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Exploring the Complementary Effect of Innovation Strategies on Firm's Employment Growth

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ABSTRACT

Purpose—Innovation plays an important role in the growth of a firm. It helps the firm to gain a competitive advantage domestic market as well as in the international market. Previous studies examined the outcome of various types of innovation strategies adopted by the firm on the employment of firms. Nevertheless, the role of all four types of innovation strategies, i.e., product, process, organizational, and marketing innovation may have complementary effects on the employment of firms.

Design/methodology/approach—This study analyzed the role of quadruple-complementarity among various innovation strategies in stimulating the employment of firms using the data from World Bank Innovation surveys and World Bank Enterprise surveys. In this study, Pakistan, Bangladesh, and India were included in the analysis. Logistic regression is used as an econometric technique to carry out estimation.

Findings—The finding revealed the existence of quadruple complementarity among various innovative strategies adopted by the firm in an innovation-employment relationship only in Bangladesh. The results suggest that the firm may have better employment growth by simultaneously adopting all innovation strategies compared to the adoption of either strategy.

Originality/value—Innovation plays important role in improving firms' growth. The paper addressed the role of multiple innovation strategies in enhancing firms' growth in terms of the employment potential of the firm.

Implications and Research limitation—The findings suggest that government may design policies to improve the innovation potential of firms. Along with this firms may be encouraged to implement both technological and non-technological innovation strategies simultaneously for generating more employment opportunities. Our study used cross-sectional data for analysis, however, the analysis may be conducted using panel data for obtaining more detailed results.

Keywords: Employment, Innovation, Research, and Development.

1. INTRODUCTION

Economic Globalization has raised competition in the business world and demands more efficiency. Due to the increase in competition survival of the firm is facing

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several challenges. Hence, the firm must uphold a competitive advantage in the market for its survival ([Stobierski, 2021, APR, 01](#)). Innovation is a key tool for firms to sustain competitive advantage and expand market share ([Myllyla, 2019](#)). Since the outcome of innovation is a new product or an entirely new market, therefore, demand for labor increases. Therefore, innovation has a positive effect on employment ([Waheed, 2012](#)). The effect of technology on employment has been studied since the industrial revolution in eighteen centuries. There was the prevailing fear that the massive development of machinery may have a destructive effect on labor employment ([Rothwell & Zegveld, 1979](#)). “On Machinery” written by ([Ricardo, 1817](#)) highlights the adverse effect of industrial development on labor employment. Technological innovation, i.e., product and process innovation, effects employment in the opposite way. Product innovation has a positive effect on employment while process innovation has a labor-saving effect. The dominance of one effect over the other is situation-specific ([Edquist et al., 2001](#); [Smolny, 1998](#)). However, these effects are subject to change e.g. in the case of product innovation if a firm is radically innovating a new product then it will create a monopoly and would try to reap more profits by decreasing output and thereby, workforce. Similarly, the labor-saving effect of the process innovation may be counterbalanced when cost reduction turns into price reduction which in turn increases the demand for the product. The increased demand for the product would lead to more labor force employment. The literature presents empirical evidence for the counterbalancing effect of process innovation [Okumu et al. \(2019\)](#) found that both product innovation and process innovation have a positive effect on employment. In contrast, [Aguirre and Malagón \(2021\)](#) found a positive effect of product innovation while process innovation negatively effects on firms’ employment.

Some studies also argued that different innovation strategies are complementary while considering the effect on employment. In other words, different types of innovations when used as compliments may have a better effect on employment. [Waheed \(2012\)](#) checked the complementarity between product and process innovation and find that technological innovation complimenting in high technology industries and low technological industries of Bangladesh and Pakistan. Therefore, different types of

innovation significantly affect the potential of a firm to generate employment. Along with this, the effect is more pronounced when different innovation strategies are used simultaneously. These studies mostly examine the pattern of complementarity among two types of innovation. However, the pattern may differ when four types of innovation are used. This study examined the pattern of complementarity among all types of innovation in influencing employment.

South Asia is among the most highly populated region of the world with about one-fifth of the world population residing in this area. Due to the high population, South Asia is facing the huge challenge of unemployment and this region is strong to overcome unempt unemployment proof for a long, however, still unable to create employment opportunities for the unemployed labor force ([Niazi et al., 2020](#)). Past studies found that innovation positively influences the employment potential of a firm ([Okumu et al., 2019](#); [Waheed, 2012](#)). This study evaluated the effect of innovative strategies, adopted by three neighboring countries, India, Pakistan, and Bangladesh, on firms' employment. According to the Global innovation index 2021, India ranked 93, Pakistan ranked 132, and rank of Bangladesh 116 ([Dutta et al., 2021](#)). Therefore, this study examined the effect of technological innovation when it is complemented by non-technological innovation on the employment of a firm. Hence, one of the objectives of the study is to explore the factor determining the innovative potential of the firm. The second objective of the study is to examine the existence of quadruple complementarity, among different types of innovation, in influencing the employment of firms.

2. LITERATURE REVIEW

2.1. Determinants of Innovation

Economists view innovation as an essential tool for the survival of firms, economic development, and growth. The proposition is more valid in developing countries, where more of the population is involved in activities that are far from technological boundaries ([Schumpeter, 1942](#)). The relationship between firms' innovation and factors affecting firms' innovation is explained by the Schumpeterian theory of creative destruction. This theory stated that the introduction of improved goods, techniques of production,

administrative procedures, and advertising strategies lead to improved economic growth. Hence, innovation is an important element of market economies ([Schumpeter, 1934, 1943](#)). [Schumpeter \(1942\)](#) further argued that increase in firm's size probability of a firm undertaking innovation increases. Past studies viewed a firm's size as a key determinant of innovation. According to [Abdu and Jabir \(2018\)](#), an increase in a firm's size leads to more innovative growth as a firm as the firm's capacity to make inventions in the production process increase. Further large firms provide a good working environment to their workers, therefore, employees' innovative potential increases ([Atkinson, 2021](#)). [Elshamy \(2021\)](#) also found a positive effect of firms' size on innovation. On the other hand, [Chen \(2017\)](#) stated that small-sized firms are more innovative than larger firms due to quick internal communication systems, supportive management, and comparatively less rigid structure of the organization. According to [Cisková and Ďurčková \(2019\)](#), the small sized firms are more likely to innovate in the product, while, large-sized firms are more focused on innovation in techniques of production. This study examined the effect of firm size on a firm ability to undertake product, process, organizational and marketing innovation simultaneously. Accordingly, study hypothesis is as follows.

H_{Size}: *Firms' size significantly affects innovative capability.*

Past studies also reveal that the age of a firm effects the firm's probability to carry on innovative activities ([Kireyeva et al., 2021](#)). [Abdu and Jabir \(2018\)](#) stated that small-aged firms are more inventive than older firms. Similarly, [Bouncken et al. \(2021\)](#) stated that older firms may not be able to innovate effectively due to a more rigid organizational structure as compared to younger firms. Our study analyzed the effect of age on firm-on-firm ability to undertake product, process, organizational, and marketing innovation simultaneously. On the other hand, past studies also found a U-shaped relationship between the age of a firm and innovation ([Tran & Santarelli, 2013](#)). Firm's ability to carry on innovative activities increases up to certain stage, after which innovative activities start declining. Accordingly, study hypothesis is as follows.

H_{Age}: *The age of a firm significantly affects the firm capacity to innovate.*

The ownership status of a firm also determines the firm's capacity to undertake innovative activities. [Jang \(2017\)](#) stated that firms having foreign ownership are more

innovative in low-technology industries in South-Korea. Similarly, [Kireyeva et al. \(2021\)](#) found that foreign-owned firms have more probability to innovate in product and process innovation. In addition to this [Antón et al. \(2021\)](#) found that shared ownership improves the effectiveness of the R&D efforts of a firm. While [Goel and Nelson \(2018\)](#) found that firms having sole proprietors are comparatively more innovative than their counterparts. This study examined the effect of a firm's ownership on the probability of a firm to undertake all types of innovation strategies simultaneously. Accordingly, the study hypothesis is as follows.

H_L: *The ownership status of a firm significantly determines the firm capacity to innovate.*

A skilled workforce is another main determinant of the innovative capacity of a firm. [Djampagau et al. \(2018\)](#) stated that the active creation of knowledge increase to human capital, which stimulates the innovation capability of a firm. Moreover, [Khan \(2021\)](#) stated that knowledge of the firm's employees along with the strong innovative environment of the institute encourages employees to actively participate in innovative activities. Likewise, [Falk and Hagsten \(2021\)](#) stated that a skilled workforce improves the innovation intensity of firms. Moreover, training the workforce improves human capital which, in turn, boosts the innovation potential of the firm ([Khatiwada & Arao, 2021](#)). On the other hand, [Abdu and Jabir \(2018\)](#) found an adverse effect of educating the workforce on innovation. This study examined the effect of the education of the firm's employees on the probability of the firm to undertake all types of innovation strategies simultaneously. Accordingly, the study hypothesis is as follows.

H_{edu}: *Education of a firm's employees has a significant effect on innovation.*

Literature also reveals that a highly trained labor force is a significant factor in a firm's innovation ([Fonseca et al., 2019](#); [Ma et al., 2019](#)). [Dostie \(2017\)](#) stated that formal training of the workforce improves human capital, and thus, improves the innovative capability of the firm. Studies found that skilled human sources play important role in determining the innovation potential of the firm ([Leogrande et al., 2020](#); [Sun et al., 2020](#)). [Abdu and Jabir \(2018\)](#) also emphasized the significance of training employees in improving the innovation capability of a firm. Similar evidence was presented by [Kireyeva et al. \(2021\)](#). This study examined the effect of on-job training of a firm's

employees on the probability of a firm to undertake all types of innovation strategies simultaneously. Accordingly, the study hypothesis is as follows.

H_{trg}: *On-job training of a firm's employees has a significant effect on innovation.*

Past studies found that the availability of financial resources aids in improving the innovative capability of a firm. According to [Abdu and Jabir \(2018\)](#), financial support of a firm for research and development and support positively affect the innovation capacity of the firm. [Ali et al. \(2021\)](#) stated that investment in research and development activities significantly affects a firm's propensity to innovate in the product. This study examined the effect of research and development activities on the probability of a firm to undertake all types of innovation strategies simultaneously. Accordingly, the study hypothesis is as follows.

H_{rd}: *Spending on research and development activities has a significant effect on innovation.*

2.2. Impact of innovation on employment

The discussion on the effect of innovation on employment started during the period of the industrial revolution in the eighteen century. There was fear that the massive development of machinery may have a negative impact on labor employment ([Rothwell & Zegveld, 1979](#)). [Ricardo \(1817\)](#) in the chapter "On Machinery" showed the negative effect of industrial development on employment. Technological innovation has two contrasting effects on employment. One is the labor-saving effect and the other is the compensation effect. The labor-saving effect can be attributed to process innovation while the compensation effect is due to product innovation. The dominance of one effect over the other is situation-specific ([Edquist et al., 2001](#); [Smolny, 1998](#)). The Existing literature reported a positive effect of innovation on employment ([Okumu et al., 2019](#); [Sart & Sezgin, 2021](#)).

Different types of innovations have different effects on employment e.g [Avenyoa et al. \(2019\)](#) reported a positive effect of product innovation in the employment of firms in sub-Saharan Africa. In addition to this, [Okumu et al. \(2019\)](#) found that product innovation and process innovation have a positive effect on employment. On the other hand, [Aguirre and Malagón \(2021\)](#) found a positive effect of product innovation and the negative effect of

process innovation on firms' employment. On the other hand, [Zhu et al. \(2021\)](#) found that process innovation has a positive effect on employment, while product innovation has a negative effect. [Goel and Nelson \(2018\)](#) found that process innovation positively influences firms' ability to generate employment. The authors also proposed a model for comparison of different types of innovation on employment. [Evangelista and Vezzani \(2012\)](#) found that technological innovation, products, and processes, have a significant positive effect on employment. However, the effect of process innovation in combination with organizational innovation is negative. [Cirera and Sabetti \(2019\)](#) found that product innovation boost firm employment, however, process and organizational innovation have an adverse effect on employment. [Díaz et al. \(2020\)](#), found that product and process innovation significantly affect employment during a crisis. Further, the effect is more pronounced for skilled workforce compared to low-skilled workers. [Ganzer et al. \(2017\)](#), found that companies are undergoing four types of innovation i.e. product, process, marketing, and organizational innovation using the data of flat knitting industries. Further, the turnover in the case of product, process, marketing, and organizational innovation is 4.79%, 2.18%, 1.08%, and 0.99% respectively. Moreover, a positive correlation was found between investment in marketing innovation and its turnover ([Ganzer et al., 2017](#)). [Waheed \(2012\)](#), studied the impact of innovation on employment in developing countries using a sample from Pakistan and Bangladesh. The innovation is measured in terms of its types i.e. product innovation and process innovation. The author found that innovation has a significant effect on Employment. [Osabohien et al. \(2022\)](#), stated that firms should be encouraged to create more and more jobs to secure future employment.

In the nutshell, different studies have analyzed the effect of innovation on employment generation by the firm and found that innovation in more specific product and process significantly affect employment. However, there is a need to examine the effect of technological innovation when it is complemented by non-technological innovation. In other words, how does the use of technological innovation along with non-technological innovation influence the relationship between technological innovation and employment? In addition to this labor law of the country may affect the employment

opportunities of the country which is needed to be addressed e,g worker's unions reduce employment growth of the firm because the firm may be hesitant to hire more employees due to the negotiation power of worker union ([Waheed, 2012](#)).

3. RESEARCH METHODOLOGY

3.1. Empirical analysis of innovation and employment

The impact of Innovation on the employment of labor has been estimated using a framework proposed by [Van Reenen \(1997\)](#) who used CES production function in a perfectly competitive market as follows

$$q = F(AL^{\frac{\alpha-1}{\alpha}} + BK^{\frac{\alpha-1}{\alpha}})^{\frac{\alpha}{\alpha-1}} \quad (1)$$

Where q is output, K and L are capital and labor, respectively. F, A, and B represent Hick's neutral, Harrod-neutral, and Solow-neutral technology, respectively. The first order condition for labor would be.

$$\log L = \log q - \alpha \log(W/P) + (\alpha - 1) \log A \quad (2)$$

The labor elasticity concerning a labor-saving technology, A, with the fact that in perfect competition $P=MC$, is given as

$$\frac{d \log L}{d \log A} = \frac{d \log q}{d \log P} \frac{d \log MC}{d \log A} + (\alpha - 1) \quad (3)$$

In the labor demand function in equation 3.16, substituting output with FOC of capital gives

$$\log L = (\alpha - 1) \log A/B - \alpha \log W + \log K + \alpha \log R \quad (4)$$

Replacing unobserved variables of technology with innovation, the stochastic model is

$$l_{it} = \alpha_1 Inn + \beta_3 w + \beta_4 k + t_i + u_i \quad (5)$$

Equation 5 represents labor demand where capital is fixed, and t represents time dummies. This study uses the labor demand function derived by [Van Reenen \(1997\)](#) with modifications. This study used panel data and used lagged values and the first difference of employment to find change in employment. The study also used a trend variable. Since our data is cross-sectional, therefore, we used the dependent variable as a change in

several employees or the growth rate of firm employees from 2009-10 to 2011-12 as in the study of [Waheed \(2012\)](#).

$$\text{LOG}(\text{employment})_{it} = \beta_1 \text{Innovation}_{it} + \beta_2 \text{Log}(\text{wages})_i + \beta_2 \text{Log}(\text{Capital})_i + t_t + e_{it} \quad (6)$$

Moreover, [Waheed \(2012\)](#) also used control variables such as age, labor union, training of employees, and large principal buyer. This study used obstacles posed by labor regulation as a control variable, as, obstacles posed by labor regulation may affect the labor force hired by the firm. This model used both technological and non-technological innovation in complementarity analysis to check the effect of technological innovation on employment when combined with non-technological innovation.

Accordingly, the model is as follows

$$\text{LOG EMPLOYEES}_i = \pi_0 + \alpha_0 \text{LR}_i + \alpha_1 \text{CL}_i + \alpha_2 \text{CE}_i + \beta_{1i} \text{I}_i + e_i \quad (7)$$

where LOG EMPLOYEES refers to a change in several employees or the growth rate of firm employees from 2009-10 to 2011-12 ([Waheed, 2012](#)). CL is the cost of labor, and CE is the cost of electricity. LR is the degree of obstacle faced by a firm in running its operations and is categorized from no obstacles to major obstacles.

According to [Van Reenen \(1997\)](#), there is the possibility of endogeneity since a firm may increase its workforce and innovation when it anticipates increase demand. To address this issue [Van Reenen \(1997\)](#) lag the value of innovation. [Waheed \(2012\)](#) used predicted values of innovation to tackle endogeneity. This study used cross-sectional data for which lag values are not applicable. The innovation is predicted by its determinants. Following [Waheed \(2012\)](#), the proposed equation is as follows

$$\text{I}_i^m = \pi_0 + \alpha_0 \text{SIZE}_i + \alpha_1 \text{AGE}_i + \alpha_2 \text{R\&D}_i + \alpha_3 \text{EDU}_i + \alpha_4 \text{TRAINING}_i + \alpha_5 \text{LEGAL}_i + e_i \quad (8)$$

$$\text{LOG EMPLOYEES}_i = \pi_0 + \alpha_0 \text{LR}_i + \alpha_1 \text{CL}_i + \alpha_2 \text{CE}_i + \beta_{1i} \hat{\text{I}}_i + e_i \quad (9)$$

Equation (8) shows innovation as the dependent variable as a dummy which takes the value of 1 when the firm undergoes all types of innovation and otherwise zero. Control variables are various factors that affect innovation i.e., size age, R&D EXP, education of employees, training of employees, and legal status of the firm while I is the Innovation

variable. According to [Schumpeter \(1942\)](#), the probability of a firm innovating increase with an increase in the size of the firm. Age is a significant factor for survival in those industries which heavily relied on innovation, since, the younger firm are less likely to innovate than older ones ([Bouncken et al., 2021](#)). Size is categorized into small medium and large, while age is a continuous variable. Spending on research and development expenditure improves the innovative capacity of the firm. The effect of research and development on innovation has been examined by [Ali et al. \(2021\)](#). R&D EXP is a dummy variable that takes the value 1 if a firm spends on research and development activities and 0 otherwise. A firm with more educated employees innovates more effectively as compared to a firm with less educated employees ([Khan, 2021](#)). In our study, we measure the education of employees abbreviated by EDU as a percentage of full-time workers who completed secondary or higher education. An increase in the stock of human capital, through formal training, increases the innovative activity of a firm ([Dostie, 2017](#)). In our study, we measure the training of employees abbreviated TRAINING as a dummy variable which takes the value of 1 if a firm provides formal training full-time employees. The ownership structure of a firm affects innovation of the firm by determining decision making ability to innovate. Ownership status abbreviated as LEGAL is measured by categorical variable which is categorized into Shareholding Company with traded share in the stock market, Shareholding Company with non-traded shares, Sole proprietorship, Partnership and Limited partnership. The predicted value of innovation from equation (8) is incorporated into equation (9).

The analysis is carried out using data from World Bank Enterprise Survey. The World Bank Enterprise Survey published data from enterprise surveys and innovation surveys for firms from different countries. The study used data from the World Bank Innovation surveys and World Bank Enterprise surveys of the Year 2013 for Pakistan and Bangladesh and the World Bank Innovation and Enterprise survey of the Year 2014 for India. STATA 14 is used for the estimation of data.

4. RESULTS AND DISCUSSION

The study has been conducted to analyze the role of quadruple-complementarity

among different innovative strategies in influencing the employment of a firm. The evaluation was based on various criteria using appropriate econometric and statistical techniques. Table 1 shows the impact of innovation on employment. The effect is measured to examine Quadruple Complementarity among four innovation strategies.

Table 1. Quadruple Complementarity in employment and innovation							
Determinant of Innovation				Quadruple Complementarity using four innovation strategies simultaneously as complement			
Dependent: PDPFROM		Coef.		Dependent: LOG EMPLOYESS		Coef.	
	Pakistan	India	Bangladesh		Pakistan	India	Bangladesh
Age	0.0123* (0.0071)	-0.0036* (0.0019)	0.0026 (0.1078)	CL	-1.82e-10 (7.49e-10)	-1.82e-10 (7.49e-10)	2.13e-08 (1.74e-08)
RCedu	-0.0011 (0.0037)	-0.0035*** (0.0010)	0.0058** (0.0020)	CE	1.42e-07*** (7.59e-09)	-1.27e-08 (1.41e-08)	-6.59e-08 (6.90e-08)
RCtraining		-0.0317 (0.0583)	0.0988 (0.1108)	LRdum3		-7.1198* (3.8151)	
RCh7	0.8110*** (0.2466)	0.4369*** (0.0564)	0.2147* (0.1259)	LRdum4		-8.0535** (3.7939)	
Sizedum1				LRdum5		-8.5351** (3.906)	
sizedum2		1.5219*** (0.1216)	-1.6308* (0.1911)	LRdum6		-9.1579** (4.0800)	9.7636 (8.0887)
sizedum3	0.7334*** (0.2554)	1.8921*** (0.1280)	-0.3516** (0.1127)	LRdum7	37.7676** (17.2095)		
Legaldum1				P1	-89.7504 (58.3556)	0.2497 (3.7400)	25.9457** (9.3582)
legaldum2	0.6614 (0.6033)	-0.0494 (0.1828)	0.7071** (0.3507)	Cons	11.4346* (6.0030)	20.0037*** (3.7440)	9.0651*** (2.3351)
legaldum3	0.4978 (0.4983)	0.1091 (0.1718)	0.9336** (0.3479)				
legaldum4	-0.4914* (0.2646)	0.0969 (0.1754)	0.9781** (0.3479)				
legaldum5		0.3006* (0.1699)					
legaldum6		0.2713 (0.2238)					
Age square			-0.0002 (0.0002)				
Cons	-2.3909*** (0.3757)	-2.3330*** (0.2141)	-1.4191*** (0.3798)				

*: significant at 10 percent, **: significant at 5 percent, ***: significant at 1 percent

Results of equation (8), shown in Table 1, illustrated factors determining the likelihood of the firm to carry on all types of innovation simultaneously. The findings show that the age of firms has a positive effect on all types of innovation strategies when adopted simultaneously in Pakistan, while the negative effect in India and an insignificant

effect is in Bangladesh. A positive result may be attributed to the likelihood of younger firms innovating less than older ones ([Abdu & Jabir, 2018](#)). On the other hand, small firm has fewer obstacles and faceless organizational bureaucracy, therefore, are more capable to undertake innovation than larger ones ([Martha, 2021](#)). In the case of Bangladesh effect of age on innovation is the insignificant effect on innovation. Although firms improve their invention approaches with time, however, they may be unable to produce innovative techniques competitively at the commercial level ([Meijdam, 2017](#)). According to the global innovation index Bangladesh rank 116th of 132 countries ([Dutta et al., 2021](#)), which shows that firm in Bangladesh should improve their innovative efforts. These findings confirm hypothesis HAge for Pakistan but contradict for India and Bangladesh. The education of employees plays a significant role in the research and development abilities of firms, as, an educated workforce is more capable to undertake innovation, and thereby, improves firms' competitiveness of firm ([Khan, 2021](#)). In our study, the education of the firm's employees has no effect on innovation in Pakistan. The literacy rate of Pakistan is lowest among south Asian countries. Moreover, Pakistan ranks 134 out of 157 countries in investment in human capital. Both literacy rate and investment in human capital contribute to the low job performance of employees and low innovative potential ([Shabbar, 2021](#)). Therefore, education does not play a significant role in promoting innovation. In the case of India, the education of employees has a negative effect on innovation. [Abdu and Jabir \(2018\)](#) also found an adverse effect of educating the workforce on innovation. Our findings show that the education of employees has a significant positive effect on innovation in Bangladesh. [Khan \(2021\)](#) stated that more educated employees of the firm are comparatively more competent in performing innovative tasks than low-educated employees, and therefore, promote innovation. Likewise, [Romer \(1990\)](#) stated in his endogenous growth theory that the stock of knowledge gathered in past is a key factor of innovation. These findings confirm hypothesis Hed_u. The results show that training of the firm's employees does not influence the innovative capability of the firm. There is the probability of a lack of sufficient training and development programs commenced by firms that improve the innovative ability of employees ([Michaelis & Markham, 2017](#)). These results do not support hypothesis H_{trg}.

The Results show that expenditure on Research and development positively influences a firm's innovation. Research and development expenditure helps the firm to improve existing products and techniques of production ([James, 2019, October, 13](#)). Our findings are in accordance with [Romer \(1990\)](#) endogenous growth theory, according to which, the number of employees devoted to research and development activities are important determining factors of innovation. Moreover, enthusiasm and active involvement in research and development activity have an influential effect on a firm's innovation [Joshi \(2017\)](#). These findings confirm hypothesis Hrd. The size of the firm size has a positive effect on the ability of the firm to undertake innovative activities, According to [Atkinson \(2021\)](#) large sized firms provide a better working environment to their employees therefore the innovative potential of workers increases. Findings support the Schumpeterian hypothesis (1942) according to which an increase in the size of the firm probability to innovate increases. This finding support hypothesis H_{Size}. Finding further showed that firms having Partnership have substantial effect on innovation.

In the second equation impact of innovation on employment by Quadruple Complementarity by using the predicted probability of four innovation strategies simultaneously as a compliment. It can be seen that the cost of labor has an insignificant effect on employee growth. According to [Waheed \(2012\)](#) higher search costs of a new employee in the short term urge firm to increase the wages of existing labor. The cost of electricity has a positive effect on employee growth in the case of Pakistan, since, positive cost effects, may offset negative demand effects ([Hille & Mobius, 2019](#)) while the insignificant effect is in other countries. Legal status significantly determines employee growth. The predicted probability of four innovation strategies simultaneously, indicated by P1, is only significant in Bangladesh showing that all types of innovation strategies, when adopted simultaneously, result in better employee growth. One of the objectives of this study was to examine the pattern of complementarity among different types of innovation in influencing employment. In this equation impact of innovation on employment by Quadruple Complementarity, using four innovation strategies simultaneously as a complement is analyzed. Results show that Quadruple complementarity among four innovation strategies does not exist except in Bangladesh.

In Bangladesh, firms have a favorable environment to carry out business activities, which helps them to create more jobs and enjoy economies of scale. The presence of a favorable environment for firms facilitates the effectiveness of all innovative strategies, and thereby, encourages the firm to simultaneously adopt all innovation strategies to have better employee growth ([Basu, 2018](#)). Further, the cost of labor and electricity has an insignificant effect on employee growth.

5. CONCLUSION

The purpose of this study was to examine quadruple complementarity among various types of innovation strategies, adopted by the firm, in influencing the firm's employment. In the first stage, the study examined the factors determining the firm's innovative capability. Results show that Research and development expenditures and the size of firms are significant factors that determine a firm's ability to undertake all innovation strategies simultaneously. Job training of employees does not affect the innovative capability of the firm, while, the age of the firm and education of the firm's employees have a different effect on the firm's innovation across countries due to diverse socioeconomic environments. The Second step study examined the effect of quadruple complementarity among various types of innovation strategies, adopted by the firm, in influencing firms' employment. The results of this study showed that there exists quadruple complementarity among various innovative strategies in an innovation-employment relationship only in Bangladesh.

The study has various contributions to existing literature. Firstly, to our best knowledge, the study is the first in South Asia to evaluate the existence of quadruple complementarity among different innovation strategies in influencing firm employment in South Asia. Secondly, this study also included the retail sector in the analysis in addition to the manufacturing and service sectors. The retail sector has a great contribution to revenue generation and can generate employment opportunities for the skilled and unskilled workforce ([TechnoFunc, 2013](#)). This study highlighted the significance of innovation in influencing the employment potential of the firm in an economy. The findings suggest that governments of the South Asian region may focus on

making policies to ensure better access to the latest research technologies to a firm which will help in improving the innovation potential of firms. Along with this firms may be encouraged to adopt all four innovation strategies to increase employment opportunities.

This study used cross-sectional data for both the standard enterprise survey and the innovation survey. However, the analysis may be carried out using panel data, which may help to examine the effect of innovation on employment, in more depth.

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