



The Impact of Open Innovation (OI) on Competitive Advantage (CA) in Presence of Knowledge Coupling (KC): An Empirical Study on Small and Medium Enterprises (SMEs), District of Gujranwala, Pakistan

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ABSTRACT

SMEs play a major role in domestic growth and essential to the economy of every country. The study investigated the impact of "open innovation" on "competitive advantage" in the presence of "knowledge coupling" in SMEs in Pakistan. The study used a quantitative research design and tested the hypotheses. A sample of 290 employees from SMEs in District Gujranwala, Pakistan, was selected using a simple random probability technique. The research study used SPSS software to compute regression analysis, mediation analysis, and correlation analysis. The study's conclusions show that "open innovation" is essential to "competitive advantage." For Pakistani SMEs, concentrating on "open innovation" may provide a "competitive advantage." The study went on to conclude that "open innovation" and "knowledge coupling" are crucial for gaining a "competitive advantage" because they allow companies to leverage outside ideas and experience, which accelerates innovation and reduces research and development (R&D) costs. The effectiveness of "open innovation" in boosting a company's competitiveness is determined by its capacity to successfully integrate internal and external knowledge.

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1. Introduction

Three concepts and variables are used in this study: "open innovation" (OI), "competitive advantage" (CA) and "knowledge coupling" (KC). Chesbrough (2003) initially used the open innovation concept. The open innovation refers to incorporating external ideas, knowledge and expertise into innovation process of a company (Huizingh, 2011; Musiello-Neto et al., 2021). OI is a concept used to enhance the performance of innovative process (Chiaroni et al., 2011). The OI is a firm's internal capability (Bigliardi et al., 2021). It is a practice of companies sourcing ideas from internal sources and external sources. It means a change towards more open and extended models of invention and acting as a key for innovation for long established firms to contribute as competitors on already surviving platforms (Khan et al., 2015). Various aspects of knowledge are gathered and integrated to create innovation in a corporate setting. The two "knowledge couplings" are complementary and interchangeable (Dibiaggio, Nasiriyar, & Nesta, 2014; Huiping & Yuxin, 2023; Yayavaram & Chen, 2015). State Bank of Pakistan (2022, March, 21) highlighted that the SMEs sector is crucial to Pakistan's economy. Despite the relatively slow expansion of SMEs in Pakistan, these businesses are assisting the economy in staying robust during a time of intense competition (Amir, Ali, & Ahmad, 2020). For the SMEs sector to function better, new business models and strategies must be employed (Dar, Ahmed, & Raziq, 2017; Zafar & Mustafa, 2017). The study investigated the impact of OI on CA in the presence of KC in SMEs, District of Gujranwala, Pakistan.

2. Literature Review

"Open Innovation" is an essential element for companies and it impacts differentiation-based and cost-based advantage (Baierle et al., 2020; Brem & Tidd, 2012; Kumar & Ayedee, 2021; Musiello-Neto et al., 2021). Many research studies have examined the "open innovation", "competitive advantage" and "knowledge coupling" and concluded that open innovation is a better strategy to gain competitive advantage (Farida & Setiawan, 2022; Lima Rua, Musiello-Neto, & Arias-Oliva, 2023; Musiello-Neto et al., 2021; Zhang et al., 2023). Many studies have investigated the other aspects and stated that the degree of platform openness significantly moderates the relationship between coupling open innovation and innovation performance (Zhao, 2023). Researchers also examined how network cohesiveness moderates relational knowledge coupling and innovation performance (Jin et al., 2022). They concluded that the association between "open innovation" and competitive advantage is positively moderated by flexible organizational structure (Farida & Setiawan, 2022; Rumanti et al., 2021). Research on "open innovation," "competitive advantage," and "knowledge coupling" has been attractive and several aspects are investigated (Chesbrough, 2003; Hameed, Nisar, & Wu, 2021; Huiping & Yuxin, 2023; Kamasak et al., 2016; Li, Liu, & Bi, 2021; Wang & Yang, 2019; Yayavaram & Chen, 2015; Žemaitis, 2014; Zheng et al., 2022).

2.1. "Open Innovation" and "Competitive Advantage"

Rumanti et al. (2021) give a precise picture, comprehensive, and updated, of the importance of readiness of organization to innovate with open Innovation. They also tried comprehensively identify open innovation's impact on company performance. They discussed policy strategies to enhance performance of organization by implementing the open innovation. Chatzoglou and Chatzoudes (2018) conducted research and put forth a novel conceptual framework and concluded that innovation is caused by "knowledge management," "intellectual capital," "organizational capabilities," and "organizational culture." Lee and Yoo (2019) stated that "transforming capability" is a crucial prerequisite for "sensing capability" and "seizing capability." It affects "product innovation performance," which in turn affects competitive advantage, either directly or indirectly. According to Sulistyo and Ayuni (2019), "entrepreneurial orientation" and "social capital" have a big impact on "innovation." Musiello-Neto et al. (2021) stated that an organization's strategy and open innovation are related with each other. The processes of invention contain risks. But if the process is well managed, this can be reduced and competitive competence can be attained (Baierle et al., 2020; Skordoulis et al., 2020). Zhao (2023) looked into the positive effects of "the proportion of in-bound open innovation" on an organization's performance. According to Anuntarumporn and Sorhsaruht (2022), competitive advantage is positively correlated with innovation capacity, quality management, and strategy. An association between an organization's competitive advantage and its strategy was found by Lima Rua, Musiello-Neto and Arias-Oliva (2023), who carried out a thorough investigation in this area.

2.2. "Open Innovation" and "Knowledge Coupling"

One important component of a company is its digital environment and capabilities. A "System Dynamics Model" was developed by Huiping and Yuxin (2023) to reveal the structure and "dynamics of knowledge coupling" and how it affects a firm's innovation outcomes in a digital setting. They came to the conclusion that the mechanism of knowledge coupling is positively impacted by "technical resources" and "digital dynamic capability." It also affects a company's innovation outcomes. They further stated that "organizational inertia" has a detrimental impact on the "knowledge coupling" process that produces innovative results (Hameed, Nisar, & Wu, 2021). The ownership control also affects how "knowledge flows" and "asset specificity" relate to one another in the "open innovation paradigm," as well as how specific knowledge flow modes affect shifts in "asset specificity" (Zheng et al., 2022).

2.3. "Knowledge Coupling" and "Competitive Advantage"

Innovation results from the knowledge coupling process (Huiping & Yuxin, 2023). Domain knowledge searching and "architectural knowledge coupling searching" are the two categories into which Huiping and Yuxin (2023) separated knowledge cross border searching. They created a "model of system dynamics." They discovered that the mechanism of "knowledge coupling" is positively impacted by technical resources and digital dynamic capabilities and affects a company's innovation outcomes. A study by Jin et al. (2022) examined how improvements in "knowledge couplings" and network cohesion can improve innovation performance. They came to the conclusion that "an enterprise's innovation performance has been impacted inverted U-

shaped by changes in external existing and new knowledge couplings." They discovered that modifications to internal knowledge couplings, both new and old, directly improve a firm's performance in terms of innovation. Additionally, they discovered that the inverted U-shaped effect of the coupling between external fresh knowledge and old knowledge is flattened by the moderation effect of network cohesion. They discovered that its impact on the external existing knowledge coupling is negligible. They added that the effects of internal knowledge couplings are amplified by network cohesion. Zhang et al. (2023) discovered that knowledge management skill positively moderates the linkages of "open innovation" to exploration and exploitation and their combination, and that open innovation adds to sustained competitive advantage. The following hypotheses are developed for testing following a comprehensive literature review.

H1: "Open Innovation" in SMEs significantly impacts its "Competitive Advantage" over its competitors.

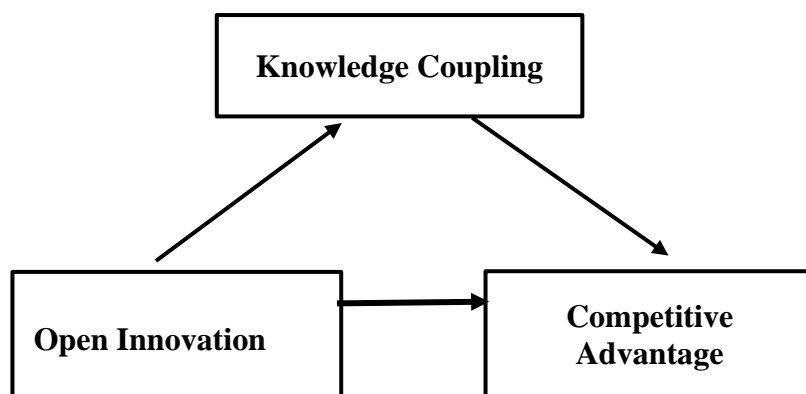
H2: "Open Innovation" in SMEs significantly impacts its "Knowledge Coupling".

H3: "Knowledge Coupling" significantly impacts its "Competitive Advantage" over its competitors.

H4: "Knowledge Coupling" mediates the relationship between "Open Innovation" and "Competitive Advantage" over its competitors.

The figure 1 shows the research study's conceptual framework. The variables and the relationships between them are shown in the framework.

Figure 1: Conceptual Framework



3. Research Methodology

The study investigated the impact of open innovation on competitive advantage in the presence of knowledge coupling in SMEs, in the District Gujranwala, Pakistan. This study examined the hypotheses using a quantitative research design (Lima Rua, Musiello-Neto, & Arias-Oliva, 2023). The population consists of SMEs' employees in District Gujranwala, Pakistan. A simple random sampling technique is used and choose a sample of 290 respondents (Gay, Mills, & Airasian, 2012). Data is gathered via an on-line questionnaire using a 5- and 7-point Likert scale. Six items regarding inbound or inward open innovation were included in the study. Five outbound openness items are adapted from a Zhou et al. (2018) study. The three cost-related items, four service-related items, and three product-related items are adapted from a Musiello-Neto et al. (2021) study. The eight-knowledge coupling-related items were adapted from a Huiping and Yuxin (2023) instrument. The research study employed the SPSS software for the analysis. The Pearson correlation is used to examine the relationship among variables, and to determine the direction, degree, and association of associations (Bougie & Sekaran, 2019). Multiple regression analysis is used to determine how open innovation affects competitive advantage. The study used mediation analysis to examine the mediating variable's function (Baron & Kenny, 1986).

4. Analysis and Results

The study investigated the impact of open innovation on competitive advantage in the presence of knowledge coupling in SMEs, in the District Gujranwala, Pakistan. The research study has applied the Pearson correlation (see Table 1) to check the relationship among variables (Bougie & Sekaran, 2019).

Table 1: Correlation Analysis

			Inward OI	Outward OI	KC	CA
Inward Innovation	Open	Pearson Correlation	1			
Outward Innovation	Open	Pearson Correlation	.340**	1		
Knowledge Coupling		Pearson Correlation	.222**	.327**	1	
Competitive Advantage		Pearson Correlation	.040	.196**	.335**	1

Legend: OI: Open Innovation, KC: Knowledge Coupling, CA: Competitive Advantage
 ** Correlation is significant at the 0.01 level (2-tailed).

The value of correlation ($r=.040$) (see table 1) is showing that inbound or inward open innovation has positive but very weak relation with competitive advantage. When inbound open innovation increases, an enterprise gets a competitive advantage over other enterprises in the market (area, industry / city) to some extent and vice versa only. Value of correlation ($r=.196$) is showing that outbound open innovation has positive and weak relation with competitive advantage. When outbound open innovation increases, an enterprise gets a competitive advantage over other enterprises in the market and vice versa. When, an enterprise focuses on open innovation, the enterprise may get an advantage over its competitors in the city, market or area. Next value of correlation ($r=.222$) describes that there is positive and weak relationship between inbound open innovation and knowledge coupling. It means when inward open innovation increases, knowledge coupling also increases and vice versa. Value of correlation ($r=.327$) is describing that there is positive and moderate relationship between out-bound open innovation and knowledge coupling. It means when, an enterprise adopts open innovation, it may combine elements of knowledge and vice versa. Next value of correlation ($r=.335$) is describing that there is positive and moderate relation-ship between knowledge coupling and competitive advantage. It means that when an enterprise combines elements of knowledge, it gets an advantage over competitors in the market and vice versa.

H1: "Open Innovation" in SMEs significantly impacts its "Competitive Advantage" over its competitors.

Table 2: Model Summary

Model	R	R Square	Adj. R Square	Std. Error of Estimate
1	.226	.051	.046	3.41225

Predictors: inward open innovation, outward open innovation

The value of r square ($r^2=.051$) (see table 2) is indicating that about 5.1% fluctuation or variation in competitive advantage has been significantly explained by selected dimensions of open innovation. Very low variation is being explained. It shows that competitive advantage depends on open innovation to some extent only.

Table 3: ANOVA

Model		Sum of Squares	df	Mean Square	f	Sig.
1	Regression	224.111	2	112.055	9.624	.000
	Residual	4168.344	358	1.643		
	Total	4392.454	360			

The value of f states ($F=9.624$) is showing a low linear relationship (see Table 3) in the proposed model. It is supporting the proposed model statistically so some extent. These SMEs may achieve a competitive advantage by focusing on open innovation. Coefficient of p or value of sig. ($sig=.000<.05$) is above the criteria, so the H1 hypothesis is accepted.

Table 4: Table of Coefficients of Regression

Model	Un-standardized Coefficients		Standardized Coefficients		t Sig.
	B	Std. Error	Beta		
1. Constant	54.100	4.215			
Inward Open Innovation	.277	.126	.120	2.192	.029
Outward Open Innovation	.415	.096	.237	4.320	.000

a. Dependent Variable: Competitive Advantage

Value of constant (C=54.100) describes that if the influence of selected variables (dimensions) is kept as zero or ignored, the current competitive advantage in selected SMEs is 54.100 or 54.1% edge over existing competitors. It is due to the influence of other variables like E-commerce. Value of beta ($\beta=.120$) is indicating that if 1 unit is added to inbound open Innovation, competitive Advantage will increase by .120 units and vice versa. Inbound activities directly form the same goal with suppliers. Therefore, innovation process of a firm and financial performance improves continuously. In other words, as a result of open Innovation, competitiveness of a firm gets enhanced. Next value of beta ($\beta=.237$) describes that if 1 unit is added to outbound open Innovation, competitive Advantage will increase by .237 units and vice versa. It can be explained that if SMEs spend one million to get outbound open Innovation, they will get an edge over competitors. Competition is increasing; ultimately companies are depending on external partners. When managers focus on bringing innovation, this ultimately helps to gain and sustain advantage over competitors. SMEs should provide employees with collaborative tools like instant messaging and video conferencing, to facilitate knowledge exchange and teamwork. The multiple regression analysis is conducted.

H2: Open Innovation in an SME positively impacted its Knowledge Coupling.

Table 5: Model Summary

Model	R	R Squ-are	Adj. R Square	Std. Error of Estimate
1	.347	.121	.116	2.53430

Predictors: Inward Open Innovation, Outward Open Innovation

Value of r square ($r^2=.116$) is showing that about 11.6% of the variation in knowledge coupling has been significantly explained by selected dimensions of open innovation. Low variation is being explained. It shows that knowledge coupling depends on open innovation to some extent.

Table 6: ANOVA

Model	Sum of Squares	df	Mean Square	f	Sig.
1	Regression	315.465	2	157.73	24.559.000
	Residual	2299.311	358	6.423	
	Total	2614.776	360		

Dependent Variable: Competitive Advantage

Value of f states ($f=24.559$) is indicating that normal linear relation-ship in the proposed model. It is supporting the statistically proposed relationship of dependency of knowledge coupling on open innovation. These may achieve knowledge coupling by focusing on open innovation. Coefficient of p or value of sig. ($\text{sig}=.000<.05$) is above the criteria. The H2 hypothesis is accepted.

Table 7: Coefficients of Regression.

Model	Unstandardized Coefficients		Standardized Coefficients		t Sig.
	B	Std. Error	Beta		
1. Constant	26.376	3.130			
Inward Open Innovation	.223	.094	.125	2.372	.018
Outward Open Innovation	.385	.071	.284	5.394	.000

Dependent Variable: Knowledge Coupling

The value of constant (C=26.376) describes that if the influence of selected variables (dimensions) of open innovation is ignored or kept as zero, current knowledge coupling in selected SMEs is 26.376. It is due to the influence of other variables like E-commerce. Value of beta ($\beta=.125$) is indicating that if 1 unit is added in inbound open Innovation, knowledge coupling will increase by .125 units and vice versa. Simply, if SMEs spend one million to get Inbound Open Innovation, they will be able to combine elements of knowledge and vice versa. Value of beta ($\beta=.284$) is indicating that if 1 unit is added in outbound open Innovation, knowledge coupling will increase by .284 units and vice versa. Simply, if SMEs spend one million to get outbound open Innovation, they will be able to combine elements of knowledge. The study applied multiple regression on open innovation, demographical variables, and competitive advantage.

H3: Knowledge Coupling positively impacted its Competitive Advantage over its competitors.

Table 8: Coefficients of Regression (Demographic Variables)

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.
	B	Std. Error	Beta			
1 Constant	54.445	4.201	.0279			.780
Size	.092	.328	.014	0.279		.780
Industry	.662	.256	.135	2587		.010
Inward Open Innovation	.235	.127	.102	1.860		.064
Outward Open Innovation	.430	.096	.245	4.496		.000

a. Dependent Variable: Competitive Advantage

The values of beta of inbound open innovation and outbound open innovation are .102 and 0.245 respectively. We checked the dependency of competitive advantage on knowledge coupling or whether knowledge coupling influences competitive advantage. We applied simple linear regression.

Table 9: Table of Coefficients of Regression (Knowledge Coupling)

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.
		B	Std. Error	Beta			
1	Constant	37.212	2.903	12.817			.000
	Knowledge Coupling	.435	.064	.335			.000

Dependent Variable: Competitive Advantage

The beta value ($\beta=.335$) is showing that if one unit is added in knowledge coupling, competitive Advantage will increase with .335 units and vice versa. It means if an enterprise applies knowledge coupling & combines elements of knowledge, it achieves an advantage over its competitors in the area, city or market. If it ignores combining elements of knowledge; other competitors will get an advantage over this enterprise. The values of sig. and t (sig=.000<.05, t=6.747>1.96) are meeting criteria. The H3 hypothesis is accepted. SMEs can apply knowledge coupling to enhance their competitive advantage. By aligning the know-ledge and abilities of employees with organizational goals, SMEs can be more agile, innovative, and efficient. Moreover, they can invite and keep expert employees and create a culture of learning and development. SMEs that embrace knowledge coupling are better positioned to succeed in current competitive environment in the cities. Therefore, it is essential for SMEs to assess their human resources, identify critical knowledge and skills, and develop strategies to align them with their organizational goals.

The mediation analysis is conducted by comparing the coefficient of regression (betas values) results produced in 1st and 3rd steps. We compared values when the control variable was size & industry and when the control variable was knowledge coupling.

Table 10: Table of Coefficients of Regression (Knowledge Coupling)

Model		Unstandardized Coefficients		Standardized Coefficients		t	Sig.
		B	Std. Error	Beta			
1	Constant	43.029	4.390		9.802		.000
	Inward Open Innovation	.370	.121	.160	1.860		.002
	Outward Open Innovation	.254	.095	.144	4.496		.008
	Knowledge Coupling	.420	.068	.324	6.199		.000

Dependent Variable: Competitive Advantage

Table 11

	Before	After
Inbound Open Innovation	.102	.160
Outbound Open Innovation	0.245	.144

Values show that due to knowledge coupling, coefficients of beta have reduced. Thus, H4 hypothesis is accepted. Knowledge coupling is intermediary variable and it is the substantive and internal reason of the effect of "open innovation" on competitive advantage. It is proved that knowledge coupling plays mediating role in the relationship between "open innovation" and advantage over competitors. Open innovation affects knowledge coupling, knowledge coupling ultimately affects advantage over competitors, and thus open innovation indirectly affects advantage of SMEs in Pakistan over their competitors. The effectiveness of open innovation in enhancing competitiveness of a firm depends on its ability to couple external knowledge with internal knowledge effectively.

5. Conclusion

The study investigated the effect of "open innovation" on "competitive advantage" in the presence of "knowledge coupling" concerning SMEs in District Gujranwala, Punjab, Pakistan. The findings of the study indicate that "open innovation" is necessary for "competitive advantage." Focusing on "open innovation" could give Pakistani SMEs a "competitive advantage." A number of studies on the relationship between "open innovation" and "competitive advantage" have also found that open innovation is a viable method for gaining an advantage over competitors (Bigliardi et al., 2021; Huizingh, 2011; Musiello-Neto et al., 2021). The study's conclusions are in alignment with previous research, which suggested competitive advantage and performance enhancement through open innovation strategies (Chatzoglou & Chatzoudes, 2018; Lee & Yoo, 2019; Rumanti et al., 2021). The findings show that "knowledge coupling" will rise by .255 units for every unit contributed to inbound open innovation, and vice versa. The SMEs will be able to integrate knowledge if they invest one million dollars in inbound open innovation. The study came to the conclusion that "open innovation" and "knowledge coupling" are essential for obtaining a "competitive advantage" because they enable businesses to take benefit of outside ideas and experience, which speeds up innovation and lowers R&D expenses. Companies may stay ahead of the competition by addressing difficult challenges and responding to market changes more quickly by integrating varied viewpoints and technologies. The findings are consistent with the conclusions of other studies (Bigliardi et al., 2021; Hameed, Nisar, & Wu, 2021; Huiping & Yuxin, 2023). The ability of a company to successfully integrate external and internal knowledge determines how effective "open innovation" is at increasing its competitiveness.

5.1. Recommendations

SMEs in Pakistan must work with universities, research institutes, and other organizations on joint research and development projects in order to obtain fresh knowledge and expertise. They should also promote the sharing and cooperation of ideas and other resources through open-source efforts. These organizations' managers should learn to scan and learn from outside sources. To prevent accidents involving research and development personnel, safety precautions

in operations should be assured. SMEs need to look for and choose the right external partners based on their markets, technologies, and expertise.

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