)	343	1.83	1.01	-1.39	5.04							
2. ln(Revenues generated)	222	13.14	1.59	6.21	16.88	0.57						
3. Free-to-play	343	0.16	0.36	0.00	1.00	-0.18	-0.28					
5. Independent studio	343	0.60	0.49	0.00	1.00	-0.41	-0.21	-0.07				
6. User review score	343	0.79	0.16	0.18	0.99	0.21	0.18	-0.23	0.17			
7. High expert score	343	0.20	0.40	0.00	1.00	0.30	0.32	-0.19	-0.10	0.28		
8. Medium expert score	343	0.28	0.45	0.00	1.00	0.10	0.08	-0.16	-0.15	-0.07	-0.31	
9. Low expert score	343	0.02	0.15	0.00	1.00	-0.06	0.00	0.04	-0.03	-0.23	-0.08	-0.10

Note: Pairwise correlations greater than |.15| are significant at $p < 0.05$. Mean VIF: 1.73.

Table 4. The effects of *free-to-play* on video games' value creation and value capture

Variable	1. Time	2. Revenues	3. Time	4. Revenues
Free-to-play	-0.41*	-2.47**	-1.02**	-1.56*
	[0.17]	[0.66]	[0.21]	[0.69]
Independent studio	-0.84**	-0.63**	-0.86**	-0.62**
	[0.10]	[0.20]	[0.10]	[0.19]
User review score	1.56**	1.46*	1.61**	1.46*
	[0.33]	[0.68]	[0.31]	[0.64]
High expert score	0.47**	1.15**	0.44**	1.15**
	[0.12]	[0.24]	[0.11]	[0.23]
Medium expert score	0.29**	0.48+	0.25*	0.47+
	[0.11]	[0.28]	[0.10]	[0.26]
Low expert score	-0.08	0.46	-0.09	0.45
	[0.27]	[0.53]	[0.26]	[0.50]
Genre dummies	YES	YES	YES	YES
Month of release dummies	YES	YES	YES	YES
Endogenous treatment correction	NO	NO	YES	YES
Constant	0.76*	11.91**	0.83**	11.90**
	[0.35]	[0.68]	[0.33]	[0.64]
R^2	0.47	0.40		
Observations	343	222	343	222

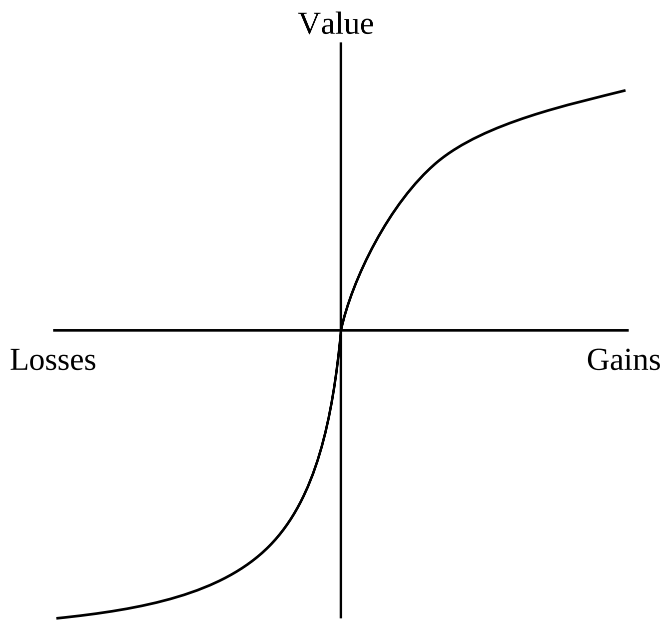
** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Heteroskedasticity robust standard errors clustered on the firm in parentheses.
Note: Models 1 and 2 estimate OLS regressions. Models 3 and 4 estimate endogenous treatment effects regressions via maximum likelihood; see Table 5 for first-step probit estimates of the treatment effects model.

Table 5. Selection into *free-to-play*

Variable	1. F2P
Independent studio	-0.56*
	[0.24]
RAM requirements	-0.16+
	[0.09]
Hard drive requirements	-0.09**
	[0.03]
Genre:	
Casual	0.27
	[0.26]
Massive multiplayer	3.08**
	[0.51]
Racing	-1.34*
	[0.59]
Role playing	-0.23
	[0.24]
Simulation	-0.64*
	[0.28]
Strategy	0.07
	[0.26]
Constant	-0.28
	[0.29]
Pseudo R^2	0.36
Observations	343

** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Heteroskedasticity robust standard errors clustered on the firm in parentheses.

Figure 1: Prospect theory's value function



APPENDIX 1: RANDOMIZED CONTROLLED TRIAL CONDITIONS[13]

Manipulation 1: Free-to-play and pay-to-play

Toki Tori is an addictive video game in the puzzle genre in which the player is tasked to find and collect Toki's lost eggs. The game consists of four worlds, each packed with many levels offering hours of fun. In order to solve the increasingly difficult puzzles the player can use a number of in-game tools such as the 'Telewarp', the 'Freeze-o-Matic', and the 'InstantRock'. The game is critically acclaimed, having received positive reviews from experts and gamers. The price of the game is 10 euros.

Toki Tori is an addictive video game in the puzzle genre in which the player is tasked to find and collect Toki's lost eggs. The game consists of four worlds, each packed with many levels offering hours of fun. In order to solve the increasingly difficult puzzles the player can use a number of in-game tools such as the 'Telewarp', the 'Freeze-o-Matic', and the 'InstantRock'. The game is critically acclaimed, having received positive reviews from experts and gamers. The game can be downloaded free of charge.

Manipulation 2: Price menu variety

Assume you downloaded this game free of charge/purchased this game for 10 euros. Further assume that you completed the game in approximately six hours. The developer of the game now offers you the opportunity to purchase a level editor at a price of 5 euros (see the image below for information). Purchasing this level editor allows you to create and play your own levels and share your created levels with other players in the game.

Assume you downloaded this game free of charge/purchased this game for 10 euros. Further assume that you completed the game in approximately six hours. The developer of the game now offers you the opportunity to purchase a number of extra's (see the images and text below for prices and information). These options have different functionalities and each come at their own price.

---

[13] Texts translated from subjects' native language. Color emphasis added.

APPENDIX 2: MULTIVARIATE ANALYSIS OF TRIAL DATA

The experimental design randomly allocated subjects into four conditions. Because of this randomization, inference can be drawn from simple mean comparisons such as reported in the Results section for Study 1. Any differences between subjects are evenly distributed across conditions and will be averaged away. That said, by conducting multivariate analyses that control for potentially relevant demographics (e.g., age, gender, preference for video games), we can assess the study's internal validity and further check for the robustness of the findings.

--- INSERT TABLE A1 ABOUT HERE ---

Additional data were collected for a number of demographics including whether subjects used their computers to play video games, measured as a binary variable; the amount of time subjects spent playing video games each week, measured as an ordinal variable; subjects' age, measured as a continuous variable; and subjects' gender, measured as a binary variable where the value of 1 corresponds with being male. These variables together with the outcome variables and the two manipulations (*free-to-play* and *price menu variety*) are summarized in Table A1. Pairwise correlations are directionally consistent with the hypotheses, and subject characteristics generally correlate with the outcome variables as expected (e.g., the time subjects spent playing video games per week is positively correlated with the stated time spent on the focal game).

--- INSERT TABLE A2 ABOUT HERE ---

Table A2 reproduces Study 1's main findings in a multivariate regression analysis. Models 1 and 2 estimate results from the first manipulation, Models 3 and 4 estimate results from the second manipulation, and Models 5 and 6 interact the manipulations to form four separate conditions. The results show the following: subjects in the free-to-play condition had a €2.40 less WTP than subjects in the pay-to-play condition ($p < 0.01$); subjects in the free-to-play condition spent 1.28 hours less playing the game than subjects in the pay-to-play condition ($p < 0.01$); subjects in the free-to-play condition were 77 percent less likely to adopt a paid extra than subjects in the pay-to-play condition ($p < 0.01$); subjects in the free-to-play condition spent €0.80 less on paid extras than subjects in the pay-to-play condition ($p < 0.01$); subjects in the high-variety price menu condition were four times more likely to adopt a paid extra than subjects in the low-variety price menu condition ($p < 0.01$); and subjects in the high-variety price menu condition spent €0.55 more on paid extras than participants in the low-variety price menu condition ($p < 0.05$). The findings from these regressions lend robust support to the hypotheses.

Support for the theoretical framework is further validated by Models 5 and 6. The results in these models show that, compared with subjects in the pay-to-play and high-variety price menu condition, subjects in the free-to-play and the low-variety price menu condition were 94 percent less likely to adopt a paid extra ($p < 0.01$) and spent €1.35 less on paid extras ($p < 0.01$); subjects in the free-to-play and the high-variety price menu condition were 76 percent less likely to adopt a paid extra ($p < 0.01$) and spent €1.02 less on paid extras ($p < 0.01$); and subjects in the pay-to-play and the low-variety price menu condition were 72 percent less likely to adopt a paid extra ($p < 0.01$) and spent €0.77 less on paid extras ($p < 0.05$).

The demographic controls show that subjects who used their computers to play video games had a higher WTP for the game and were more likely to adopt paid extras and to spend more money on these items. Subjects who spent more time playing video games were more likely to spend more time on the focal game. Last, the gender and age variables did not significantly correlate with any of the outcome variables.

Table A1. Descriptive statistics and pairwise correlations

Variable	Mean	St Dev	Min	Max	1	2	3	4	5	6	7	8	9
1. WTP for game	1.68	2.80	0.00	19.95									
2. Time spent on game	3.05	2.42	0.00	6.00	0.25								
3. Adopt paid extra	0.18	0.38	0.00	1.00	0.16	0.08							
4. Revenues by extras	0.75	1.71	0.00	7.50	0.15	0.08	0.94						
5. Free-to-play	0.51	0.50	0.00	1.00	-0.43	-0.25	-0.24	-0.24					
6. Price menu variety	0.51	0.50	0.00	1.00	-0.02	0.04	0.20	0.14	0.03				
7. Uses PC for gaming	0.39	0.49	0.00	1.00	0.15	0.03	0.13	0.17	-0.01	-0.07			
8. Time spent gaming	2.09	0.89	1.00	5.00	0.02	0.17	-0.07	-0.06	0.09	-0.03	0.30		
9. Age	19.18	1.29	18.00	26.00	-0.01	-0.08	-0.04	0.00	0.03	-0.09	0.21	0.02	
10. Male	0.60	0.49	0.00	1.00	-0.06	0.09	-0.11	-0.06	0.10	-0.14	0.13	0.46	0.07

Note: N = 246. Pairwise correlations greater than |.12| are significant at $p < 0.05$. Mean VIF: 1.18.

Table A2. The effect of *free-to-play* and *price menu variety* on value creation and capture

	Manipulation 1		*Manipulation 2*		*Man 1 * Man 2*	
Variable	**1. WTP game**	**2. Time game**	**3. Adopt extra**	**4. Rev extra**	**5. Adopt extra**	**6. Rev extra**
Free-to-play	-2.40**	-1.28**	-1.46**	-0.80**		
	[0.33]	[0.29]	[0.41]	[0.22]		
High-variety price menu			1.33**	0.55*		
			[0.38]	[0.22]		
*Free-to-play * low variety price menu*					-2.88**	-1.35**
					[0.77]	[0.34]
*Free-to-play * high-variety price menu*					-1.41**	-1.02**
					[0.49]	[0.35]
*Pay-to-play * low variety price menu*					-1.28**	-0.77*
					[0.45]	[0.38]
Uses PC for gaming	0.86*	-0.11	1.09**	0.73**	1.08**	0.75**
	[0.36]	[0.32]	[0.40]	[0.27]	[0.41]	[0.27]
Time spent gaming	0.10	0.51**	-0.23	-0.19	-0.23	-0.19
	[0.24]	[0.19]	[0.27]	[0.15]	[0.27]	[0.15]
Age	-0.06	-0.15	-0.13	-0.03	-0.12	-0.03
	[0.10]	[0.11]	[0.16]	[0.12]	[0.16]	[0.12]
Male	-0.29	0.19	-0.20	0.02	-0.20	0.02
	[0.31]	[0.32]	[0.45]	[0.25]	[0.44]	[0.26]
Constant	3.60*	5.37*	0.76	1.60	2.06	2.82
	[2.02]	[2.09]	[3.10]	[2.36]	[3.07]	[2.26]
(Pseudo) R^2	0.21	0.11	0.15	0.12	0.15	0.12
Observations	246	246	246	246	246	246

** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. Heteroskedasticity robust standard errors in parentheses.
Note: Models 1, 2, 4, and 6 estimate OLS regressions. Models 3 and 5 estimate logit regressions.