

Does Firm Size Matter? The Critical Role of the Attitude of Top Management in Technological Innovation

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ABSTRACT

Research offers contradictory findings on the relation between firm size and innovation. The meta-analytic study of Camison-Zornoza et al. (2004) suggests that the inconsistency cannot be attributed to just the variance of methodological designs between studies, and that the existence of moderators in the relation must be noted. In this study, we examine the critical role of the attitude of top management in the adoption of technological innovation. Our results indicate that this attitude moderates the relation between firm size and the adoption of technological innovation. In particular, the size-innovation relation is absent for firms in which the attitude of top management is less positive, but the relation does exist for firms in which the attitude is more positive. The main effect of firm size on the adoption of technological innovation can be confounded, disregarding the moderating effect in the relation.

Keywords: Inconsistent findings; moderating effect, technological innovation, top managers' attitude.

INTRODUCTION

In the past decade, theories of innovation have been widely used to study the adoption of technologies (e.g., Attewell, 1992; Chau & Tam, 1997; Davis et al., 1989; Frambach & Schillewaert, 2002; Grover & Goslar, 1993; Iacovou & Benbasat, 1995; Rogers, 1983; Thong 1999; Tornatzky & Klein, 1982). Although innovation theories have provided a basis for investigating the determinants of the adoption of technological innovation, the research findings have been criticized as inconsistent across studies (Wolfe, 1994). The inconsistent relation between firm size and innovation has been a typical example (Camison-Zornoza et al., 2004; Damanpour, 1991). Although some studies have found that larger firms are more inclined to adopt technological innovations (e.g., Germain & Droge, 1995; Lind et al., 1989; Thong, 1999; Zmud, 1982), others have not indicated the existence of such a relationship (e.g., Boeker & Huo, 1998; Brandyberry, 2003; InduShobba & Peter, 1999; Grover & Goslar, 1993). Without explicit explanations, the inconsistent findings lead to inconclusive results in innovation research (Downs & Mohr,

1976; Rogers, 1983; Wolfe, 1994). Downs and Mohr (1976) argue that the inconsistent findings seem to be unreasonable and beyond interpretation. This diversity of findings has drawn sustained research attention. Camison-Zornoza et al. (2004) clarify the inconsistent relation between firm size and innovation in their recent meta-analytic study by pointing to the divergences in methods used across studies. However, they point out that such a high variability of findings cannot be attributed to variations in methodology alone; rather, “the existence of other variables that have a moderating effect on the relation must be recognized” (Camison-Zornoza et al., 2004, pp. 352). Thus, there is a need for further research into the size-innovation relation to establish a more explanatory theory of the relationship.

In this study, we attempt to fill the abovementioned research gap by providing a more conceptual explanation for the inconsistent findings. We propose that the relation between firm size and the adoption of technological innovation is moderated by the attitude of top management toward that adoption. The importance of top management in the adoption of innovation has been reflected in diverse branches of the literature (e.g., Kichul & Gundry, 2001; Srinivasan et al., 2002; Young et al., 2001). As most innovations interrupt existing systems and practices, top managers must play important roles in facilitating the adoption of innovation. First, they have the direct decision-making authority to adopt innovations in organisations (Young et al., 2001). Organisational resources cannot be fully mobilized in the adoption without such direct authority. Second, top management can have a strong social influence on the innovative behaviour of organisational members (Leonard-Barton & Deschanps, 1988). When top management shows a favourable attitude toward an innovation, organisational members can be highly influenced and be more willing to devote resources to that innovation (Srinivasan et al., 2002). This helps firms to explore the potential for innovation adoption, which increases the prospect of actual adoption. In contrast, small firms can be more eager to use new technologies when motivation exists (Grover & Goslar, 1993). Hence, further research is needed to ascertain the particular roles of top management in facilitating innovation adoption in different organisational sizes in response to the unsettled relationship.

In this study, we first propose that the top management’s attitude has a mediating effect on the relations between four major characteristics (perceived relative advantage, perceived compatibility,

perceived competitive pressure and perceived conflict with partner) and the adoption of technological innovation. Second, we argue that the top management's attitude, as the overall evaluative outcome of the four major characteristics, moderates the relation between firm size and the adoption of technological innovation. We perform empirical analyses to test the mediating and moderating roles.

THEORY AND HYPOTHESES

Mediating Role of Top Managerial Attitudes in the Adoption of Technological Innovation

Perceived Characteristics of Innovation

The perceived characteristics of innovation are one of the most predictive determinants of innovative behaviour (Moore & Benbasat, 1991; Rogers, 1983; Tomatzky & Klein, 1982). In studies of technological innovations, perceived relative advantage and perceived compatibility have been widely used to explain innovative behaviour of organisations (e.g., Premkumar et al., 1994; Srinivasan et al., 2002; Thong, 1999). Rogers (1983) defines relative advantage as the degree to which an innovation is perceived as being better than the idea it supersedes. It is reasonable to believe that top managers take into consideration the additional benefits that they expect to reap from a new technology. The more relative advantages there are perceived to be from adopting the innovation, the greater the likelihood that the innovation will be adopted. Compatibility is the degree to which an innovation is perceived as being consistent with existing values, past experience, and the needs of potential adopters (Rogers, 1983). This also positively relates to the likelihood of the adoption of technological innovation. Top managers consider whether a new technology fits well with the internal operations systems, product natures, and other business settings and objectives of their firms. Hence, the greater the perceived compatibility of the innovation adoption, the greater the likelihood of adopting that innovation. In sum, perceived relative advantage and compatibility are positively associated with the adoption of technological innovation.

Perceived Characteristics of Environment

Apart from the perceived characteristics of adopting an innovation, the perceived characteristics of the external environment of an organisation are also influential in the adoption of technological innovation. Perceived competitive pressure and perceived conflict with business partners have been shown to be the important aspects in the external environment (e.g., Gatignon & Robertson, 1989; Srinivasan et al., 2002; Teo et al., 2003). It has been suggested that firms which experience intense competition more readily adopt technological innovation than those which do not (Gatignon & Robertson, 1989; Teo et al., 2003; Warrts et al., 2002). Top managers tend to be more responsive and cautious about the actions of competitors in an environment in which they face many rivals, so they are more eager to follow their competitors in adopting new technologies. Some of the capabilities of non-adopters in the areas that are enabled by innovations might be perceived to be lower or actually be lower than those of adopters. Thus, firms tend to be receptive to innovations as a result of competition (Gatignon & Robertson, 1989). In addition to perceived pressure from competitors, perceived conflict with business partners as a result of adopting innovations can be another concern. The adoption of online retailing is a typical example. Firms, especially manufacturers, that adopt this technology can cause channel conflict, which refers to the frequency, intensity, and duration of disagreements between a firm and its channel partners or intermediaries (Anderson & Narus, 1984). This electronic direct to the consumer channel can diminish the role of intermediaries in physical channels due to the lowering of transaction costs (Bailey & Bakos, 1997; Benjamin & Wigand, 1995). Although such a complete “disintermediation” seems to be unrealistic, the potential threats might induce retaliation or unsupportive behaviour from intermediaries, which could constrain firms from adopting online retailing. In other words, the more seriously that top management perceives the partner conflict that could arise from adopting a particular technology, the less likely the firm will be to adopt that technology. In sum, perceived competitive pressure is positively associated with the adoption of technological innovation, and perceived conflict with partners is negatively associated with it.

The foregoing arguments address the relations between the four perceived characteristics and the adoption of technological innovation. However, another variable intervenes in this relationship. According to Fishbein and Ajzen’s (1975) theory of reasoned action (TRA), the probability of performing a given type

of behavior is indirectly affected by the perceived characteristics of that behaviour: that is, the attitude toward the behaviour determines the behavioural intention. When considering the adoption of technological innovations, top managers conduct evaluations according to characteristics such as relative advantage, compatibility, competitive pressure, and conflict with partners. Such evaluations form overall attitudes that greatly influence the likelihood of innovation adoption. Thus:

Hypothesis 1. The attitude of top management toward the adoption of technological innovation mediates the relations between the perceived characteristics of the innovation (perceived relative advantage, perceived compatibility, perceived competitive pressure, and perceived conflict with partners) and the adoption.

Moderating Role of the Attitude of Top Management in the Size-Innovation Relation

The literature offers inconsistent findings on the relation between firm size and innovation adoption, which indicates the existence of moderators in the relation (Camison-Zornoza et al., 2004; Damanpour, 1991). While some studies indicate that larger firms are more inclined to adopt technological innovations (e.g., Germain & Droge, 1995; Lind et al., 1989; Thong, 1999; Zmud, 1982), others do not (e.g., Boeker & Huo, 1998; Brandyberry, 2003; InduShobba & Peter, 1999; Grover & Goslar, 1993). Camison-Zornoza et al. (2004) draw at least two crucial conclusions on this inconsistency in their meta-analytical study. First, their findings show that the general size-innovation relation is significant and positive with an average low size effect. Second, they clearly point out that the high variability of the size-innovation relation cannot be explained by methodological variations such as sampling error alone, and that there must be moderators in the relation. In line with this argument, we propose that the attitude of top management toward innovation has a potential moderating effect in the size-innovation relation.

Firm size has been frequently used as a general indicator of the physical availability of resources in organisations because large firms tend to have more competent resources, more sophisticated facilities, and higher financial tolerance to the loss of unsuccessful innovations, all of which fosters the adoption of

innovation (Damanpour, 1987; Kimerly & Evanisko, 1981; Yao, et al., 2002). In line with the Camison-Zornoza et al. (2004) findings, we believe that firm size has a positive relation with the adoption of technological innovation in general. However, the relational strengths are contingent upon the attitude of top management toward that adoption. As hypothesized in our mediation model, the attitude of top management is the overall favourable (or unfavourable) evaluation based on the four major characteristics of innovation adoption. This attitude is highly prominent in creating the actual organisational capability for innovation. First, top managers have direct decision-making authority for innovation adoption (Young et al., 2001). As most innovations interrupt existing systems and practices, top managers consent to mobilize organisational resources to adopt them only when they are thought to be good for the firm in general. There are three basic alternatives for actualizing innovation capability from potential resources: (1) congregate and reserve current resources to make them available for the innovation project; (2) begin to develop the resources that will be necessary for the project in the future; and (3) acquire external sourcing when they is a lack of internal ability. In resource-based view research, the concept of resources is clearly distinct from the concept of capability. Without the advocacy of top management, organisational resources can never be well gathered for the innovation, even in large firms where potential assets are readily available. In fact, this can specifically hinder the adoption of innovation in large firms due to their relatively higher formalized structures and bureaucratic control that inherently discourages the exchange of intellectual capital (Subramaniam and Youndt 2005), the connection of network ties (Smith et al., 2005), and other forms of resource mobility that are conducive to innovation. Second, the favourable attitude of top management can have an important social influence on the innovative behaviour of organisational members. According to Salancik and Pfeffer's (1978) social information processing (SIP) theory, organisational members pick up social clues to interpret norms in their social context and behave accordingly. More importantly, their interpretations are influenced by others. Top managers are presumed to be enormously influential in organisations (e.g., Kickul & Gundry, 2001; Leonard-Barton & Deschanps, 1988). When top managers show favourable attitudes toward innovation, other organisational members are likely to be positively influenced. They are more willing to devote their effort, ability, time, and other forms of intellectual capital

to explore the real potential of the organisational resources for innovation. Taking full advantage of a firm's actual organisational capability for innovation increases the possibility of the adoption of innovation. Smaller firms are very likely to adopt new technologies when they are willing to explore and concentrate resources on the adoption. The influence of top management in small firms can be magnified due to the fewer bureaucratic barriers, higher flexibility, and closer network ties in their organisational structures. Grover and Goslar (1993) argue that small firms are eager to use new technologies when they have sufficient motivation. Thus:

Hypothesis 2a. Firm size is positively related to the adoption of technological innovation.

Hypothesis 2b. The relation between firm size and the adoption of technological innovation is moderated by the attitude of top management toward that adoption. In particular, the relation is stronger for firms in which the top management holds a positive attitude toward the adoption.

METHODS

Data Collection

We used a questionnaire as the research instrument. We drew a stratified sample from the database of the Hong Kong government's Census and Statistics Department (C&SD). The official database of the C&SD is the most representative frame in the region. It provides the Hong Kong Standard Industrial Classification (HSIC), which serves as a standard framework for the statistical classification of economic units into different industry classes. The frame is collected and updated by official surveys with reference to records of the Business Registration Office of the Inland Revenue Department. The database is stratified by industrial sectors and firm sizes, and the C&SD provided stratified random samples by computer. A

package containing the questionnaire, a cover letter that stated the study purpose, and a prepaid reply envelope was mailed to each top executive of the sampled firms.

Sample

We received 152 responses to the survey and made follow-up telephone calls to those respondents who had not completed their questionnaires, thus collecting 140 usable questionnaires. Of the respondents, 35% were in manufacturing, 32.1% were in wholesaling and retailing, and 32.1% were in business service sectors. Thirty-three percent of the respondents worked in firms with less than 50 employees, 11% worked in firms with between 50 and 99 employees, 26% worked in firms with between 100 and 499 employees, 12% worked in firms with between 500 and 999 employees, and 18% worked in firms with 1000 or more employees. Thirty-seven percent of the respondents worked in firms with annual revenues of below HK\$50 million, 15% worked in firms with annual revenues of between HK\$50 and HK\$99 million, 14% worked in firms with annual revenues of between HK\$100 million and HK\$199 million, 18% worked in firms with annual revenues of between HK\$200 million and HK\$499 million, and 16% worked in firms with annual revenues of HK\$500 million or above. In addition, 109 of the respondents' firms had not yet adopted online retailing, and only 31 of them had.

Research Variables and Measures

Technological innovation adoption and control variables. Adapting items from Teo et al. (2003) and Azjen and Fishbein (1980), we measured the technological innovation adoption with a seven-point Likert scale. Factor analysis revealed a single factor ($\alpha=.96$). The items in the questionnaire included the action (likely to adopt), subject (online retailing), context (organisation) and timing (in the near future), elements that are critical for measuring the adoption of an innovation (Teo et al., 2003). An item example is, "Our firm is likely to adopt online retailing in the near future". Two major concepts in innovation research were controlled through the dependent variable: (1) the typology of the innovation, and (2) the stage of the

innovation. In this study, we used the primary criterion (online retailing) to control the innovation typology. Furthermore, there have been two common dimensions with respect to the stages of innovation: (a) the degree to which the likelihood to adopt an innovation is contemplated, and (b) the degree to which an implemented innovation is diffused (Fichman, 2001). This study focuses on the first dimension. Also, we controlled for the self-reported age and gender of respondents. Gender was dummy-coded. Women were coded 1 and men , 0.

Perceived relative advantage and perceived compatibility. We measured perceived relative advantage with five items and perceived compatibility with four items using the scale adapted from Moore and Benbasat (1991) and C&SD's annual survey on IT usage and penetration in 2002. The two constructs were measured by the perceptions of "adopting" the technology. The respondents indicated the two constructs on a seven-point Likert scale. Factor analysis revealed a single factor for each of the constructs ($\alpha = .95$ and $.97$, respectively). An item example of perceived relative advantage is, "Adopting online retailing increases our business opportunities"; and an example of perceived compatibility is, "Adopting online retailing fits well with our firm's selling strategy".

Perceived competitive pressure and perceived conflict with business partner. We measured perceived competitive pressure with five items using the items adapted from Srinivasan et al. (2002) and Wang (2001). The respondents indicated on a seven-point Likert scale. Factor analysis revealed a single factor for the items ($\alpha = .94$). An item example is, "Our firm is now facing active competition in the area of online business". We measured perceived conflict with business partner with three items using the scale adapted from Scovotti (2000). Also, the respondents indicated on a seven-point Likert scale. A factor analysis revealed a single factor for the items ($\alpha = .90$). An item example is, "The relationship between our firm and marketing partners is prone to conflict due to our firm's online retailing".

Firm size. Firm size was measured by the number of employees in the organisation, which is a common measurement in studies on the adoption of innovations (e.g., Thong, 1999; Zmud, 1982). The

numbers of employees were subjected to a logarithmic transformation to reduce variances in highly skewed values (see Thong, 1999).

Adoption attitude. We measured attitude of top managers towards adopting the technological innovation with three items using the scales adapted from Jackson et al. (1997). The respondents indicated on a seven-point Likert scale. Factor analysis showed that the items loaded onto a single factor ($\alpha = .96$). An item example is, “We (top management) take a positive attitude towards adopting online retailing in the near future”.

We performed the chi square difference test (see Chin, 1998; Ryu et al., 2003) by using the confirmatory factor analysis with AMOS to verify the discriminant validity between the variables i.e., perceived characteristics (perceived relative advantage, perceived compatibility, perceived competitive pressure, and perceived conflict with business partner), top managers’ adoption attitude and the innovation adoption. We tested, successively, one 1-factor model (all variables were loaded on 1-factor), two 2-factor models (first 2-factor model – perceived characteristics and adoption attitude were loaded on 1-factor while the adoption was load on another factor; second 2-factor model – adoption attitude and the adoption were loaded on 1-factor while perceived characteristics were loaded on another factor), and one 6-factor model (perceived characteristics, adoption attitude and the adoption) were treated as six distinctive variables. Results indicated that the 6-factor model displayed a significant improvement over the first 2-factor model ($\Delta\chi^2 = 905.68$, $df = 14$, $p < .001$), second 2-factor model ($\Delta\chi^2 = 1005.70$, $df = 14$, $p < .001$) and 1-factor model ($\Delta\chi^2 = 1114.04$, $df = 15$, $p < .001$); and displayed an obviously improvement in the fit indexes (e.g., CFI = .93; IFI = .93; TLI = .92). The findings supported the distinctiveness of the variables.

RESULTS

Mediation

Table 1 shows the descriptive statistics between the adopter and non-adopter. Hypothesis 1 states that top managers’ attitude mediates the relation between the perceived characteristics (perceived relative advantage, perceived compatibility, perceived competitive pressure, and perceived conflict with business

partner) and technological innovation adoption. We controlled for the control variables (here, gender and age) and used Baron and Kenny's (1986) three step procedures to assess the mediating effect. In the first step, the independent variables (here, the four perceived characteristics) should be significantly related to the dependent variable (here, technological innovation adoption). The step was supported in Table 2 (model 1) for the beta weights of perceived relative advantage ($p < .01$), perceived compatibility ($p < .05$), and perceived competitive pressure ($p < .01$). The beta weight of perceived conflict with business partner was not significant for the adoption, and the variable was thus disregarded in the mediation model. In the second step, the independent variables should be significantly related to the mediator variable (here, adoption attitude). The step was supported in Table 2 (model 2), for the beta weights of perceived relative advantage ($p < .001$) and perceived compatibility ($p < .001$). The beta weight of the perceived competitive pressure and perceived conflict with business partner was not significant, and the two variables were thus disregarded in the mediation model. In the third step, the mediator variable (here, adoption attitude) should be related to the dependent variable (here, technological innovation adoption), with the independent variables (here, the perceived characteristics) entered in the equation. The independent variables should be controlled in step 3 to establish the mediation. If the significant beta weights of the independent variables found in step 1 become non-significant in step 3, full mediation is found. The step was supported in model 3, which showed that the beta weights of perceived relative advantage and perceived compatibility, which were significant in step 1, became non-significant in step 3. The statistical significance of the mediated effects, i.e., the reduction in the effect of perceived relative advantage and perceived compatibility on the adoption was assessed by dividing them respectively by their standard error and providing the Z-score of the values. The mediating effects were significant ($Z = 2.10 (>1.96)$ and $1.97 (>1.96)$, respectively). In sum, full mediating effects were presented for perceived relative advantage and perceived compatibility → adoption attitude → technological innovation adoption. Thus, Hypothesis 1 was partly supported.

Insert Table 1 and Table 2 about here

Moderation

Table 3 shows the results of the regression analyses of the moderating effect. We enter the variables into the regression equation by four hierarchies to better depict the variance explained by the different sets of predictor variables. First, we entered the perceived characteristics (here, gender, age, perceived relative advantage, perceived compatibility, perceived competitive pressure, and perceived conflict with business partner) in the first block as control variables. Next, we entered the independent variable (here, firm size) in the second block. Then, the moderator (here, adoption attitude) was entered into the third block. Finally, the interaction term (here, adoption attitude x firm size) was entered into the last block. The centering procedure suggested by Aiken and West (1991) was used for regression analyses using interaction terms.

Table 3 (model 1) shows that three of the four control variables were significantly related to the adoption. In particular, perceived relative advantage ($p < .01$), perceived compatibility ($p < .05$), and perceived competitive pressure ($p < .01$) were significantly related to the dependent variable. Hypothesis 2a states that firm size is positively related to the adoption. The hypothesis that the relationship between firm size and the innovation adoption was not significant was not supported (Table 3, model 2). The adoption attitude ($p < .05$) was significantly related to the adoption (Table 3, model 3). Hypothesis 2b states that the relationship between firm size and technological adoption is moderated by the adoption attitude. As shown in Table 3 (model 4), the hypothesis that the interaction between adoption attitude and firm size ($p < .01$) was significant was supported, and explained a significant incremental portion of the variance ($\Delta R^2 = .04$, $p < .01$) when entered last into the equation. This indicated that, in model 2, no significant direct effect was found for firm size on the adoption; while a significant effect was found for the interaction between adoption attitude and firm size on the adoption in model 4. To further analyze the interaction term, we conduct a simple slopes analysis (Aiken & West, 1991). The regression equations were rearranged into simple regressions of firm size on technological innovation given the conditional values of adoption attitude (one standard deviation above and below the mean). It was found that firm size was not significantly correlated to the adoption for the lower adoption attitude ($b = -.05$, $t = -.68$, ns); while firm size

was significantly correlated to the adoption ($b = .44, t = 3.66, p < .001$) for the higher adoption attitude. Figure 1 graphically reveals the results. In sum, we found three “inconsistent” relations between firm size and technological innovation adoption: (1) the relation between firm size and the adoption was confounded and non-significant before the interaction term was added in the equation; (2) the relation was absent in firms with a lower top managers’ attitude, and (3) firm size had a significantly positive relation with the adoption only in firms with a higher top managers’ attitude. Based on the findings of the significant interaction term and the simple slopes test, our results clearly showed that the existence of these “inconsistent” relations was basically attributed to the moderating effect of top managers’ attitude. They were not real inconsistent findings.

 Insert Table 3 about here

Insert Figure 1 about here

DISCUSSION

Research findings on the determinants of innovations have been criticized as inconsistent across studies. Some of the inconsistent findings seem unreasonable and beyond interpretation (Downs & Mohr, 1976; Wolfe, 1994). The inconsistent findings of the relation between firm size and innovation adoption are typical examples. Explaining the inconsistent findings by just errors in measurement or biases of sample cannot help to establish a more general theory. The high variability of the findings indicates the existence of moderators in the relation (Camison-Zornoza et al., 2004). To provide a more conceptual explanation for the inconsistent size-innovation relation, we have posited and examined the mediating and moderating roles of top managers’ attitude in the relation. Our findings indicated that, through the attitude of top

management, perceived relative advantage and compatibility of innovation adoption have indirect effects on the technological innovation adoption. The full mediation model indicated that top managers' attitude is the total favourable (or unfavourable) evaluative outcome of the two perceived innovation characteristics, and positively affect technological innovation adoption in organisations. In other words, top managers will evaluate the innovation adoption by considering whether the innovation will bring additional advantages and be compatible with the current systems, practices, or cultures in their firms. The evaluation will result in a positive or negative attitude towards the adoption, and eventually affect the adoption of that innovation.

More importantly, our findings indicated that this top managers' attitude moderated the relation between firm size and technological innovation adoption. The moderating role of the top managers' attitude in the relation provides a more conceptual explanation to the past inconsistent findings. In fact, the effect of firm size on the adoption can be confounded if we ignore the existence of moderators in the relation. Here, we found the significant interaction between the attitude and firm size. A larger firm which has more resources for innovation may not necessarily adopt more technologies if the attitude of top management towards the adoption was less positive. Management plays an important role in facilitating the championship of innovation adoption, since most innovations interrupt existing systems and practices in organisations. Without the innovative propensity, organisational members may naturally have a reluctance to change and would never utilize the real organisational capability for innovation. In fact, making a good use of the internal know-how (Subramaniam & Youndt, 2005) or seeking a good source of external know-how (Steensma & Corley, 2001) in innovation increase firms' innovative capabilities. In contrast, even though small firms generally have less resource slacks than big firms, they can be likely to adopt technologies when specifically devoting resources and efforts for the adoption. Firms which lack of resources are still able to overcome the constraint on innovation (Rao, & Drazin, 2002; Katila & Shane, 2005). Top managers' attitude towards the adoption plays particular roles in advocating the processes. In sum, the past highly diverse findings of the relation between firm size and innovation clearly indicates the existence of moderators. One of them is the interaction between firm size and the attitude of top management towards the adoption. A real organisational capability for innovation should not be indicated

by just the size or absolute amount of physical infrastructures but also the real propensity to explore and well utilize the resources for innovations. Top management is one of the most important parties to achieve the success of adopting innovations.

This study has potential contributions and implications for innovation research. We addressed the mediating and moderating roles of top managers' attitude in technological innovation adoption. The mediation model provides a scheme for top managers to evaluate the innovation adoption. The evaluation can be based on the internal factors (i.e., advantage and compatibility) and external factors (e.g., competitive pressure and conflict with partner). This can form the overall attitudes of top managers towards the adoption. Our findings in the moderation model suggest that the attitude moderates the relation between firm size and technological innovation adoption. The finding provides a more theoretical explanation for the past inconsistent size-innovation relation in response to the previous meta-analytical study which have called for further research works to find out moderators in the relation. This study is one of the first research to perform concrete analyses to highlight the critical roles of top managers in the size-innovation relation. This research has the following limitations. We collected a single response per each organisation. Top managers were chosen as the key informants, according to the guidelines suggested by Huber and Power (1985) for research involving a single informant per organisation. Due to the explicit firm-level wordings of the questionnaire, the responses of these informants were believed to represent the perspective of the organisations. Based on our model, future research can collect multiple responses in each organisation and aggregate the data for analyses. Also, future studies can examine more other potential moderators such as business natures, industrial contexts, and other organisational settings (e.g., formalization and centralization) in the size-innovation relation.

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TABLE 1
Descriptive Statistics of the Non-adopter and Adopter

Variable	Non-Adopter (n=109)		Adopter (n=31)	
	Mean	s.d.	Mean	s.d.
Perceived relative advantage	3.78	1.53	5.95	.92
Perceived compatibility	2.83	1.35	5.61	1.11
Perceived competitive pressure	2.62	1.35	5.35	1.07
Perceived conflict with business partner	3.03	1.44	3.16	1.45
Firm size ^a	4.81	1.91	5.96	1.43
Adoption attitude	3.35	1.53		

Technological innovation adoption 2.72 1.41

^a measured as log (number of employees)

TABLE 2
Results of the Regression Analysis of the Mediation

Variable	Model 1 Dependent Variable Technological Innovation Adoption	Model 2 Dependent Variable Top Managers' Attitude towards the Adoption	Model 3 Dependent Variable Technological Innovation Adoption
Adoption attitude			.26*
Gender	.08	-.05	.07
Age	.08	.03	.08
Perceived relative advantage	.33**	.44***	.22
Perceived compatibility	.25*	.36***	.16
Perceived competitive pressure	.27**	.13	.24**
Perceived conflict with business partner	.025	.03	.02
R^2	.57	.71	.59
Adjusted R^2	.55	.69	.56
F	22.56***	41.58***	20.71***

* $p < .05$

** $p < .01$

*** $p < .001$

TABLE 3
Results of the Regression Analysis of the Moderation

Variable	Model 1	Model 2	Model 3	Model 4
Dependent Variable Technological Innovation Adoption				
Block 1: Control				
Gender	.08	.07	.06	.03
Age	.07	.07	.07	.07
Perceived relative advantage	.33**	.33**	.21	.21
Perceived compatibility	.24*	.26*	.16	.19
Perceived competitive pressure	.28**	.27**	.23*	.22**

Perceived conflict with partner	.03	.03	.02	.04
Block 2: Independent Firm size		.08	.09	.18*
Block 3: Moderator Adoption attitude			.27*	.28*
Block 4: Interaction terms Adoption attitude x Firm size				.23**
R^2	.57	.58	.60	.64
Adjusted R^2	.54	.55	.56	.60
F	21.96***	19.16***	18.14***	19.00**
ΔR^2		.01	.02*	.04**

* $p < .05$

** $p < .01$

*** $p < .001$

FIGURE 1
Interaction of Adoption Attitude and Firm Size

