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Business Model Innovation and Competitive Imitation: The Case of Sponsor-Based Business Models*

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Abstract

We study sponsor-based business model innovations where a firm monetizes its product through sponsors rather than setting prices to its customer base. We analyze strategic interactions between an innovative entrant and an incumbent where the incumbent may imitate the entrant's business model innovation once it is revealed. The results suggest that an entrant needs to strategically choose whether to reveal its innovation by competing through the new business model, or conceal it by adopting a traditional business model. We also show that the value of business model innovation may be so substantial that an incumbent may prefer to compete in a duopoly rather than to remain a monopolist.

Key words: business model innovation; imitation; sponsor-based business model; strategic revelation; strategic concealment

INTRODUCTION

Schumpeter (1934) distinguishes between five types of innovations: new products, new methods of production, new sources of supply, exploitation of new markets, and new ways to organize business. Much of the literature so far has focused on the first two types of innovation (e.g., Shan, Walker, and Kogut 1994; Banbury and Mitchell 1995; Eisenhardt and Tabrizi 1995; Schroeder 2006; Katila and Chen 2008; Leiblein and Madsen 2009; Roberts 1999; Adner and Kapoor 2010; Leiponen and Helfat 2010; Zhou and Wu 2010). Our study focuses on the last type of innovation, often referred to as business model innovation today. Business model innovation has become increasingly important both in academic literature and in practice given the increasing number of opportunities for business model configurations enabled by technological progress, new customer preferences, and deregulation.

At root, business model innovation refers to the search for new logics of the firm, new ways to create and capture value for its stakeholders, and focuses primarily on finding new ways to generate revenues and define value propositions for customers, suppliers, and partners (e.g., Amit and Zott 2001; Magretta 2002; Zott and Amit 2007, 2008; Baden-Fuller *et al.* 2008; Casadesus-Masanell and Ricart 2010; Gambardella and McGahan 2010; Teece 2010). As a result, business model innovation often affects the whole enterprise (Amit and Zott 2001).

New entrants in a wide array of industries have demonstrated time and again that innovative business models can provide the basis for sustainable business success, even in competitive settings with well-established incumbents. But just as product and process innovations are hard to protect, business model innovations can be imitated: British Airways (BA) launched Go, a copycat of Ryanair's no-frills model, to compete against European low-cost airlines; Recoletos, one of the largest Spanish media groups, launched Qué!—an ad-sponsored free newspaper—in 2005 to fight the entry of similar titles such as Metro Spain; and in 2007, CBS Interactive copied Hulu's media streaming business model.

These empirical observations suggest that incumbents often learn about new business models from entrants and respond by incorporating these innovations (in full or in part)

into their own businesses. The possibility of competitive imitation, in turn, suggests that entrants need to strategically choose whether to reveal their ideas by competing through the new business model or, instead, to conceal them by adopting a traditional, established logic of value creation and value capture.

While a few theoretical studies have created frameworks to examine competitive dynamics among firms employing different business models (e.g., Lin, Ke, and Whinston 2008; Casadesus-Masanell and Zhu 2010), these frameworks do not capture the role of innovation and competitive imitation in firms' choices of business models. In this paper, we examine the desirability or lack thereof of business model innovations when such innovations cannot be protected and, thus, competitive imitation is possible. Specifically, we ask: *under what circumstances will an entrant benefit from adopting a new business model when the innovation may be imitated by an incumbent?*

Given the diversity of business models currently employed by companies in all sorts of industries, we must constrain the scope of our undertaking by studying—from among the many that exist, could exist—an important class of business model innovations. We focus here on business model innovations that allow a firm to monetize its product through sponsors rather than by setting prices directly to its customer base. We refer to this class of innovations as *sponsor-based* business model innovations. To illustrate, consider the following examples:

- Publishing houses traditionally earn their revenues by selling books to readers at positive prices. Alternatively, the publisher could include ads intertwined with the book's text and monetize this content by charging advertisers. In the extreme, the publishing house could give the books away for free and make money through ads only. Implementing such a scheme would be relatively easy for ebooks, as the ads could change over time, just as they do in news websites.
- The traditional way for porn websites to monetize their content is by charging prices to surfers. However, some sites are currently competing with a business model whereby

surfers can obtain free porn if they help solve a few "captchas" to create new, legitimate email accounts.[1] The free email accounts are often worth more to spammers than the bandwidth porn surfers consume downloading videos and images, and the porn site can monetize them by selling these email accounts to spammers.

- The traditional way ski resorts monetize their offering is by charging skiers positive prices for access to the slopes. With the growth of timeshare apartments close to the slopes,[2] ski resorts are increasingly partnering with real estate firms in a business model where skiers are offered free access to the slopes in exchange for enduring several hours condominium timeshare sales-pitches. In this new scheme, the ski resort monetizes access to the slopes through revenues obtained from the real estate company instead of prices paid by the skiers.

- When commercial email service appeared in the early 1990s, ISPs such as CompuServe, Prodigy, and America Online supplied email to paying subscribers through a usage-based billing system and, later, through monthly subscriptions. Launched on July 4, 1996, Hotmail (originally "HoTMaiL") was the first free email service. A few months after launch, Hotmail began displaying advertisements, thus becoming the first ad-sponsored email service. Implementing such business model required Hotmail to provide access to email through an interface where ads could be easily updated. Hotmail stored emails on "the cloud" rather than on users' own desktops and most users accessed their accounts through a browser where ads could be updated quickly.

These four examples are instances of the general class of situations that we study. Specifically, there is a traditional business model that involves monetizing the product through prices charged to consumers (for books; for porn; for access to the slopes; for email ser-

[1] Captchas are scrambled text boxes that many websites use to block bots. For example, Gmail uses captchas on its account creation page to prevent automatized creation of Gmail accounts which would later be used to send spam.

[2] Timeshare is a form of ownership of real estate (condominiums generally) whereby multiple parties hold rights to use the property, and each sharer is allotted a period of time (typically one week, and almost always the same time every year) in which they may use the property.

vice), but an innovator has found a new way to monetize the offering by giving it away to customers and obtaining revenue from some sponsors. To persuade sponsors to pay, a firm needs its consumers to provide something to the sponsors in return. Consumers often derive less utility from the firm's product or service as a result: indeed, in the above examples the customer suffers a reduction in the quality of the good or service, and thus an impoverished consumption experience (book readers and email users must be exposed to advertisements; porn surfers must solve some captchas; skiers must sit and listen about timeshare for a number of hours).

We choose to focus our study on *sponsor-based* business model innovations for three reasons. First, such innovations appear to be increasingly prevalent in today's economy. For example, many companies choose to finance themselves using ad revenues and offer their products or services free to consumers. Such products and services today range from newspapers to software applications, from television programs to online search engines. The increasing popularity of sponsor-based business models has been partly fueled by opportunities granted by Internet technologies which allow much improved targeting of advertisements and promotions as well as improved opportunities for direct interaction between firms and consumers.

Second, while many business model innovations that are to be adopted require full reconfigurations to a firm's activity system, sponsor-based business model innovations are generally not overly burdensome. For example, it is easier for the New York Times to offer a free, ad-sponsored newspaper than for Ethan Allen to operate like IKEA or for Avis to reinvent itself into a Zipcar. The implication is that sponsor-based business model innovations seem particularly easy to imitate. Since the purpose of our study is to analyze the effects of potential imitation on a firm's incentives for business model innovation, the case of sponsor-based business models is most relevant.

Third, although the notion of sponsor-based business model is well-known in sectors of the media industry, its penetration into other arenas has been a gradual process, as success-

ful implementation of this business model type is not always obvious. For example, while the modern magazine industry originated in the mid-17th century, magazines began using advertisements as a means of financial support only late the 19th century.[3] Similarly, European no-frills air service providers (such as Ryanair) earn a large share of their revenues not from ticket prices but from such ancillary sources as subsidies from secondary airports or payments from bus companies taking passengers from those airports to city centers. Obviously, such revenue sources had been available to traditional flag carriers before the entry of low-cost airlines. Without a doubt, sponsor-based business models will become feasible in an ever-increasing number of industries.

Setup and main results

Our study offers the first formal model of business model innovation in a game-theoretic framework. We focus on sponsor-based business model innovation and provide a comprehensive analysis of strategic interactions between an innovative entrant and an incumbent where their choices of business models are endogenously determined, and where the incumbent may imitate an entrant's innovation once it is revealed.

We analyze a three-stage game with two firms, an entrant and an incumbent, offering vertically differentiated products. In the first stage, the entrant chooses the business model through which it intends to compete: it can either compete through the traditional business model (charging a price to customers for the product) or innovate by adopting a sponsor-based business model (charging zero price and monetizing the customer base in ways that affect product quality negatively—as noted above). Prior to entry, the incumbent operates the traditional model and is unaware of the innovation. For simplicity, we assume that firms face no capacity constraints.

In the second stage, the incumbent observes the entrant's business model and chooses its own in response. If the entrant chooses the traditional business model, then the incumbent

[3]Source: `http://www.answers.com/topic/magazine`, accessed May 2010.

does not learn that there is an alternative way to compete and it may only respond with a version of the traditional business model (for example, it may introduce several products all based on the traditional model). However, if the entrant chooses the new business model, the incumbent can learn the innovation and may choose to imitate it, in full or in part.

In the third stage, firms make their tactical choices about how they will compete within their choices of business model. We use the expression *monetization intensity* to refer to the size of the cost imposed to customers in exchange for the free product. In the examples above, monetization intensity corresponds to the number of ads in the book or on the website, to the number of captchas to be solved for access to free porn, and to the number of hours that skiers must listen to promoters of timeshare condominiums. Obviously, the stronger is the monetization intensity, the larger is the revenue per customer that the firm derives from the sponsors. However, as monetization intensity grows, product quality (and consumers' willingness to adopt) deteriorates. In this stage, the entrant chooses price if it entered with the traditional business model, or monetization intensity if it entered with the new business model. The incumbent chooses price and/or monetization intensity, depending on its business model and the entrant's choice.

Our analysis provides several new results. First, we find that the entrant will sometimes choose to strategically reveal or conceal its innovation. *Strategic revelation* refers to a situation where the entrant prefers to compete through the new business model when it would choose not to do so if the incumbent was expected to continue competing through the traditional model. Such revelation induces the incumbent to change its business model in a way that is beneficial to the entrant. *Strategic concealment* refers to a situation where the entrant prefers not to compete through the new business model when it would choose to do so if the incumbent was expected to continue competing through the traditional model. Such concealment prevents the incumbent from changing its business model in a way that is detrimental to the entrant.

We find that strategic revelation (concealment) may occur only when the entrant's prod-

uct is of higher (lower) quality than the incumbent's product. This result suggests that revealing or concealing business model innovations is an important strategic decision for innovators. Moreover, the result implies that there may be a range of business model innovations that end up not being implemented because of the expected competitive imitation by incumbents.

We also find that not all business model combinations emerge in equilibrium. In particular, we find that the equilibrium industry configuration often entails both firms competing through different business models (and our model, therefore, provides a rationale for firm heterogeneity). Understanding why firms operate under different business models in the same industry is a long-standing question in strategy. Our study shows that explicitly endogenizing firms' choices of business models in a game-theoretical framework is a promising approach to tackle this question.

While much of the prior literature on positioning focuses on differentiation through product design, our work finds that the benefits from business model differentiation (i.e., the value of innovation) can be substantial for both firms: indeed, we find that both the incumbent and the entrant could make more profits with the innovation, even if the incumbent does not directly benefit from it.

Finally, we find that the value of business model innovation may be so substantial that the incumbent may prefer a duopoly than remaining a monopolist. This happens when the entrant's choice of business model reveals the innovation, and the benefit to the incumbent from learning about it more than compensates for the loss of profit incurred in competing with the entrant. To the best of our knowledge, our paper is the first to show formally that, when competitors complement each other through business model innovation, competition for the same customers with vertically differentiated products can lead to more profits for the incumbent than a monopoly.

Related literature

Our study contributes to several strands of literature. First, our paper contributes to the literature on innovation and imitation. Scholars have looked at how new products or processes can be imitated by their competitors (e.g., Benoit 1985; Gallini 1992; Pepall and Richards 1994; Ethiraj, Levinthal, and Roy 2008) and whether firms should disclose or license their innovations (e.g., Hill 1992; Gans, Murray, and Stern 2008; Mukherjee and Stern 2009). Following these studies, we assume firms can imitate each other's business model innovations once they are revealed.

The literature on imitation is closely related to the broader literature on the transfer of best practices among firms (e.g., Csaszar and Siggelkow 2010). Studies have identified a variety of factors such as the absorptive capacity of the imitator, and the complexity of the strategy to be imitated that facilitate or inhibit successful transfer of practices across firms or across different units within a firm (e.g., Cohen and Levinthal 1990; Kogut and Zander 1992; Zander and Kogut 1995; Rivkin 2000; Knott 2003; Szulanski, Cappetta, and Jensen 2004). Unlike these studies that typically look from the perspective of an imitating firm and examine practices within it, we study an innovator's decision on whether to reveal its new way of creating and capturing value, and explicitly model the competitive dynamics between the innovator and its imitator in a game-theoretic framework. In addition, we also allow the imitator to creatively combine the innovator's new business model with its current model to create new ones.

Our work also contributes to the growing literature examining competitive dynamics between firms with different business models. Studies have examined such dynamics in a number of industries, including the software industry (e.g., Casadesus-Masanell and Ghemawat 2006; Economides and Katsamakas 2006; Casadesus-Masanell and Yoffie 2007; Lee and Mendelson 2008), the cable industry (Seamans forthcoming), and the music industry (Casadesus-Masanell and Hervas-Drane 2010). Much of this literature has focused on interactions between firms with exogenously given business models. A few recent studies (e.g.,

Casadesus-Masanell and Zhu 2010; Casadesus-Masanell and Llanes 2011; Lin *et al.* 2008) have endogenized firms' choices of business models by allowing firms to select their business models before deciding their optimal tactics to compete (as they would do in the real world). In these studies, however, the available business models are assumed to be common knowledge among all firms. As a result, these models are not suitable for evaluating the value of business model innovation. Our paper extends this line of work by explicitly modeling the role of innovation. We assume that, initially, an entrant is the only firm aware of a new business model and it chooses its business model before the incumbent reacts. The set of business models available to the incumbent may expand or remain unchanged, depending on whether the entrant chooses to reveal the innovation.

Our approach to modeling innovation follows the literature on unawareness (see Dekel, Lipman, and Rustichini 1998, and references therein). Bages-Amat (2008) suggests that incorporating unawareness is a useful approach to studying innovation and creativity, and (according to this literature, e.g., Li 2008; Bages-Amat 2008), an agent is unaware of something if he does not know it, and he does not know that he does not know it (and so on *ad infinitum*). Therefore, "being unaware of" a business model is different from simply "not knowing" about it: a firm that does not know the new business model, but is aware of it (i.e., knows that it does not know about it) can still take it into account. We apply the concept of unawareness to study business model innovation. In our game, the incumbent is bounded rational: if the entrant does not reveal the business model innovation, the incumbent remains "unaware" of the innovation—and continues to compete as if the new business model did not exist; once the entrant reveals the innovation, however, the incumbent becomes aware of it, and can then take it into account when formulating its strategy. As Gavetti and Levinthal (2004) point out, bounded rationality in theoretical models "has typically taken the form of myopic hill-climbing, or quasi-Skinnerian bases of action. Strategic action clearly involves greater degrees of intentionality, so fuller representations of cognition would need to be incorporated into such theoretical efforts." Our approach to incorporating unawareness allows

the players to have great degrees of intentionality—the incumbent always makes an optimal decision given the information it has and becomes fully rational once the entrant reveals the innovation.

Our approach to modeling competitive dynamics between the entrant and the incumbent is similar to Shaked and Sutton (1982) in that firms' products are vertically differentiated and the extent of differentiation affects the intensity of competitive rivalry. Different from Shaked and Sutton (1982), our setting also allows firms to differentiate themselves by adopting different business models. The difference between our setup and that of the Shaked and Sutton (1982) is most pronounced when we consider two firms offering products of similar quality. In their setup, the low product differentiation leads to intense price competition and nullify both firms' profits. Hence, firms find it hard to co-exist. In our model, the two firms can easily co-exist and be profitable by choosing different business models, which create differentiation in the realized product quality.

Finally, the paper is related to the literature on platforms and multi-sided markets (e.g., Rochet and Tirole 2003; Caillaud and Jullien 2003; Armstrong 2006; Hagiu 2009; Casadesus-Masanell and Ruiz-Aliseda 2009; Zhu and Iansiti forthcoming). Platforms are institutions that act as intermediaries to enable transactions between multiple sides of a market—such as sponsors and consumers. Most of the literature on multi-sided markets and platforms considers situations where the sides attract one another. For example, operating system platforms connect two sides: independent software vendors and users. Clearly, the more applications are available for a particular operating system, the more attractive that system is to users. Likewise, the larger the number of users of a particular operating system, the more attractive it is for developers to produce applications for that system. When a platform is sponsor-based, however, consumers prefer to access the product without interference by the sponsors (i.e., consumers prefer books or email without ads, porn without captchas, or access to slopes without sales pitches). Our paper contributes to this literature by exploring the desirability (or lack thereof) of entering a market with a two-sided business model when

one side imposes a negative externality on the other.

The rest of the paper is organized as follows. We first present our model setup and provide the theoretical results. We then discuss the implications of the results and conclude after suggesting some extensions to the analysis.

MODEL

Setup

Our model involves two profit-maximizing firms, an incumbent and an entrant, indexed by $k \in \{i, e\}$. Firms may obtain revenues from two different sources: they may charge a price for their product p_k, and they may find a business model innovation that allows them to monetize their offering while giving the product away to customers. To model the second source of revenue, let m_k be the intensity of this alternative monetization effort (a variable that can be decided by firms within the game, since such choices are endogenous within its framework). In the examples above, m_k is the number of ads in the book or on the website, the number of captchas to be solved to access free porn, and the number of hours that skiers must listen to promoters of timeshare condominiums. If $s_k(m_k)$ individuals adopt the product, then the total revenue derived from this monetization effort m_k is: $M_k = \alpha \cdot s_k(m_k) \cdot m_k$, where $\alpha > 0$ is an exogenous parameter that represents the (per consumer) monetization rate.[4,5] For simplicity, we assume that firms face no capacity constraints.

On the demand side, there is one unit mass of consumers. Consumers are differentiated by their type θ, which represents their marginal willingness to pay for product quality and is uniformly distributed on $[0, 1]$. The utility that a consumer of type θ receives from product $k \in \{i, e\}$ is $U(\theta) = \theta(q_k - m_k^2) - p_k$, where $q_k > 0$ denotes the (exogenous) quality of product

[4]In advertising models, $\alpha > 0$ corresponds to the (per consumer) advertising rate charged to each advertiser. See, for example, Gabszewicz, Laussel, and Sonnac (2004).

[5]We note that it would be natural to allow the composition of the firm's customer base to affect sponsors' willingness to pay for access to the firm's customers. The simplest way to incorporate this dependence would be by allowing α to vary across consumer type. Unfortunately, such an extension renders the model intractable. Thus, we follow earlier theoretical work (e.g., Armstrong 2006; Gabszewicz *et al.* 2004; Jiang 2010; Lin *et al.* 2008) and assume that α is constant.

k. Note that the monetization intensity m_k is felt as a nuisance by consumers—the greater it is, the lower they perceive the quality of the firm's product to be. The convex functional form implies that mild monetization efforts (such as forcing consumers to listen for a few minutes the selling of a timeshare apartment opportunity) are tolerated well but more intense monetization efforts are irritating. Note that the use of a sponsor-based business model has implications not only concerning value capture (sponsors, rather than consumers, are the sole source of revenue), but also relating to value creation (the firm's monetization efforts lead to lower willingness to pay for the product).

Prior to entry, the incumbent employs the traditional business model: it sells its product at positive prices but is unaware of other opportunities to further monetize its offering. Thus, the traditional business model has: $m_k = \varnothing$ and $p_k > 0$.[6] The entrant may adopt the traditional business model or it may innovate as already described. If it innovates, its business model has: $m_k > 0$ and $p_k = \varnothing$. Thus, the business model innovation is 180° away from the traditional business model. We denote the traditional business model by T and the new business model (the innovation) by I.

If entry occurs and the entrant innovates, the incumbent becomes aware of the entrant's monetization idea and may then choose to reconfigure its business model to respond. For example, the incumbent may choose to compete with I, which entails moving from ($m_k = \varnothing$, $p_k > 0$) to ($m_k > 0$, $p_k = \varnothing$). Alternatively, it may decide to stay put with the original model T, or to adopt elements of the new business model by setting ($m_k > 0$, $p_k > 0$) so that its product is sold at positive prices and, at the same time, it is further monetized through m_k. We denote this combined business model by M, because it is a mixture of T and I.

We impose a non-negativity constraint on price p_k and monetization intensity m_k, and normalize consumers' utility from outside options to zero. Each consumer only adopts one product. In addition (and without loss of generality), we adopt two tie-breaking rules: 1) if a consumer receives zero utility from adopting a product, they will choose to adopt the

[6] We use the empty set symbol $\varnothing$ to denote that that element is not in the business model.

product, and 2) if a consumer is indifferent between two products, they will choose to adopt the product with a higher quality.

Timing

The timing of the game is as follows. First, the entrant decides its business model (the incumbent's model is preset at T). Second, the incumbent learns about the entrant's choice of business model and chooses a business model to respond. Third, tactical choices (prices and/or the monetization intensities) are made by both firms, and demand and profits are realized.

As mentioned, the set of business models available to the incumbent in the second stage is contingent on the entrant's business model choice. If the entrant chooses T, then the incumbent remains unaware of how to further monetize the product—their choice is limited to T. However, if the entrant chooses I, then the set of business models available to the incumbent expands.

We allow the incumbent to respond to entry in one of two ways—by staying with one product and competing through business models T, I, or M, (I and M are available only if the entrant has chosen I), or by introducing a fighting brand.[7] We use a 2-tuple, (x, y), to denote the business model choices of the two firms: x denotes the entrant's and y the incumbent's. Different business model choices give rise to different tactical interactions between firms, which we study in the next section.

Figure 1 shows the game where each combination of business models corresponds to a different subgame. The possible business model combinations we consider are:

(T, T): The entrant chooses the traditional business model and the incumbent responds with the same business model;

(T, TT): The entrant chooses the traditional business model and the incumbent responds

[7]The term "fighting brand" has been frequently used by scholars and practitioners (e.g., Mintzberg 1987; Rao, Bergen, and Davis 2000) to refer to situations where an incumbent responds to competition by expanding its product line with a lower-quality product.

by introducing a fighting brand with quality $q_{i'} < q_i$. Therefore, the incumbent offers two products in this case, the original product of quality q_i and the fighting brand of quality $q_{i'}$;[8]

(I, T): The entrant chooses to innovate and the incumbent responds by staying put with the traditional business model;

(I, M): The entrant chooses to innovate and the incumbent responds with the mixed business model (combining price and monetization efforts);

(I, I): The entrant chooses to innovate and the incumbent imitates and responds by imitating this new business model;

(I, TT): The entrant chooses to innovate and the incumbent responds by introducing a fighting brand with quality $q_{i'} < q_i$ based on the traditional business model. The incumbent winds up with two products;

(I, TI): The entrant chooses to innovate and the incumbent responds with a fighting brand with quality $q_{i'} < q_i$ based on the new business model. The incumbent winds up with two products.

[Figure 1 about here.]

It is easy to see that business model II (where the incumbent offers two products, both based on the innovation) is dominated by I when the entrant chooses I. Moreover, business models IT and TI (where the incumbent offers two products, one based on the traditional business model and the other on the innovation) are equivalent. Therefore, it is unnecessary to consider subgames (I, II) and (I, IT) explicitly in our setup and this is why they do not appear in Figure 1.

Business models as profit functions

As noted above, by business model we mean "the logic of the firm, the way it operates and how it creates and captures value for its stakeholders" (Baden-Fuller *et al.* 2008; Casadesus-

[8] We model the choice of $q_{i'}$ as preceding the pricing choices of the two firms, since quality decisions are often longer-term decisions than price decisions.

Masanell and Ricart 2010). To be able to work formally with business models, we represent them in the form of simple profit functions. Thus, the choice of a particular business model corresponds, in our development, to the choice of a particular profit function. Profit functions are highly simplified, reduced form representations of business models. These stylized representations allow tight mathematical analyses. Zott and Amit (2010) propose the use of Porter's (1996) activity systems to represent business models. Porter's activity systems embody richer representations of business models and provide a textured picture of how the firm creates and captures value. Activity systems emphasize that a firm is more than the mere addition of activities as complementarities may result in important competitive advantages. On the negative side, activity systems are not amenable to game-theoretical analysis because they often contain many elements and are too complex.[9]

To illustrate our approach, consider the subgame (I, T) where the entrant has chosen to innovate and the incumbent stays put with the traditional business model. The profit functions are obtained as follows. We first examine the case where $q_i > q_e$. Here, the incumbent maximizes profits by setting p_i and the entrant maximizes profits by setting m_e subject to the constraint that $q_e - m_e^2 \geq 0$ (so that its product has nonnegative net quality). As the entrant's product is given away for free, consumers who do not buy product i will adopt product e. The type of the consumer who is indifferent between the two products, θ^*, is defined by $\theta^* q_i - p_i = \theta^*(q_e - m_e^2)$ and the profits are:

$$\pi_i^{(I,T)} = (1 - \theta^*)\, p_i \quad \text{and} \quad \pi_e^{(I,T)} = \alpha\, \theta^*\, m_e, \tag{1}$$

[9]We think of profit functions as representations of business models as if looked at from a distance. We could "zoom down" closer to the actual details of the business model used by the firm and come up with more complex profit functions that explicitly accounted for additional elements in the business models that we have not considered. For example, the particular human resource management policies in place, the production technologies used, or the marketing policies (just to name a few) are all part of "the logic of the firm, the way it operates and how it creates value for its stakeholders" and, thus, are all part of a firm's business model, and could be included in the profit function to have a more detailed representation of the firm's business model. However, in most cases, these "closer," more complete representations of business models are too complex to be amenable to mathematical analyses.

subject to $0 \leq \theta^* \leq 1$, and $q_e - m_e^2 \geq 0$.

Consider now the case where $q_e > q_i$. There are two cases:

Case 1: $q_e - m_e^2 \geq q_i$. Here, as the entrant product is free and is of higher quality, the incumbent is pushed out of the market, and all consumers adopt product e. The profits of the two firms are: $\pi_i^{(I,T)} = 0$ and $\pi_e^{(I,T)} = \alpha \cdot 1 \cdot m_e = \alpha\, m_e$.

Case 2: $q_e - m_e^2 < q_i$. Now, as the entrant's product is free, all consumers will adopt either the incumbent's product or the entrant's product as long as $q_e - m_e^2 \geq 0$. Profit functions in this case coincide with equation (1).

The entrant will compare the profits from these two cases and decide the optimal level of m_e. This concludes our derivation of the profit functions for subgame (I, T). The derivations of profit functions for the six remaining subgames are presented in Appendix A of the working paper version of this paper (Casadesus-Masanell and Zhu 2011).

RESULTS

We look for the subgame perfect equilibria of the game. Therefore, we proceed by backward induction by first finding the equilibrium tactical choices in each subgame (p_k and/or m_k, depending on the business model combination) and then considering the equilibrium business model choices.

Optimal tactics for each business model combination

The equilibrium analysis of the optimal tactical choices for each subgame is straightforward.[10]

We allow the entrant's product quality, q_e, to be higher or lower than the incumbent's, q_i. In both cases, we find that if the entrant chooses the traditional business model, both firms will coexist in equilibrium. As the incumbent does not learn about the innovation, it will continue to adopt the traditional business model.

If the entrant chooses to innovate in its business model, it is possible that the entrant or

[10]See Appendix B of the working paper version of this paper for the equilibrium analysis (Casadesus-Masanell and Zhu 2011).

the incumbent will be pushed out of the market. In particular, when the entrant's product is of higher quality than the incumbent's, the incumbent can co-exist with the entrant only when its product is of relatively high quality ($q_i > \frac{3}{4}\, q_e$). In this case, the entrant chooses to maximize monetization intensity such that its net quality, $q_e - m_e^2$, is 0, as pushing the incumbent out of the market requires setting a low monetization intensity which brings lower profits. When the entrant's product is of lower quality than the incumbent's, the entrant risks being pushed out of the market by the incumbent when α is large.

These results suggest that an entrant that does not innovate cannot be killed—one that does, however, can be forced out if it introduces the innovation in the wrong situation. Therefore, if the entrant is unsure about how its product's quality compares to that of the incumbent, it is "safer" to choose not to innovate but, instead, to compete through the traditional business model.

Business model choice

Having derived the equilibrium tactics and payoffs under each possible combination of business models, we now analyze the first and second stages of the overall game—when firms choose their business models.

The following diagram shows the equilibrium business model combinations for different parameter values. The horizontal axis is the monetization rate α and the vertical axis is the quality ratio q_e/q_i.

[Figure 2 about here.]

Proposition 1 summarizes the features of Figure 2a and Proposition 2 those of Figure 2b.

Proposition 1. *When $q_i < q_e$:*

a. The only business model combinations that may arise in equilibrium are (T,T), (I,T), and (I,TT).

b. The entrant always survives and the incumbent is pushed out in the (I,T) region only.

c. (T, T) *is the equilibrium business model configuration when* α *is small and* q_e/q_i *is large.* (I, TT) *is the equilibrium business model configuration when* α *is large and* q_e/q_i *is small.* (I, T) *is the equilibrium business model configuration when both* α *and* q_e/q_i *are large.*

To understand why (I, I), (I, TI), (I, M), and (T, TT) cannot be equilibrium business model configurations, note that when the entrant chooses to innovate and $q_e > q_i$, the incumbent will never respond with a business model that involves $m_i > 0$ because the Bertrand-style competition results in $q_e - m_e^2 = q_i$, pushing the incumbent out of the market: hence (I, I) and (I, TI) will never be the equilibrium business model choices. Choosing a mixed model can also never be an incumbent's best response to fight an entrant adopting the new business model, since the entrant will always prefer to push the incumbent out of the market in this case. Finally, when the entrant chooses the traditional business model, the only possible choices for the incumbent are T and TT, and as argued above, TT will be dominated by T.

Part (b) states that the incumbent is pushed out of the market only when the equilibrium business model configuration is (I, T). Obviously, when the equilibrium business models are (T, T) both firms co-exist. In the (I, TT) case, the incumbent best-responds to the entrant's adoption of the innovation by introducing a fighting brand that induces the entrant to respond with a large monetization intensity. As vertical differentiation between the entrant product and the incumbent's high-quality product increases, the incumbent can earn greater profits: however, the introduction of a fighting brand in response to an entrant adopting innovation results in positive incumbent profits only when the quality ratio q_e/q_i is less than 4/3.

To understand part (c), note that when α is large, the entrant has a strong incentive to innovate. In this case, if the quality ratio q_e/q_i is larger than 4/3 the entrant pushes the incumbent out of the market no matter which business model the incumbent adopts. However, when the quality ratio is lower than 4/3, the incumbent can avoid being killed by

choosing TT, which forces the entrant to set the maximum possible monetization intensity. Vertical differentiation increases and the incumbent earns positive profits. When α is low and the quality ratio q_e/q_i sufficiently large, the entrant prefers to choose the traditional model as the monetization revenue is low otherwise. In this case, the incumbent (still unaware of the innovation) can only respond by choice of T or TT (as it continues to be unaware of the innovation) and, as we have argued, the former dominates the latter.

We now turn to studying the situation where $q_e < q_i$, as illustrated in Figure 2b.

Proposition 2. *When $q_i > q_e$:*

a. The only business model combinations that may arise in equilibrium are (T,T), (I,T), and (I,M).

b. Both firms co-exist in equilibrium.

c. (I,M) is the equilibrium business model configuration when α is intermediate and q_e/q_i is small, and (I,T) is the equilibrium business model configuration when both α and q_e/q_i are intermediate. For all other values of α and q_e/q_i, (T,T) is the equilibrium business model configuration.

The intuition for why (I,I) and (I,TI) are never equilibrium outcomes is the same as in Proposition 1, except that here it is the entrant rather than the incumbent that tries to avoid being killed. (I,TT) and (T,TT) do not occur in equilibrium because having a second, low-quality product makes no difference to the incumbent's profits.[11]

To understand part (b), note that the incumbent cannot be pushed out because it has a higher-quality product and can always price its product close to zero to obtain positive demand. Moreover, the entrant can always choose to compete through the traditional business model to obtain positive profits.

[11]It is important to realize that the incumbent is not concerned about being pushed out of the market when $q_e < q_i$. Therefore, releasing the second product does not serve the same purpose as when $q_e > q_i$ (see the discussion following Proposition 1).

Turning to (c), note that (I, M) is the equilibrium business model configuration that has a quality ratio below 1/2, in which case, the entrant is pushed to the corner where its net quality is zero (i.e., $m_e = \sqrt{q_e}$). When the entrant adopting the innovation is expected to be at the corner, the incumbent's optimal choice is the mixed business model.

In the (I, T) region, the monetization rate α is sufficiently high for the entrant to prefer to innovate but *not* sufficiently high for the incumbent to best-respond by imitating. Nor will the incumbent choose the mixed model as its response because when $q_e/q_i > 1/2$, monetization intensities are strategic substitutes. This means that if the incumbent chooses the mixed business model M (thus setting m_i), product differentiation will be smaller than if it competes with the traditional model (because the entrant will respond to M by setting a lower m_e). The reduced product differentiation is more detrimental to the incumbent's profits than the additional monetization of the customer base (given the relatively low monetization rate).

To understand the (T, T) region, note first that when α is large, the entrant does not want to reveal the innovation because the incumbent will respond by imitating the new business model and will end up pushing the entrant out of the market. If, however, the monetization rate α is low, the business model innovation is unattractive because the impact of additional m_k on market share is substantial but the additional monetization would be very small. In this case, the entrant chooses the traditional business model and the incumbent responds with the same business model.

DISCUSSION

This section discusses several implications of our formal business model innovation framework.

Strategic revelation and strategic concealment

We begin by examining the conditions under which the entrant prefers to strategically reveal or conceal its innovation. We first formally define strategic revelation and concealment in our context.

- *Strategic revelation* refers to a situation where the entrant prefers to compete through the new business model when it would choose *not* to do so if the incumbent was expected to continue competing through the traditional model.

- *Strategic concealment* refers to a situation where the entrant prefers to *not* compete through the new business model when it would choose to do so if the incumbent was expected to continue competing through the traditional model.

In other words, strategic revelation means choosing the new business model (revealing the innovation) to induce the incumbent to change its business model in a way that is beneficial to the entrant; and strategic concealment means choosing the traditional business model (concealing the innovation) to prevent the incumbent from changing its business model in a way that is detrimental to the entrant.

Figures 3 and 4 illustrate the regions where the entrant strategically reveals or conceals its business model innovation, respectively. In both figures, panel (a) shows the entrant's optimal choice of its business model under the assumption that the incumbent will not change its business model.[12] Panel (b) superimposes panel (a) and the equilibrium business model configurations derived in Figure 2 to show the regions with strategic revelation and concealment.

[Figure 3 about here.]

Region *1* in Figure 3b exhibits strategic revelation: here the entrant reveals the innovation by choosing to compete through the new business model to induce the incumbent to change

[12] Of course, we are allowing the incumbent to adjust price in response to the entry.

its business model. Specifically, because region *1* is contained in region (I, TT), the entrant knows that the incumbent will respond by introducing a fighting brand, which in turn will induce the entrant to increase its monetization intensity that help increase entrant's profits. Interestingly, if the incumbent continued to compete through the traditional model *without* a fighting brand, in equilibrium, the entrant would lower monetization intensity and thus its profits. The reason is that the trade-off between market share and monetization revenue per user is resolved differently when the fighting brand is available—since the fighting brand makes the entrant less worried about market share and induces it to choose more aggressive monetization m_e.

Turning to the case where $q_e < q_i$, regions *1* and *2* in Figure 4b exhibit strategic concealment: the entrant chooses the traditional business model, thus concealing the innovation, even though it would choose to reveal it if the incumbent were constrained to stay with the traditional model.

[Figure 4 about here.]

Strategic concealment takes place through different mechanisms in these two regions. In region *1*, if the entrant chose to innovate in its business model, the incumbent would respond by introducing a fighting brand based on the new model. Because the entrant has a product of lower quality, it would be pushed out of the market, so it chooses to conceal the innovation. In region *2*, if the entrant chose to innovate, the incumbent would respond by adopting the mixed business model. The resultant lower vertical differentiation would end up hurting (though not killing) the entrant, so here, again, the entrant is better off by concealing the innovation.

Figures 3 and 4 indicate that strategic revelation (concealment) may occur only when the entrant's product is of higher (lower) quality than the incumbent's product. This suggests that business model innovations are more likely to be revealed when the quality of the innovators' product is high and that revealing or concealing business model innovations is

an important strategic decision for innovators. Moreover, the result implies there may be a range of business model innovations that end up not being implemented because of the expected competitive responses by incumbents.

Who benefits from business model innovation?

To tackle this question, we consider as a benchmark a situation where the entrant has not come up with the business model innovation. This means that the entrant must compete with the traditional business model and we compute the profits that the incumbent and the entrant obtain if the entrant adopts the traditional business model. We compare this benchmark to the profits that both firms obtain under the equilibrium business model configurations that we have derived in the section titled "Results" (which are summarized in Figure 2). This comparison allows us to determine the value of the business model innovation to the incumbent and to the entrant.

Proposition 3. *The entrant strictly benefits from the innovation in all regions where it adopts the innovation (i.e.,* (I, M)*,* (I, T)*, and* (I, TT) *in Figure 2). The incumbent strictly benefits from the innovation in the* (I, TT) *region of Figure 2a, and* (I, T) *and* (I, M) *region of Figure 2b, and becomes strictly worse off in the region* (I, T) *of Figure 2a. The innovation has no effect on either the incumbent's or entrant's profitability in regions where the entrant does not adopt the innovation (i.e., the* (T, T) *regions of Figure 2).*

Obviously, if the entrant does not adopt the innovation, both the entrant and incumbent will compete with the traditional business model and, as a result, their profitability will remain unchanged. Because the entrant is the first mover and has superior knowledge from the innovation, it will benefit from choosing the new business model (i.e., regions (I, M), (I, T), and (I, TT) in Figure 2)—otherwise it would choose to compete with the traditional business model.

In regions (I, TT) of Figure 2a and (I, M) of Figure 2b, the entrant will be at the corner, so the incumbent makes more profits than what it would have if the entrant had adopted

the traditional business model (as in this case the entrant would not be at the corner). In region (I, T) of Figure 2b, with innovation, the entrant's net quality becomes lower and the two products are more differentiated. With the low intensity of competition, the incumbent profits increase with the innovation. The incumbent's profitability decreases, however, in region (I, T) of Figure 2a: without innovation, the two would co-exist with both earning positive profits—but with innovation, the entrant will push the incumbent out.

Might the incumbent ever prefer to be a duopolist rather than a monopolist?

We now investigate whether the benefits from innovation could ever be so substantial that the incumbent preferred facing competition from an innovative entrant to remaining a monopolist. In this case, the benchmark is a situation where the incumbent faces no competition. We show that while the transition from monopoly to duopoly generally implies lower profitability, in certain circumstances, an incumbent may strictly prefer a duopolistic industry structure!

Proposition 4. *The incumbent is strictly better off as a duopolist than as a monopolist in region (I, M) of Figure 2b, and is indifferent between being a duopolist and being a monopolist in region (I, TT) of Figure 2a. In all other regions in Figure 2, the incumbent is strictly better off as a monopolist.*

In all regions where the entrant chooses the traditional business model, the incumbent is strictly worse off in a duopoly, as it does not learn the innovation and has to compete with a product with positive net quality. Hence, we only need to consider the regions (I, M), (I, T) and (I, TT) in Figure 2. In the (I, T) region of Figure 2a, the incumbent is pushed out of the market; in the (I, T) region of Figure 2b, the incumbent is competing with an entrant whose product has a positive net quality. Hence, the incumbent becomes worse off with the entrant in these two regions. The incumbent makes the same profits with or without the entrant in the region (I, TT) of Figure 2a because in equilibrium, the net quality of the entrant's product is zero and thus it has no strategic interaction with the incumbent's products.

Interestingly, the incumbent gains strictly greater profitability in the (I, M) region of Figure 2b. In this case, because the quality ratio q_e/q_i is low, the net quality of the entrant's product is zero. In addition, the incumbent now learns how to combine the innovation with the traditional model and can derive some additional revenue (through the monetization of its customer base). Therefore, in the (I, M) region *both* firms benefit (strictly) from the business model innovation!

We conclude that when firms compete with *different* business models, competition may be beneficial to both firms, as well as to their consumers. This result contrasts with the common scenario where firms compete with the *same* business model, when their profitability is always adversely affected by competition. While this phenomenon has been documented elsewhere through case study research (Casadesus-Masanell, Fernandez, and Jobke 2007; Casadesus-Masanell and Campbell 2008), to the best of our knowledge, our paper offers the first formal model where this sort of business model complementarity between competitors arises endogenously.

LIMITATIONS, EXTENSIONS AND CONCLUSIONS

We conclude this paper by discussing several limitations and extensions to our model.

Endogenous quality

Our analysis has deemed the entrant's quality q_e exogenous.[13] We now consider the endogenous choice of q_e at a stage prior to the entrant's choice of business model. Given that the game is already intricate when quality is exogenous, we resort to numerical analysis to analyze the entrant's optimal quality level.

The game is as before except that there is a stage zero where the entrant chooses q_e at cost $c(q_e) = c\,q_e^2$, where $c > 0$ is a constant cost parameter. To identify the entrant's optimal quality level, we plot the entrant's maximum profits as a function of quality q_e for different

[13] We note, however, that the realized quality when the entrant chooses to innovate $q_e - m_e^2$ is endogenous as it depends on the monetization intensity chosen in equilibrium.

combinations of monetization rate α and cost parameter c in Figure 5.[14] The figure also indicates the equilibrium business model choice by the entrant for each q_e by making use of the results summarized in Figure 2.[15]

[Figure 5 about here.]

The curve can be discontinuous as the incumbent may respond by changing its business model. Comparing Figure 5a to Figure 5b, we find that when α is low—so that there are equilibria where the entrant chooses the innovative business model when $q_e < q_i$ (see Figure 2b)—the optimal quality is $q_e < q_i$ and the business model chosen is the innovative one; when α is so high that the *only* equilibrium when $q_e < q_i$ is (T, T) (see Figure 2b), the entrant prefers $q_e = q_i$ and the innovative business model. Thus, while entrants with sponsor-based business models will often choose to have lower-quality products than incumbents, they will choose to increase their product quality when α is high.

We also find that when c is low, as in Figure 5c, the entrant's profits are maximal by choosing quality $q_e > q_i$ and competing with the traditional business model. When c is high and α low, however, the entrant will choose quality $q_e < q_i$ and the traditional business model (see Figure 5d).

These results show that there is no necessary correlation between equilibrium business models and endogenous quality levels. The quality levels and business models observed in equilibrium are the outcome of complex tradeoffs between the cost of quality $c\,q_e^2$, the monetization rate α, and the expected competitive response by the incumbent as summarized by Propositions 1 and 2.

Adoption cost of different business models

For simplicity, our model assumes the adoption cost of any business model to be zero, but in reality, of course, there will always be cost involved in reconfiguring one's business model,

[14] The figure has $q_i = 1$.

[15] The colorings of Figures 2 and 5 are mutually consistent.

which may vary for different business models. For example, ad-sponsored business models could be less costly to adopt than fee-based models, since a firm such as Metro often does not have to manage such complicated distribution channels, or maintain billing systems for collecting subscription fees. Hence, our analysis may underestimate the benefits an entrant might gain from the lower costs of its business model innovation. We also assume the costs to the incumbent involved in learning about the business model innovation as zero, although (as Rivkin 2000 shows) firms may suffer large penalties from small errors when learning and imitating others' business models. If the cost of imitation seems likely to be high and the entrant product is of lower quality, the incumbent may choose not to learn and copy, and the entrant will be more likely to reveal than to conceal its innovation.

Partial unawareness

In our analysis, we have assumed that the incumbent remains unaware of the business model innovation if the entrant chooses not to adopt it. The assumption is consistent with prior studies suggesting that business model imitation often requires changes to the entire activity system and partial imitation may lead to large penalties (e.g., Zott and Amit 2010; Rivkin 2000). In this regard, our model and results are applicable to situations where an incumbent knows about the new business model conceptually but is unable to adopt it without observing the actual implementation by another firm.

When a business model innovation requires simple changes to an activity system, it is possible that an incumbent can implement it by simply learning about the idea (through employee mobility, for example) after an entrant has figured out the innovation (e.g., Agarwal, Ganco, and Ziedonis 2009). While the full analysis of the entrant's strategic decisions incorporating the possibility that an incumbent can implement a business model innovation without observing its implementation is beyond the scope of the current paper, the spirit of the paper carries over to this new setting: an entrant will face a similar strategic dilemma over whether to engage in research on a new business model anticipating that an incumbent may learn about it and implement it.

The possibility that an incumbent may adopt a business model innovation even if an entrant does not adopt it does not necessarily lead to worse outcomes for the entrant. For example, consider the situation where an entrant's product quality is right below that of an incumbent. In this case, our current analysis shows that $\{T, T\}$ is the equilibrium business model combination when α is sufficiently large (see Figure 2b). In this case, the entrant prefers to conceal the innovation as otherwise the incumbent would imitate and push the entrant out of the market. The equilibrium profits for both firms under $\{T, T\}$ are low due to the low vertical product differentiation. In this case, both firms can earn higher profits if the incumbent is able to learn about the innovation and implement it. In the new equilibrium, the entrant adopts the traditional business model, the incumbent adopts the innovation, and the two firms end up with products that are substantially vertically differentiated.

Empirical implications

While a few studies have examined the linkage between business model choices and firm performance (e.g., Pauwels and Weiss 2008; Zott and Amit 2007, 2008), no empirical studies have looked at how firms strategically conceal or reveal new business models. The lack of empirical studies on this question is most likely due to the difficulty in collecting data on possible business model implementations that did not happen. Our paper provides a conceptual framework to think about this issue. While empirically testing our propositions using a large sample dataset seems a daunting, if not impossible, task given the difficulty involved in data collection, these theoretical results can be helpful to ethnographic researchers as they conduct detailed case studies of business model innovations.

Our work also points to the possibility of a potential selection bias and an endogeneity concern in empirical studies of business models. As firms may conceal new business models because of competitive imitation, researchers will only be able to observe business models adopted. In addition, the adoption decisions of business model innovations can be endogenously determined by firm-level characteristics and market factors (e.g., product quality and the prevailing monetization rate in the market in our setting), both of which are likely to

be correlated with firm performance at the same time. Hence, empirical studies examining business model choices and firm performance need to explicitly account for this endogeniety to avoid spurious correlations.

Conclusion

Our paper shows that, as well as differentiating themselves in product quality terms, firms can adopt different business models. We find some win-win scenarios, where entrants' new business models can benefit both them and their incumbent competitors, and is of greatest value when both offer products of similar quality. Indeed, new entrants (such as Hotmail and Pandora) offering similar products or services to the incumbents' have became very successful by adopting different business models.

Perhaps the most important implication of our study is that firms should take into account the likely competitive effects before revealing a business model innovation. Entrants should realize that incumbents will react to innovations in two main ways: they can keep their business model intact and adjust its tactical variables (such as price); or they can adopt a new business model so as to change their value creation and capture logic. The new business model may be a replica of the innovator's, or alternatively a new hybrid that combines some of its elements with others from the incumbent's original model in a mixed business model.

When an innovative entrant decides whether to adopt a new business model, it must consider the possible responses of its rival. Such rival actions may nullify gains that might otherwise accrue to the entrant's innovation. The range and power of incumbents' potential strategic responses mean that there might be many business model innovations out there that never see the light of day. Finding examples of strategic concealment is difficult because we are looking for cases of business model innovations that have not been implemented by an innovative entrant for fear of imitation. These are particularly difficult to find in the setting of sponsor-based business models, which are a relatively new phenomenon. It is easy, however, to observe situations where an entrepreneur mistakenly chooses to adopt a new business model innovation and subsequently gets killed by an incumbent after the incumbent copies

the innovation. In such cases, the entrant would be better off concealing its business model innovation. An example in the context of sponsor-based business models would be Metro Spain, the first ad-sponsored free newspaper launched in Spain in 2001. After observing the implementation of Metro Spain, several incumbents copied its business model. For example, Recoletos launched Qué! in 2005 and Editorial Página Cero launched ADN in 2006, both of which are ad-sponsored free newspapers. In 2009, Metro Spain ceased its operation as a result of stiff competition. The business model of Metro, the parent company of Metro Spain, is also being imitated in many other countries (e.g., Switzerland) by incumbent newspapers. As a result of this competitive imitation, Metro's financial situation has been deteriorating in recent years: its stock price dropped from more than 80 kr in 2000 to less than 0.8 kr in 2011.[16,17]

From the society's perspective, strategic concealment could generally be seen as not good for welfare: some might argue that some form of intellectual property protection regulation might encourage the emergence of more new business models. However, the practical difficulties of enshrining and policing such an extension to intellectual property rights would probably be insurmountable.

Business model innovation is a slippery construct to study. The first implementation of a new business model idea in an industry makes all firms in the sector (and beyond) aware of the new way of conducting business, thus (there being no intellectual property protection) limiting the innovator's ability to take advantage of its idea. Hence, any studies of a business model innovation that has already been implemented may offer little lessons for entrants. While for readers of this paper the idea of sponsor-based business model innovation should

[16]Source: `http://www.reuters.com/finance/stocks/chart?symbol=MTROsdbb.ST`, access August 2011.

[17]While our study focuses on sponsor-based business models, entrepreneurs may find the concept of strategic concealment useful when they consider adopting other business model innovations. For example, PPG entered China's clothing retail industry in 2005 using a new business model that relies exclusively on call centers and the Internet to sell traditional clothing. Traditional clothing retailers such as Younger and Good News Bird in China responded by imitating the business model and integrating it with their existing store-based business model, and pushed PPG out of the market in 2009.

be clear by now, the different ways in which such a general notion can come to life are theoretically infinite, and even in practical terms myriad: every particular implementation constitutes a business model innovation in its own right, to which our analysis can apply. We can expect firms in all breeds of industries to continue to amaze us with unprecedented new ways to capture value through sponsor-based business model innovation for many years to come.

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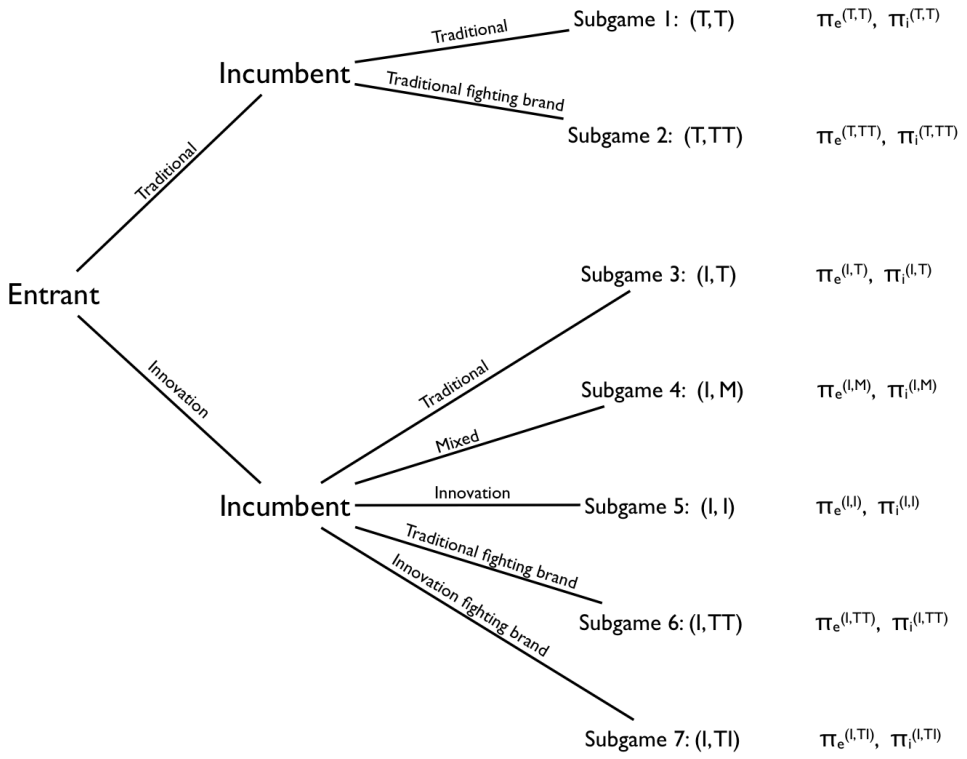
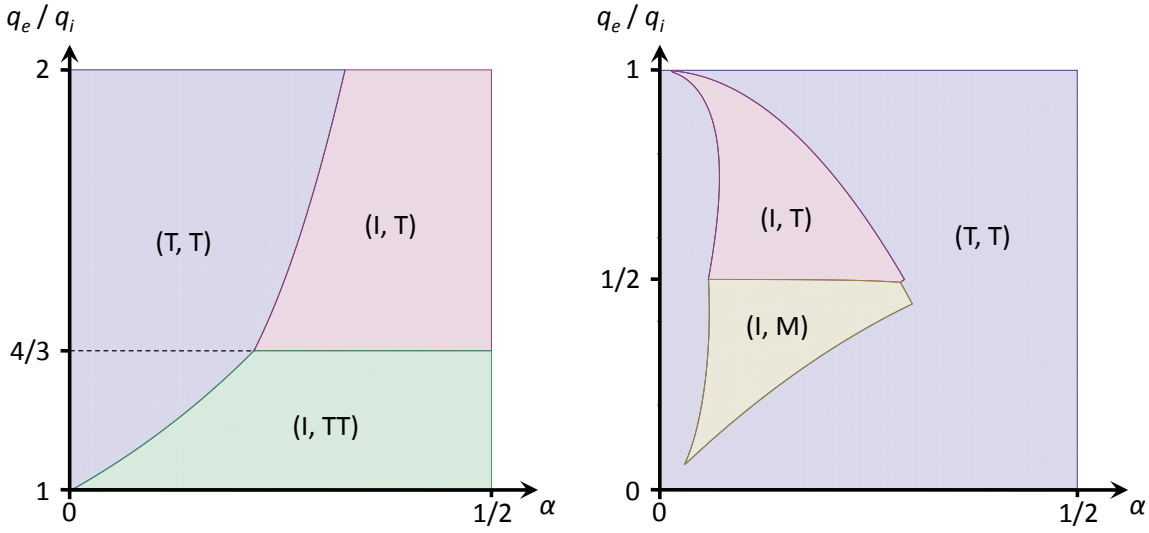
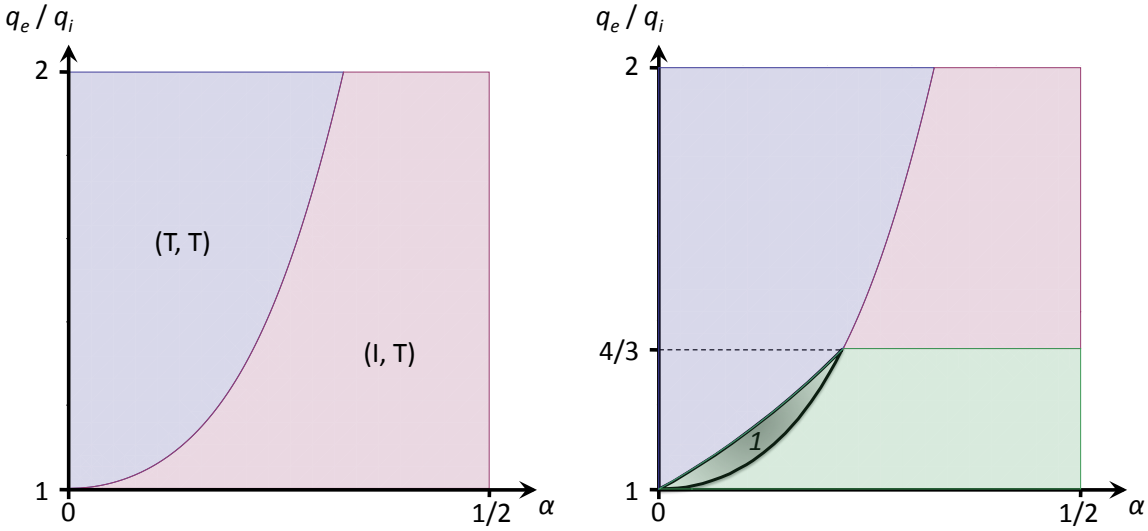


Figure 1: The strategic innovation game.



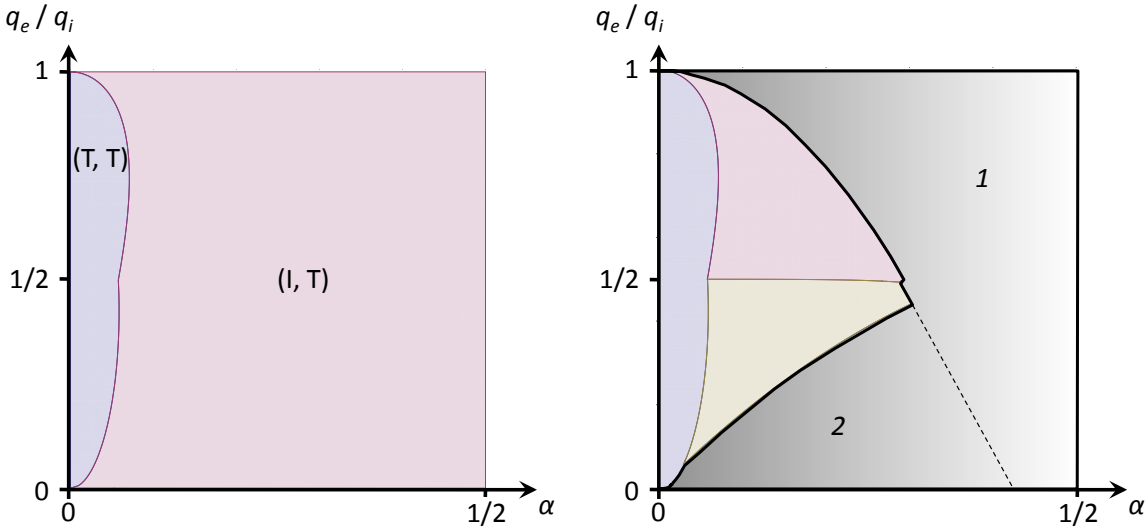
(a) $q_e > q_i$. (b) $q_e < q_i$.

Figure 2: Optimal business models.



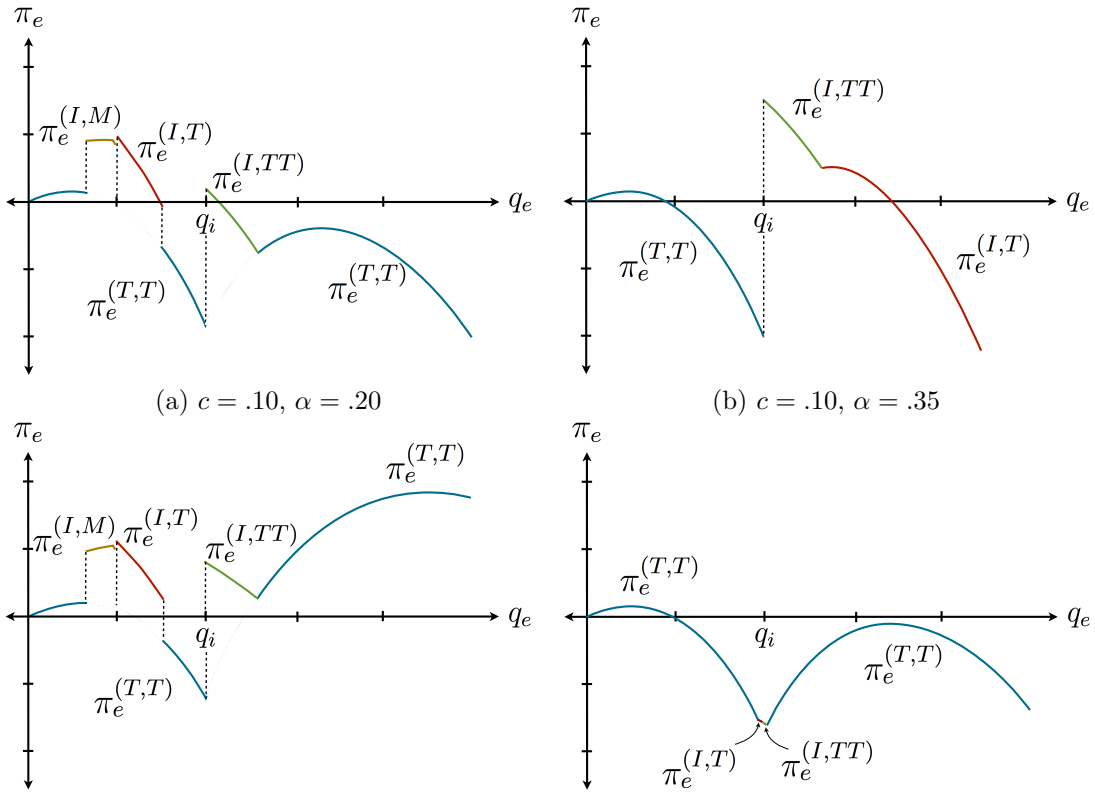
(a) Optimal BM without imitation. (b) Strategic revelation and concealment.

Figure 3: Optimal business models when $q_e > q_i$.



(a) Optimal BM without imitation. (b) Strategic revelation and concealment.

Figure 4: Optimal business models when $q_e < q_i$.



(a) $c = .10$, $\alpha = .20$ (b) $c = .10$, $\alpha = .35$

(c) $c = .06$, $\alpha = .20$ (d) $c = .085$, $\alpha = .01$

Figure 5: Entrant's profits as a function of q_e.

ONLINE APPENDICES

APPENDIX A: PROFIT FUNCTIONS FOR THE SEVEN SUBGAMES

Subgame 1: (T, T)

In this case, the entrant chooses the traditional business model and the incumbent chooses to compete with the same model.

We first consider the case when the incumbent has a better quality, i.e., $q_i > q_e$. The consumer θ_1 indifferent between purchasing from the incumbent and the entrant is determined by $\theta_1 q_i - p_i = \theta_1 q_e - p_e$. Hence, $\theta_1 = \frac{p_i - p_e}{q_i - q_e}$. The consumer θ_2 indifferent between purchasing from the entrant product and not purchasing at all is determined by: $\theta_2 q_e - p_e = 0$. Hence,

$\theta_2 = \frac{p_e}{q_e}$. Therefore, the profits for the incumbent and the entrant are:

$$\pi_i^{(T,T)} = (1 - \frac{p_i - p_e}{q_i - q_e})\, p_i.$$
$$\pi_e^{(T,T)} = (\frac{p_i - p_e}{q_i - q_e} - \frac{p_e}{q_e})\, p_e.$$

We can similarly derive the profit expressions when $q_e > q_i$:

$$\pi_i^{(T,T)} = (\frac{p_e - p_i}{q_e - q_i} - \frac{p_e}{q_e})\, p_i.$$
$$\pi_e^{(T,T)} = (1 - \frac{p_e - p_i}{q_e - q_i})\, p_e.$$

Subgame 2: (T, TT)

In this case, the entrant chooses the traditional business model and the incumbent offers two products, i and i', with $q_i > q_{i'}$. While the quality of q_i is exogenously given, the incumbent may create a fighting brand by strategically downgrading the quality of its original product, choosing $q_{i'}$ before engaging in the pricing subgame with the entrant.

When $q_i > q_e$, there are two cases to consider:

Case 1: $q_i > q_{i'} > q_e$. We first derive the types of indifferent consumers, θ_1, θ_2, and θ_3, between adopting q_i and $q_{i'}$, between adopting $q_{i'}$ and q_e, and between adopting q_e and not adopting. We have $\theta_1 = \frac{p_i - p_{i'}}{q_i - q_{i'}}$, $\theta_2 = \frac{p_{i'} - p_e}{q_{i'} - q_e}$, and $\theta_3 = \frac{p_e}{q_e}$. Profits of the incumbent and the entrant are:

$$\pi_i^{(T,TT)} = (1 - \frac{p_i - p_{i'}}{q_i - q_{i'}})\, p_i + (\frac{p_i - p_{i'}}{q_i - q_{i'}} - \frac{p_{i'} - p_e}{q_{i'} - q_e})\, p_{i'}.$$
$$\pi_e^{(T,TT)} = (\frac{p_{i'} - p_e}{q_{i'} - q_e} - \frac{p_e}{q_e})\, p_e.$$

Case 2: $q_i > q_e > q_{i'}$. We again derive the types of indifferent consumers, θ_1, θ_2, and θ_3, between adopting q_i and q_e, between adopting q_e and $q_{i'}$, and between adopting $q_{i'}$ and not adopting. We have $\theta_1 = \frac{p_i - p_e}{q_i - q_e}$, $\theta_2 = \frac{p_e - p_{i'}}{q_e - q_{i'}}$, and $\theta_3 = \frac{p_{i'}}{q_{i'}}$. Profits of the incumbent and the entrant are:

$$\pi_i^{(T,TT)} = (1 - \frac{p_i - p_e}{q_i - q_e})\, p_i + (\frac{p_e - p_{i'}}{q_e - q_{i'}} - \frac{p_{i'}}{q_{i'}})\, p_{i'}.$$
$$\pi_e^{(T,TT)} = (\frac{p_i - p_e}{q_i - q_e} - \frac{p_e - p_{i'}}{q_e - q_{i'}})\, p_e.$$

When $q_e > q_i$, we must have $q_e > q_i > q_{i'}$. We could similarly derive the following profit functions:

$$\pi_i^{(T,TT)} = (\frac{p_e - p_i}{q_e - q_i} - \frac{p_i - p_{i'}}{q_i - q_{i'}})\, p_i + (\frac{p_i - p_{i'}}{q_i - q_{i'}} - \frac{p_{i'}}{q_{i'}})\, p_{i'}.$$
$$\pi_e^{(T,TT)} = (1 - \frac{p_e - p_i}{q_e - q_i})\, p_e.$$

Subgame 3: (I, T)

Please see the main text as this case has been presented when we introduce the model in detail.

Subgame 4: (I, M)

We first consider the case where $q_i > q_e$. The incumbent product now comes with monetization intensity, m_i, and is priced at $p_i > 0$. The indifferent consumer is defined by $\theta^*(q_i - m_i^2) - p_i = \theta^*(q_e - m_e^2)$. Hence, $\theta^* = \frac{p_i}{q_i - m_i^2 - q_e + m_e^2}$, and the profits are:

$$\pi_i^{(I,M)} = (1 - \frac{p_i}{q_i - m_i^2 - q_e + m_e^2})(p_i + \alpha m_i).$$
$$\pi_e^{(I,M)} = \frac{p_i}{q_i - m_i^2 - q_e + m_e^2}\, \alpha m_e.$$
$$s.t. \quad q_i - m_i^2 \geq 0,\ q_e - m_e^2 \geq 0.$$

For this business model to be meaningful, we need that $p_i > 0$ and $m_i > 0$. Otherwise, one of the pure business models is the effective one.

We now consider the case where $q_e > q_i$. There are two cases.

Case 1: $q_e - m_e^2 \geq q_i$. In this case, the incumbent is pushed out. The profits are thus:

$$\pi_i^{(I,M)} = 0.$$
$$\pi_e^{(I,M)} = \alpha m_e.$$
$$s.t. \quad q_e - m_e^2 \geq q_i.$$

Case 2: $q_e - m_e^2 < q_i$. In this case, the incumbent product will always be active as it can come with lower monetization intensity and low price. The indifferent consumer's type, θ^*, is determined by $\theta^*(q_i - m_i^2) - p_i = \theta^*(q_e - m_e^2)$. Hence, $\theta^* = \frac{p_i}{q_i - m_i^2 - q_e + m_e^2}$. The profits are

thus:

$$\pi_i^{(I,M)} = (1 - \frac{p_i}{q_i - m_i^2 - q_e + m_e^2})(p_i + \alpha m_i).$$
$$\pi_e^{(I,M)} = \frac{p_i}{q_i - m_i^2 - q_e + m_e^2}\,\alpha m_e.$$
$$s.t. \quad q_i - m_i^2 \geq 0,\ q_e - m_e^2 \geq 0.$$

The entrant will compare the profits from both cases and decide the level of m_e.

Subgame 5: (I, I)

When both the incumbent and the entrant provide free products, all consumers will adopt the product with the highest net quality. This competitive situation is similar to Bertrand competition, except that now the two firms are setting the monetization intensities, not prices.

When $q_i > q_e$, the profits are:

$$\pi_i^{(I,I)} = \begin{cases} \alpha m_i & \text{if } \ q_i - m_i^2 \geq q_e - m_e^2 \\ 0 & \text{otherwise.} \end{cases}$$
$$\pi_e^{(I,I)} = \begin{cases} 0 & \text{if } \ q_i - m_i^2 \geq q_e - m_e^2 \\ \alpha m_e & \text{otherwise.} \end{cases}$$
$$s.t. \quad q_i - m_i^2 \geq 0 \ \text{ and } \ q_e - m_e^2 \geq 0.$$

When $q_e > q_i$, the profits are:

$$\pi_i^{(I,I)} = \begin{cases} 0 & \text{if } \ q_e - m_e^2 \geq q_i - m_i^2 \\ \alpha m_i & \text{otherwise.} \end{cases}$$
$$\pi_e^{(I,I)} = \begin{cases} \alpha m_e & \text{if } \ q_e - m_e^2 \geq q_i - m_i^2 \\ 0 & \text{otherwise.} \end{cases}$$
$$s.t. \quad q_i - m_i^2 \geq 0 \ \text{ and } \ q_e - m_e^2 \geq 0.$$

Note that we are assuming that when both products, i and e, are of the same net quality, consumers prefer the offering of the higher quality firm. This is without loss of generality.[18]

[18]For example, when $q_i > q_e$, the incumbent could always set its net quality, $q_i - m_i^2$, at $q_e - m_e^2 + \epsilon$ to attract all consumers.

Subgame 6: (I, TT)

First, we consider the case where $q_i > q_e$. There are two cases.

Case 1: $q_i > q_{i'} > q_e - m_e^2$. As the entrant product is free, as long as $q_e - m_e^2 \geq 0$, all consumers will make adoptions. We first derive the types of the indifferent consumers between the incumbent's two products, and between the incumbent low-quality product and the entrant product: $\theta_1 = \frac{p_i - p_{i'}}{q_i - q_{i'}}$ and $\theta_2 = \frac{p_{i'}}{q_{i'} - q_e + m_e^2}$, respectively. The profits are thus:

$$\begin{aligned}
\pi_i^{(I,TT)} &= (1 - \frac{p_i - p_{i'}}{q_i - q_{i'}})\, p_i + (\frac{p_i - p_{i'}}{q_i - q_{i'}} - \frac{p_{i'}}{q_{i'} - q_e + m_e^2})\, p_{i'}. \\
\pi_e^{(I,TT)} &= \alpha \frac{p_{i'}}{q_{i'} - q_e + m_e^2}\, m_e. \\
s.t. \quad & q_i > q_{i'} > q_e - m_e^2 \geq 0.
\end{aligned}$$

Case 2: $q_i > q_e - m_e^2 \geq q_{i'}$. In this case, product i' obtains no demand in equilibrium. The type of the indifferent consumer between product i and q_e is $\theta = \frac{p_i}{q_i - q_e + m_e^2}$. The profits are:

$$\begin{aligned}
\pi_i^{(I,TT)} &= (1 - \frac{p_i}{q_i - q_e + m_e^2})\, p_i. \\
\pi_e^{(I,TT)} &= \alpha \frac{p_i}{q_i - q_e + m_e^2}\, m_e. \\
s.t. \quad & q_i > q_e - m_e^2 \geq q_{i'} \geq 0.
\end{aligned}$$

We now consider the case where $q_e > q_i$. There are three cases.

Case 1: $q_e - m_e^2 \geq q_i > q_{i'}$. In this case, the incumbent is pushed out of the market and the entrant has a demand of 1. The profits are thus:

$$\begin{aligned}
\pi_i^{(I,TT)} &= 0. \\
\pi_e^{(I,TT)} &= \alpha m_e. \\
s.t. \quad & q_e - m_e^2 \geq q_i.
\end{aligned}$$

Case 2: $q_i > q_e - m_e^2 \geq q_{i'}$. In this case, the low quality product of the incumbent is pushed out of the market. Hence, this is equivalent to the case where the incumbent uses only one

product to respond to the entrant. From our discussion of the (I,T) case, we have:

$$\begin{aligned}\pi_i^{(I,TT)} &= (1-\frac{p_i}{q_i-q_e+m_e^2})\,p_i.\\ \pi_e^{(I,TT)} &= \alpha\frac{p_i}{q_i-q_e+m_e^2}\,m_e.\\ s.t. \quad & q_i > q_e - m_e^2 \geq q_{i'}.\end{aligned}$$

Case 3: $q_i > q_{i'} > q_e - m_e^2$. In this case, all three products may be active. We first derive the types of indifferent consumers between the two products offered by the incumbent, and between the low-quality product of the incumbent and the entrant product as $\theta_1 = \frac{p_i - p_{i'}}{q_i - q_{i'}}$ and $\theta_2 = \frac{p_{i'}}{q_{i'}-q_e+m_e^2}$. The profits are thus:

$$\begin{aligned}\pi_i^{(I,TT)} &= (1-\frac{p_i-p_{i'}}{q_i-q_{i'}})\,p_i + (\frac{p_i-p_{i'}}{q_i-q_{i'}} - \frac{p_{i'}}{q_{i'}-q_e+m_e^2})\,p_{i'}.\\ \pi_e^{(I,TT)} &= \alpha\frac{p_{i'}}{q_{i'}-q_e+m_e^2}\,m_e.\\ s.t. \quad & q_i > q_{i'} > q_e - m_e^2 \geq 0.\end{aligned}$$

In equilibrium, both the incumbent and the entrant will compare their profits from these three cases and decide their optimal levels of $q_{i'}$, p_i, $p_{i'}$, and m_e.

Subgame 7: (I,TI)

In this case, the incumbent introduces two products: product i that is traditional and product i' that is based on the new business model. When $q_i > q_e$, suppose that the monetization intensities $m_{i'}$ and m_e are such that the entrant is pushed out of the market. Then, consumers either buy the high-quality product of the incumbent or consume the free product of the incumbent. In this case, the indifferent consumer θ^* is determined by $\theta^* q_i - p_i = \theta^*(q_i - m_{i'}^2)$. That is, $\theta^* = \frac{p_i}{m_{i'}^2}$. Suppose instead that the monetization intensities, $m_{i'}$ and m_e, are such that the entrant is *not* pushed out of the market. Then, consumers either buy the high-quality product of the incumbent or consume the product of the entrant. In this case, the indifferent consumer θ^{**} is determined by $\theta^{**} q_i - p_i = \theta^{**}(q_e - m_e^2)$. That is, $\theta^{**} = \frac{p_i}{q_i - q_e + m_e^2}$.

The profits are:

$$\pi_i^{(I,TI)} = \begin{cases} (1-\frac{p_i}{m_{i'}^2})\,p_i + \frac{p_i}{m_{i'}^2}\,\alpha m_{i'} & \text{if } \; q_i - m_{i'}^2 \geq q_e - m_e^2 \\ (1-\theta^{**})\,p_i & \text{otherwise.} \end{cases}$$

$$\pi_e^{(I,TI)} = \begin{cases} 0 & \text{if } \; q_i - m_{i'}^2 \geq q_e - \; m_e^2 \\ \alpha\frac{p_i}{q_i - q_e + m_e^2}\,m_e & \text{otherwise.} \end{cases}$$

$$s.t. \qquad q_i - m_{i'}^2 \geq 0, \quad q_e - m_e^2 \geq 0.$$

This business model is meaningful only when $p_i > 0$, $m_{i'} > 0$, and $m_e > 0$.

Now consider the case where $q_e > q_i$. In this case, the entrant again engages in Bertrand type competition with the free product of the incumbent. The entrant will push out both products of the incumbent when $q_e - m_e^2 \geq q_i$. The entrant will push out the free product of the incumbent if $q_i > q_e - m_e^2 > q_i - m_{i'}^2$. The case is equivalent to the (I,T) case. When $q_i - m_{i'}^2 > q_e - m_e^2$, the entrant product will be pushed out. In this case, the indifferent consumer between the incumbent's two products θ^* is determined by $\theta^* q_i - p_i = \theta^*(q_i - m_{i'}^2)$. That is, $\theta^* = \frac{p_i}{m_{i'}^2}$. The profits are:

$$\pi_i^{(I,TI)} = \begin{cases} 0 & \text{if } \; q_e - m_e^2 \geq q_i \\ (1-\frac{p_i}{q_i - q_e + m_e^2})\,p_i & \text{else if } \; q_i > q_e - m_e^2 > q_i - m_{i'}^2 \\ (1-\frac{p_i}{m_{i'}^2})\,p_i + \frac{p_i}{m_{i'}^2}\,\alpha m_{i'} & \text{otherwise.} \end{cases}$$

$$\pi_e^{(I,TI)} = \begin{cases} \alpha m_e & \text{if } \; q_e - m_e^2 \geq q_i \\ \alpha\frac{p_i}{q_i - q_e + m_e^2}\,m_e & \text{else if } \; q_i > q_e - m_e^2 > q_i - m_{i'}^2 \\ 0 & \text{otherwise.} \end{cases}$$

$$s.t. \quad q_i - m_i^2 \geq 0 \;\text{ and }\; q_e - m_e^2 \geq 0.$$

APPENDIX B: OPTIMAL TACTICS FOR EACH BUSINESS MODEL COMBINATION

Propositions A-1 and A-2 describe the equilibrium tactics for each subgame.[19] Without loss of generality, we adopt the following tie-breaking rule: when two different business model combinations yield the same payoffs, we select the combination with fewer products. This rule captures the fact that introducing new products will generally involve some cost. For example, Propositions A-1 and A-2 show that the payoffs are the same in subgames (T,T)

[19] We provide all proofs in Appendix C.

and (T, TT). The tie-breaking rule suggests that (T, T) is preferred to (T, TT).

We consider first the interactions when the entrant's quality is above that of the incumbent.

Proposition A-1. *When $q_i < q_e$, the optimal prices and monetization intensities under each business model combination are:*

- (T, T)*:* $p_i = \frac{(q_e - q_i)q_i}{4q_e - q_i}$ *and* $p_e = \frac{2q_e(q_e - q_i)}{4q_e - q_i}$.
- (T, TT)*: The optimal p_i and p_e are the same as in the (T, T) case: $p_i = \frac{(q_e - q_i)q_i}{4q_e - q_i}$ and $p_e = \frac{2q_e(q_e - q_i)}{4q_e - q_i}$. The incumbent sets $p_{i'} = \frac{(q_e - q_i)q_{i'}}{4q_e - q_i}$ in equilibrium such that there is zero demand for product i'.*
- (I, T)*: $p_i = 0$ and $m_e = \sqrt{q_e - q_i}$. The incumbent is pushed out of the market.*
- (I, M)*: $p_i = 0$, $m_i = 0$, and $m_e = \sqrt{q_e - q_i}$. The incumbent is pushed out of the market.*
- (I, I)*: $m_i = 0$ and $m_e = \sqrt{q_e - q_i}$. The incumbent is pushed out of the market.*
- (I, TT)*: When $q_i < \frac{3}{4}q_e$, the entrant sets $m_e = \sqrt{q_e - q_i}$ and the incumbent is pushed out of the market. Otherwise, $m_e = \sqrt{q_e}$ and the incumbent receives positive demand. The equilibrium choices are $q_{i'} = 0$, $p_i = q_i/2$, and $p_{i'} = 0$. The incumbent's lower-quality product i' receives no demand but affects the equilibrium outcome.*
- (I, TI)*: $p_i = 0$, $m_{i'} = 0$ and $m_e = \sqrt{q_e - q_i}$. The incumbent is pushed out of the market.*

The intuitions for these results are as follows.

Subgame (T, T). In this case, we obtain the standard result of two vertically differentiated competitors fighting for the same customers.[20] The high-quality firm sells twice the demand (at a higher price) than the low-quality firm. In equilibrium, the entrant sells to more than half of the market.

Subgame (T, TT). Just as in the standard model of a muti-product monopolist with vertically differentiated products, the incumbent prefers offering only one product: its low-quality product i' is priced such that it obtains no demand, so payoffs in this case coincide with those of (T, T). Of course, if offering two products was costlier than offering only one, (T, TT) would be strictly dominated by (T, T).

[20] See, for example, Shaked and Sutton (1982) or Tirole (1994).

Subgame (I,T). In this case, the incumbent is pushed out of the market. The entrant's two choices are either to set the monetization intensity so that its product's net quality is greater than the incumbent's quality, $q_e - m_e^2 \geq q_i$, or it can choose a monetization intensity so that its net quality is lower, $q_e - m_e^2 < q_i$. In the first case, the entrant's product is both free and of higher quality, so the incumbent is pushed out of the market. In the second case, the entrant trades off market share and revenue per unit of share. The entrant's profits are: market share ($\frac{p_i}{q_i - q_e + m_e^2}$) times revenue per consumer ($\alpha\, m_e$), i.e., $\pi_e^{(I,T)} = \frac{p_i}{q_i - q_e + m_e^2}\, \alpha\, m_e$. As m_e increases, market share decreases faster than revenue per consumer grows. As a consequence, the entrant will prefer to reduce m_e when $q_e - m_e^2 < q_i$. The entrant ends up choosing m_e such that $q_e - m_e^2 = q_i$, and the incumbent ends up with no demand.

Subgame (I,M). In equilibrium the incumbent is pushed out of the market for the same reasons as in subgame (I,T). Even though it has the option of using its monetization efforts to differentiate itself from the entrant, the entrant's trade-off between market share and revenue per consumer still results in the incumbent being pushed out.

Subgame (I,I). In this case, there is Bertrand-type competition between the incumbent and the entrant.[21] Therefore, the entrant cannot choose a high m_e as it has to offer a product of net quality at least as large as that of the incumbent *without ads*. Hence, the optimal m_e is constrained by $q_e - m_e^2 \geq q_i$. When this constraint is satisfied, all consumers adopt product e. Therefore, it is in the entrant's interest to maximize its monetization intensity by setting m_e so that $q_e - m_e^2 = q_i$.

Subgame (I,TT). In this case, there are three possible scenarios. First, the entrant's net quality may be larger than the incumbent's high-quality product (i.e., $q_e - m_e^2 > q_i$), and the incumbent is pushed out because the entrant's product is of higher quality and is free. Second, the entrant's net quality may be between the quality levels of the incumbent's two products (i.e., $q_i > q_e - m_e^2 > q_{i'}$), making product i' irrelevant. Just as in the (I,T) subgame, the entrant's net quality ends up being equal to q_i so the incumbent is again pushed out. Finally, the entrant's net quality may be lower than the incumbent's low-quality product, $q_e - m_e^2 < q_{i'}$. Now, the same argument as in the (I,T) subgame applies to the interaction between the entrant's product e and the incumbent's low-quality product i'. As in that case, the entrant ends up setting its net quality to match $q_{i'}$, although, in this case, the incumbent's high-quality product obtains positive demand. It is optimal for the incumbent to set $q_{i'} = 0$ so that there is no interaction between its high-quality product and the entrant's product, leaving the incumbent with monopoly power for its high-quality product.

[21] While in Bertrand's model firms choose prices, here firms choose the monetization intensity.

The entrant thus has the power to decide whether the incumbent is pushed out or not (by choosing m_e so that $q_e - m_e^2 > q_i > q_{i'}$, $q_i > q_e - m_e^2 > q_{i'}$, or $q_i > q_{i'} > q_e - m_e^2$). The entrant can compare its profits in these scenarios: when the quality difference between e and i is low ($q_i > \frac{3}{4} q_e$), coexistence brings more profits to the entrant because (given the incumbent's relatively high quality) pushing the incumbent out requires setting a low monetization intensity.

Subgame (I, TI). As in the (I, I) case, a Bertrand competition argument implies that only the higher-quality product offered through I survives. Therefore, in equilibrium, the incumbent will reduce the monetization intensity for its I product to zero. In the end $q_e - m_e^2 \geq q_i = q_{i'}$ and hence, the incumbent obtains no demand.

We now present the results when the entrant's product is of lower quality.

Proposition A-2. *When $q_i > q_e$, the optimal prices and monetization intensities under each business model combination are:*

- (T, T)*:* $p_i = \frac{2(q_i - q_e)q_i}{4q_i - q_e}$ *and* $p_e = \frac{q_e(q_i - q_e)}{4q_i - q_e}$.
- (T, TT)*: The optimal p_i and p_e are the same as in the (T, T) case:* $p_i = \frac{2(q_i - q_e)q_i}{4q_i - q_e}$ *and* $p_e = \frac{q_e(q_i - q_e)}{4q_i - q_e}$. *The incumbent sets $q_{i'} = q_i$ so that product i' obtains zero demand.*
- (I, T)*: When $q_i \geq 2q_e$, $p_i = q_i/2$ and $m_e = \sqrt{q_e}$; when $q_i < 2q_e$, $p_i = q_i - q_e$ and* $m_e = \sqrt{q_i - q_e}$.
- (I, M)*: We may have a corner solution in which $q_e - m_e^2 = 0$ or an interior solution in which $q_e - m_e^2 > 0$.*

  At the interior solution, m_i and m_e solve the following system:

$$\begin{cases} q_i - q_e + m_e^2 = \frac{m_i^3}{m_i - \alpha} \\ m_e = \sqrt{q_i - q_e - m_i^2} \end{cases},$$

  and $p_i = \frac{1}{2}\left((q_i - m_i^2) - (q_e - m_e^2) - \alpha\, m_i)\right)$.

  At the corner solution, m_i solves: $m_i^3 + q_i(\alpha - m_i) = 0$, $m_e = \sqrt{q_e}$, and $p_i = (q_i - m_i(\alpha + m_i))/2$.
- (I, I)*:* $m_i = \sqrt{q_i - q_e}$ *and* $m_e = 0$. *The entrant is pushed out of the market.*
- (I, TT)*: Same as* (I, T).

- (I, TI): $p_i = \frac{1}{2}(q_i - q_e + \alpha\sqrt{q_i - q_e})$, $m_{i'} = \sqrt{q_i - q_e}$, *and* $m_e = 0$. *The entrant is pushed out.*

The intuitions for these results are as follows.

Subgames (T, T), (T, TT), (I, I), and (I, TI). The intuitions for these are analogous to those in Proposition A-1, except that now the high-quality product is offered by the incumbent.

Subgame (I, T). The optimal tactics of the incumbent in this case depend on whether the entrant sets its monetization intensity at the corner or not (i.e., $m_e = \sqrt{q_e}$ or $m_e > \sqrt{q_e}$), which in turn depends on the exogenous vertical differentiation between the incumbent's and the entrant's products. The entrant's profits increase with its market share and with m_e, but there is a tradeoff between the two. When the entrant's product is of very low quality ($q_i \geq 2q_e$), it is best for it to maximize monetization intensity because its market share, $\theta^* = \frac{p_i}{q_i - q_e + {m_e}^2}$, is insensitive to m_e (the derivative of θ^* with respect to m_e approaches zero as the difference between q_i and q_e grows). On the other hand, if its quality is close to the high-quality incumbent ($q_i < 2q_e$), θ^* is sensitive to the monetization intensity and it is optimal for the entrant to reduce m_e to gain market share.
When $q_i \geq 2q_e$, there is no cannibalization between the two products: $q_e - m_e^2 = 0$. The indifferent consumer obtains zero utility. When $q_i < 2q_e$, the net quality of the entrant in equilibrium is positive: $q_e - m_e^2 = q_e - q_i/2 > 0$. The indifferent consumer has positive utility from both products.[22]

Subgame (I, M). As the incumbent product is not free, consumers with low θ will not buy it: they will adopt the entrant's product as long as it offers positive utility. As a result, both the incumbent and the entrant co-exist in equilibrium.
The solution may be at a corner, where the entrant chooses the maximum possible monetization intensity ($m_e = \sqrt{q_e}$) such that the utility for its product is zero. The corner solution happens when the quality difference is large (i.e., $q_i > 2q_e$). In this case, the unconstrained profit-maximizing m_e (i.e., $\sqrt{q_i - q_e - m_i^2}$) would exceed the maximum monetization intensity that the entrant can possible have (i.e., $\sqrt{q_e}$). The entrant chooses to set m_e at $\sqrt{q_e}$, and the indifferent consumer receives zero utility. Or the solution may be interior ($m_e < \sqrt{q_e}$).

[22] It is interesting to note that $\theta^* = 1/2$ in both cases. That is, the incumbent and the entrant always split the market equally, regardless of their quality difference. Given any m_e, the residual demand for product i is $D_i = 1 - \theta^* = 1 - \frac{p_i}{q_i - q_e + m_e^2}$. The marginal revenue implied by this demand function equals marginal cost (which is zero) at $D_i = \frac{1}{2}$ regardless of the value of m_e. Of course, the equilibrium p_i changes with m_e, and so does the incumbent profits, but the equilibrium D_i does not change.

This happens when $q_i \leq 2q_e$. In this case, the entrant's product offers strictly positive utility. The indifferent consumer thus gets positive utility.

Subgame (I, TT). The entrant may be at the corner ($m_e = \sqrt{q_e}$) or not ($m_e > \sqrt{q_e}$). If the entrant is at the corner, the incumbent's and entrant's products do not interact, so there is no business stealing. In this case, the incumbent sets $q_{i'} = q_i$ and the outcome is the same as in the (I, T) subgame.

If the entrant is not at the corner, then the incumbent has two options as to the quality of its fighting product. It can either set $q_i > q_{i'} > q_e$ or $q_e > q_{i'}$. The first case is never optimal because the competition in the low end ends up hurting profits for the high-quality product, and so the incumbent will seek to maximize profits by setting $q_{i'} = q_i$. In the second case, there are two possibilities. First, the incumbent introduces a very low quality i' which does not affect the entrant's optimal amount of monetization intensity (as $q_e - m_e^2 > q_{i'}$, and i' obtains no demand). This case is equivalent to subgame (I, T). Second, the incumbent introduces product i' with quality close to q_e. In this case, the entrant will set a smaller monetization intensity to kill product i' and the competitive pressure on product i will be greater than if i' had not been introduced.

In summary, the outcome of (I, TT) coincides with that of the (I, T) subgame.

APPENDIX C: PROOFS

Proof of Proposition A-1. Subgame (T, T): The derivation is straightforward by setting the FOC of the profit function to zero and solve for the optimal p_i and p_e. $p_i = \frac{(q_e - q_i)q_i}{4q_e - q_i}$ and $p_e = \frac{2q_e(q_e - q_i)}{4q_e - q_i}$. The profits are $\pi_i^{(T,T)} = \frac{q_i q_e (q_e - q_i)}{(4q_e - q_i)^2}$ and $\pi_e^{(T,T)} = \frac{4q_i^2(q_i - q_e)}{(4q_i - q_e)^2}$.

Subgame (T, TT): We first take FOCs of the profit functions and solve for the optimal p_i, $p_{i'}$ and p_e, assuming that $q_{i'}$ is given. $p_i = \frac{(q_e - q_i)q_i}{4q_e - q_i}$, $p_{i'} = \frac{(q_e - q_i)q_{i'}}{4q_e - q_i}$ and $p_e = \frac{2q_e(q_e - q_i)}{4q_e - q_i}$. The profits are $\pi_i^{(T,TT)} = \frac{q_i q_e (q_e - q_i)}{(4q_e - q_i)^2}$. Note that this profit is the same as in the (T, T) case and is independent of $q_{i'}$. Similarly, $\pi_e^{(T,T)} = \frac{4q_i^2(q_i - q_e)}{(4q_i - q_e)^2}$. Therefore, this case is weakly dominated by (T, T).

Subgame (I, T): When $q_e - m_e^2 \geq q_i$, the incumbent is pushed out the market and $\pi_e^{(I,T)} = \alpha m_e$. Hence the entrant will increase its monetization intensity as much as possible subject to the constraint that $q_e - m_e^2 \geq q_i$. Hence, $m_e = \sqrt{q_e - q_i}$. Thus, $\pi_i^{(I,T)} = 0$ and $\pi_e^{(I,T)} = \alpha\sqrt{q_e - q_i}$. When $q_e - m_e^2 < q_i$, the FOC of $\pi_i^{(I,T)}$ w.r.t. p_i gives $p_i = \frac{1}{2}(q_i - q_e + m_e^2)$. The FOC of $\pi_e^{(I,T)}$ w.r.t. m_e is negative. Hence, the entrant will choose m_e as small as possible

subject to the constraint, $q_e - m_e^2 < q_i$. At the end of the process, the entrant essentially kills the incumbent. Therefore, the entrant will set m_e to $\sqrt{q_e - q_i}$ and the incumbent is pushed out.

In summary, the profits are: $\pi_i^{(I,T)} = 0$ and $\pi_e^{(I,T)} = \alpha\sqrt{q_e - q_i}$.

Subgame (I, M): When $q_e - m_e^2 \geq q_i$, the entrant pushes out the incumbent. Hence, the optimal $m_e = \sqrt{q_e - q_l}$. We have $\pi_i^{(I,M)} = 0$ and $\pi_e^{(I,M)} = \alpha\sqrt{q_e - q_i}$.

When $q_e - m_e^2 < q_i$, the FOC of $\pi_e^{(I,M)}$ w.r.t. m_e is negative. Hence, similar to the (I, T) case, the entrant will try to reduce m_e as much as possible. The incumbent responds by lowering m_i and p_i. In the end, $m_e = \sqrt{q_e - q_i}$. The incumbent is again pushed out of the market.

In summary, $\pi_i^{(I,M)} = 0$ and $\pi_e^{(I,M)} = \alpha\sqrt{q_e - q_i}$.

Subgame (I, I): In this case, the Bertrand-style competition happens and the entrant pushes out the incumbent by setting $q_e - m_e^2 = q_i$, and obtain the whole market. Hence, $\pi_i^{(I,I)} = 0$ and $\pi_e^{(I,I)} = \alpha\sqrt{q_e - q_i}$.

Subgame (I, TT): When $q_e - m_e^2 \geq q_i > q_{i'}$, the incumbent is pushed out and the entrant has a demand of 1. The maximum m_e the entrant can set is $\sqrt{q_e - q_i}$. The profits are $\pi_i^{(I,TT)} = 0$ and $\pi_e^{(I,TT)} = \alpha\sqrt{q_e - q_i}$.

When $q_i > q_e - m_e^2 \geq q_{i'}$, the incumbent's product i' is pushed out. m_e is bounded by $\sqrt{q_e - q_{i'}}$. The FOC of $\pi_i^{(I,TT)}$ w.r.t. p_i gives $p_i = \frac{1}{2}(q_i - q_e + m_e^2)$. The FOC of $\pi_e^{(I,TT)}$ w.r.t. m_e is negative. Similar to the (I, T) case, product i will be pushed out as well. Hence, in this case, the profits are the same as in the first case.

When $q_i > q_{i'} > q_e - m_e^2$, the FOC of $\pi_e^{(I,TT)}$ w.r.t. m_e is negative so that the low-quality product of the incumbent, i', is pushed out and $m_e = \sqrt{q_e - q_{i'}}$. It is optimal for the incumbent to set $q_{i'} = 0$ and $p_{i'} = 0$ as in this case, m_e will be set at the corner. Then in equilibrium there is no interaction between the entrant and the incumbent's high-quality product. The incumbent sets $p_i = \frac{q_i}{2}$ and the entrant sets $m_e = \sqrt{q_e}$. Each firm has half of the market. Hence, $\pi_i^{(I,TT)} = \frac{q_i}{4}$ and $\pi_e^{(I,TT)} = \frac{1}{2}\alpha\sqrt{q_e}$.

The entrant decides whether to push the incumbent out of the market or co-exist with it. Comparing the entrant's profits under both cases, we have: when $q_i < \frac{3}{4}q_e$, the entrant chooses to push out the incumbent, and $\pi_i^{(I,TT)} = 0$ and $\pi_e^{(I,TT)} = \alpha\sqrt{q_e - q_i}$; otherwise, the entrant chooses to co-exist with the incumbent, and $\pi_i^{(I,TT)} = \frac{q_i}{4}$ and $\pi_e^{(I,TT)} = \frac{1}{2}\alpha\sqrt{q_e}$.

Subgame (I, TI): The entrant product will get into Bertrand-type competition with the

incumbent low-quality free product. In equilibrium, the incumbent is better off not having the second product as the Bertrand competition eventually kills both incumbent's products. Therefore, in this case $m_e = \sqrt{q_e - q_i}$. $\pi_e^{(I,TI)} = \alpha\sqrt{q_e - q_i}$ and $\pi_i^{(I,TI)} = 0$. □

Proof of Proposition A-2. Subgame (T,T): The derivation is straightforward by setting the FOC of the profit function to zero and solve for the optimal p_i and p_e. The profits are $\pi_i^{(T,T)} = \frac{4q_i^2(q_i-q_e)}{(4q_i-q_e)^2}$ and $\pi_e^{(T,T)} = \frac{q_i q_e(q_i-q_e)}{(4q_i-q_e)^2}$.

Subgame (T,TT): We first consider the first case where $q_i > q_{i'} > q_e$. We first take the FOC of the two profit functions w.r.t. p_i, $p_{i'}$ and p_e assuming that $q_{i'}$ is given. We obtain $p_i = \frac{4q_iq_{i'}-q_eq_i-3q_eq_{i'}}{8q_{i'}-2q_e}$, $p_{i'} = \frac{2q_{i'}(q_{i'}-q_e)}{4q_{i'}-q_e}$ and $p_e = \frac{q_e(q_{i'}-q_e)}{4q_{i'}-q_e}$. The incumbent profits are $\pi_i^{(T,TT)} = \frac{q_e^2(q_i-q_{i'})+16q_iq_{i'}^2-8q_eq_{i'}(q_i+q_{i'})}{4(q_{i'}-q_e)^2}$. The FOC of $\pi_i^{(T,TT)}$ w.r.t. $q_{i'}$ is positive. Hence, it is optimal for the incumbent to set $q_{i'} = q_i$. Effectively, the incumbent will prefer to just offer one product only. Hence, the optimal tactics are the same as in the (T,T) case. In this case, (T,TT) is weakly dominated by (T,T).

Subgame (I,T): The FOC of the incumbent profit function w.r.t. p_i gives the optimal price $p_i = \frac{1}{2}(q_i - q_e + m_e^2)$. The FOC of the entrant profit function gives the optimal monetization intensity of product e, $m_e = \sqrt{q_i - q_e}$. The constraint that $q_e - m_e^2 \geq 0$ gives $m_e \leq \sqrt{q_e}$.

Therefore, when $q_i < 2q_e$, we have an interior solution. In this case, $m_e = \sqrt{q_i - q_e}$. Substituting it to the expression of equilibrium p_i, we have $p_i = q_i - q_e$. Hence, $\pi_i^{(I,T)} = \frac{q_i-q_e}{2}$ and $\pi_e^{(I,T)} = \frac{\alpha}{2}\sqrt{q_i - q_e}$. When $q_i \geq 2q_e$, we have a corner solution. In this case, $m_e = \sqrt{q_e}$. Thus, $p_i = \frac{q_i}{2}$, $\pi_i^{(I,T)} = \frac{q_i}{4}$ and $\pi_e^{(I,T)} = \frac{\alpha}{2}\sqrt{q_e}$.

Subgame (I,M): The FOC of $\pi_i^{(I,M)}$ w.r.t. p_i gives $p_i = \frac{1}{2}(q_i - q_e - \alpha m_i - m_i^2 + m_e^2)$. Substituting p_i into the profit function, we have: $\pi_i^{(I,M)} = \frac{(q_i-q_e+\alpha m_i+(m_e^2-m_i^2))^2}{4(q_i-q_e+(m_e^2-m_i^2))}$. We can then take FOC w.r.t. m_i and obtain

$$m_i^2 + q_i - q_e = \frac{m_i^3}{m_i - \alpha}. \tag{A-1}$$

The FOC of the entrant profit function w.r.t. m_e gives:

$$m_e = \sqrt{q_i - q_e - m_i^2}. \tag{A-2}$$

We also need $q_e - m_e^2 \geq 0$, i.e., $m_e < \sqrt{q_e}$. Hence, when $q_i \leq 2q_e$, $\sqrt{q_i - q_e - m_i^2} \leq \sqrt{q_e}$ and we always have an interior solution. In this case, we could solve equations (A-1) and

(A-2) for m_i and m_e, and obtain the expressions for equilibrium profits.

When $q_i > 2q_e$, we may have a corner solution: this happens when m_e computed from equation (A-2) is greater than $\sqrt{q_e}$. When we are at a corner, $m_e = \sqrt{q_e}$ and m_i is solved by equation (A-1).

Subgame (I, I): If $q_i - m_i^2 < q_e$, the entrant will choose a small m_e such that $q_i - m_i^2 < q_e - m_e^2$ and get all the demand. The best response for the incumbent is to decrease m_i. Then the entrant will decrease m_e. This process ends when $q_i - m_i^2 = q_e$.

Hence, the equilibrium monetization intensity for the incumbent is $m_i = \sqrt{q_i - q_e}$. All consumers purchase product i. Thus, $\pi_i^{(I,I)} = \alpha\sqrt{q_i - q_e}$ and $\pi_e^{(I,I)} = 0$.

Subgame (I, TT): When we are in the $2q_e < q_i$ case, we know from the (I, T) case that the best outcome the incumbent can have is that the incumbent offers one product and the entrant is at the corner. Hence, the incumbent does not want to offer product i'.

Now we look at the case where $2q_e \geq q_i$. First consider $q_{i'} > q_e$. We know that $2q_e > q_{i'}$. Hence, the entrant will be at the interior. From the (I, T) case, we know that $m_e = \sqrt{q_{i'} - q_e}$. Now the FOCs of the profit function of the incumbent w.r.t. p_i and $p_{i'}$ give $p_i = (-q_e + q_i + m_e^2)/2$ and $p_{i'} = \frac{1}{2}(-q_e + q_{i'} + m_e^2)$. The profits of the incumbent are thus $\frac{1}{4}(-q_e + q_i + m_e^2)$, which is independent of $q_{i'}$. Hence, the incumbent will set $q_{i'}$ such that m_e is as large as possible. In equilibrium, $q_{i'} = q_i$ and we are back to the case (I, T).

We then consider the case where $q_{i'} \leq q_e$. If $q_{i'} < q_e - (\sqrt{q_i - q_e})^2$, where $\sqrt{q_i - q_e}$ is the equilibrium amount of m_e without $q_{i'}$. Then $q_{i'}$ has no effect as i' is killed by the entrant and the equilibrium outcome is the same as in the (I, T) case.

Hence, the final case we need to consider is when $q_e \geq q_{i'} > q_e - (\sqrt{q_i - q_e})^2$. In this case, if the equilibrium m_e is such that $q_e - m_e^2 > q_{i'}$, i.e., the entrant kills i'. The case is worse than the (I, T) case because the entrant quality is forced to be higher.

Now we look at the case where $q_e - m_e^2 < q_{i'}$. The FOC of the entrant profit function, $(\frac{p_{i'}}{q_{i'} - (q - e - m_e^2)})\alpha m_e$, w.r.t. m_e is negative. Hence, the entrant wants to lower its monetization intensity as much as possible subject to $q_e - m_e^2 < q_{i'}$. Hence, $m_e = \sqrt{q_i - q_e}$. Essentially, the entrant kills product i'. We know that the incumbent prefers not to have product i' as having it may force m_e to be smaller.

To summarize, the incumbent prefers not to offer product i' and this case is dominated by the (I, T) case.

Subgame (I, TI)*:* We know that the two free products will compete as in the (I, I) case and the incumbent will push the entrant out of the market. The incumbent maximizes $\pi_i^{(I,TI)}$ by

setting p_i and $m_{i'}$. The FOC w.r.t. p_i gives: $p_i = \frac{1}{2}m_{i'}(\alpha + m_{i'})$. We then substitute p_i into $\pi_i^{(I,TI)}$ and obtain:

$$\pi_i^{(I,TI)} = \frac{(\alpha + m_{i'})^2}{4}. \tag{A-3}$$

It is easy to see that $\pi_i^{(I,TI)}$ increases in $m_{i'}$. We conclude that the incumbent will set $m_{i'}$ to the maximum. Hence, $m_{i'} = \sqrt{q_i - q_e}$ as the incumbent needs to make sure that the entrant is pushed out. Therefore, the profits are $\pi_i^{(I,TI)} = \frac{\alpha^2+(q_i-q_e)+2\alpha\sqrt{(q_i-q_e)}}{4}$ and $\pi_e^{(I,TI)} = 0$. □

Proof of Proposition 1. We first show that (I, I), (I, TI), (I, M), and (T, TT) cannot be equilibrium business model combinations. According to Proposition A-1, we know that (I, I), (I, TI) and (I, M) will never the equilibrium outcomes as the entrant will push the incumbent out of the market in these cases. In addition, when the entrant chooses the traditional business model, the only possible choices for the incumbent are T and TT and TT is dominated by T in this case.

According to Proposition A-1, in the case of (T, T), both firms coexist. In the case of (I, T), the entrant kills the incumbent. In the case of (I, TT), when $q_e/q_i < 4/3$, the entrant chooses to co-exist with the incumbent; otherwise, the entrant chooses to push the incumbent out and in this case, (I, T) weakly dominates (I, TT). Hence, only when the equilibrium outcome is (I, T), the incumbent is pushed out of the market.

It is easy see that when α is large, the entrant prefers the new model to traditional model. When the entrant prefers the new model model, the incumbent will be killed when q_e/q_i is larger than $4/3$ (regardless which business model the incumbent chooses). Hence, the incumbent will stay put with T and the equilibrium outcome is (I, T). When the entrant chooses the new model model and q_e/q_i is smaller than $4/3$, the incumbent can survive only by choosing TT. Hence, (I, TT) will be the equilibrium outcome. □

Proof of Proposition 2. (I, I) and (I, TI) are never equilibrium outcomes as the entrant will prefer T to avoid being pushed out of the market. According to Proposition A-2, (I, TT) and (T, TT) do not occur in equilibrium because having a second, low-quality product makes no difference for the incumbent's profit.

Part (b) is straightforward. The incumbent cannot be pushed out as it has a higher quality product and can always price its product close to zero and obtain positive demand. At the same time, the entrant can always choose to compete through the traditional business model and obtain some positive profit.

When $q_e/q_i < 1/2$, in the case of (I, M), the entrant will be at the corner and there will be no strategic interaction between the entrant and the incumbent. We know as a monopolist, the incumbent will prefer M to T. In addition, when α is not very large, the incumbent will not want to choose TI or I as the competition between two free products will result in cannibalization. The entrant will choose I only when α is large enough. Hence, (I, M) is the outcome when α is sufficiently large and q_e/q_i is small. When $q_e/q_i > 1/2$, the incumbent will prefer T to M as in this case, the entrant is not at the corner and with M, the net quality levels of incumbent and the entrant will be closer.

Finally, when α is large, the incumbent will prefer I if it becomes aware of I and it will push out the entrant. The entrant prefers not to reveal the innovation and enter with T. And the best response of the incumbent is then T. □

Proof of Proposition 3. Clearly, whenever the entrant adopts the traditional business model, the competition is the same as in the case without innovation. As the entrant will only choose to adopt the innovation if it can make more profits than competing with the traditional model, in all regions where it adopts the innovation, its profitability increases (note that we assume that when the entrant is indifferent from adopting and not adopting the innovation, it will choose not to adopt the innovation).

The entrant is at the corner in regions (I, TT) of Figure 2a and (I, M) of Figure 2b. Therefore, the incumbent makes more profits than what it would have earned if the entrant adopts the traditional business model (as in this case the entrant would not be at the corner).

In region (I, T) of Figure 2b, the incumbent profits are $\frac{q_i - q_e}{2}$ with innovation and $\frac{4q_i^2(q_i - q_e)}{(4q_i - q_e)^2}$ without innovation. It is easy to see that the former profits are greater than the latter. □

Proof of Proposition 4. In the (I, M) region where $q_e < q_i$, the entrant is at the corner and the incumbent acts as a monopolist. In this case, the incumbent prefers M to T. Hence, it earns more profits as a result of the revelation of the innovation by the entrant.

In the case of (I, TT) where $q_e > q_i$, the entrant is at the corner and the incumbent earns the monopoly profit.

The other two equilibrium outcomes are (T, T) and (I, T). In neither case, the entrant will be at the corner and hence its existence decreases incumbent profits. □