Innovation by Competitors and Firm Performance: The Influence of Demand Side Heterogeneity

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Abstract

This study explores the effects of innovation by competitors on firm performance. Building on the demand side perspective in strategy and innovation, we posit that competitor innovative efforts, through the introduction of new technologies, can help to reveal latent demand heterogeneity. This results in a customer response that is underlaid by two mechanisms - migration of existing customers to the new technology and market expansion due to the addition of new customers. The salience of each particular mechanism, however, depends on the extent of competitive innovation resulting in a U shaped influence on firm performance. In addition, we suggest that this U shaped relationship between competitive innovation and firm performance is moderated by the firm’s position with respect to its consumers, in the market and in its use of collaborations to serve customers. We test our propositions in a sample of mobile operators that face the introduction of 4G technologies by their competitors, over a period of 10 years. Our results support our hypotheses on the suggested U shaped relationship between competitor innovation and firm performance. We find partial support for the moderating role of firm position in the market, with counterintuitive evidence of the biggest migration and expansion for firms at the high end of the market.
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Abstract
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Introduction

At the core of strategy research is the question of how firms can build advantage vis a vis their competitors. Such competitive advantage is expected to derive from the value of the firm’s offerings to its customers (Adner and Kapoor, 2010; Porter, 1985). A firm that offers greater value over the long term to the consumer solidifies its sustainable competitive advantage in relation to rivals. One avenue for greater value offering to new customers is through innovation. Consequently, competitive actions introducing new technology have the potential to change the status quo and have implications for a firm’s viability and success.

Much of the work on the competitive threats posed to firms, however, has highlighted a supply side perspective, with a focus on differences in the resource endowments of the firms and their rivals (Li et al., 2006; Shamsie, Phelps, and Kuperman, 2004). Similarly, research on the introduction of new technologies emphasizes supply side issues. For example, firms struggle to respond to the technological innovation introduced by rivals and often go into decline (Henderson and Clark, 1990; Tushman and Anderson, 1986). Other research offers opposing predictions of firm investment in the cultivation of their own capabilities to better understand customer needs in order to innovate and preempt or survive competitor threat (Ahuja and Lampert, 2001; Christensen and Rosenbloom, 1995).

Competition is at the core of Schumpeter’s (1942) theory of creative destruction, where the creativity and innovation of some firms prompt movements and actions by others in an attempt to challenge the initiators of such actions. In this scenario, competition and rivalry is a key driver of organizational response to an opportunity (Dosi, 1984). As Hill and Rothenberg (2003) note research documents numerous counterexamples of incumbents successfully navigating the introduction of a new product or technology (Ahuja and Lampert, 2001; Rothenberg, 2001). Competitor innovation may thus have positive implications for some firms that are better poised to respond to this challenge.
A key aspect that determines whether firms are better off or not in the face of competitor innovation, appears to be related to their ability to meet customer preferences. This necessitates a demand side perspective, which emphasizes the importance of heterogeneity in customer preferences that allow firms to create and capture value (Adner and Levinthal, 2001; Priem, Li, and Carr, 2012). We integrate ideas from the demand side perspective to explore the conditions under which competitive threat of innovation influences firm performance. We examine the effects of a specific type of innovation, the introduction of a new technology, by competitors, for a focal firm’s performance. Our research addresses two related questions: (1) how does innovation by competitors influence focal firm performance? and (2) how does the focal firm position influence this relationship? By focusing attention on the customers and their preferences, we propose that the differing effects of innovation by competitors can be reconciled to illustrate how the extent of such innovation has implications for firm performance.

The introduction of new technologies and products based on them can help to reveal previously latent heterogeneity in consumer preferences (Adner and Snow, 2010a, 2010b). We posit that innovation by competitors reveals demand heterogeneity among current consumers, which in turn leads to two mechanisms –customer migration due to an erosion of consumers of old technology as they opt for newer technology and customer and market expansion due to the addition of new customers, who did not use the old technology but now adopt the new technology. The dominance of a particular mechanism, however, is contingent on the extent of competitor adoption. When fewer competitors offer the innovation, there is less awareness of the new technology in the market and consequently little addition of potential new consumers. Yet, existing consumers who may be more conversant with industry trends are likely to migrate to the new technology. Therefore at lower levels of competitor innovation, due to the dominance of the migration effect, a firm may have negative performance. As the extent of competitor innovation increases, there is greater awareness of the new technology, as the number of firms offering the
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New technology increase their promotion efforts in a bid to spur market growth. This draws potential new consumers into the fold increasing market size for both the older and newer technology. As a result, market expansion effects may outweigh the diminishing migration effect and the focal firm has a positive performance. We, therefore, expect that extent of competitor innovative efforts have a U shaped relationship with firm performance.

We argue these effects of competitor innovation on firm performance to be moderated by the firm’s position related to customer preferences. Two aspects of this position are considered – which consumers the firm serves, by considering affordability and willingness to pay of the firm’s consumers and how it chooses to serve them by determining the extent to which the firm collaborates with other firms to reach consumers. We suggest that because of the variability in the customer migration and expansion at different levels of competitor innovation for firms in the low, middle and high end of the spectrum of willingness to pay, the relationship between competitor innovation and firm performance is flatter for a firm at the low end compared to one in the middle. We posit more nuanced effects for firms at the high end, who are expected to encounter a steeper downward part of the curve and a flatter upward part of the curve, compared to the firm in the middle. We expect that both migration and expansion effects are likely to be relatively larger for firms that rely on collaborators to serve customers in contrast to firms that do not. We, therefore, hypothesize that U shaped curve between competitor innovation and firm performance is steeper for firms with more collaborators to serve customers.

We empirically test our hypotheses in the context of the global telecommunications industry and the rollout of 4G technologies. Our sample consists of 545 mobile operators in different national markets observed over a period of 10 years. We find support for a U shaped relationship between competitor innovation and firm performance. As hypothesized, firm positioning at the low end of the market flattens the competitor innovation-firm performance relationship, compared to a firm in the middle. For firms in the high end while we find support
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for a steep downward portion of the U shape, we counterintuitively find that these firms also have steeper upward portion of the U shape compared to the firm in the middle. The extent of firm collaborators to serve consumers, moderates the relationship between competitive innovation and firm performance as hypothesized.

**Theory and Hypotheses**

The introduction of new innovations by competitors has significant implications for the firm performance. Successfully navigating technology competition confers competitive advantage (Caves, 1996; Dunning, 1993; Porter, 1985) and enables firm survival (Christensen, Suárez, and Utterback, 1998; Cooper and Schendel, 1976). In contrast, an inability to do so can result in cannibalization of existing technological base (Kamien and Schwartz, 1982) and organizational inertia (Hannan and Freeman, 1977; Tushman and Romanelli, 1985) and eventually dooming the firm to failure (Ahuja, Lampert, and Tandon, 2008; Leonard-Barton, 1992). Recognizing the threat of competition, prior research has mainly applied a supply side perspective by drawing on the resource-based view (Barney, 1991; Wernerfelt, 1984). The resource-based view suggests that success in competitive rivalry depends on the nature of assets held by the firm. Thus competitive threats have been evaluated by focusing on differences in the resource endowments of the firms and their rivals (Li et al., 2006; Shamsie et al., 2004). This emphasis on supply side issues is also evident in the introduction of new technologies and resulting competition. Prior research documents firm struggles and inability to respond to competitors’ technological innovation or alternately reports firm flexibility and creation of capabilities to counter the threat (Ahuja and Lampert, 2001; Christensen and Rosenbloom, 1995; Henderson and Clark, 1990; Tushman and Anderson, 1986).

This approach, however, neglects the demand environment where most of the interactions with customers take place. Demand side approaches in contrast to the supply side focused on resources have shifted attention towards the demand environment that enables the
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competitive advantage of the firms (Priem, Li, and Carr, 2012). This stream of literature focuses on “downstream from the focal firm, toward product markets and consumers” (Priem et al., 2012:346) suggesting that value creation for (or with) customers comes hand in hand with value capture for companies (Priem, 2007). Central to this research are several key characteristics (Priem et al., 2012). First, consumer preferences are heterogeneous which in turn leads to differing strategic decisions by firms. Dealing with a diverse set of consumer preferences is evident across many industries, from integrated circuits to food and apparel. Firms that strategically respond to such heterogeneity, through “coupling” with customers, are able to maximize the value-added for customers (Danneels, 2003). Second, consumer preference is not constant but rather evolves and dynamically changes. In a study of the typesetting industry, (Tripsas, 2008) suggests that the trajectory of customer preferences follows a pattern of incremental and discontinuous changes in customer tastes. In this way, major technological transitions in this industry were driven by discontinuities in customer preferences. Third, product markets are an important source of value capture for the firm (Adner and Snow, 2010a; Priem and Butler, 2001) in addition to resource markets. This means that the value that firms eventually capture is contingent on the customer experience during consumption of a product or simply the value created for customers (Priem, 2007). In order to achieve competitive advantage, firms need to first compete for creating higher value for their customers (Gans, MacDonald, and Ryall, 2008).

Recognizing this perspective on value creation and value capture, different studies on innovation and technology have embraced the demand environment. Innovations are driven by consumers needs or attempts to satisfy existing consumer needs in different ways (Baldwin and Von Hippel, 2011; Bogers, Afuah, and Bastian, 2010). In open source software communities, as an example, consumers use tool kits provided by firm to come up with customized, flexible solutions that better meet their personal needs (Von Hippel, 2005; Von Hippel and Von Krogh,
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2006). Demand heterogeneity also has significant implications for the firm’s strategies when faced with new technology. Seamans and Zhu (2017) show that following the entry of Craigslist in the US, newspapers are more likely to engage in repositioning strategies –through content change – when reader preferences are heterogeneous. On the contrary, they note that when reader preferences are homogeneous, newspapers are more likely to respond to the new entrant threat through implementing cost-cutting strategies. Firms can adopt strategies such as technology retreat to cope with the introduction of a new technology, by retrenchment through targeting a new niche market with the old technology or applying the old technology in a new use (Adner and Snow, 2010a). Examples of successful technology retreat are evident in several industries, the mechanical watch industry’s response to quartz technology, bicycle manufacturers response to automobiles and pager manufacturers response to cell phones (Priem et al., 2012).

Thus, the underlying argument is that firms facing new technology can benefit from the revealed heterogeneity in customers’ preferences, and therefore, apply or modify their existing resources and technology to satisfy a different demand setting.

We apply this demand side heterogeneity lens to consider the implications for firm performance as a result of competitor innovation in the telecommunication industry. The introduction of an innovation can reveal a previously unknown customer preference for heterogeneity, which in turn, influences customer choices and response (Adner and Snow, 2010a, 2010b). We theorize about two mechanisms that underlie customer response – migration of existing customers to new technology and expansion through the addition of new customers who did not previously utilize the technology – arguing that the effects of these mechanisms vary with the extent of competitor innovation, thereby influencing performance. Our context readily lends itself to this evaluation because the new technology (introduction of a new generation of technology) is homogenous allowing for easier comparison across firms.
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To complement the demand side perspective, we consider the firms interactions with consumers by considering how they differ in the market segments they serve and the manner in which they serve these consumers. We propose that firm stance on two dimensions - consumers served based on willingness to pay and co-operation with other firms to serve consumers – imposes boundary conditions on the effects of competitor innovation on firm performance. Firms make a choice related to the product market areas or consumer segments in which they will compete, demonstrating substantial variation in this respect (Rumelt, 1997). These segments correspond to positions in market space that offer heterogeneous products to clusters of customers based on demographics, socioeconomics and lifestyle preferences (Dobrev and Kim, 2006). They further note that differences in market segment positions are observed across a broad spectrum of industries including automobiles, airlines and hospitality. One aspect of such positioning is the relative focus of the firm within a segment, for example a criteria based on affordability and customer willingness to pay results in decisions about relative emphasis on luxury and/or economy segments. The important implication from a demand side perspective is that firms competing in the same market segment “tend to be perceived as categorically similar to each other by relevant external constituents (e.g. consumers....)” (Dobrev and Kim, 2006, page 232, emphasis added).

A related aspect of the firm’s position in market space is a choice of whether to achieve such a position on its own or by co-operating with other firms for the purpose of accessing consumers. Co-operation with other firms can allow for mobilizing and pooling of external resources (Gnyawali and Madhavan, 2001; Koka and Prescott, 2008) supporting sales growth and market share (Stuart, 2000; Zaheer and Bell, 2005). This results in increased legitimacy and greater prominence with consumers. Such performance can also confer necessary resources to enhance products – either jointly or singly - thus broadening the firm’s reach to other consumers. From a demand side perspective, such collaborations, therefore have consequences for the firm.
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Few or no collaborations may imply limited reach to consumers and possibly fewer segments that the firm can tap into because of the limitations of relying on own resources. Such firms may therefore focus on satisfying specific needs of a particular customer segment. The characteristics of these firms may reflect some aspects of specialist organizations that attract a specific segment consumers such as the development of a unique identify or connection with these consumers (Carroll, 1985; Swaminathan, 2001). In contrast firms with many collaborations may be similar in some aspects to generalist organizations with a broad set of consumers, albeit without the unique connections with consumers that specialists are able to forge.

We evaluate the consequences of firm position for the mechanisms of market migration and expansion to posit that the effects of competitor innovation on firm performance will be moderated by its position in the market segment and its collaborations for serving consumers. Figure 1 presents our theoretical model.

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Insert Figure 1 here
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**Competitor innovation**

Applying a demand side perspective to technology competition suggests that when competitors introduce a new technology to the market, it can reveal latent customer heterogeneity and influence customer response. The effects on customer response, however, will vary depending on the intensity of competitive efforts. We posit that customer response and the resulting implications for firm performance are shaped by two mechanisms, migration of existing customers and market expansion through the addition of new customers. The dominance of each mechanism, however, will vary depending on intensity of competitive efforts. When the extent of such competitor innovation is limited with few competitors offering the new technology, current customers, because of their familiarity with the industry, are more likely to be aware of the new technology. At this stage, we therefore expect, the customer migration mechanism to
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dominate, because of limited dissemination of new technology to potential customers. Note that
all firms, regardless of their technology status, are likely to experience some migration effects.
While the incentives for customers to migrate from a firm that does not offer the new technology
are clear, there may also be some migration from a firm that has introduced the new technology,
because of increased competition and incentives offered by rivals (in terms of price or product
that embodies the technology) to encourage consumers to switch.

As more competitors introduce new technology, there are two consequences. First, the
migration effect decreases as the customer segment with a preference for a product with a new
technology who still has not migrated to competitor shrinks. Indeed some of these non-migrators
may potentially not move for other reasons related to the cost of and unfamiliarity with new
technology. Second, as more competitors introduce new technology, they aggressively promote
it, increasing market visibility. This is likely to result in a market expansion effect, as non-
customers are attracted to the product. Such market expansion can occur for both products with
new technology and with existing technology\(^1\). Thus, with greater competitor innovation, we
expect positive implications for firm performance because of the dominance of market expansion
and limited migration.

Taken together, we posit that competitor innovation has a U shaped effect on firm
performance. Such a U shaped relationship is a result of two linear effects: a decreasing
customer migration effect and an increasing market expansion effect.

**Hypothesis 1:** Competitor innovation has a U shaped relationship with firm performance such
that there is a) negative linear effect and b) a positive quadratic effect on firm performance.

**Moderating effects of firm position - Market segment**

\(^1\) An analogy for expansion of products with existing technology is in the case of ebikes. Customers who don’t own a
bicycle but become aware of ebikes may choose to own bicycles to avoid paying the premium associated with the
newer technology.
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A key aspect of the firm’s relationship with its consumers hinges on its position on a spectrum of affordability, or customer willingness to pay for its products. A firm may choose to compete on the basis of cost leadership offering low prices to consumers who are looking for affordable products, or it may differentiate its products on the basis of quality for more discriminating consumers who are willing to pay higher prices, or it may offer some combination of the two tapping both sets of consumers, as well as offer a combination of reasonable price for viable quality (Caves and Porter, 1977; Hill, 1988; Porter, 1980, 1985; Reitsperger et al., 1993). The position of the firm on this spectrum of affordability and resulting heterogeneity of demand has implications for the dual mechanisms of migration and expansion.

To explain the effects on the migration mechanism, consider a firm positioned with an emphasis on the low end of the affordability spectrum i.e., one that is focused on meeting customer needs with basic products at lower prices. When few competitors introduce an innovation, the price of a product encompassing the new technology is likely to be higher, because the market size is small, as many consumers are less aware of the new technology. Further, the competitors introducing the innovation are recouping the heavy costs of their investment in innovation and are unable to price the new technology in a competitive manner, in comparison to older technology. Such a firm’s customers at the low end of the affordability spectrum are less willing to pay the higher price for the new technology. Further given their focus on a basic product, they are also less likely to be interested in the added features provided by the new technology. In contrast, the willingness to pay and experience the new features of the technology is likely to be greater for customers at a firm serving the higher end of the affordability spectrum, whose consumers demonstrate both an interest in the bells and whistles provided by the latest technology and are willing to pay a price for it. A firm that straddles both segments either by competing in both or operating in the middle, is also likely to see some customer erosion. However, this migration effect will be less than the erosion faced by the firm
Innovation by competitors and firm performance: The influence of demand side heterogeneity at the high end, as the customer base of the firm in the middle is more cognizant of obtaining more value for money. Yet, such migration effect will be higher than the erosion faced by the firm at the low end, as the customer base of the firm in the middle is receptive to the new technology features. Consequently, customer erosion effects due to migration are likely to be minimal for a firm at the low end, moderate for the firm in the middle and highest for a firm at the high end.

As more competitors introduce the innovation to the effect, market expansion effects kick in as a result of the addition of new customers who have not previously used the product. At this point, because many competitors have introduced the technology, the price reduces as firms compete with each other in an attempt to both spur and capitalize on market expansion. The customer is also more aware of the added benefits of the new technology as more firms step up their promotion efforts. These new customers encounter choices of products, based on the older generation of the technology and more basic versions of the new technology offered by firms at the low end or better versions of the new and old technology offered by firms in the middle and at the high end. While market expansion draws customers to all of these products and segments, we expect that the market expansion will be weakest for the firms at the low end that offer either the old product or a watered down version of the new technology. In this situation, the customer may prefer not to buy this product as they did not own similar technology in the past and do not see any benefits to buying it at this stage. The market expansion effect will be strongest for firms in the middle, as they offer a useful middle route for these customers to try new technology at an affordable price. We expect the effect to be weaker for firms at the high end, compared to the firm in the middle, because although they offer all the advantages of the new technology, the product price may result in fewer customers who are willing to pay the price.

Taken together these two mechanisms imply that the relationship between competitive innovation and firm performance is steeper for a firm in the middle versus a firm at the low end.
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Further the downward part of the curve is steepest for a firm at the high end and the upward part of the curve is steepest for a firm in the middle. We therefore posit:

**Hypothesis 2:** Firm market segment position moderates the relationship between competitor innovation and firm performance, steepening the U shaped curve for a firm in the middle compared to one at the low end. The steepest part of the downward curve is for a firm at the high end, while the steepest upward part of the curve is for a firm in the middle.

**Moderating effects of firm collaborations to serve customers**

Firms can differ in their approaches to serving customers. Some firms may opt to tap customers on their own, building unique connections with a smaller group, while others may prefer a broad based approach partnering with other firms to collaboratively tap a broad and more heterogeneous set of customers. These choices are likely to influence migration and expansion mechanisms.

A firm that opts to reach customers on its own may be insulated to a larger extent from customer migration when competitors introduce new technology. This occurs for two reasons, first such a firm is likely to have stronger connections to its customers based on a unique identity (Swaminathan, 2001) making customers more resistant to switching from the firm. Second, such a firm may have a smaller reach compared to others that rely on broader coalitions to serve customers, because the resources of a single entity are limited. Consequently the threat of the migration effect is likely to be lower. In comparison, a firm that relies on collaborative relationships to serve different consumers, is unlikely to have the unique identity that would offer customers incentives to stick with it, in the face of competitor innovation. Similarly, this firm relies on a broad spectrum of customers, who may reveal more heterogeneity in preferences, thus the threat of migration it faces is high. We therefore expect customer migration to be highest for a firm that relies on collaborations to serve its customers, and lowest for the firm that does not rely on such collaborations.
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The benefits of market expansion due to greater awareness of new technology as more competitors innovate, accrue to a larger extent to the firm that relies on collaborations. The demand heterogeneity of its customers allows it to add customers interested in different manifestations of the product offered by it. In contrast, the benefits are smaller for the firm that relies on its own resources because of its limited reach, as well as lower heterogeneity across consumers. This implies that both migration and expansion effects are likely to be relatively larger for firms that rely on collaborators to serve customers in contrast to firms that do not. We thus posit:

**Hypothesis 3**: Firm collaborations to serve customers moderate the relationship between competitor innovation and firm performance, such that the U shaped relationship is steeper as a result of the extent of firm’s collaborators, with the steepest U shape observed for a firm with many collaborators and the flattest U shaped for a firm with no collaborators.

**Empirical Context and Methods**

We consider competitor innovation through the patterns of 4G technology introduction by mobile operators in their national markets. This setting is particularly appropriate to test our hypotheses for two reasons. First, the availability of 4G technology provides a unique opportunity for all firms to roll out the latest generation of the technology\(^2\). The operators shift to 4G technology is widespread globally. A significant number of operators have already committed to 4G since the first commercial networks rolled it out in 2009 (Menard et al., 2012). While 4G technology is accessible (upon purchasing the license), there is a considerable difference in the timing of introduction of the new technology within the local markets. Thus, the availability of 4G technology leads operators worldwide to face an increasing technology competition from competitors that introduce the new technology in the national market. Second,

\(^{2}\) The new technology we consider (4G) is homogenous, which makes it comparable across all firms.
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4G technologies enable operators to better satisfy customer needs in a number of ways – supporting up to 10 times faster data speeds, enabling intensive downloads and streaming; allowing for faster connection times, ensuring an “always-on” service experience; and reducing round trip latency, making real-time applications such as VOIP and online gaming possible (Bender and Zakaria, 2014). Thus, 4G technology appears to better fulfill needs of some customers, especially early adopters and heavy users (Eggers, Grajek, and Kretschmer, 2011; Grajek and Kretschmer, 2009). Therefore, this new technology with better functionality on many performance attributes can reveal inherent heterogeneity in preferences: some customers migrate to the new technology and pay a premium for a much faster internet connection, while others select the basic versions through existing technologies.

We construct our sample of 545 global mobile operators from 2006 to 2015, located in a total of 174 countries from the GSMAi Intelligence database. Our unit of analysis is firm-year and in total, there are 4839 observations in our panel dataset.

**Measures**

*Outcome variable.* Firm performance is measured as the firm’s total revenues in the national market in year t. Total revenues are calculated by multiplying the firm’s average revenue per user\(^3\) (ARPU) by its total number of subscribers. To reduce the skewness of our outcome variable, we compute the natural logarithm of total revenues for firm i in year t.

*Explanatory variable.* Competitor innovation reflects the extent of 4G offerings by competitors in a particular national market. This variable is constructed as the market share weighted ratio of the number of competitors that have introduced 4G in year \(t-1\).

*Moderator.* Our first moderator variable, firm position, measures the extent to which a firm serves customers at low end of consumer affordability spectrum. This measure is a continuous

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\(^3\) A well-established and widely accepted metric of operational performance in the industry
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variable between 0 and 1 based on the percentage of prepaid customers of a firm in that national market in year t-1. In this way, if this variable is equal to 0 the firm is positioned at the high end of the spectrum, whereas, if it is equal to 1, the firm is positioned at the low end of the spectrum.

Our second moderator, *firm collaborations*, captures the number of partnerships that a given firm has established with mobile virtual network operators (MVNOs). MVNOs allow the firm to target different market segments. This variable is the total number of collaborations that a firm creates up to the year t-1 in that national market.

**Controls.** We use several control variables to account for firm and country characteristics. At the firm-level, we proxy for *firm performance relative to the market*, by the ratio of firm ARPU to the average ARPU at the country level in year t-1. Firms with a higher relative performance may be more capable of dealing with competitor innovation. Further, we control for *firm innovation* to measure the focal firm’s response as well as position with respect to the new technology, 4G. This variable is captured by the share of the 4G customer base of the focal firm (in comparison to existing technologies like 2G/3G) in year t-1. *Firm prior technological experience* by measuring the cumulative number of times that a firm has introduced any generations or evolutions of existing technologies (like GSM, CDMA) up to year t-1. At the country level, we proxy for *Market potential* through measuring population in year t-1. We control for the stage of adoption of cellular services across countries in our study by using *Market penetration*. This variable is calculated based on the total number of subscribers in a given country divided by population in year t-1. Controlling for market penetration enables us to proxy for the extent to which mobile telecommunication services are widespread in a given country. This measure also to some extent reflect the propensity of customers adopting a new technology. In addition, we construct *Market concentration* to measure competitiveness at the country level using the Herfindahl-Hirschman Index in year t-1. Finally, we control for firm- and year-fixed effects.

**Results**
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Table 1 shows the descriptive statistics and correlations. We use OLS regression models with fixed effects to test our hypotheses and present them in Table 2.

Results of the baseline specification are reported in Table 2, Model 1. Of the controls, firm position at low end⁴, firm performance relative to the market, market potential, penetration, and concentration all have positive and significant effects as expected. In Model 2, we add competitor innovation and its squared term to test Hypothesis 1. As expected, the extent of competitor innovation has a significant negative linear effect and a positive quadratic effect on firm performance. These findings lend support to Hypothesis 1 showing that competitor innovative efforts have an overall U shaped relationship with firm performance, demonstrated in Figure 2.

Models 3 and 4 test the moderating effect of firm position and collaborators on the firm performance-competitor innovation relationship (Hypotheses 2 and 3) and Model 5 presents the comprehensive model. A graphical depiction of these results is presented in Figures 3 and 4.

In Models 3 and 5, the estimated coefficients reveal a positive interaction effect of firm position and the linear competitor innovation effect and a negative interaction with the quadratic term of competitor innovation. Figure 3 demonstrated how the relationship changes for firms at

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⁴ Because our outcome variable considers total revenues of the firm by factoring in the total number of subscribers, a focus on the low end of the market may result in increasing the scale of the customer base and consequently performance in contrast to high end which may have a smaller customer base.
Innovation by competitors and firm performance: The influence of demand side heterogeneity low, middle and high end. In accordance with Hypothesis 2, the findings show that positioning at low end flattens the U shaped relationship between competitor innovation and firm performance, compared to a firm in the middle. We also find evidence of greatest customer migration for the firm at the high end. However, the firm at the high end appears to benefit the most from customer expansion as the extent of competitive innovation increases, in contrast to our expectation of gains for the firm in the middle. While these findings are quite counterintuitive, they may reflect a consumption trend showing increased spending on the telecommunications services as the market continues to expand.

Model 4 and 5 include the moderating effect of firm collaborations on the firm performance-competitor innovation relationship (Hypothesis 3). The results show a negative interaction effect of firm collaborations and the linear term of competitor innovation and a positive (but not significant) interaction effect of firm collaborations and the quadratic term of competitor innovation. A graphical depiction of the findings is presented in Figure 4 and it reveals that the number of collaborations steepens the U shaped relationship.

**Post hoc analysis**

Besides the results presented above, we run a number of additional tests to further elaborate on the suggested mechanisms. In particular, to examine the observed trend of market expansion, we test the effect of new technology introduction on the market sizes of new technology as well as existing technology at the country-market level. Doing so, we study the effects of the introduction of new technology at the national level on the total market size (proxied by number of subscribers) across 4G and 3G technologies. Our initial findings reveal that the introduction of new technology in the local market leads to increase in the size of the new technology market (4G subscribers), and has dual effects of migration and expansion on the size of existing technology market (3G subscribers). In addition, we rerun the regression models presented in Table 2 using different operationalization of our dependent variable, competitor innovation. In
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In particular, we constructed other measures based on the absolute and relative number of competitors that introduce the new technology in a given country. The results remain consistent with our initial findings.

Conclusions and Implications

Successfully navigating competitor innovation is critical for firm success and performance. Our study explores this by using a demand side perspective (Adner and Levinthal, 2001; Priem et al., 2012). Our study shows how and why firm performance changes with the extent of innovation by competitors. We identify two mechanisms that underlie consumer response namely, customer migration through the movement of consumers of existing technology to new technology, and market expansion through the addition of consumers who have not yet used the technology in any form, and theorize about their implications for firm performance. Our findings support the notion that customer preferences evolve with the extent of competitor innovation, resulting in the migration of existing customers at low to moderate levels of competitor innovation and the addition of new customers at moderate to higher levels of competitor innovation.

Furthermore, our findings suggest that the relationship between competitor innovation and firm performance is bounded by the firm’s stance with respect to its customers. We find interesting and some counterintuitive effects for the firm’s position in the market segment. As expected, firms at the high end are most susceptible to market erosion at low levels of competitor innovation. But surprisingly firms at the high end in contrast to those in the middle are also the biggest gainers of market expansion as competitive innovation increases, an effect that may be partly driven by the nature of the industry. In this way, potential network externalities in this setting, following an increasing market expansion effect, might result in changes in consumption behavior or willingness to pay for the telecommunication services that are more on the high end spectrum of the customer affordability. Findings for firm collaborations to serve customers align
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with expectations, as firms with mode collaborators experience both sharper customer erosion and better customer expansion.

Our study contributes to the literature on demand side perspectives in several ways. We spotlight the importance of product markets (Priem et al., 2012) and consider the latent heterogeneity of consumer preferences that are unveiled in the light of competitive innovation. Our evaluation of the effects of the demand environment on firm performance offers a complement to the focus on strategic changes in the literature in this arena (Adner and Snow, 2010a; Seamans and Zhu, 2017). The consideration of the mechanisms of customer migration and expansion allow us to consider manifestations of dynamic customer preferences (Tripsas, 2008). The dynamism of customer preferences in our context is shaped by the variation in competitive innovation. By exploring the interactions between firm position and competitive innovation we integrate the demand side perspectives with positioning and supply side views (Barney, 1991; Porter, 1980; Wernerfelt, 1984) to present a comprehensive understanding of implications for firm performance.

This research offers interesting avenues for further exploration. We consider the effects of two mechanisms, yet we do not directly assess them and instead consider their outcome in firm performance. While this limitation can be attenuated by our post hoc tests at the country level, future research may wish to examine these mechanisms in detail and consider other outcomes. In particular, more fine grained data on performance and pricing of each technology at the firm level can shed additional light on the two proposed mechanisms. We conduct our tests within the context of a specific industry, telecommunications and with respect to a particular technology 4G. With the move towards 5G other research may examine whether firms perform similarly. Other extensions may consider different industries to increase the generalizability of our findings.
In conclusion, our study highlights the role of a demand side perspective in understanding consequences for firm performance because of competitor innovation. It presents practical insights for managers of firms seeking to deal with competitive threats of innovation. While they are likely to experience customer erosion, a greater competitive adoption is beneficial for all in terms of spurring market expansion thanks to an increased consumer awareness. In order to ensure that the firm can capitalize on the upswing in performance, managers may need to make careful strategic choices related to their product market position and collaborators to serve these markets.
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Figure 1. Proposed conceptual model

Figure 2. Testing the effects of competitor innovation on firm performance (Hypothesis 1)
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Figure 3. Testing the moderating effects of firm position-market segment on the competitor innovation- firm performance relationship (Hypothesis 2)

Figure 4. Testing the moderating effects of firm collaborations on the competitor innovation- firm performance relationship (Hypothesis 3)
Innovation by competitors and firm performance: The influence of demand side heterogeneity

Table 1. Descriptive statistics and correlations (N=4839)

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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
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<td>.13</td>
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<td>.04</td>
<td>.04</td>
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Table 2. Regression models showing the effects of competitor innovation on firm performance

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<th>DV, Firm performance</th>
<th>Model (1) Baseline</th>
<th>Model (2) H1</th>
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Standard errors in parentheses

** p<0.01, * p<0.05
References


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