IT-Enabled Product and Process Innovations in Transition Markets: The Moderating Role of Dysfunctional Competition

Completed Research Paper

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Abstract

Since transition markets are playing an increasingly important role in the global economy and in the international innovation arena, there is a need to understand how IT affects firms' process and product innovations and ultimately their competitive performance in these markets. Drawing on innovation literature and the IT capabilities portfolio perspective as well as the distinctive environment of the transition markets, we compare and contrast how IT internal integration and IT market integration affect process and product innovations, which in turn lead to competitive performance under different levels of dysfunctional competition. We test our model and hypotheses using data collected from 241 firms in China, one of the largest and fastest growing transition economies. The results reveal how dysfunctional competition shapes the efficacy of IT-enabled product and process innovations. We find IT internal integration has a greater positive effect on process innovation and on product innovation, and consequently, competitive performance, when dysfunctional competition is high. In contrast, IT market integration is more effective in influencing process and product innovations when dysfunctional competition is low. Furthermore, when dysfunctional competition is high, it becomes harder for firms to obtain value from their investment in product innovation, while the performance return from process innovation increases. We discuss the implications, for theory and practice, of the role IT integration capabilities have on innovation in transition economies.

Keywords: IT integration capabilities, product and process innovations, transition markets, dysfunctional competition, competitive performance.

Introduction

Innovation has been recognized as an engine to sustain a firm's competitive advantage over its rivals. A recent survey of innovative activity in business firms shows that in most countries between 30 and 50 percent of firms introduce a product or process innovation during a three-year period (Hall, 2011). On average, more than one-third of a corporation's revenue comes from products or processes that did not exist five years ago (Nambisan 2003). Indeed, the Organization for Economic Co-operation and

Development (OECD) (2010) has stated that innovation – the introduction of a new or significantly improved product, process, or method – holds the key to boosting productivity in today's highly competitive and connected global economy. With the expanding role of information technology (IT) on key organizational activities that have competitive implications, scholars have examined how firms can leverage IT to support product innovation (Grover and Saeed 2007; Sambamurthy et al. 2003; Xue et al. 2012) and process innovation (Davenport 1993; Krishnan et al. 2007; Rai and Tang 2010). However, the role of IT capabilities in affecting these two types of innovations needs to be examined in the context of the competitive environments in which firms operate.

Furthermore, we have observed that more innovations occur in transition economies, which are defined as any economy that is transitioning from planned to free market. A recent report from OECD indicates that many transition markets have become important contributors/investors in innovation. When advanced markets including the United States, the European Union and Japan, reduced their investments in R&D in the period of 1996-2007, transition markets, such as China, India, and Brazil, greatly increased their R&D expenditures. Specifically, China accounted for almost a third of the global increase in R&D between 2001 and 2006 (OECD 2010), as much as Japan and the EU combined. Since most existing studies on innovation focus on advanced markets, the recent change in the international landscape for innovation calls for more research on innovation in transition markets.

Transition markets like China and Vietnam have adopted a gradual mode of reform in its government policies and institutional arrangements. While governments in these transition economies make continuous efforts to promote privatization and reform ownership structures to create opportunities for firms, such opportunities also come with challenges – the competitive landscapes in these transition economies are so unpredictable that many firms may not know the exact rules of the game. Since the legal systems are often underdeveloped and enforcement of existing laws is inefficient (Ostergard 2000) in transition economies, some firms may take advantage of loopholes and engage in activities such as copyright piracy and counterfeiting (Li and Atuahene-Gima 2001), putting those firms that play fair at a disadvantage. In such a so-called "dysfunctional competition" environment, an important question arises: *How does a firm's appropriation of IT capabilities for product and process innovations, and consequently competitive performance change because of the level of dysfunctional competition?*

Extending from the IT-enabled capabilities perspective (Mithas et al. 2011), we argue that a firm's IT capabilities influence innovations differently, depending upon the types of IT capabilities and the level of dysfunctional competition. We examine both inside-out and outside-in IT capabilities. *IT internal integration*, an inside-out capability, is defined as the extent to which a firm uses IT to facilitate information sharing, coordination, and alignment inside the firm (Barua et al. 2004). In contrast, *IT market integration*, an outside-in capability, depicts the extent to which a firm uses IT to collect and analyze market information to support its strategic decisions (Tippins and Sohi 2003). In the presence of different levels of dysfunctional competition, we expect that each of these IT capabilities plays a different role in supporting product and process innovation. We also expect that the competitive performance implications of product and process innovations are not identical but are subject to the different levels of dysfunctional competition firms face.

Overall, we contribute to the literature in three ways. First, extending the research on IT capabilities, we examine how IT internal integration and IT market integration enable product and process innovations differently. Second, by differentiating process innovation from product innovation, we provide a more fine-grained understanding of the direct effects and the relative importance of each innovation strategy on firm performance. Third, with transition economies playing an expanding role in the global economy, it is imperative to identify a boundary condition where firms can adopt a more profitable innovation strategy to sustain their competitive advantage in these markets. While previous research has examined several important environmental contingencies (Porter 1991; Zhou et al. 2005), we add to the literature by investigating the role of dysfunctional competition in changing the efficacy of IT-enabled process and product innovation for competitive performance.

In the remainder of the paper, we develop our research model based on the IT capabilities and innovation literature. We then test the proposed relationships using survey data collected from 241 manufacturing and service firms in China. The theoretical and practical implications of the findings are then discussed.

Theoretical Framework

The literature has long suggested that the context, such as external environments, in which a firm operates and competes, provides resources and constraints to the firm's strategic decisions and actions, which subsequently influences its performance (Pfeffer and Salancik 1978; Johns 2006). Firms can maximize their performance when their structural positions and strategic choices are aligned with the contextual conditions in which the firms are embedded.

One critical yet underexplored contextual factor in the IT capabilities, innovation and business value literature is the institutional environment in transition economies. The institutional environment, or the "rules of the game" (North 1990), significantly constrain an organization's strategies and actions. The institutional environment determines the extent to which a firm can appropriate value from its investment in innovation (Gans et al. 2008). Firms in advanced economies tend to rely on intellectual property rights laws to protect the value of innovations from appropriation by external market entities. In transition economies, however, such protection is far from transparent and efficient (Zhao 2006), resulting in so-called dysfunctional competition.

Dysfunctional competition reflects the extent to which opportunistic, unfair, or even unlawful competitive behaviors persist among firms in a given industry (Li and Atuahene-Gima 2001). This phenomenon is relatively widespread in transition economies (Ceccagnoli 2009), sometimes even with the implicit support of local authorities (Li and Atuahene-Gima 2001; North 2005). This kind of "institutional void" could significantly affect the outcomes of a firm's strategic choices and investment in innovation (Shen et al. 2013).

Product innovation and process innovation are two of the most common forms of innovation. Product innovation, defined as the creation of new products or services, enables a firm to earn abnormal profits and possibly expand into new markets and industries (Agarwal and Bayus 2002a; Roberts 1999). Process innovation, on the other hand, which depicts the reconfiguration of existing processes or the creation of alternative procedures for doing businesses, can facilitate cost reduction and perhaps help generate new lines of revenue growth (Damanpour and Gopalasrishan 2001). To realize the full potential of product and process innovations, it is imperative for a firm to evaluate two aspects of its IT capabilities, e.g., internal integration and market integration, in conjunction with the firm's external environment.

Since the efficacy of a firm's strategic choice depends on its external environment (Donaldson 2001), a firm can maximize its performance when resources and strategy are aligned with the environment in which it resides. In other words, either IT-enabled product or process innovation could result in positive performance outcomes when a fit exists between a firm's external environment and its organizational resources and strategies. A lack of fit suggests that the environmental shift leads to disequilibrium between a firm's current resources and strategy, thereby diminishing the firm's performance.

In this study, we examine how dysfunctional competition, a unique environmental force of transition economies, affects the efficacy of IT-enabled product and process innovation on competitive performance. Figure 1 presents our research model while the major constructs are defined in Table 1.
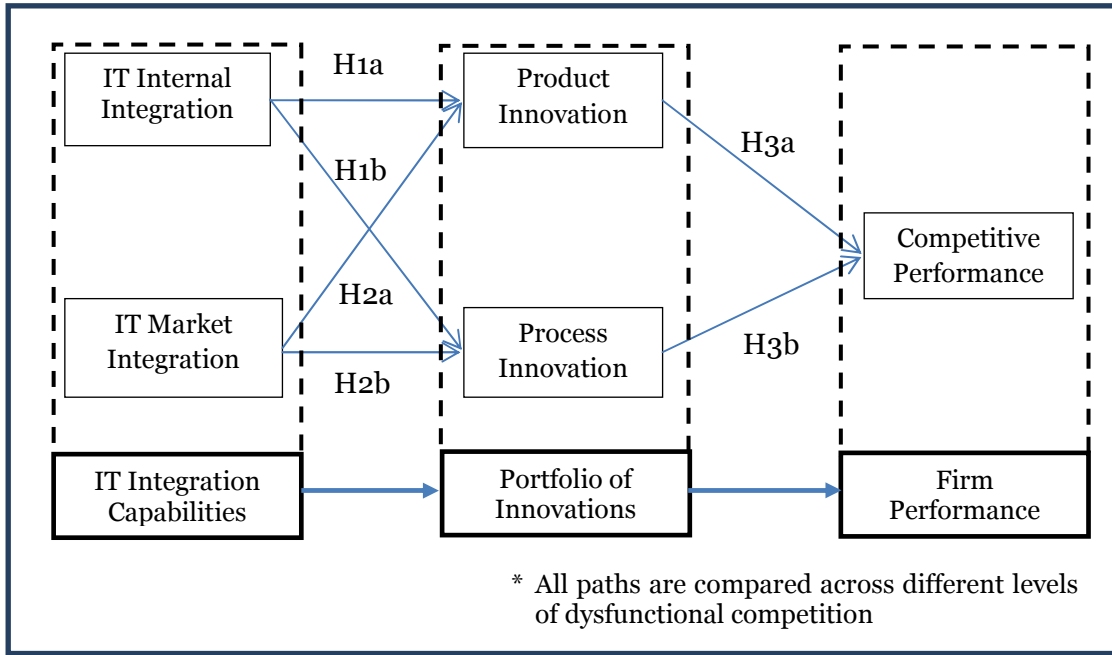
Figure 1: Research model

Construct	Definition	Source
IT Internal Integration	The extent to which a firm uses IT to facilitate information sharing, coordination, and alignment inside the firm.	(Barua et al. 2004)
IT Market Integration	The extent to which a firm uses IT to collect and analyze market information to support its strategic decisions.	(Tippins and Sohi 2003)
Product Innovation	The extent to which a firm is committed to developing and marketing products that are new to the firm or the market.	(Li and Atuahene-Gima 2001)
Process Innovation	The extent to which a firm is committed to developing new production technologies, and recombining resources and business processes for production.	(Damanpour and Gopalasrishan 2001)
Dysfunctional Competition	The extent to which the competitive behavior of firms in a market is opportunistic, unfair, or even unlawful.	(Li and Atuahene-Gima 2001)
Competitive Performance	Achievement of a firm's objectives in relation to its external environment.	(Ferrier 2001; Porter 1980b)

Table 1: Construct Definition

The Effects of IT Integration Capabilities on Innovation Strategies

Drawing on previous research on IT-enabled capabilities (Barua et al. 2004; Rai et al. 2006; Xue et al. 2012), we suggest that the extent to which a firm pursues product innovation and process innovation is influenced by its IT capabilities portfolio. Contemporary firms are now making significant investments in IT to align business strategies, enable innovative functional operations and participate in extended

enterprise networks that characterize global supply chains (Rai et al. 2006). These firms are investing in IT to develop the capabilities of their internal and external processes (Agarwal and Sambamurthy 2002b; Grover 1999), with the objective of enhancing their competitive market performance (Sambamurthy et al. 2003). Indeed, in today's Internet based or "net-enabled" organizations (Wheeler 2002), a phenomenon that now characterizes transition markets as well as developed economies, IT is either a major component or a facilitating force in product and process innovation (Dewett and Jones 2001; Kleis et al. 2012; Pavlou and El Sawy 2006). Yet, it is unclear what IT capabilities portfolio is needed to support a firm's innovation strategy (Sambamurthy et al. 2003). We specifically focus on how IT internal integration and IT market integration affect product and process innovation under dysfunctional competition.

IT internal integration, an inside-out capability that aligns and coordinates the various internal systems of a firm, affects product innovation by facilitating cross-functional collaboration. Because product innovation requires new knowledge and ideas, IT internal integration provides a platform for different parties to explore domains and areas that may not be familiar to them. It further improves the efficiency of knowledge use and facilitates decision making in new product project teams (Madhavan and Grover 1998). IT internal integration provides visibility across functional areas, which makes it easier for management to identify required talent and other resources for product innovation. It also increases the connections between project team members, fostering collaboration, communication and coordination among them (Ozer 2000). Thus, IT internal integration enables the firm to analyze and exploit its own resources to develop alternative ways of performing various business functions, such as new product development and product manufacturing.

While IT internal integration is likely to have positive effects on both product innovation and process innovation, we expect that its impact is stronger on both types of innovation when dysfunctional competition is high than when dysfunctional competition is low. When dysfunctional competition is high, firms face greater challenges protecting intellectual property and investment in innovative ideas and activities. IT internal integration emphasizes coordination and alignment among departments inside a firm. Such internal coordination provides support to the firm as a whole in streamlining its business activities and exploiting alternative ways of performing certain functions. It also brings in creative ideas about new product development through cross-functional information sharing (De Luca and Atuahene-Gima 2007). Since such innovative activities happen inside a firm, it would be relatively easy for the firm to protect and control its internal-driven resource exploitation and exploration. Therefore, when dysfunctional competition is high, firms would increasingly look internally to generate innovative ideas, which would enhance the positive effect of IT internal integration on product and process innovation. Thus, we posit that,

H1a: *IT internal integration has a stronger positive effect on product innovation when dysfunctional competition is high than when dysfunctional competition is low*

H1b: *IT internal integration has a stronger positive effect on process innovation when dysfunctional competition is high than when dysfunctional competition is low*

IT market integration reflects the extent to which a firm is capable of collecting and analyzing a large amount of customer information (Tippins and Sohi 2003). This outside-in capability allows the firm to develop broad-based market knowledge, and thus increases the firm's ability to make connections among disparate market information, ideas, and concepts.

Specifically, given the increase in heterogeneous information and customer understanding a firm gains through IT market integration, it is also likely to advance its product innovation. IT market integration not only expands access to data but also includes analytic and decision support tools that enable the firm to hone in on select markets where it wishes to focus with scarce resources. For example, CRM technology can help a firm quickly identify customer segments from customer profile analysis and recorded interactions with customers, thereby enabling the focal firm to identify new demand, and design customized products and/or services, all of which influence the extent of its product innovation. In addition, through data mining, IT market integration can help a firm discover underserved markets and serve them with novel products (Berianato 2002).

Further, IT market integration increases the firm's ability to implement and execute series of complex tasks quickly to support process innovation (De Luca and Atuahene-Gima 2007). An analysis and comparison of historical data and current data provides feedback on the processes used by the firm to

produce and distribute its goods and services. Such feedback is instrumental in the sense making process of how a firm's end-to-end processes (i.e., from suppliers to customers) along with their enabling technologies should be coordinated to achieve process innovation (Hsieh et al. 2011; Malhotra et al. 2005). As such, IT market integration generates feedback from the market both about emergent product needs that in turn promote product innovation and gaps in the effectiveness of a firm's work systems (i.e., end-to-end processes and enabling technologies), that promote process innovation.

Despite the fact that IT market integration has the potential to enable both product and process innovations, a high level of dysfunctional competition could hurt the positive effect of IT market integration on product and process innovations. When dysfunctional competition is high, the market is filled with low-quality and even fake products. Thus, the information collected from the market cannot accurately reflect customer opinions about the innovative products. The low quality of the information collected could marginalize the positive effects of IT market integration on product and process innovation. Thus, we posit:

H2a: *IT market integration has a stronger positive effect on product innovation when dysfunctional competition is low than when dysfunctional competition is high*

H2b: *IT market integration has a stronger positive effect on process innovation when dysfunctional competition is low than when dysfunctional competition is high*

Performance Implications of Innovation Strategies under Dysfunctional Competition

Competitive success is attainable by providing high-quality products and services to meet customer desires and by being responsive to changes in market conditions and competitors' strategies (Roberts and Amit 2003). Innovation is a key contributor to a firm's competitive success. It involves the creation and implementation of new ideas, processes, and products, and has been documented to have substantial impacts on a firm's long-term well-being (Brown and Eisenhardt 1997; Hauser et al. 2006). It underscores the potential and the ability of the firm to meet challenges arising from new demands, competition, and changing market contexts. Innovation can take different formats. The most profound and fundamental classification has long been recognized as product vs. process innovation (Utterback and Abernathy 1975).

Viewed as a strategic posture, product innovation refers to the extent to which a firm is committed to developing and marketing products that are new to the firm or the market (Li and Atuahene-Gima 2001). Offering new products to fit customer needs could enable firms to keep pace with the shifting desires of customers and help improve brand image. Managing such innovation may help firms meet or even drive changing market demands, which leads to sustainable success in business operations (Henard and Szymaski 2001). Process innovation, on the other hand, reflects the extent to which a firm is committed to developing new production technologies, and recombining resources and business processes for alternative uses (Pisano 1996). In other words, process innovation involves creating or improving methods of production, service or administrative operations. For example, Toyota's production system is built on a premise that encourages employees to improve quality outputs and efficiencies through a continuous commitment to developing new or alternative uses of resources and processes, which is a tenet of process innovation strategy. Effective process innovation is found to enhance organizational efficiency and market responsiveness (Damanpour and Gopalasrishan 2001; Rai and Tang 2010).

Despite the positive impact of product innovation and process innovation on competitive performance, we suggest that their impacts vary with the presence of dysfunctional competition in transition markets. Although product innovation has been valued as a key component of a firm's sustainable competitive advantage and has the potential to bring in significant returns (Roberts 1999), it incurs huge investment and sunk costs, long development time, and high uncertainty in returns (He and Wong 2004). In addition, the market for new products is normally less mature and it takes time for consumers to buy in to them. Thus, firms investing in product innovation need a long window to recoup the benefits of their investment. When dysfunctional competition is high, regulations regarding intellectual property protection, enterprise autonomy, and governance mechanisms that are known to foster innovation are less well-established (Lu et al. 2008). As a result, inadequate regulations and legal enforcements on intellectual property rights leave many firms unprotected from violations by competitors. Once a new product is on the market, the competitors can reverse engineer to figure out how to make a similar

product, and with improved features. For example, many businesses in China become formidable market disrupters and even outperform the original innovators by "Shan Zhai" (clone) their new products. The increased level of dysfunctional competition in transition markets would shorten the time window for a firm to profit from its product innovation efforts, making heavy investments in product innovation even more risky and a less profitable strategy (Li and Atuahene-Gima 2001).

In contrast, process innovation may have a stronger impact on competitive performance when dysfunctional competition is high due to two reasons. First, process innovation occurs internally, and thus is less likely to catch as much public attention as product innovation (Damanpour and Gopalasrishan 2001). Even when dysfunctional competition is high, process innovation is less likely to catch the attention of copycats. Second, process innovation involves higher causal ambiguity than product innovation. Process innovation focuses on recombining existing technologies and effective organization of the manufacturing and marketing of products. It would be much more difficult for a competitor to replicate the whole business network of the firm in a timely manner (Rai et al. 2006), thus giving a firm more time to capitalize on its investments in process innovations even when dysfunctional competition is high. Taken together, process innovation should have a stronger effect on a firm's competitive performance when dysfunctional competition is high. Hence, we posit:

H3a: Product innovation has a stronger positive impact on competitive performance when dysfunctional competition is low than when dysfunctional competition is high

H3b: Process innovation has a stronger positive impact on competitive performance when dysfunctional competition is high than when dysfunctional competition is low

Research Methods

Sample and Data Collection

China provides an ideal context for this study. With an improved system of intellectual property protection and increased competition from other Southeast Asian countries, more and more Chinese firms have seen the value of innovation (Luo et al. 2011). Moreover, the central government listed informationization as a top priority in its Eleventh Five-Year Planning (published on Mar. 17, 2006), pushing computerization in all industries. This has increased firms' investments in IT to comply with the priorities, suggesting an important avenue for us to examine the role of IT capabilities in shaping innovation strategies in China. Further, although a growing body of research has started examining the role of innovation in the context of China, researchers largely treat China's unique institutional environment as a background and seldom consider its effects on a firm's innovation strategy. The insufficient understanding of process innovation vs. product innovation as a strategic posture and the oversight of institutional environments not only adds to the void of the literature on innovation, but also hinders our discernment of why innovation is inadequate among firms in China.

To examine the research model, we collected data from firms in a traditional manufacturing province in China. This province is historically less developed than other coastal areas such as Shanghai, Jiangsu, and Guangdong, and attracts less foreign investment. Therefore, companies in this region face less control and monitoring from the central government and catch little attention from internal and external media. Without effective monitoring and control from the central government and media, local governments are reluctant to promote legislation that prohibits unfair competition practices or enforce existing laws on intellectual property protection. Firms are thus more likely to face tighter constraints on resources and more unfair competition, which is an ideal setting for us to examine their strategy on IT capability development and innovation strategies.

To develop a base list of firms in the northeast province from which we drew our sample, we contacted and obtained support from the local subdivision of China Mobile, the largest mobile service provider in China, which offers mobile services to over 80 percent of businesses in the province. Using stratified sampling techniques to ensure an accurate representation of different size firms, a total of 250 firms in the manufacturing and services industries were selected from the customer database of the subdivision of China Mobile.

China Mobile account managers at the local subdivision followed our guidelines to contact senior managers in the marketing or operations department in order to solicit their agreement to take part in the study. Once the agreements were established, the account managers then delivered the questionnaires to the respondents and collected the questionnaires in person a week later. Of the 250 firms that we contacted, 247 surveys were returned, of which 6 were dropped due to incomplete data -- representing a 96.4 percent response rate.

On average, the respondents had served in the current positions for 5.82 years (s.d. = 4.55), and had worked in the industry for 8.58 years (s.d. = 5.86). We also examined the quality of the informants by asking them to indicate on a five-point scale their degree of familiarity (1 = "not at all knowledgeable," and 5 = "extremely knowledgeable") with strategic issues in the firm. 86.9 percent of the respondents responded with a 4 or 5, indicating high levels of familiarity with their firms' business (mean = 4.23, s.d. = 0.69). Table 2 presents the demographic profile of the respondent firms.

Industry Type	No. of Firms	Percentage of Sample
Manufacturing	157	73.4
Services	57	26.6
Ownership Type	**No. of Firms**	**Percentage of Sample**
Public[1]	72	33.6
Private	142	66.4
Firm Size (# of Employees	**No. of Firms**	**Percentage of Sample**
<=50[2]	62	29.0
51-100	32	15.0
101-500	63	29.4
501-1000	27	12.6
>1000	30	14.0

1 Since a planned economy and a market economy co-exist in China, the firms classified as public include state-owned enterprises, collective companies, and publicly listed companies.

2 The smallest firm in our sample has nine employees. The average size of firms in this category is about 30 employees.

Table 2. Demographic Profile of The Respondent Firms

Instrument Development

The survey instrument was developed through successive stages of literature review, theoretical modeling, and refinement, as suggested by Churchill (1979). Whenever possible, existing measures were adopted and adapted to fit in our research context. Further, three experts reviewed the questionnaire and provided feedback. The questionnaire was then translated into Chinese and back translated into English to validate its accuracy. The Chinese version was pilot tested on eight managers with extensive business experience to solicit their inputs before finalizing the questionnaire.

We adopted approaches suggested in recent research to reduce common method biases (Podasakoff et al. 2003). Specifically, we separated our key measures into several subsections and used different formats (e.g., circle responses vs. written responses) and scales to reduce simply "straight line" responses by managers. After data was collected, we conducted two tests to assess common method bias (Podasakoff et al. 2003). First, we ran Harmon's single-factor test, in which the first factor accounts for 44.7 percent of

the total variance, which is lower than the 50 percent threshold. Second, we conducted a marker variable analysis as suggested by Lindell and Whitney (2001) and Malhotra et al. (2006). After controlling for the potential correlation due to the existence of method variance, all the correlations between the constructs remained significant and the magnitude of the correlation did not decrease by more than 0.06. Results from both tests suggest that common method bias is not a significant issue in this study.

All the measurement items and their respective sources are listed in Appendix. Descriptive statistics and correlations among the study variables are reported in Table 3.

	Mean	S.D	1	2	3	4	5	6
1. IT Internal Integration	5.19	1.24	.87					
2. IT Market Integration	5.46	1.09	.47	.88				
3. Product Innovation	5.11	1.19	.51	.53	.94			
4. Process Innovation	5.12	1.17	.68	.55	.65	.83		
5. Dysfunctional Competition	4.81	1.39	.48	.39	.52	.55	.95	
6. Competitive Performance	4.96	1.24	.45	.46	.58	.59	.53	.85

Notes: The diagonal elements are square roots of AVE.
All the correlations are significant at p<0.05

Table 3:   Correlation Matrix and Descriptive Statistics

Assessing the Reliability and Validity of the Constructs

We conducted confirmatory factor analysis using AMOS 18. The fit indices ($\chi 2$/d.f. = 1.69, comparative fit index [CFI] = .97, and root mean square error of approximation [RMSEA] = .04) indicated overall good fit of the measurement model. Each item loaded significantly on the expected constructs, providing evidence of convergent validity. We further assessed convergent validity by examining the internal consistency reliability (Straub et al. 2004). We assessed discriminant validity among the constructs by examining the square roots of the average variance extracted in relation to zero-order correlations between constructs (Table 2). The results of the CFA and the reliability tests are reported in the Appendix, which provide strong evidence that the measures are of good quality.

Analysis and Results

To compare the theorized mediation effects of IT integration on market performance across levels of dysfunctional competition, we used the "median cut-off" criterion to divide the sample into two groups—namely, high and low levels of dysfunctional competition. Specifically, we applied the median cut-off criterion to the average score of the three measurement items for dysfunctional competition. The resulting low dysfunctional competition group has 117 firms, whereas the high dysfunctional competition group has 124 firms. We compared the covariance matrices of the two group using Box's M and did not find evidence to reject the null hypothesis of equality of covariance matrices (Box'M = 0.927, F= 0.917, p = 0.338).

Following the suggestions of Byrne (2006), we assessed the measurement invariance of the constructs across the low vs. high levels of dysfunctional competition. The purpose of this test is to make sure that the measurement models of the two samples are comparable and not significantly different from each other. In sequence, we tested for configural, metric and measurement invariance (Steenkamp and Baumgartner 1998). Configural invariance tests whether the same number of factors and factor-loading pattern holds across independent groups. Metric invariance tests whether the measurement model is equal across independent groups. Measurement invariance tests for similarity of measurement and structural models across independent groups (Byrne, 2006). The resulting two constrained models (Table 4) were not significantly different than the unconstrained model (p = .35 and p = .12 respectively), providing evidence of configural and metric invariance across the high and low levels of dysfunctional

competition samples (Cheung and Rensyold 2002). We can thus meaningfully interpret similarities and differences in the structural relationships among constructs across the two samples.

Model	χ^2	*d.f.*	χ^2/ *d.f.*	CFI	TLI	RMSEA
Configural invariance	540.85	318	1.69	.95	.93	.04
Metric invariance	557.28	333	1.67	.95	.93	.04
Measurement invariance	601.48	368	1.63	.93	.92	.05

Table 4:   Invariance Test Results

We estimated a structural model to assess the effects proposed in the research model and to compare the results across the two levels of dysfunctional competition (Byrne 2001). The fit indices for the two group SEM analysis are: χ^2(*d.f.*) = 637.12(362), CFI = .93, TLI = .91, RMSEA = .05. To test our hypotheses associated with differential impacts on the outcome variables, we compared the coefficients of the individual paths involved in the relationships using one-tailed differential t-test results since these hypotheses are directional. The path coefficients for the two-group comparative analysis are presented in Table 5.

H1a and H1b predict that the positive effect of IT internal integration on product and process innovations would be higher when dysfunctional competition is high. The test results show that under high dysfunctional competition, IT internal integration has a significantly higher effect on product innovation (t = 1.83, p < .05) as well as process innovation (t = 1.69, p < .05), thus providing support to both H1a and H1b. H2a and H2b predict that the positive effect of IT market integration on product and process innovation would be lower when dysfunctional competition is high. The test results show that the positive effect of IT market integration on product innovation is lower when dysfunctional competition is high (b = .49, p < .001 vs. b = .33, p <0.001), but the difference is not statistically significant (t = 1.22, p > .10), indicating that H2a is not supported.   The test results provide support to H2b. When dysfunctional competition is high, the positive impact of IT market integration is significantly weaker than when dysfunctional competition is low (t = 1.85, p < .05).

As predicted in H3a, product innovation has a positive effect on competitive performance across the two levels of dysfunctional competition (b = .36, p < .001 and b = .09, p = .35 respectively), but the effect is not significant under high levels of dysfunction competition. A t–test comparison of the two path coefficients indicates that product innovation has a much stronger effect on competitive performance when dysfunctional competition is low (t = 1.80, p < .05), thus supporting H3a. As predicted in H3b, process innovation has a positive effect on competitive performance across the two levels of dysfunctional competition (b = .29, p = .08 and b = .73, p <.001 respectively), but the effect is quite marginal when dysfunctional competition is low. A t-test comparison of the two path coefficients indicates that process innovation has a much stronger effect on competitive performance when dysfunctional competition is high (t = -2.82, p < .01), providing support to H3b.

To test the robustness of our results, we evaluated an alternative model including firm ownership, firm size, and industry type as control variables. Literature suggests that the competitive performance of a firm can be affected by the firm's size, which indicates its dominant position among peers and its ability to achieve economies of scale (Zaheer and Venkatraman, 1994), and by industry, which represents the industry structure and the environment in which the firm competes (Porter, 1980). Since China used to be a centrally planned economy, publicly owned, especially state-owned, firms have better access to resources than the private firms, and thus achieve better competitive performance. We therefore include firm ownership as a control variable. The test results remain stable. Following the recommendations from recent studies on organizational research methods (Becker, 2005; Spector and Brannick, 2011), we only report the results from the test without control variables.

Hypotheses				Low DC (N = 117)		High DC (N = 124)		Group Comparison	
				Estimate	P	Estimate	P	T- Test[1]	
H1a	IT internal integration	→	Product innovation	.20	**	.45	***	-1.83 *	Supported
H1b	IT internal integration	→	Process innovation	.31	***	.50	***	-1.69*	Supported
H2a	IT market integration	→	Product innovation	.49	***	.33	***	1.22	Not Supported
H2b	IT market integration	→	Process innovation	.42	***	.19	***	1.85*	Supported
H3a	Product innovation	→	Competitive performance	.36	***	.09		1.80*	Supported
H3b	Process innovation	→	Competitive performance	.21		.73	***	-2.82**	Supported

Note: [1] One-tailed t-test for group comparison test.
*p<0.05, **p<0.01, ***p<0.001

Table 5: **Hypotheses Test Results**

Discussion

Theoretical and Managerial Implications

Responding to calls for research on the role of IT in shaping innovation strategy (Xue et al, 2012) and innovation in transition markets, we examined how IT integration capabilities affect product and process innovation to improve competitive performance in China, a major transition market. We compare and contrast the value creation mechanism of IT-enabled innovations at different levels of dysfunctional competition, a unique characteristic of transition markets. Our major findings have important theoretical and practical implications.

First, our results reveal that IT internal integration and IT market integration are two driving forces behind product and process innovation. While IT's role in promoting process innovation has been documented in the IS literature, how IT would affect product innovation is an area that needs further exploration in both developed and transition markets. We fill in this void by comparing and contrasting IT internal integration and IT market integration' effects on product and process innovation under different levels of dysfunctional competition.

Our results indicate that different IT capabilities can affect product and process innovations differently with the existence of dysfunctional competition. Specifically, IT internal integration has a much stronger effect on product innovation and process innovation when dysfunctional competition is high. These results confirm that IT internal integration can help firms facilitate cross-functional collaboration by promoting information and knowledge sharing inside the firm. The visibility about the internal operations and seamless flow of information across different functional areas allow a firm to identify product and process innovation opportunities and effectively organize innovation activities. This capability becomes even more valuable for innovative activities in a high level of dysfunctional competition since this internal-focused capability is under the firm's greater control and thus is not so easily copied by competitors.

On the other hand, IT market integration has a much smaller impact on process innovation when dysfunctional competition is high. When the market is filled with low-quality and even fake products, the information collected from the market cannot accurately reflect customer preferences and demand signals can be distorted. Such inaccurate information cannot provide the needed guidance for process innovation, thus hurting the impact of IT market integration on process innovation. However, IT market integration has a comparable impact on product innovation across the different levels of dysfunctional competition. IT market integration helps firms develop a broad market knowledge base by actively collecting and analyzing market information. By understanding the differential impacts of inside-out and outside-in IT capabilities on product and process innovations under different levels of dysfunctional competition, the managers can build an IT capability portfolio that provides effective support to the innovation strategy of the firm.

Furthermore, being innovative is an even more important issue for firms in transition markets like Brazil, China, and South Korea. Facing increased competition from Southeast Asian countries, firms in these markets have found that their original copycat business model is no longer viable, pushing them to be more innovation oriented to stay competitive (Luo et al. 2011). However, how the unique environment of transition markets could affect the returns on different types of innovation remains unknown. Our results indicate that the level of dysfunctional competition would affect how much value firms can accrue from their efforts on product and process innovations. While product innovation is an important source for competitive performance when dysfunctional competition is low, its positive effect diminishes when the level of dysfunctional competition gets high. This result indicates that product innovation becomes a less viable strategy when dysfunctional competition is high. On the contrary, the impact of process innovation on competitive performance is enhanced when dysfunctional competition is high. This result reveals that when the intellectual property cannot get proper protection, firms would achieve better performance by investing in process innovation, which is less likely to catch public attention and involves high causal ambiguity. These results can help firms to develop appropriate innovation strategies when competing with the existence of dysfunctional competition.

Limitations and Future Research

While we based our research model on existing literature and conducted empirical study following best practice, we acknowledge some limitations and identify avenues for future research.

First, we collected our survey data from Chinese firms. While China is the largest transition economy in the world, we cannot say that it represents other countries in the transition period. Future research can examine our research model using data from other transition economies to validate our results and reveal other unique contingency factors. Second, survey data are cross-sectional and represent a snap-shot of firm activities and performance. Thus the empirical test provides evidence of association between constructs in our research model. Future research can collect longitudinal data to examine the performance impacts of IT-enabled innovations over time under different levels of dysfunctional competition and better test the causal relationships proposed in our research model. Finally, we only consider two major types of innovations in our research model. Future research can extend our model to examine IT's role in other types of innovations, such as organizational innovation.

Conclusion

Transition economies present both opportunities and challenges for firms. Our research suggests that firms need to take the unique institutional environment into consideration when developing IT integration capabilities and selecting innovation strategies. Specifically, our results reveal the important role of dysfunctional competition on shaping the performance outcomes of IT-enabled product and process innovations. Even though firms can achieve better performance by investing more in their IT internal integration capabilities and process innovation, firms can hardly obtain performance benefits from their investments in product innovation without an efficient legal system and appropriate law enforcement. While process innovation can bring in higher profit in the short-run, product innovation is essential to obtaining sustainable competitive advantage. To capitalize on their increased investments in IT capabilities and R&D, transition economies need to reduce dysfunctional competition to create a healthy competitive environment for firms.

Appendix: Measures

Construct	Measurement Item	Loading
IT Internal Integration (Barua et al. 2004) AVE = .76 CR = .93	Data can be shared easily among various internal systems (e.g., forecasting, production, manufacturing, shipment, finance, accounting, etc.)	.85
	Policy changes are automatically reflected in all of our business units' information systems.	.87
	Each business unit can easily transmit, integrate, and process data from and with each other.	.87
	Employees at different business units can easily retrieve information from various databases for decision support (e.g., cost information, reporting tools).	.89
IT Market Integration (Tippins and Sohi 2003) AVE = .78 CR = .93	We routinely utilize computer-based systems to access market information from outside databases.	.89
	We have set procedures for collecting customer information from online sources.	.89
	We use computer-based systems to analyze customer and market information	.88
	We utilize decision-support systems frequently when it comes to managing customer information.	.87
Product Innovation (Voss et al. 2008) AVE = .67 CR = .89	We create revolutionary conceptual approaches.	.85
	We experiment with radical new works.	.90
	We challenge traditional product boundaries.	.80
	We increase the firm's overall commitment to develop and market new products.	.71
Process Innovation (Damanpour and Gopalasrishan 2001) AVE = .69 CR = .90	We have changed the way the firm's current products are produced.	.77
	We have placed an emphasis on developing new processes through the reconfiguration of existing resources and procedures.	.87
	We have developed alternative uses of resources and business routines.	.84
	We have increased the firm's overall commitment to develop new approaches, routines, and processes to produce products.	.85
Dysfunctional Competition (Li and Atuahene-Gima 2001) AVE = .74 CR = .90	In the past three years, unlawful competitive practices such as illegal copying of new products have increased in our industry.	.86
	In the past three years, counterfeiting of products and trademarks was commonly found in our industry.	.84
	In the past three years, unfair competitive practices have increased in our industry.	.88
Competitive Performance AVE = .73 CR = .89	Market share	.91
	Sales growth	.91
	Return on assets	.72

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