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Innovation Performance of Pakistani SME's: Micro Level Evidence

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Abstract

This study investigates empirically the determinants of innovation performance of Pakistani SMEs, through micro level evidence. There is research gap of innovation analysis of Pakistani SMEs at micro level. The data has been drawn from World Bank Enterprise Survey of 1247 Pakistani manufacturing SMEs, by applying Bivariat Probit model. Our findings indicated that Pakistani SMEs are less probability to introduce product and process innovation. Additionally, external R&D, networking, absorptive capacity and exports have positive and significant effect on product and process innovation. This provides a way for policy makers to increase investment in infrastructures (i.e. telecommunications and network) and knowledge based assets (i.e. R&D) and should contribute private and public sectors organizations to increasing the innovation performance of SMEs.

Keywords: Innovation, R&D, SMEs

Introduction

Innovation generally makes a firm competitive, profitable and productive according to the needs and requirement of the consumers (Mon *et al*, 1998; Mcevily *et al*, 2004; Senge and Carstidt, 2001). Sandvik (2003) examined that innovation has an important significant competitive weapon and usually seen as a firm core value of ability. Innovation is also regarded as an efficient way to increase firm productivity because of resource restriction issue when a firm facing (Lumpken and Dess, 1996).

This empirical study is more focused on innovation analysis of SMEs because these are the backbone of the economy in the world. Small and Medium Enterprises (SMEs) played a very vital role in the economic development of the developed as well as developing countries (Ahmadani; Andrea and Michael, 2010). As argued by (Ahmad *et*

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al, 2011; Akhtar *et al*, 2011) that SMEs are important source to reduce poverty, basic source of employment and social uplift, major participation to the growth and competitiveness of the economy. In South Asia, 99% of the industry is comprises SMEs (<250 employees) and provides 70% of the employment opportunities (Neito and Santamaria, 2010). In Pakistan approximately 87% of industrial sector constitutes SMEs and has enough opportunity for its innovation and development. Furthermore, this sector has also significant impact on distribution of income, tax returns, employment and efficiently using the resources. More than 90%[2] of enterprises comprise SMEs; shared 40% to annual GDP, 46.5% exports and approximately 78% of the workforce[3] is employed in the business sector. In developing countries SMEs are lower survival rate because they had unenough financial resources and on the other hand innovation activities (i.e.R&D) are risky and has large cost, this suggest the research question that why SMEs are less innovative that large firms?. Through this empirical study examines the determinants of innovation performance of SMEs that are derived from previous literature.

To the best of my knowledge, to date, not even a single study has been carried out to explore the innovation performance of SMEs in Pakistan. Therefore, the proposed research will investigate the determinants of innovation (i.e. internal/external R&D, networking) of Pakistani SMEs; it is an interesting and challenging task, especially when investigating this lack of research for SMEs in developing countries. These facts about to the innovation performance of Pakistani SMEs and the lack of research on manufacturing sector in general motivated this researcher to analyze this sector of economy through an empirical analysis. The result of this paper is that Pakistani SMEs undertaking internal R&D have small probability for product and process. Furthermore, engage in external R&D and networking has positive effect on product and process innovation. Similarly exports have positive relationship with product and process innovation.

The remaining paper is structured as follow; section-2 outlines the literature review and develops major hypothesis, section-3 presents descriptive statistics, section-4 empirical analysis, section-5 presents conclusion and policy recommendation.

Review of Literature

Internal R&D and Innovation

Anuar*et al.* (2012) define in-house or internal R&D is an achievement of firm's through which it standard and accomplishes the need of a research project within itself. Their study found that internal R&D produce and develop human resource, contribution in R&D program and link the information, encourage the operational performance of the company in future (Anuar*et al,* 2012*)*. With based on input resources, a wide range of empirical studies state that R&D is one of the important input of firm's innovation performance (Domingo and Borras,2007; Audretsch,2004; Harris and Trainor,2005) For example, Harris and Trainor (2005)examine a panel data analysis of manufacturing firms

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[2] Pakistan Country Assistance Strategy, World Bank Report, Annex II, Page 3.
[3] Census of Establishments-1998.

in Northern Ireland. They find that R&D enhance innovation output and hence the firm's profitability and long term growth

Similarly Mairesse and Mohen (2004) conduct a study of 2253 French manufacturing firms using the Tobit regression and established that R&D has a significant positive influence on product and process innovation. The empirical studies of Harhoff (1998) which studied the panel data of West German manufacturing firms showed that firm undertaking R&D has a positive significant impact on the firm's innovation. Furthermore, Ganotakis and Love (2011) studied 412 UK SMEs. Their empirical studies showed that R&D and firm product innovation has positive and significantly correlated. Similarly, Ornaghi (2006) analyzed the manufacturing firms of Spanish and showed that R&D create knowledge spill overs that enhance the firm's innovation. The empirical studies of (Acs *et al*., 2002; Ngoc *et al*., 2008) reveal that firm undertaking R&D produce highly innovative products/ process as well as export to highly innovative international market for higher firm performance. From the literature it is concluded that internal R&D has a positive impact on the innovation activities of SMEs. The first hypothesis is as follows:

H1. There is a positive relationship between internal R&D and product and process innovation in SMEs.

External R&D and Innovation

Hertog and Thurik, (1993) defined external R&D refers to "R&D that is conducted out to external research organizations like universities". SMEs internal or in-house learning is not enough for production of new products and that firms required to increment internal knowledge with knowledge picked up external of the firm. They mostly acquired to keep relation with firms and institutions in the global environment if they want to preserve the inflow of new ideas and methods that will ultimately bring to innovation (Svetina and Prodan, 2008). The research studies of (Teirlink and Spithoven, 2013) empirically analyzed the data of 140 Belgium SMEs and found that external R&D collaboration gives access to intangible information through contacts to people-by-people.

In addition, Mukherje*et al*. (2013) studied external R&D in a sample of 854 German SMEs and concludes that external R&D mainly enhances the innovative performance of firm. Similarly, Spithoven*et al*. (2013) studied 967 Belgium SMEs. SMEs dependence on external R&D significantly increases the firm innovation performance (product/process). Furthermore, Belderbo *et al*. (2004) analysis the data of Dutch innovating firms, the result confirm that R&D cooperation has a positive effect on firm performance. Several research studies investigate that SMEs are limited in resources than large firms (Dundas, 2006; Abor and Beikpi, 2007). The problem of resource constraint is overcome by R&D cooperation with suppliers, competitors, and research organization which increase the firm's competitiveness (Chun and Mun, 2012; Hottenrott and Lopes-Bento, 2012).External R&D overwhelm the firm restrictions of their R&D budgets and technological risks allied with R&D (Hertog and Thurik,1993).Many studies found a positive relationship between external R&D and firm performance (Alarcon and Sanches, 2013), enhance the knowledge spillover which develop capability of SMEs to acquire external information (Chun and Mun 2010). In summary, the empirical finding indicates

that a positive impact of external R&D on product and process innovation in SMEs. Our second hypothesis is as the following:

H2.There is a positive relationship between internal R&D and product and process innovation in SMEs.

Absorptive Capacity and Innovation

Absorptive capacity gives firms to adjust for a rapidly altering environment and obtained sustained competitive advantage. To enhance their competitive potential in the existing environment, firm has to open up their process and applied knowledge from external resources. An important factor that affects the ability to acquire this knowledge is absorptive capacity, define as "a firm ability to identify, assimilate and exploit knowledge from the environment (Cohien and Leventhal, 1989). Various researchers (Muroveca and Prodan, 2009; Yufen and Jin, 2008) confirmed by empirical studies that absorptive capacity effect the innovation performance of firms positively, and regarded as that firms with improved absorptive capacity were oftenly greater prominent capability of innovation. Similarly, Escribano *et al*, (2009) investigated the influence of absorptive capacity on innovation performance by analysed the panel data of 2200 Spanish innovative firms and argue that absorptive capacity has significant and positive effect on firms innovation performance.

Furthermore, Sun *et al*, (2015) studied the relationship between absorptive capacity and its impact on innovation performance of 126 high technology Chinese firms. They found that innovation performance of firm is positively affected by absorptive capacity. Kheng *et al*, (2014)examined the impact of multidimentions of firm's absorptive capacity and their process innovation collected the data from 69 manufacturing firms of northern area of Malaysia. Their findings indicated that absorptive capacity has a positive significant affect on process innovation. This persuaded the research question as to that whether manufacturing firm's higher absorptive capacity and what have expected link with firm innovative performance. The next hypothesis is the following:

H3. Absorptive capacity has a positive relation with firm's innovative performance.

Firm Age and size

Regarding to the relationship between age of the firm and innovation. Various research studies such as (Umidjun *et al,* 2014; Huergo and Jaumandreu, 2004). Umidjun *et al.,* (2014) investigate the factors which affect the innovation behaviour of Uzbekistan and china SMEs. They identified that age has significant impact on innovation of China SMEs. The model shows younger SMEs are more innovative than large one (Umidjun *et al.,* 2014). Huergo and Jaumandreu (2004) reveal that younger firms have higher probability of innovation than older ones. Furthermore, Hansen (1992) found in a sample of American firms that the number of newly goods through unit of sales and the number of innovative sales are inverse relationship to firm age. On the contrary, the researchers (Sørensen and Stuart, 2000; Avermaete *et al*, 2003). Confirmed that older firms are more likely to introduce new products than younger ones.

Gabsi *et al*, (2008) examined the determinants of innovation in emerging countries at Tunisian firms. Their study found that small firms are more likely to innovate than large firms. Furthermore, a study on firm size and dynamic technological innovation by Stock *et al*, (2002) indicates that smaller firms are high level of innovation performance. To the opposite of this Huergo and Jaumandreu, (2004) argued that large firms are highly innovative and excellent performance in the market. Similarly Laforet, (2006) discovered that large size firm is assume to has a key make possible situation for making high innovation performance.

This encouraged the following fourth hypothesis:

H4: *Innovation performance of SMEs is influenced by their age and size.*

Networking

Innovation procedure is not only an internal process. Firms, particularly small and medium one (Hoffmen, 1998) to generate innovations generally search for mutual assistance by way of external linkage such as research institutions, universities etc. Ford *et al* (2003) define Networking is a structure of social interactions between companies. The empirical studies of Rogers, (2004) and (Radas, 2009) showed that networking are the most important factor of firm's innovativeness. Rogerrs (2004) had carried out research to test whether networking has a significant impact on firm innovation performance (product and process)in both manufacturing and non-manufacturing Australian firms and found that small firms largely depends on external knowledge networking as an input of innovation. In addition, the research studies of (Radas, 2009) particularly on Croatian SMEs explain to the certainty that alliance with further firms or organizations make a greater affect on product and process innovation, while, association with academics and research institutions allocate more on radical product innovation. Additionally, Santammaria (2009) highlight that cooperation of external R&D, hiring of personnel and use of consultants to be largely important outdoor sources of innovation (especially in process innovation) in low and medium technology industries. The empirical studies of Koch and Strotman (2008) and Name (2005) enlighten the fact that networking has a positive effect on SMEs innovation performance (product and process innovation) and increase external source of knowledge. Another hypothesis was defined:

H5: Networking has a positive relationship with product and process innovation of SMEs.

Exports and firm performance

Various empirical studies have describing the association between exporting and innovation performance of firms (Greenaway and Kneller, 2005; Soloman and shever, 2005). For example, Uterlass (2013) find export has positive relationship with innovation of firm. Damijan and Kostevc (2008) examined data of Slovenian firms from 1996 to 2002 and conclude that exporting strongly positive associated with innovation. The studies of Soloman and shever (2005) test innovation by exporting for Spanish firms from 1990 to 1997 by analyzing non linear GMM model and they finding that exporting

positive relation with innovation. Girma *et al*, (2008) conclude that exporting increases innovation capability in Irish firms uses bivariate probit model. Similarly, Damijan *et al*, (2008) examined survey data of innovation, production and trade information in Slovenia firms from 1996 to 2002 by estimating bivariate probit regression and concluding that exports positive impact on product and process innovation. For Chilean manufacturing industries Alvarez (2016) investigated survey of 541 firms and found that exporting positively and significantly influenced innovation. Similarly, the research study of Bratti and Felice (2009) showed that through learning by exporting, exports status of firm have positive effect on product innovation. Vannoorenberghe (2015) estimated firm level data of 500 African firms and found that exporting significant impact on innovation. From this literature it is shown that exporting has a positive influence on SMEs innovation performance. Our hypothesis is:

H6. Exports positively influence the firm's innovation performance.

Methodology

In this section, the methodology is discussed in terms of role of SMEs in Pakistan economy, the data sources, firms' characteristics and regression analysis. STATA 13 software was used for analysis.

SMEs in Pakistan economy

Pakistan is the second largest economy in South Asia, indicating about 15% of regional GDP. According to World Bank report (2014) Pakistan GDP per capita $1427 and growth rate 4.24%. Small and medium enterprises (SMEs) sector has seen major changes around the world. In the economic development of the developed and developing countries, Small and Medium Enterprises (SMEs) played a very important role (Ahmadani *et al*, 2012). As argued by (Ahmad *et al*, 2011; Akhtar *et al*, 2011) that SMEs are important source to reduce poverty, basic source of employment and social uplift, major participation to the growth and competitiveness of the economy. On the other hand, in compare to their involvement, SMEs are face up with significant barriers which hamper their development. In Pakistan more than 90%[4] of enterprises are SMEs, shared 40% to annual GDP, 46.5% exports and approximately 78% of the workforce[5] is employed in the business sector.In developing countries SMEs are lower survival rate because they had unenough financial resources and on the other hand innovation activities (i.e.R&D) are risky and has large cost, this suggest that SMEs are less innovative that large firms. This empirical study examines the determinants of innovation performance of SMEs that are derived from previous literature.

However, the level of SMEs productivity and innovation performance is an important issues related to Pakistan still pending. The proposed research will investigate the innovation performance of Pakistani SMEs; it is an interesting and challenging task, especially when investigating this lack of research for SMEs in developing countries. These facts about to the innovation performance of Pakistani SMEs and the lack of

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[4]World Bank Report, of Pakistan Country Assistance Strategy, Annex II, Page 3.
[5] Survey of Establishments-1998.

research on manufacturing sector in general motivated this researcher to analyze this sector of economy through an empirical analysis.

Data Source

This research is based on dataset of Enterprise Survey of Pakistan carried out by World Bank in 2014. In this research the researcher used cross-sectional data. The survey contains data for 1247 enterprises including manufacturing sector (90%) and service sector (Retail and other services) 10%. While some values are missing of each variable's using in this studies. The sample of 1247 firms comprises 509 small firms (5 to 19 employees), 471 medium firms (20 to 99 employees) and 267 large firms (more than 100 employees). The strength of the data provides vast and comprehensive information of the key variables such as internal/external R&D, product and process innovation, absorptive capacity, networking, age and exports. Whereas, the cross-sectional data is limited, so it is not enough to find causal relationship between the variables.

Dependent variable

Large number of researchers used different indicators for measure firm innovation performance (Hermansen, 2011; Conte and Vivarelli, 2013; Aghion *et al*, 2017). In this paper two proxies are used for measuring firm innovation performance (i.e. product/process innovation) also used by the earlier researchers (Prajogo and Ahmad, 2009).

Independent Variables

From the literature it is suggests that R&D (i.e. internal/ external R&D), absorptive capacity, networking, firm size and age are the important factors that are expected to have a positive impact on innovation performance of firms. Additionally, in this studies exports has used as independent variable in the empirical analysis by the following reasons. Export would improve the firm process innovation because in international markets firm learn innovation process for highly innovation products and as well as increases the competitive advantages in international market. (Neve *et al*, 2016).

Descriptive analysis

In this section we discuss the firm's innovation characteristics. Table 1 presents the information of firm innovation characteristics. Out of the total 1212 firms, 17% firms engage in R&D. 7% of firms are undertaking internal R&D, while 23% firms of the sample undertaking external R&D. In addition, 30% of firms introducing product innovation and 26% of firms introducing process innovation. Approximately, 54.4% of firms are engaged in absorptive capacity. Similarly, 26% of firms make networks with other firms and institutions.

Table 1 shows the innovation activities of firms.

Table: 3.1 Innovation activities (figures are inRow %)				
Variables	N	Yes	No	Total
Internal R&D	653	7	93	100
External R&D	670	23	77	100
Product Innovation	1212	30	70	100
Process Innovation	1225	26	74	100
Absorptive capacity	1247	54.4	45.6	100
Networking	1177	26	74	100

Source: Author Own Calculations

Firm's Innovative activities by size wise

Table 2 summarizes the innovation activities in Pakistanis small firms on the basis to their size. From this table we draw the following insight.

Table 2 Innovation activities size wise (figures are presented row wise in percentages)

Variables	Size	N	Yes	No
	Size1 (1-4)	43	1.1	12.6
Internal R&D	Size2 (5-19)	285	2.8	91.6
	Size3 (20-99)	230	9.1	67.7
	Size4 (>=100)	138	9.8	37.5
	Size1 (1-4)	43	0.4	13
External R&D	Size2 (5-19)	285	13	40
	Size3 (20-99)	230	6	70.2
	Size4 (>=100)	138	8.4	37.5
	Size1 (1-4)	79	27	73
Product innovation	Size2 (5-19)	490	21	74
	Size3 (20-99)	372	34	63
	Size4 (>=100)	271	38	61
	Size1 (1-4)	77	27	71
Process innovation	Size2 (5-19)	498	19	80
	Size3 (20-99)	377	26	72
	Size4 (>=100)	273	37	63
	Size1 (1-4)	79	3.6	12
Absorptive Capacity	Size2 (5-19)	505	27.5	72.5
	Size3 (20-99)	387	38	38.6
	Size4 (>=100)	276	43.6	11.1
	Size1 (1-4)	77	18	80
Networking	Size2 (5-19)	474	12	83
	Size3 (20-99)	357	26	67
	Size4 (>=100)	269	47	51

Source: Author own Calculations

The table 2 obviously indicates that majority of large firms (>=100 employees) are engage in R&D as compared to other size (size1 to size3). Additionally, the proportion of firms that carry out the innovation activities rises directly with firm size. So we conclude that a large amount of the innovative activity is identified among the large firms in the sample. This finding is on accordance with prior findings, such as Dilling-Hansen *et al,* (1998), who found that large firms are more probably to engaging in R&D than small firms.

Regression analysis

Table 3 indicates information of the list of variables which is using in regression model. Their definitions, means and standard deviations (i.e. measure of dispersion). Furthermore, the firm's financial information i.e. exports and productivity has been changed into international currency (US$). The average exchange rate has been calculated i.e.US$ 1= 104 PKR in the year 2014. First using the correlation matrix before estimation to find the correlation between the two variables and shows that any variable that is perfectly correlated with itself (i.e. see Table 4.2). The following table indicates the correlation of the variables of our model. And we discover the Pearson Correlation of the variables, to see whether the variables correlation greater than 0.80 or 80%. If it is greater than 0.80 then we have Multi-Collinearity. The correlation matrix is using to investigate the multicollinearity problem. Multicollinearity is the problem resulting when some or all of the independent variables are highly correlated with each other and it is hard to tell which variable is influencing the predicted variable (Koop, 2004). Overall, no variables showed multicollineairty. And this suggests no multicollinearity exist in the proposed variables of our model.

Table 3 shows data variables and their definition.

Variable Name	n	Definition	Mean	std.Dev
Internal R&D	653	Dummy valued 1 if firm undertake Internal R&D, otherwise 0	0.06	0.246
External R&D	670	Dummy valued 1 if firm conduct external R&D undertaking by other firms, public or private research organization	0.22	0.417
Product innovation	1212	Dummy valued 1 if firm with new or significantly improved products / services	0.30	0.458
Process innovation	1225	Dummy valued 1 if firm with new or significantly improved process	0.26	0.437
Absorptive capacity	1247	Dummy coded 1 if firm gain	0.46	0.498
Networking	1177	Dummy valued 1 if firm cooperate innovation activitieswith other firms or science and technology institutions	0.25	0.435

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Variable Name	n	Definition	Mean	std.Dev
Log Age	1125	Log (2014- Age)	0.52	0.500
Log Export	562	Direct exports plus indirect exports	2.64	11.859
Micro (1-4) employees	79	Dummy valued 1if firm employees are between 1-4	0.06	0.244
Small (5-19) employees	505	Dummy valued 1if firm employees are between 5-19	0.40	0.491
Medium (20-99) employees	387	Dummy valued 1 if firm employees are between 20-99	0.31	0.463

Source: Author own calculation

Table 4 shows correlation matrix of all variables

	Prd-Inno	Prc-Inno	In-R&D	Ex-R&D	Abs-Cpt	Network	Age	Export	Micro	Small	Medium
Prd-Inno	1										
Prc-Inno	.629	1									
In-R&D	-.035	-.026	1								
Ex-R&D	.045	.037	.307	1							
Abs-Cpt	.303	.336	.024	.078	1						
Network	.235	.278	.014	.022	.620	1					
Age	.166	.143	.018	.007	.122	.066	1				
Export	.057	.150	-.065	-.029	.182	.135	.076	1			
Micro	-.018	.010	-.003	-.010	-.119	-.043	-.057	-.064	1		
Small	.147	.128	-.037	.016	-.300	-.255	-.133	-.013	-.215	1	
Medium	.075	.006	.010	.004	.054	.032	.055	.046	-.174	-.153	1

Prd-Inno indicates product innovation. In-R&D indicates internal R&D.
Prc-Inno indicates process innovation. Ex-R&D indicates external R&D
 Abs-Cpt indicates absorptive capacity.

Regression Model

Bivariate probit model was used to examine the determinants (independent variables) of product and process innovation (dependent variables). From this study we have excluded one variable of large firms because it produced multicollinearity within other size firms and this study hold only estimation of SMEs. Bivariat model estimates by Wald test to test interesting hypothesis. This model contains two equations and everyone has two binary choice models.

$$Y^*_1 = x_i\beta_1 + \varepsilon_1 \ldots\ldots\ldots\ldots\ldots (1)$$

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$$Y^*_2 = x_i\beta_2 + \varepsilon_2\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

Where Y^*_1 and Y^*_2 are the two unobserved latent variables depends on x_i. X_i is a common vector for both independent variables with estimator's β. The error terms ε_1 and ε_2 are equally normally distributed with constant variance and zero mean; hence the observed variables are the following.

$$Y_1 = \begin{Bmatrix} 1^{if\ y^*_1 > 0} \\ 0_{if\ y^*_1 \leq 0} \end{Bmatrix}$$

$$Y_2 = \begin{Bmatrix} 1^{if\ y^*_2 > 0} \\ 0_{if\ y^*_2 \leq 0} \end{Bmatrix}$$

Table 5 shows Bivariate Probit Regressions for Pakistani SMEs

Table 5 Results of Bivariate Probit Regressions for Pakistani SMEs Model 1

Independent variables	Product innovation		Process innov1ation	
	Coefficients	z-valiue	Coefficients	z-value
Intern1al R&D	-0.3565 (0.4432)	-0.80	-0.9121 (0.6408)	-1.42
Exter1nal R&D	0.1651** (0.3219)	2.51	0.0155** (0.3152)	3.15
Absorptive capacity	1.0252*** (0.2905)	3.53	1.0253** (0.2963)	3.46
Networking	0.1694** (0.3042)	5.16	0.1086** (0.3182)	2.34
Log Age	0.0635** (0.2385)	2.27	0.3032** (0.2434)	3.25
Log Export	0.0188 (0.0089)	1.19	0.0228** (0.0108)	2.11
Micro (1-4) employees	-4.6325*** (0.3277)	-14.13	-4.9132*** (0.3142)	-15.64
Small (5-19) employees	-0.1642* (0.3164)	-2.52	-0.4827 (0.3406)	-1.42
Medium (20-99) employees	0.3749 (0.2844)	1.32	-0.1456 (0.2804)	-0.52
Constant	-1.2165** (0.3521)	-3.46	-1.4779*** (0.3328)	-4.44
Rho product innovation	0.9252*** (0.0414)	5.64	-	-
Rho process innovation	0.7856*** (0.9752)	5.64	-	-
Wal1d te1st r1ho=0 ch1i2(1) = 31.8169 Pro1b> chi2 = 0.000				

*** (**, *) represents a significance level of 1% (5%, 10%) respectively.
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Table 5 shows the result of the bivariate probit regression. Which indicate the systematic relations between determinants of product and process innovation in Pakistani manufacturing SMEs. The one variable large size firm is excluded from regression due to co linearity. The coefficient of internal R&D is negative and insignificant which shows that 1% rise in internal R&D decreases product innovation by 35% and process innovation by 91%. This result rejects our hypothesis and consistent with the findings of (Rehman, 2016; Santamarria *et al*, 2009) found that internal R&D has been statistically insignificant impact on product and process innovation in SMEs. This outcome shows the evidence that Pakistani SMEs have small assets and innovation activities have large fixed cost and uncertainty which reluctant the SMEs to take internal R&D.

In contrast external R&D has positive and significant effect on both product and process innovation. The coefficient value of external R&D indicates that 1% rise in external R&1D increases the probability of SMEs product innovation by 16% and process innovation by 15%. This outcome suggests that outsourcing R&D with other firms or research organizations would increase the product and process innovation. These results support our hypothesis and the finding consistent with the earlier literature review Segarra and Teruel, 2011; Mukherjee *et al*. (2013). The coefficient of absorptive capacity is positive and highly significant impact on product and process innovation. The coefficient value of absorptive capacity increases the probability of product innovation by 102% and process innovation by 125%. This outcome supports the initial hypothesis. Networking with other firms, organizations and research institutions show positive and significant relations with product and process innovation which means that increasing the probability of SMEs product innovation by 16% and process innovation by 10%. This implies that networking improve the innovation behaviour of SMEs since it allocate firms easier access to new concept and increase the knowledge transfer from institutions to business activities because SMEs suffer from limited resources such as shortage of finance, time and good market information, limited skills of owner-manager's in marketing. This result also confirm earlier findings, including those by Rogers (2004); Rammer *et al.*, (2009).

Age has a positive and significant impact for both product and process innovation which suggest that older Pakistani SMEs incline to invest more in R&1D activi1ties than do younger firms' and hence more likely to introduced both product and process innovation than younger, this finding with the line of Arrow, (1962); Sorensen and Stuart, (2000); Change *et al.,* (2002). The coefficient of export has been a positive and insignificant association to product innovation but posi1tive and signif1icant imp1act on process innovation. This reflects that firm engaged in export would improve the firm process innovation because in international markets firm learn innovation process for highly innovation products. This result confirms the finding of Neve *et al*, (2016).

Micro firms (1-4) ha1s a negative an1d signi1ficant imp1act on both prod1uct and proc1ess innov1ation. Similarly, small firms (5-19) ha1s a negative an1d insignificant imp1act on both pro1duct and proc1ess innov1ation. This means that Pakistani SMEs has lesser probability for both pro1duct and pro1cess innov1ation. This result suggests that SM1Es are less innovative than large firms because innovation activities are risky and expensive. This result confirms the similar finding of Dundas, (2006); Rammer et al, (2009). Medium firms (20-99 employees) ha1ve a pos1itive insignificant imp1act on probab1ility of product innov1ation but have a negative insignificant impact on pro1cess innov1ation. This suggests that Pakistani SMEs are not likely to spend on process innovation. The reason is Pakistani SM1Es are lack of enough financial resources.

The value (i.e. 0.9252) of Wald test rho is positive and significantly. It shows that the two results are related positively to both dependent variables.

Conclusion

To date, not even a single study has been carried out to explore the innovation performance of SMEs for Pakistan. Our findings indicated that Pakistani SMEs are less probability to introduce product and process innovation. The result shows that small number of Pakistani SMEs was involved in innovation activities. Further the knowledge based resources like as external R&D, networking, exports have positive relationship with product and process innovation. Internal R&D has negative relationship with innovation. This implies that Pakistani SMEs are resource constraints and unable to invest in R&D because R&D has high cost and a risky project.

Public polices of SMEs related must transformed to enhance their innovation output. Firm size has negatively related with innovation performance. This result suggests that small firms are less innovative than large firms because innovation activities are risky and expensive and small firms are fewer resources.

In summary, SMEs are required to increase the investment in knowledge based assets (i.e. R&D, networking, and absorptive capacity) for improvement of innovation performance and productivity. This provide a way for policy makers to take into account the requirement for such knowledge based assets and should contribute private and public sectors organizations to boost up their innovation output. The need of further work to understanding who less innovative firms becomes more innovative.

In the last, this paper addresses certain limitation like as non-availability of patent citation information and firms received which type of support program of innovation. This measure provides additional insight to innovation more

appropriately. In this study causality between exports and innovation is not discussed. It will be left for future research.

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