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Understanding how Complementarities in Innovation Affect Firm Performance: Evidence from Pakistan

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Abstract: *We use primary data collected from firms in the textile, light engineering and automotive sectors of Pakistan to measure the impact of various types of innovation on firm performance. We estimate a modified version of the CDM model to explore the impact on firms of complementary adoptions of innovations. This heterogeneity in adoption is the result of an uneven distribution of the sources of innovation across sectors. We focus on five different types of innovation: technological, product, process, marketing and business model innovations. We begin by estimating the individual impacts of each of these types of innovation on firm revenue, cost of production, product quality and price of the final product. We then explore the joint impact of multiple innovations on these same firm outcomes. Our results show that both product and technological innovations have a significant impact on firm outcomes. We then find a significant positive impact of joint adoption of innovations in firms who adopted process and technological innovations, product and technological innovations and marketing and technological innovations as well as in those firms who adopted both process and business modelling innovations. Lastly, we show that most of these benefits are experienced by younger firms, smaller firms and exporting firms.*

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Understanding how Complementarities in Innovation Affect Firm Performance: Evidence from Firms in Pakistan

1. Introduction

While the literature on the importance of innovation in economic growth is well established (Schumpeter, 1942), more recent firm-level analyses have investigated how innovation and R&D expenditures can affect firm productivity (see for example Griliches, 1998,, O' Mahony et al., 2010, Abazi-Alili et al., 2017, and Exposito & Sanchis-Liopis, 2018). The available literature then turns towards distinguishing between different types of innovation, such as product or process innovation, and focuses upon separating the impact of these different innovation types on firm level outcomes (see for example Hervas-Oliver et. al., 2014 and George & Teimuraz, 2018). In this paper, we use a unique dataset from a developing country to analyze the impact of different types of innovation on firm outcomes and then extend this to see how these different innovation types may interact when introduced simultaneously to affect firm performance. We argue that different types of knowledge resources within a firm may have varying impacts on the firm's performance, and that these different types of knowledge may interact with each other in complex ways that can either enhance, or hinder, firm performance.

Innovation is understood to be critical for firm growth, but it is also important to understand that firms need to be able to use their knowledge resources to innovate in an environment that is characterized by limited resources (human, financial and technical), rapid change and in the case of many developing countries, significant instability. So, while firms may realize that innovation is important, these constraints limit the number of innovation related activities that firms engage in. At the same time, certain types of innovations may need to adopt another type of innovation at the same time to have a significant impact. A firm may develop a new product (i.e., engage in product innovation), for example, but may at the same time need to develop a new marketing strategy to ensure that the demand exists for this new product (i.e., engage in a marketing innovation). As a result, the impact of complementary innovations (product and marketing) may have a different impact as compared to when each innovation is introduced at different times. We emphasize the importance of the adoption of specific types of innovation alone, as well as the dual combination of this adopted technology with other specific forms of innovation, in order to enhance a firm's performance.

In this paper, we analyze the impact of five types of innovation on firm performance: product innovation, process innovation, technological innovation, business modelling and marketing innovation. We then test to see if innovation complementarities, i.e., whether two different types of innovations adopted simultaneously, exist and impact firm performance. Finally, we test to ascertain if the impact of innovation differs for different types of firms, such as larger firms, older firms and exporting firms.

Our results are important for a number of reasons. First, they add to a small but growing body of literature on the impact of innovation on firm performance in a the context of a developing country. Second, this paper aims to add to recent literature on the benefits of complementary innovations introduced concurrently at the firm level. Understanding which combinations of innovation are most conducive to enhancing a firm's performance can aid managers in optimizing their innovation strategies and resource allocation, which in turn can result in competitive advantages for modern firms operating in a dynamic market landscape. Third, the results from this paper will be useful from a policy perspective, since governments have focused on promoting domestic innovation to gain economic as well as strategic advantages.

This study recognizes that innovation is rarely a singular effort and often involves the combination of different types of innovation. Therefore, a crucial objective of this research is to investigate how the combination of two specific types of innovation can result in varying impacts on firms. For instance, exploring the *'synergistic effects'* of product innovation coupled with marketing innovation might yield different outcomes compared to the combination of process innovation with business modelling innovation.

Adopting multiple innovations simultaneously can offer several advantages to firms. First, that simultaneous adoption could provide diversified skills, perspectives and insights for solving various problems that exist within and outside of firms. Second, the pairing of different forms of innovations can create synergies where the strengths of each can complement leading to better firm level outcomes. Third, opting to adopt complementary innovations may give firms a competitive advantages in an ever-changing global environment.

However, there are also possibledisadvantages associated with adopting complementary innovations. First, there may be higher costs associated with managing and integrating knowledge from different domains that may be time consuming and complex. Second, adopting multiple innovations simultaneously may split managerial focus, which in turn could have detrimental impacts. Third, new problems may occur as firms try to adopt multiple innovations simultaneously. Fourth, certain innovations may be incompatible as natural synergies may not exist, which in turn can negatively impact firm performance. Lastly, there is the possibility of resistance within firms as they attempt to adopt complementary innovations. These potential disadvantages imply that not all innovations are naturally complementary which makes the analysis of the impact of different combinations of innovations a relevant issue at the firm level.

The analysis in this paper utilizes data from a unique sample of Pakistani manufacturers from Sindh and Punjab. This list was developed using the Punjab government's Directory of Industries, which is also used in the Pakistan Census of Manufacturing Industries (CMI). The surveyed firms were taken from the textile, light-engineering and automotive sectors which have special relevance in the context of Pakistan.

The textile sector is critical in the context of Pakistan for multiple reasons. First, textile exports make up approximately 60% to Pakistan's total exports. Textile output also accounts for 46% of the total manufacturing output in the country and the sector employs around 40% of the total labor force (PBIT,2022). This sector has attracted foreign investment and is well integrated in global supply chains which means that firms in the sector should be engaging in innovation. Similarly, the automotive sector is a significant contributor to Pakistan's GDP and has ensured substantial revenue and employment opportunities. It has a wide-ranging value chain, from vehicle assembly, to auto parts manufacturing, creates significant employment for both skilled and unskilled workers. As Pakistan's middle class expands and there is also significant potential for the export of auto parts, upgradation in manufacturing capabilities is strongly linked to innovation. Also, the presence of multinational automakers in Pakistan has facilitated the process of technology adoption and knowledge sharing in this sector hence making it an important sector for our research.

The surgical sector also contributes significantly to Pakistani exports and many of their goods are destined for markets in high income countries. In order to maintain market share in these economies, innovation plays a critical role. The final sector under analysis, the light engineering sector, plays a critical role in the domestic economy since it not only provides critical products but also provides a significant amount of employment in Pakistan. But this sector has faced significant competition from Chinese imports and innovation is critical for its survival. innovation in light engineering sector is crucial to ensure efficient lighting solutions by implementing energy-saving technologies and practices. Basic infrastructure development, urbanization, commercial facilities, agricultural and farming expansion all require efficient lighting design and practices that may in future facilitate better standard of living and push the local manufacturers to export the lighting products and expertise to regional markets.

We use detailed primary data (already collected by the Lahore School) from firms in Pakistan's textile, light engineering and automotive sectors. The relevance of these sectors for Pakistan is especially acute due to the fact that the products produced in these sectors are also exported to the world market. We argue, therefore, that any improvements in efficiency of these firm and quality of the products due to innovation could eliminate excess pressure on the balance of payments.

In our analysis, we used a modified version of the Crepon-Duguet-Mairesse (CDM) model which corrects for the simultaneity and selectivity bias in the estimation process to explore heterogeneity and complementarities amongst the adoption of innovations and how these innovations affect firm performance measured by revenues, the cost of production, the quality of the final product and the market price of the final product. The CDM model addresses the problem of endogenous adoption of innovation by using an instrumental variable approach. The issue of endogeneity arises as firms that decide to adopt innovation might have certain unobservable characteristics that affect both their decision to innovate and their performance. This creates a potential bias in estimating the impact of innovation on firm performance. To overcome this endogeneity problem, the CDM model employs instrumental variables that are correlated with the decision to adopt innovation but do not directly affect the firm's performance.

The focus of the paper is to address three main research questions: First, we estimate the combined impact of innovation on three main firm’s performance indicators in Pakistan, i.e., on the increase on the revenues, decrease in the prices of the final products produced by them and lastly on the reduction in costs experienced by the innovating firms. Second, we disaggregate the impact on these same outcome variables of five different types of innovations: technological innovations, product innovations, process innovations, marketing innovations and business model innovations. Third, we explore complementarities between adopting two different types of innovations and argue that pair-wise adoption of innovations may impact firms differently as compared to the adoption of individual innovations.

Finally, we test to see if the impact of innovation varies across different types of firms, where firms are differentiated based on size, age and their status as an exporter and the type of destination country (developed versus developing) that they export to. We find that certain types of innovations are complementary and that their simultaneous adoption results in improvements in certain firm level indicators and that the benefits of innovation are experienced by younger firms, smaller firms and exporting firms.

The paper is divided in five sections: The Introduction, followed by a review of the literature. We then discuss our empirical strategy and methodlogy in Section 3 and present our results in Section 4. We conclude in Section 5.

2. Literature Review

In recent years, there has been a growing interest in understanding the impact of different types of innovation on firms, according to various performance indicators. Understanding the dynamics of innovation within firms has become an important area of research, as organizations attempt to stay competitive in in a rapidly changing global environment. Some authors have found positive effects of innovation on the output of firms (Crepon et al., 1998; Criscuolo,2009; Mohnen & Dagenais, 2002; Stojcic, 2013; Janz et al., 2004) while others have found mixed results in regards to the firm level impacts of different forms of innovation and their specific effects of innovation firm outcomes. In order to motivate our analysis, it is useful to look at the literature on the various types of innovation analyzed in the literature, and the effects of these innovations on firms in Pakistan.

2.1 Technological Innovation

One of the most common forms of innovation is technological innovation. Much of the literature analyzing the impacts of technological innovation has focused on the number of patents across countries or firms as a proxy for innovation and their impact on productivity. An example of a cross-country analysis is the work by Al-Azzawi (2012) which examines how innovation affects productivity in the host and home countries through foreign direct investment. The article by Al-Azzawi (2012) uses the number of new patents as a measure of innovation and finds that the relationship between innovation and productivity is different between countries that are technological leaders as compared to those countries that are technological followers. It explores the dynamics of knowledge transfer through FDI and its influence on knowledge creation and productivity in both source and recipient nations. To assess the extent of knowledge access facilitated by FDI, patent citations within FDI are utilized, while new patents are employed as an instrument for innovation. The author finds substantial variations in how FDI influences innovation and productivity, particularly when distinguishing between countries at the forefront of technology and those following technological trends. In the context of countries that track technological advancements, Al-Azzawi (2012) looked at the impact of inbound and outbound FDI on domestic innovation and productivity. It has been found that in technologically advanced nations, outward FDI increases domestic innovation, while inward FDI fosters heightened competition between domestic and foreign enterprises, potentially hindering the creation of innovative ideas. On the other hand, countries that not on the technology frontier benefit from inward FDI which leads to greater domestic productivity.

Similarly, Peri (2005) investigated the impact of knowledge dispersion and its impacts on productivity of R&D in innovation for 147 European, Canadian, and US regions. The author uses patent citations as a proxy for knowledge diffusion and finds that foreign research and development investments have a sizable positive and considerable impact on domestic innovation, which boosts productivity.

Many other authors have also taken a look at firm level data within a country or region. Aboal & Garda (2015) investigate the relationship between innovation outputs, investment in innovation activities, and productivity in the Uruguayan manufacturing and services sectors. The degree of investment in innovation activities and the size of the firm are the primary determinants of technical and non-technological innovations. The findings show that improvements in the productivity in the service sector firms are significantly correlated with both technological and non-technological advances. However, only technological advancements are important for productivity growth in the manufacturing industry. The authors also find that the productivity of small businesses is more dependent on technological advancements and they reason that this is because these small firms are significantly behind the technology frontier which means that technological advancements have the largest impacts on productivity in these firms. Fu, Mohnen, & Zanello (2017) analyzed data from a special innovation survey of 501 manufacturing enterprises in Ghana using a structural model. They found that technology advancements have a greater positive influence on firm-level labor productivity than management innovations. They also found that the impact of innovation on productivity is typically greater in firms in the formal sector.

2.2 Product & Process Innovation

As researchers expand their definition of innovation beyond technological innovations, there is greater interest in product and process innovation. Product innovation is defined as when a firm introduced a product that was new to the firm, new to the country or new to the entire industry while process innovation is defined as when a company modifications to their production process (affecting machines, organizations, or both) throughout the course of the year. Huergo & Jaumandreu (2004) uses semi-parametric techniques to examine the direct effects of process innovation and firm age on productivity growth. Using an imbalanced sample of more than 2300 businesses studied between 1990 and 1998, the authors found that new firms typically exhibit faster rates of productivity growth through innovative techniques and the learning by doing. These increase in productivity are either the result of the need to immediately adjust to industrial competitors or because firms adopt new procedures to outperform their industrial competitors. Extra growth typically lasts for a number of years, but if innovation stops, it is followed by productivity growth that is significantly below the industrial average. According to their estimates, even non-innovative enterprises see productivity gains as a result of process innovation spillovers.

Masso & Vahter (2008) utilize firm-level data from two different sets of the Community Innovation Surveys done in Estonia from 1998 to 2000 and 2002 to 2004 to investigate the association between innovation and productivity in the manufacturing sector. Applying a structural model, they found that only product innovation enhanced productivity from 1998 to 2000, while only process innovation affected productivity from 2002 to 2004. They attributed this difference to the different macroeconomic environments during these two time periods. Similarly, (Demmel, Manez, , Rochina-Barrachina, & Sanchis-Llopis, 2017) examine the relationship between innovation and productivity for the manufacturing sector in four Latin American countries, focusing on innovations in processes and products. The author tested whether the degree of development is a mediating element in the relationship between innovation and productivity using a panel of enterprise surveys for the years 2006 and 2010. The authors found that the level of development plays a mediating role in the innovation-productivity relationship.

Another strand of literature links variations in the demand for firm products, as opposed to technical efficiency, to firm survival and increased output in the long run. Based on this argument, it is product innovation and not process innovation that affects productivity in the longer run since product innovation is related more to firm specific demand variations while process innovation is expected to affect technical efficiency of a firm. While a similar strand of literature discusses the relevance of R&D investment in enhancing high-tech exports across the OECD countries, while their market size does not exert a pressure on high technology trade (Braunerhjelm and Thulin, 2008).

2.3 Business Model Innovation

Another area in which business innovation can take place is in the area of a firm's business model. A firm's business model is a structural template that describes the system of interrelated activities of the local firm in order to create value (Zott & Amit, 2001). In this sense, the business model is a strategy followed by a firm that combines complementary resources which also supports the commercialization of core products (Vidal and Mitchell, 2013). This means that an innovation in a firm's business model involves a more systemic change than product or process innovation because it involves changes in customer value proposition and value creation (Markides, 2006; Velu & Stiles, 2013). Researchers have found that business model innovation helps firms gain a competitive advantage and is also important for firm managers as they work to inceasing productivity (Baden-Fuller and Morgan, 2010; Calia et al., 2007; Esslinger, 2011). Hence, the degree of business model innovation can have a different effect on firm performance as compared to product or process innovation. Furthermore, it is also important for the survival of new firms who want to gain a competitive position in the market. Empirical evidence has shown that firms who focus on business model innovation experience significant growth. Similarly, Wannakrairoj & Velu (2020) offer empirical evidence that the Solow productivity paradox may be partially explained by business model innovation. The authors test to see if business model innovation is a key organizational aspect and potential explanation foraffects total factor productivity . The net asset turnover ratio (NATO) is used to measure business model innovation. Using the net asset turnover ratio NATO as an instrumental variable for business model innovation and find that this innovation has a significant impact of IV the results show that it increases a firm's overall productivity

2.3.1 Marketing Innovation

Implementing novel marketing techniques is important as firms introduce new products or access new markets. These innovations specifically consist of modifications to product design and packaging, as well as modifications to sales and distribution strategies. Junge, Severgnini, & Sørensen (2015) used surveys and data from registered Danish firms to examine the effect of product and marketing innovations on productivity growth. Using instrumental variables, the authors find that product innovation and marketing innovation complement each other and are key growth drivers for firms if adopted together. The authors find that that skill-intensive businesses that pursue product and marketing innovation expand more quickly than other types of businesses. Businesses that only engage in either product innovation on its own or marketing innovation on its own do not experience higher productivity growth. The authors also find that in comparison to non-skill-intensive enterprises, skill-intensive firms see better productivity growth rates as a result of innovation activities.

Our paper aims to investigate the influence of various types of innovation on performance indicators of Pakistani firms, including the likelihood of revenue growth, price reduction, and cost reduction. We begin by analyzing the individual effects of each type of innovation on the aforementioned performance indicators. We then investigate the existence of complementarities between different types of innovation. Our analysis reveals that in certain cases, the simultaneous adoption of paired innovations provide additional benefits to firms. This highlights the importance of considering the synergistic effects and potential complementarities between different innovation strategies. Lastly, we explore the heterogeneous impact of various types of innovation based on firm characteristics such as age, size, customer base (foreign vs. local), and export destination.

Through this comprehensive exploration, we seek to contribute to the existing literature by providing a detailed understanding of the impact of innovation on firm performance indicators specifically for Pakistani firms, considering the individual effects of different types of innovation, the potential complementarities between them, and the influence of firm demographics on these relationships.

3. Methodology

We employ the empirical strategy proposed by Crepon, Duguet & Mairessec (2006) to estimate the impact of heterogeneity in innovation on the performance of a firm. Their estimation strategy depends on two equations measuring research behavior (Heckman, 1976; 1979) using a Generalized Tobit model. The first equation measures whether the firm is engaged in innovation and the second equation measures the intensity of the innovation based upon the observed characteristics of the firm which solves the problem of selectivity bias in the innovating firm's equation. Next, we solve for the endogenous decision to innovate and the productivity of the firm by using a two stage least square procedure.

We start by representing the firm's innovation behavior using a latent variable g_i for firm i that takes a value of 1 if the firm is engaged in innovation and 0 otherwise. Using a set of observed variables, we estimate the predicted probabilities of firms engaging in innovation using following specification:

$$g_i = X_{0i}\beta_0 + u_{0i} \tag{1}$$

For the next equation we use, another latent variable K_i that captures the intensity of innovation and estimates the following equation:

$$K_i = X_{1i}\beta_1 + u_{1i} \tag{2}$$

Where K_i is only observable if the $g_i > 1$ and the predicted g_i is greater than the industry's threshold.

At this stage, we can define K_i measure the intensity of investment in any form of innovation. When exploring the impact of different types of innovation, we can redefine K_i based upon the specific types of innovating techniques that the firm had adopted such as: technological innovation, product innovation, process innovation, marketing innovation and business model innovation. This process will generate multiple fitted values: K_{Tech}which will be the predicted values for the intensity of technological innovation, $K_{Process}$ which will be the predicted intensity of process innovation, $K_{product}$ which will be the predicted intensity of product innovation, $K_{marketing}$ which will be the predicted intensity of marketing innovation and $K_{BusinessModelling}$, which will be the predicted intensity of business modeling innovation.

We use a set of explanatory variables which are commonly used in the innovation literature:

$$X_{0i} = X_{1i} = f$$

$$sectorleveldummies, districtleveldummies, firm'sindustrysegments,$$
$$technological\ opportunities, demandconditions, typeofthefirm,$$
$$statusonexports, innovationinputs$$

Next, we use the predicted values from equation (1) and/or equation (2) as instruments in the final specification which solves for the problem of simultaneity between innovation effort and firm's outcomes as discussed in Hall (2011):

$$q_i = \gamma_0 + \gamma_1 K_i + \gamma_2 MR_i + \gamma_3 X_i + u_{2i} \tag{3}$$

Where q_i is the firm's performance indicators which are firm revenues, costs of production and lowering of the price of the final product. Each of these performance indicators are binary response variables. K_i is the latent variable that measures the predicted innovation effort given that those firms invest in innovation. MR is the inverse mills ratio that accounts for the selection bias and lastly, we control for the standard explanatory variables in the equation. u_{2i} is the random error term with zero mean and constant variance.

We use this procedure to answer multiple questions: First, did firm revenues increase as a result of innovation? Second, did innovation reduce the cost of production of firms? Finally, did the firm lower the price of the final product as a result of innovation? K_i u_{2i}

Next, we estimate a modified version of the specification from CDM that captures the heterogenous impact of different types of innovation on the firm performance indicators as follows:

$$q_{i0} = \gamma_0 + \gamma_1 g_{iTech} + \gamma_2 g_{iProcess} + \gamma_3 g_{iproduct} + \gamma_4 g_{iMarketing} +$$

$$\gamma_5 g_{iBusinessModelling} + \gamma_6 X_i + v_{0i} \tag{4}$$

$$q_{i1} = \alpha_0 + \alpha_1 K_{iTech} + \alpha_2 K_{iProcess} + \alpha_3 K_{iproduct} + \alpha_4 K_{iMarketing} +$$

$$\alpha_5 K_{iBusinessModelling} + \gamma_6 X_i + v_{1i} \tag{5}$$

This model not only solves for the problem of endogenous decision of the firm to innovate but also eliminates to problem of selectivity bias in the estimated coefficients of the final specification. Where $u_{0i}$and u_{1i} from equation (1) and (2) are disturbance terms with mean zero and constant variance in each respective specifications that are expected to be correlated with each other but are uncorrelated with $v_{0i}$and v_{1i} from equation (3) and (4) that are expected to be correlated with each other with mean zero and constant variance.

We then test our hypothesis that there may be complementarities between types of innovations adopted by firms which means that the adoption of multiple types of innovation simultaneously may have a significant impact on firm productivity. In order to do this, we introduce interactions between each type of innovation techniques (one at a time, so that we do not lose on degrees of freedom) to our specification. We argue that certain innovation techniques may work well together, while others may not be as compatible. This means that while some synergies may naturally align and reinforce each other, others may not be as compatible and may not generate the same level of positive outcomes.

To do this, we interact with the occurrence of technological innovation with all the other innovational types:

$$q_{i2} = \gamma_0 + \gamma_1 g_{iTech} + \gamma_2 g_{iProcess} + \gamma_3 g_{iproduct} + \gamma_4 g_{iMarketing} + \gamma_5 g_{iBusinessModelling} + \gamma_6 g_{iproduct} * g_{iTech} + \gamma_7 g_{iProcess} * g_{iTech} + \gamma_8 g_{iMarketing} * g_{iTech} + \gamma_9 g_{iBusinessModelling} * g_{iTech} + \gamma_{10} X_i + v_{0i} \quad (6)$$

$$q_{i3} = \alpha_0 + \alpha_1 K_{iTech} + \alpha_2 K_{iProcess} + \alpha_3 K_{iproduct} + \alpha_4 K_{iMarketing} + \alpha_5 K_{iBusinessModelling} + \alpha_6 K_{iproduct} * K_{iTech} + \alpha_7 K_{iProcess} * K_{iTech} + \alpha_8 K_{iMarketing} * K_{iTech} + \alpha_9 K_{iBusinessModelling} * K_{iTech} + \alpha_6 X_i + v_{1i} \quad (7)$$

We then estimate a second set of regressions interacting with the process of innovation, in conjunction with all the other innovation types, a third set of regressions interacting product innovation with all the other innovational types, a fourth set of regressions interacting marketing innovation with all the other innovational types and a final set of regressions interacting business model innovation with all the other innovational techniques.

4. Data and Descriptive Statistics

We discuss the data set and its key features in this section.

4.1 Data

We used primary data from a series of surveys conducted by the Lahore School of Economics with firms in the textile, surgical, light engineering and automotive sectors in Pakistan. The survey measured innovation adoption a well as indicators of firm performance. The sample size consists of 300 firms in Punjab and Sindh selected from the firms listed by The Directory of Industries sample frame, which is same as the one used in the Pakistani Census of Manufacturing Industries (CMI).

4.2 Descriptive and Inferential Statistics

In Table 1, we show sample averages of firm level characteristics of innovating and non-innovating firms.

Table 1: Descriptive statistics for Innovating and Non-Innovating Firms

	Innovating Firms		Non-innovating Firms		
Variables	**Observations**	**Mean (1)**	**Observations**	**Mean (2)**	**Mean Difference (mean 1-Mean 2)**
Approximate Number of Workers	194	164.1753	105	129.5238	34.6514**
Firm's Age	180	23.5167	101	25.4653	-1.9487
Textile Sector	194	0.2938	105	0.2857	0.0081
Surgical Sector	194	0.0155	105	0.019	-0.0036
Automobile Sector	194	0.2629	105	0.2381	0.0248
Lightening Sector	194	0.4278	105	0.4571	-0.0293
Dummy=1 if the Firm Exports	188	0.5106	98	0.3878	0.1229**
Proportion of Output Exported	194	26.2036	105	20.1714	6.0322
Innovation Funded by Equity	194	0.9742	105	0.9238	0.0504**
innovation Funded by Bank	194	0.2474	105	0.3238	-0.0764
Innovation Funded by Government	194	0.0155	105	0.019	-0.0036
Innovation Funded by Research Groups	194	0.0000	105	0.0095	-0.0095
Family-Owned Firm	194	0.0309	105	0.0286	0.0024
Proprietorship	194	0.0052	105	0.000	0.0052
Privately Owned Firm	194	0.0155	105	0.019	-0.0036
Publicly Owned Firm	194	0.0103	105	0.0095	0.0008
Buy New Technology	194	0.6856	105	0.6095	0.076
Make New Technology	194	0.1186	105	0.181	-0.0624
Innovate to Increase market share	194	0.201	105	0.1048	0.0963**
innovate to increase export	194	0.0103	105	0.000	0.0103
innovate to increase competition	194	0.0052	105	0.0286	-0.0234*
Innovate to increase the quality	194	0.0155	105	0.0095	0.0059
Innovate for cost reduction	194	0.0000	105	0.0095	-0.0095
Planning to innovate in Next 12 months	194	0.5876	105	0.3714	0.2162***
innovation led to Increased revenues	194	0.7216	102	0.549	0.1726***
Innovation led to decrease in costs	193	0.4041	103	0.466	-0.0619
Innovation led to increased quality of the Product	193	0.7617	102	0.6667	0.0950*
Innovation led to decrease in Price of Final Product	193	0.7617	102	0.6667	0.0950*

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

We see some key differences between innovating and non-innovating firms in Table 1. First, we see that firms that innovate are significantly larger in size (i.e., have a greater number of workers) as compared to the non-innovating firms. Also, we see that a greater proportion of innovating firms export as compared to non-innovating firms. In terms of firms and their intention to innovate, a greater proportion of innovating firms plan to innovate again in the next twelve months, as compared to non-innovating firms. Further to this, a greater proportion of firms reported that they innovate in order to capture market share, as compared to non-innovating firms.

There are also important financial differences between innovating and non-innovating firms. A larger proportion of innovating firms reported funding innovation through equity as compared to non-innovating firms. Also, a greater proportion of innovating firms reported an increase in revenues as compared to non-innovating firms. Finally, a greater proportion of innovating firms reported a decrease in the prices of their final good as compared to .Number of innovating firms is significantly higher for firms that innovate to capture market share.d to the non-innovating firms.Innovating firms experienced a significant decline in prices of the final product compared to the non-innovating firms.

5. Results

In this section we report the results for the four research questions that we explore in this paper. First, we explore the overall impact of innovation on firm's performance. Second, we separate innovation into multiple categories and test to see which specific types of innovation affect firm performance. Thirdly, we investigate the implications of concurrent adoption of different types of innovation on corporate performance. Last, we explore how firm heterogeneity can affect the relationship between innovation and firm performance.

4.1 Measuring the Aggregate Impact Innovation the Firm's Performance in Pakistan

In Table 2 we report the estimates from our model which analyzes the impact of innovation (regardless of which type) on firm revenues, prices and costs. It is important to point out that the questions in the survey associated with each firm indicator were the following binary response questions: (i) "Did your revenues increase as are result of innovation?", (ii) "Did the price of your final good fall as a result of innovation?". and (iii) "Did your cost per unit of output fall as a result of innovation?"

Table 2: Measuring the Aggregate Impact of Innovation on Firm Performance Indicators

	Revenue Effect		Price Effect		Cost Effect	
Dummy = 1 if Firm has adopted any form of innovation	-0.122*	-0.294	-0.280***	-0.491**	-0.133**	-0.450**
	[0.073]	[0.250]	[0.068]	[0.206]	[0.066]	[0.215]
Age of the firm		0.014***		0.004		0.010***
		[0.003]		[0.003]		[0.004]
Age of the firm Squared		-0.000***		-0.000		-0.000***
		[0.000]		[0.000]		[0.000]
Number of workers		-0.000		-0.005		-0.004
		[0.004]		[0.003]		[0.004]
Number of Workers squared		0.000		0.000		0.000
		[0.000]		[0.000]		[0.000]
Dummy = 1 if the firm exports		-0.006		0.045		0.040
		[0.115]		[0.093]		[0.129]
Dummy = 1 if the firm produces diversified products		-0.378		-0.126		-0.356
		[0.236]		[0.144]		[0.250]
Dummy = 1 if the firm Makes Technology		0.196		0.203		0.102
		[0.141]		[0.144]		[0.148]
Dummy = 1 if the firm Buys Technology		0.221**		0.175*		0.134
		[0.103]		[0.099]		[0.089]
Dummy = 1 if the firm is family owned		-0.186		-0.002		0.121
		[0.231]		[0.152]		[0.253]
Dummy = 1 if the firm is private limited		0.498		0.886**		0.991**
		[0.458]		[0.361]		[0.465]
Dummy = 1 if the firm if public listed		0.755**		0.554**		0.686**
		[0.302]		[0.235]		[0.342]
Constant	0.997***	2.787*	1.489***	3.876***	0.795***	4.515***
	[0.197]	[1.587]	[0.177]	[1.264]	[0.184]	[1.358]
Observations	276	276	275	275	276	276
R-squared	0.012	0.204	0.074	0.276	0.013	0.168
Inverse Mills Ratio		X		X		X
Industry Fixed Effects		X		X		X
City Fixed Effects		X		X		X
Time Fixed Effects		X		X		X
Interaction of City F.E. with Time F.E.		X		X		X

Note: The three different dependent variables of the specifications comprise of dummy = 1 if the firm's revenues increased due to innovation, dummy = 1 if the firm's product price decreased due to innovation and dummy = 1 if the firm's cost decreased due to innovation. The main independent variable is dummy = 1 if the firm decides to innovate. Other independent variables comprise of the firm's characteristics such as firm's age, age squared, number of workers employed by firm, dummy = 1 if the firm exports, dummy = 1 if the firm has diversified products, dummy = 1 if the firm makes the technology, dummy = 1 if the firm buys the technology (keeping does not invest in technology), dummy = 1 if the firm is publicly owned, dummy = 1 if the firm is private limited, dummy = 1 if the firm is family owned (keeping proprietorship as base category). District fixed effects and sector fixed effects for textile, surgical, light engineering and automobile are controlled in the specification. Time fixed effects for years 2018, 2019, 2020 and 2021 are also controlled.
Robust standard errors in brackets are clustered at firm level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The first interesting result is that innovating firms tended to experience higher prices for their final goods as compared to non-innovating firms. Innovating firms have significantly lower probability of decrease in price compared to the non-innovating firms. There could be many potential reasons for this. First, innovating firms could benefit from product differentiation which means that if the innovating firm was selling differentiated products, they could potentially benefit from higher markups. Second, innovating firms may benefit from a first mover advantage which enables them to enjoy some level of market power which enables them to charge higher markups. Lastly, innovating firms may be able to access a different set of buyers (such as those in foreign markets) who may be less price sensitive.

Another result to note is that it is non-innovating firms that tend to experience lower costs as a result of innovation as compared to innovating firms. A potential explanation for this is that innovating firms may experAs firms innovate, furthermore, they may be spending more on research and development as well as on new technology which could increase their costs. At the same time, innovations may require either new workers or an upgradation of the skills of current workers which could in turn increase costs, as innovations are being adopted. There are situations wherein innovating firms can face reduced probability of decreasing costs compared to the non-innovating firms. Such as, innovation through research and development may require significant financial resources. New innovation may make old technologies redundant for which new technology may be installed, resulting in increased costs. Skill development of employees for new innovated processes and implementing technologies may push up the costs as well.

4.2 Measuring the Impact of the Type of Innovation Adoption on the firm's Performance

Next, we look at the impact of particular types of innovations, product, process, marketing, technological and business model innovations, on firm outcomes. The results are presented in Table 3.

Table 3: Impact of Innovation on Firm Performance by type of Innovation

Dependent variables	Revenue (1)	Price (2)	Cost (3)
Business Model	-0.428	0.139	0.191
Innovation Intensity	[0.411]	[0.184]	[0.457]
Constant	2.136**	0.823	-0.170
	[1.064]	[0.546]	[1.228]
Observations	135	135	135
R-squared	0.147	0.092	0.124
Product Innovation	0.856***	-0.175	0.828***
Intensity	[0.287]	[0.271]	[0.284]
Constant	-2.616**	1.450	-2.903**
	[1.180]	[1.127]	[1.214]
Observations	271	270	271
R-squared	0.129	0.201	0.139
Process Innovation	-0.413**	-0.239	-0.284*
Intensity	[0.166]	[0.202]	[0.155]
Constant	1.620***	1.089**	-0.285
	[0.414]	[0.479]	[0.428]
Observations	239	238	239
R-squared	0.081	0.185	0.098
Technology	-0.022	0.259**	0.077
Innovation Intensity	[0.199]	[0.129]	[0.202]
Constant	0.966*	0.071	0.309
	[0.527]	[0.346]	[0.603]
Observations	276	275	276
R-squared	0.110	0.211	0.128
Marketing	-0.122	0.149	0.034
Innovation Intensity	[0.224]	[0.152]	[0.164]
Constant	1.242*	0.233	-0.039
	[0.710]	[0.478]	[0.469]
Observations	228	227	228
R-squared	0.092	0.180	0.106
Inverse Mills Ratio	X	X	X
Sector F.E.	X	X	X
City F.E.	X	X	X
Survey year F.E.	X	X	X
City and Time Cross-products	X	X	X

Note: The three different dependent variables of the specifications comprise of dummy = 1 if the firm's revenues increased due to innovation, dummy = 1 if the firm's product price decreased due to innovation and dummy = 1 if the firm's cost decreased due to innovation. The six different main independent variables in each respective specification comprise of dummy = 1 if the firm innovates, innovates in business modelling, innovates in product, innovates in process, innovates in technology, innovates in marketing. Other independent variables comprise of the firm's characteristics such as firm's age, age squared, number of

workers employed by firm, dummy = 1 if the firm exports, dummy = 1 if the firm has diversified products, dummy = 1 if the firm makes the technology, dummy = 1 if the firm buys the technology (keeping does not invest in technology), dummy = 1 if the firm is publicly owned, dummy = 1 if the firm is private limited, dummy = 1 if the firm is family owned (keeping proprietorship as base category). District fixed effects and sector fixed effects for textile, surgical, light engineering and automobile are controlled in the specification. Time fixed effects for years 2018, 2019, 2020 and 2021 are also controlled. Robust standard errors in brackets are clustered at firm level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The first interesting result is that firms that engage in product innovation have a significantly higher probability of having higher revenues. At the same time, these firms experience lower costs though prices fell (though the latter was not significant). This implies that firms that created new products may have moved to lower quality products which was accompanied by a fall in costs. At the same time, the increased demand for this product led to higher revenues. The fact that innovating firms tended to experience lower costs is also interesting. It is possible that the lower costs are a result of switching to lower quality products which led to a reduction in costs. It is also possible that firms that created new products invested in new technology that lowered costs.

The results also find that firms who engaged in process innovation experience lower revenues than firms that did not engage in process innovation. These firms also experienced higher costs as compared to non-innovating firms. The reason for this may be that new processes tend to take time to adopt which in the short run can increase costs and decrease revenues.

A third important result we see in this analysis is that firms who engaged in technological innovations tended to lower the prices of their final goods as compared to firms that did not innovate. This implies that: technological innovation can result in lower prices for final products bymay have benefited firms by improving production efficiency, reducing labor and material costs, optimizing supply chains, enhancing energy efficiency, and minimizing waste. These cost reductions often allow firms to offer more competitive prices, which can attract a larger customer base and increase market share.

4.3 Exploring the Impact of pair-wise adoption of Innovation

Next, we explored the possibility that pairwise adoption of innovations may impact firm performance. Again, the rationale behind this is that some innovations if adopted simultaneously may lead to natural synergies which in turn may have a greater impact on firm performance than a singular innovation. The results are indicated in the figures below.[1]

Figure 1 shows the impact of pairwise adoption of innovations on firm revenues.

Figure 1: Examining the Impact of Pair-wise Adoption of Innovation on Firm Revenues

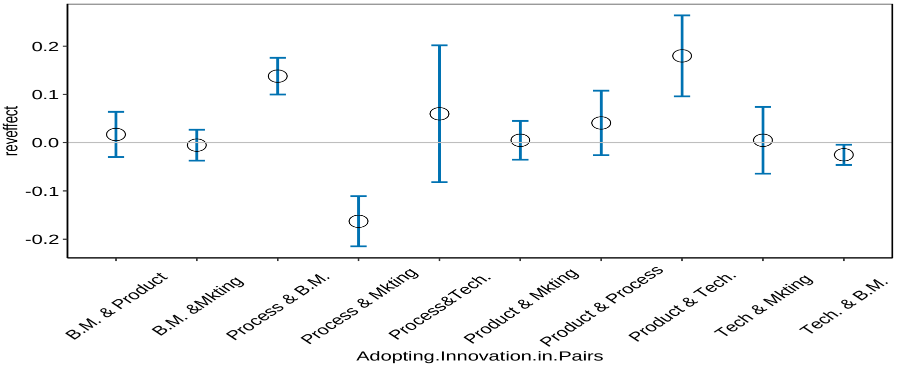


Figure 2 shows the impact of pairwise adoption of innovations on the prices of a firm's final output.

[1] The empirical results associated with each figure are presented in Appendix B.

Figure 2: Examining the Impact of Pair-wise Adoption of Innovation on Firm Output Prices

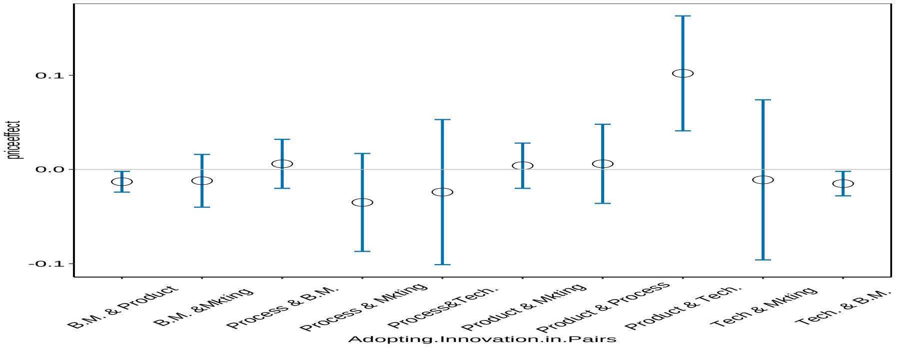
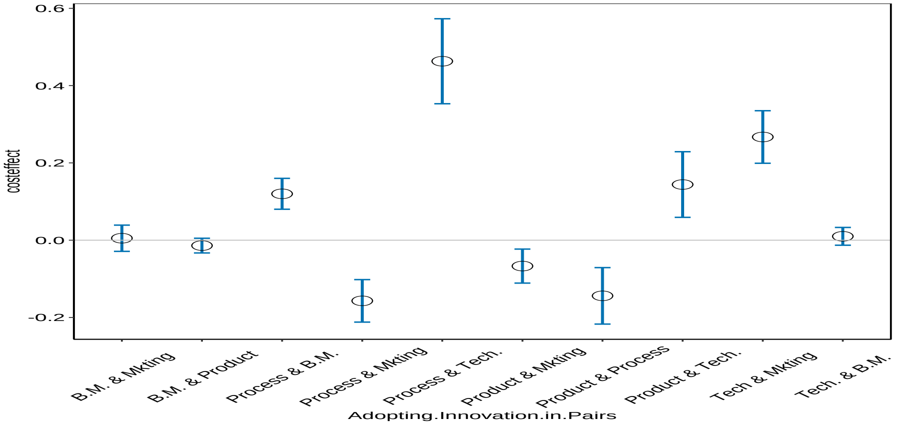


Figure 3 shows the impact of pairwise adoption of innovations on the firm costs.

Figure 3 Examining the Impact of Pair-wise Adoption of Innovation on: Examining the Synergy of Knowledge Capital on the Probability of Ddecreases in Firm's Costs through Pair Adoption



Here we see our first important result: firms that adopted a combination of product and technological innovations experienced higher returns, lower prices for their final product and lower costs. The reason for this may be that product innovations allow firms to develop new products while technological innovations can bring about better capital. It is very possible that new products require the addition of new technology. These new products can expand market reach, and create new revenue streams. At the same time the adoption of this new technology can lead to a fall in costs which allows firms to charge a lower price for their final good.

We also find that firms that adopted a combination of process and business model innovations experienced significantly higher returns. The idea behind this is that process innovations can improve productivity, reduce lead times and enhance customer satisfaction. At the same time, business model innovations can help identify ways to monetize this improved customer experience, potentially leading to higher prices or additional revenue streams. In short, the combination of process innovation and business model innovation can lead to revenue growth by optimizing internal operations, enhancing customer experiences, expanding into new markets, and diversifying revenue streams. The synergy between these two types of innovation can be important for firms seeking to drive revenue enhancement and maintain competitiveness in evolving markets.

The results in Figure 3 shows the impact of the pair-wise adoption of innovation on firm costs. We see that firms experienced significantly lower costs when they adopted four different combinations of innovations respectively. Process and business modelling innovation, process and technological innovation, product and technological innovation, marketing and technological innovation.

We again emphasize the relevance of the synergistic effect and argue that when firms strategically pair certain innovating activities, they can achieve synergies that lead to cost reduction. These synergistic effects can optimize processes, enhance collaboration, reduce waste, improve decision-making, and lead to overall operational efficiency, resulting in lower costs for the firm.

4.4 Do Other Firm Characteristics Matter?

In this section we explored whether firm level characteristics such as age, size (measured as number of workers working in the firm) and export status impact the relationship between innovation and firm's performance.

First, we start by looking at the impact of innovation on firm performance for younger (less than 15 years old) and older (more than 15 years old) firms. Table 4 reports the estimates for measuring the impact of different types of innovation on the firm's performance indicators disaggregated on the basis of age.

Table 4: Measuring the Impact of Different Types of Innovation on the Firm Performance Indicators for Younger and Older Firms

Dependent variables	Revenue	Price	Cost	Revenue	Price	Cost
	Age 15 years & less			Age 15years & more		
	Innovate or not					
Dummy = 1 if firm invests in any type of innovation	-0.305	-0.867***	-0.126	-0.369**	-0.030	-0.070
	[0.358]	[0.299]	[0.338]	[0.181]	[0.212]	[0.233]
Constant	1.732	2.937**	0.028	2.347**	0.919	-0.411
	[1.722]	[1.397]	[1.668]	[1.056]	[1.138]	[1.427]
Observations	95	93	94	188	189	189
R-squared	0.190	0.358	0.191	0.275	0.345	0.263
	Business modelling innovation					
Dummy = 1 if firm invests in business modeeling innovation	0.027	0.029	-0.114	-0.014	-0.004	-0.058
	[0.110]	[0.097]	[0.128]	[0.054]	[0.035]	[0.053]
Constant	0.303	-1.080**	-0.389	0.265	0.755**	-0.680
	[0.644]	[0.512]	[0.617]	[0.457]	[0.349]	[0.494]
Observations	95	93	94	188	189	189
R-squared	0.182	0.273	0.202	0.256	0.345	0.267
	Product innovation					
Dummy = 1 if firm invests in product innovation	3.439	24.712***	6.439	-0.263	-0.318	-0.232
	[9.329]	[7.122]	[7.920]	[0.479]	[0.438]	[0.508]
Constant	-6.609	-50.951***	-13.555	1.351	2.096	0.175
	[18.859]	[14.350]	[16.039]	[2.058]	[1.847]	[2.178]
Observations	95	93	94	188	189	189
R-squared	0.183	0.381	0.196	0.258	0.347	0.263
	Process innovation					
Dummy = 1 if firm invests in process innovation	-0.119	0.233	-0.203**	-0.015	0.009	-0.007
	[0.094]	[0.148]	[0.094]	[0.088]	[0.086]	[0.108]
Constant	0.630	-1.615**	-0.051	0.263	0.730*	-0.795
	[0.638]	[0.616]	[0.594]	[0.478]	[0.381]	[0.521]
Observations	95	93	94	188	189	189
R-squared	0.184	0.288	0.200	0.256	0.345	0.263
	Technological innovation					
Dummy = 1 if firm invests in technological innovation	0.374	2.397***	0.583	-0.231	-0.177	0.463
	[0.917]	[0.702]	[0.782]	[0.411]	[0.325]	[0.354]
Constant	-0.185	-4.391***	-1.364	0.574	1.006	-1.488**
	[1.433]	[1.054]	[1.263]	[0.773]	[0.611]	[0.645]
Observations	95	93	94	188	189	189
R-squared	0.183	0.378	0.195	0.258	0.346	0.269
	Marketing innovation					
Dummy = 1 if firm	-0.083	0.044	-0.080	-0.067	-0.010	-0.061

Dependent variables	Revenue	Price	Cost	Revenue	Price	Cost
invests in marketing innovation	[0.084]	[0.085]	[0.085]	[0.053]	[0.035]	[0.062]
Constant	0.541	-1.147**	-0.351	0.266	0.751**	-0.781
	[0.645]	[0.564]	[0.591]	[0.434]	[0.322]	[0.477]
Observations	95	93	94	188	189	189
R-squared	0.190	0.275	0.198	0.263	0.345	0.267

Note: The three different dependent variables of the specifications comprise of dummy = 1 if the firm's revenues increased due to innovation, dummy = 1 if the firm's product price decreased due to innovation and dummy = 1 if the firm's cost decreased due to innovation. The six different main independent variables in each respective specification comprise of dummy = 1 if the firm innovates, innovates in business modelling, innovates in product, innovates in process, innovates in technology, innovates in marketing. Other independent variables comprise of the firm's characteristics such as firm's age, age squared, number of workers employed by firm, dummy = 1 if the firm exports, dummy = 1 if the firm has diversified products, dummy = 1 if the firm makes the technology, dummy = 1 if the firm buys the technology (keeping does not invest in technology), dummy = 1 if the firm is publicly owned, dummy = 1 if the firm is private limited, dummy = 1 if the firm is family owned (keeping proprietorship as base category). District fixed effects and sector fixed effects for textile, surgical, light engineering and automobile are controlled in the specification. Time fixed effects for years 2018, 2019, 2020 and 2021 are also controlled. Robust standard errors in brackets are clustered at firm level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The important results here are that most of the impact of innovation on firm performance is driven by younger firms. We also find that younger firms who adopt both new products and new technology tended to lower the prices of their final goods significantly more than older firms. This may be because younger firms may use innovation, including product and technological advancements, as a strategy to enter highly competitive markets. These younger firms then try to gain market share by offering new products that require new technologies and also tend to lower prices to attract customers away for existing market players.

We then look at the impact of innovation on firm performance for firms of different sizes. In Table 5, we should the impact of innovation on firm performance for small firms (less than 100 workers), medium sized firms (between 100 and 350 workers) and large firms (greater than 350 workers).

Table 5: Measuring the Impact of Different Types of Innovation on the Firm Performance Indicators for Small, Medium and Large Firms

	Revenue	Price/	Cost	Revenue	Price	Cost	Revenue	Price	Cost
Variables	**worker50-100**			**worker100-350**			**worker350 and more**		
					Innovate or Not				
Dummy=1 If Firm Invests In Any Type Of Innovation	-0.962***	-1.018***	-0.339	0.301	-0.179	-0.567	0.326	0.427	-0.466
	[0.347]	[0.380]	[0.381]	[0.469]	[0.484]	[0.437]	[0.514]	[0.395]	[0.743]
Constant	3.588***	3.014**	1.776	-0.454	1.694	2.053	0.814	0.797*	1.178
	[1.313]	[1.351]	[1.373]	[1.988]	[1.973]	[1.793]	[0.743]	[0.413]	[0.836]
Observations	102	102	102	96	95	96	85	85	85
R-squared	0.269	0.268	0.160	0.203	0.251	0.329	0.472	0.455	0.387
					Business Modelling Innovation				
Dummy=1 If Firm Invests In Business Modeeling Innovation	0.029	0.014	-0.251***	0.049	0.023	0.053	-0.086	-0.037*	-0.092
	[0.087]	[0.147]	[0.076]	[0.109]	[0.050]	[0.105]	[0.053]	[0.020]	[0.058]
Constant	0.354	-0.400	0.790	0.663	0.908**	-0.379	1.191**	1.168***	0.991*
	[0.500]	[0.448]	[0.606]	[0.483]	[0.412]	[0.396]	[0.521]	[0.196]	[0.561]
Observations	102	102	102	96	95	96	85	85	85
R-squared	0.209	0.200	0.188	0.200	0.249	0.315	0.483	0.448	0.397
					Product Innovation				
Dummy=1 If Firm Invests In Product Innovation	-0.037	0.443	-0.100	0.514	0.447	-0.281	-6.301	-8.227	8.938
	[0.355]	[0.388]	[0.768]	[0.507]	[0.465]	[0.475]	[9.887]	[7.605]	[14.282]
Constant	0.461	-1.466	0.885	-1.261	-0.810	0.855	-2.824	-3.951	6.335
	[0.926]	[1.011]	[1.999]	[1.990]	[1.763]	[1.876]	[6.207]	[4.761]	[8.854]
Observations	102	102	102	96	95	96	85	85	85
R-squared	0.208	0.202	0.153	0.202	0.253	0.313	0.472	0.455	0.387
					Process Innovation				
Dummy=1 If Firm Invests In Process Innovation	-0.025	0.038	-0.090	-0.113	-0.119	0.015	0.789	0.187	0.333
	[0.064]	[0.120]	[0.088]	[0.106]	[0.098]	[0.103]	[1.111]	[0.590]	[1.469]
Constant	0.385	-0.412	0.690	1.057**	1.261**	-0.297	-0.708	0.691	0.099
	[0.499]	[0.426]	[0.660]	[0.501]	[0.488]	[0.447]	[2.575]	[1.429]	[3.418]
Observations	102	102	102	96	95	96	85	85	85
R-squared	0.209	0.201	0.158	0.203	0.256	0.312	0.474	0.442	0.383
					Technological Innovation				
Dummy=1 If Firm Invests In Technological Innovation	0.957*	1.116**	0.326	-0.421	0.508	1.087	-0.523	-0.743	0.971
	[0.512]	[0.545]	[0.403]	[0.914]	[0.939]	[0.849]	[0.995]	[0.757]	[1.411]
Constant	-1.019	-2.007**	0.171	1.457	0.142	-2.025	0.483	0.302	1.892
	[0.835]	[0.856]	[0.883]	[1.487]	[1.581]	[1.435]	[1.311]	[0.922]	[1.684]
Observations	102	102	102	96	95	96	85	85	85
R-squared	0.239	0.242	0.156	0.200	0.253	0.329	0.471	0.452	0.388
					Marketing Innovation				
Dummy=1 If Firm Invests In Marketing	0.005	0.018	-0.068	-0.014	0.009	0.043	-0.116	0.002	-0.124
	[0.073]	[0.099]	[0.086]	[0.078]	[0.053]	[0.081]	[0.087]	[0.034]	[0.099]

	Revenue	Price/	Cost	Revenue	Price	Cost	Revenue	Price	Cost
Variables	**worker50-100**			**worker100-350**			**worker350 and more**		
Innovation									
Constant	0.368	-0.404	0.689	0.821	0.930**	-0.405	1.492**	1.098***	1.311**
	[0.490]	[0.432]	[0.650]	[0.523]	[0.446]	[0.455]	[0.582]	[0.230]	[0.643]
Observations	102	102	102	96	95	96	85	85	85
R-squared	0.208	0.200	0.157	0.197	0.249	0.315	0.490	0.442	0.403

Note: The three different dependent variables of the specifications comprise of dummy = 1 if the firm's revenues increased due to innovation, dummy = 1 if the firm's product price decreased due to innovation and dummy = 1 if the firm's cost decreased due to innovation. The six different main independent variables in each respective specification comprise of dummy = 1 if the firm innovates, innovates in business modelling, innovates in product, innovates in process, innovates in technology, innovates in marketing. Other independent variables comprise of the firm's characteristics such as firm's age, age squared, number of workers employed by firm, dummy = 1 if the firm exports, dummy = 1 if the firm has diversified products, dummy = 1 if the firm makes the technology, dummy = 1 if the firm buys the technology (keeping does not invest in technology), dummy = 1 if the firm is publicly owned, dummy = 1 if the firm is private limited, dummy = 1 if the firm is family owned (keeping proprietorship as base category). District fixed effects and sector fixed effects for textile, surgical, light engineering and automobile are controlled in the specification. Time fixed effects for years 2018, 2019, 2020 and 2021 are also controlled. Robust standard errors in brackets are clustered at firm level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Here we see that smaller firms that innovate tend to have lower revenues and higher costs as a result of innovation. At the same time, those small firms that engage in technological innovation do benefit from higher revenues and lower prices as compared to the smaller firms that do not engage in this type of innovation. There can be two potential explanations to these findings. First, sSmaller firms may use technological innovation to enter markets, often with disruptive pricing strategies. They may offer innovative products or services at lower prices to gain a position and challenge larger competitors. Second, sSmall firms tend to have relatively less-complicated hierarchies, shorter decision-making processes, and greater responsiveness. This responsiveness allows them to swiftly adopt and implement technological innovations, making it easier to adjust pricing strategies to meet market demands promptly.

Next, we look at the impact of innovation on firm performance for firms based on their exporting status. In Table 6, we estimate the impact of innovation on firm performance for exporters and non-exporters.

Table 6: Measuring the Impact of Different Types of Innovation on the Firm Performance Indicators for Exporting and Non-Exporting Firms

	Revenue	**Quality**	**Cost**	**Revenue**	**Quality**	**Cost**
	Non-exporting firms			**Exporting firms**		
	Innovate or not					
Dummy = 1 if firm invests in any type of innovation	-0.287	-0.393**	-0.328	0.028	0.043	0.182
	[0.180]	[0.190]	[0.206]	[0.394]	[0.289]	[0.391]
Constant	0.618	0.889	2.129**	0.792	0.668	-1.858
	[0.799]	[0.732]	[1.001]	[1.907]	[1.363]	[1.977]
Observations	149	148	149	134	134	134
R-squared	0.192	0.223	0.154	0.349	0.208	0.287
	Business modelling innovation					
Dummy = 1 if firm invests in business modeeling innovation	-0.083	-0.023	-0.106	-0.032	0.006	-0.043
	[0.074]	[0.054]	[0.103]	[0.052]	[0.039]	[0.062]
Constant	-0.523	-0.410	0.788	0.973**	0.865**	-0.919*
	[0.611]	[0.667]	[1.041]	[0.484]	[0.378]	[0.544]
Observations	149	148	149	134	134	134
R-squared	0.183	0.199	0.145	0.352	0.208	0.289
	Product innovation					
Dummy = 1 if firm invests in product innovation	-0.052	-0.634**	-1.483***	0.071	0.414	-0.227
	[0.493]	[0.307]	[0.516]	[0.489]	[0.376]	[0.588]
Constant	-0.309	-0.537	0.634	0.635	-0.815	-0.054
	[0.597]	[0.513]	[0.618]	[2.027]	[1.581]	[2.413]
Observations	149	148	149	134	134	134
R-squared	0.179	0.201	0.154	0.349	0.216	0.287
	Process innovation					
Dummy = 1 if firm invests in process innovation	-0.016	-0.051	-0.010	-0.084	0.010	-0.013
	[0.083]	[0.104]	[0.171]	[0.081]	[0.126]	[0.122]
Constant	-0.293	-0.346	1.083	1.135**	0.847*	-0.949
	[0.605]	[0.657]	[0.868]	[0.490]	[0.492]	[0.608]
Observations	149	148	149	134	134	134
R-squared	0.179	0.199	0.137	0.354	0.208	0.286
	Technological innovation					
Dummy = 1 if firm invests in technological innovation	0.641	1.092**	0.796	-0.760***	-0.279	0.197
	[0.501]	[0.521]	[0.496]	[0.271]	[0.211]	[0.325]
Constant	0.360	0.757	1.900**	2.052***	1.287***	-1.273*
	[0.749]	[0.694]	[0.931]	[0.491]	[0.462]	[0.666]
Observations	149	148	149	134	134	134
R-squared	0.189	0.228	0.153	0.368	0.213	0.287
	Marketing innovation					
Dummy = 1 if firm invests in marketing innovation	0.026	0.050	0.095	-0.077	-0.009	-0.042
	[0.055]	[0.084]	[0.142]	[0.050]	[0.038]	[0.056]
Constant	-0.324	-0.407	0.969	0.882**	0.868**	-1.005*
	[0.578]	[0.585]	[0.784]	[0.442]	[0.356]	[0.534]
Observations	149	148	149	134	134	134
R-squared	0.179	0.199	0.140	0.367	0.209	0.290

Note: The three different dependent variables of the specifications comprise of dummy = 1 if the firm's revenues increased due to innovation, dummy = 1 if the firm's product price decreased due to innovation and dummy = 1 if the firm's cost decreased due to innovation. The six different main independent variables in each respective specification comprise of

dummy = 1 if the firm innovates, innovates in business modelling, innovates in product, innovates in process, innovates in technology, innovates in marketing. Other independent variables comprise of the firm's characteristics such as firm's age, age squared, number of workers employed by firm, dummy = 1 if the firm exports, dummy = 1 if the firm has diversified products, dummy = 1 if the firm makes the technology, dummy = 1 if the firm buys the technology (keeping does not invest in technology as base category), dummy = 1 if the firm is publicly owned, dummy = 1 if the firm is private limited, dummy = 1 if the firm is family owned (keeping proprietorship as base category). District fixed effects and sector fixed effects for textile, surgical, light engineering and automobile are controlled in the specification. Time fixed effects for years 2018, 2019, 2020 and 2021 are also controlled. Robust standard errors in brackets are clustered at firm level.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Here we can observe, between the exporting and non-exporting firms that non-exporting innovating firms tend to have higher final good prices as compared to non-exporting firms that innovate. Specifically, for the locally supplying firms (non-exporting firms) that engage in product innovation we see a significantly higher price of the final goods and higher costs due to innovation. There can be a number of potential reasons for this - first, the innovating firms often invest significantly in research and development (R&D) to create new and advanced products. Non-exporting innovating firms might incur higher R&D expenses, which can lead to increased production costs. These costs are then passed on to consumers in the form of higher prices. Second, innovating firms often focus on producing high-quality and differentiated products. These products may command higher prices in the market due to their unique features and enhanced quality. Non-exporting innovators may place a premium on these aspects, resulting in higher final good prices.

In addition, we find that exporting firms that engage in technological innovations tend to have lower revenues than those exporting firms that do not innovate - most likely owing to technological innovations often requiring significant upfront investments in research and development (R&D), which in turn can divert financial resources away from revenue-generating activities. This can temporarily reduce a firm's revenue until the innovations begin to yield returns. Similarly, the expanding into international markets, which many exporting firms do, can entail additional costs related to logistics, customs, marketing, and distribution. These costs can erode revenues even if innovations contribute to market entry.

Technologically innovating firms who do not engage in exports, on the hand, experienced a significant decrease in their respective product's price compared to the non-innovating firms. This may be due to the economies of scale attained by the firms, or potentially because technological innovations in the same market place can attract new entrants, or stimulate existing competitors to invest in innovation, resulting in a more competitive marketplace. This heightened competition can lead to price wars and pressure on firms to lower prices to maintain market share.

Finally, we then look at the impact of innovation on firm performance based on their export destinations. In Table 7, we show the impact of innovation for those exporters who are exporting to developed countries and those exporters who are exporting to both developed and developing countries.

Table 7: Measuring the Impact of different types of Innovation on the Firm's Performance Indicators for Firms Exporting to Developed Economies only and Firms Exporting to the World

Dependent Variables	Revenue	Price	Cost	Revenue	Price	Cost
	Export to the Entire World			Export to the Developed Countries		
			INNOVATE OR NOT			
Dummy = 1 if firm invests in any type of innovation	-5.232**	-5.224**	-3.233	-0.129	-0.066	-0.303
	[2.362]	[2.136]	[1.913]	[0.511]	[0.547]	[0.628]
Constant	16.828*	16.764**	11.234	0.429	0.320	-0.819
	[8.216]	[7.594]	[7.090]	[2.306]	[2.513]	[2.825]
Observations	21	21	21	66	66	66
R-squared	0.666	0.596	0.746	0.654	0.550	0.590
			BUSINESS MODELLING INNOVATION			
Dummy = 1 If Firm Invests In Business Modeeling Innovation	-0.204	-0.134	-0.274***	0.207*	0.124	0.095
	[0.184]	[0.194]	[0.073]	[0.121]	[0.102]	[0.127]
Constant	1.540	1.181	2.463*	-0.249	-0.034	-2.284***
	[2.117]	[1.893]	[1.258]	[0.473]	[0.439]	[0.630]
Observations	21	21	21	66	66	66
R-squared	0.628	0.352	0.853	0.688	0.569	0.591
			PRODUCT INNOVATION			
Dummy = 1 If Firm Invests In Product Innovation	2.680**	2.676**	1.655	-7.740	3.036	-9,.273
	[1.210]	[1.094]	[0.980]	[6.350]	[7.124]	[8.014]
Constant	-4.729**	-4.759***	-2.082	29,.169	-13.643	41.455
	[2.033]	[1.283]	[1.295]	[28..597]	[31.541]	[34.932]
Observations	21	21	21	66	66	66
R-squared	0.666	0.596	0.746	0.661	0.550	0.598
			PROCESS INNOVATION			
Dummy = 1 If Firm Invests In Process Innovation	-0.503*	-0.504**	-0.289	-1.538	-1.833**	0.027
	[0.245]	[0.205]	[0.205]	[1.079]	[0.910]	[0.920]
Constant	1.719	1.683	1.852	3.128	3.952*	-2.312
	[1.858]	[1.506]	[1.818]	[2.392]	[2.054]	[2.064]

Dependent Variables	Revenue	Price	Cost	Revenue	Price	Cost
	Export to the Entire World			Export to the Developed Countries		
Observations	21	21	21	66	66	66
R-squared	0.657	0.573	0.737	0.676	0.601	0.585
TECHNOLOGICAL INNOVATION						
Dummy = 1 If Firm Invests In Technological Innovation	34.095 [55.480]	41.948 [36.714]	29.960 [45.680]	27.021*** [9.427]	11.552 [8.933]	27.726** [12.474]
Constant	-44.941 [73.971]	-55.472 [48.386]	-38.812 [60.617]	-48.538*** [16.834]	-20.666 [16.009]	-51.871** [22.283]
Observations	21	21	21	66	66	66
R-squared	0.597	0.479	0.741	0.701	0.564	0.627
MARKETING INNOVATION						
Dummy = 1 If Firm Invests In Marketing Innovation	-0.170 [0.245]	-0.169 [0.165]	-0.154 [0.206]	-0.058 [0.051]	0.025 [0.053]	-0.088 [0.061]
Constant	1.879 [2.536]	1.832 [2.194]	2.366 [2.209]	-0.214 [0.642]	0.022 [0.484]	-2.303*** [0.668]
Observations	21	21	21	66	66	66
R-squared	0.610	0.436	0.754	0.661	0.552	0.600

Note: The three different dependent variables of the specifications comprise of dummy = 1 if the firm's revenues increased due to innovation, dummy = 1 if the firm's product price decreased due to innovation and dummy = 1 if the firm's cost decreased due to innovation. The six different main independent variables in each respective specification comprise of dummy = 1 if the firm innovates, innovates in business modelling, innovates in product, innovates in process, innovates in technology, innovates in marketing. Other independent variables comprise of the firm's characteristics such as firm's age, age squared, number of workers employed by firm, dummy = 1 if the firm exports, dummy = 1 if the firm has diversified products, dummy = 1 if the firm makes the technology, dummy = 1 if the firm buys the technology (keeping does not invest in technology as base category), dummy = 1 if the firm is publicly owned, dummy = 1 if the firm is private limited, dummy = 1 if the firm is family owned (keeping proprietorship as base category). District fixed effects and sector fixed effects for textile, surgical, light engineering and automobile are controlled in the specification. Time fixed effects for years 2018, 2019, 2020 and 2021 are also controlled. Robust standard errors in brackets are clustered at firm level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Here we find that innovating firms that export to both developing and developed countries tend to have higher prices and lower revenues than those firms that only exported to developed economies. This may be explained by the fact that developing and developed countries often have different consumer preferences, income levels, and market needs. Innovating firms may need to customize their products to meet the specific requirements of each market, which can result in higher prices due to additional design, manufacturing, marketing costs or distribution costs. Exchange rate fluctuation risks associated with developing countries may also be an added factor.

However, we find that the firms exporting to the developing and developed countries both if engage in product innovation experience significantly higher revenues and lower prices compared to the non-innovating firms exporting to these economies. Most of this impact can be explained by the capability of this type of firm in adapting to both types of markets as conveniently as possible. The capacity of these firms for product differentiation and creating unique and high-quality products is quite high due to which they can tap into untouched markets with broader customer base, boosting revenues, even if these firms charge lower prices.

In our last set of results, we find that firms that are only exporting to developed economies and are engaged in technological innovations tend to have significantly higher revenues and lower costs as compared to those firms exporting to both, the developed and developing economies and those who do not innovate. Our findings emphasize on the relevance of supplying to the focused sophisticated market i.e., firms that solely export to developed economies while engaging in technological innovations can leverage the advantages of market maturity, consumer willingness to pay premiums, and efficient operations to achieve higher revenues and lower costs. This can result in a more profitable and stable business environment compared to firms operating in both developed and developing economies, which often present more diverse challenges and considerations.

6. Conclusion

Our findings underscore the positive impact of different types of innovation on firm performance. In a developing country undergoing significant economic transitions, like Pakistan, innovation is critical for firms that are trying to trying to compete domestically in the presence of foreign competition as well as in foreign markets. The empirical evidence found in this paper not only emphasize the importance of innovation for firm outcomes, but also shows provides practical insights into the mechanisms through which innovation translates into enhanced firm-level performance.

The findings of this study highlight the differentiated impact of specific innovation types on firm performance. It is evident that not all innovation strategies are created equal in the Pakistani business context. Instead, our research highlights that certain innovation approaches are more impactful in enhancing a firm's performance indicators. Moreover, we show how complementarities between various combinations of innovation strategies are important for firms as they attempt to become more competitive and grow. This in-depth understanding of complementarities not only adds to the existing literature on innovation but also provides actionable guidance for firms seeking to optimize their innovation portfolios and policy makers attempting to develop strategies aim at enhancing growth through innovation.

As businesses in Pakistan navigate a rapidly evolving global economic landscape, our findings carry practical implications: Decision-makers can leverage this knowledge to tailor their innovation strategies, focusing on the specific types that align with their organizational strengths and objectives. Moreover, the identification of synergistic combinations opens avenues for strategic planning that goes beyond isolated innovation efforts. With the help of this study on innovation in the Pakistani business landscape, we move beyond a one-size-fits-all approach. By unraveling the specific innovation types and their synergies that drive firm performance, we hope to guide businesses in crafting targeted, effective innovation strategies that boost them toward sustained success in the dynamic and competitive business environment of Pakistan.

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Appendices

Appendix A

Table A1: Statistical difference between the Firms Innovating in the Area of their Business Model and the firms not innovating in the Area of Business Model Business Model

	Firms Innovate in Business Model		Firms Do not Innovate in Business Model		
Variables	**Observations**	**Mean (1)**	**Observations**	**Mean (2)**	**Mean Difference (mean 1-Mean 2)**
Approximate Number of Workers	12	241.6667	287	148.2578	93.4088**
Firm's Age	12	30.25	269	23.948	6.302
Textile Sector	12	0.3333	287	0.2892	0.0441
Surgical Sector	12	0.000	287	0.0174	-0.0174
Automobile Sector	12	0.5833	287	0.2404	0.3429***
Lightening Sector	12	0.0833	287	0.453	-0.3696**
Dummy=1 if the Firm Exports	12	0.6667	274	0.4599	0.2068
Proportion of Output Exported	12	32.4167	287	23.7369	8.6797
Innovation Funded by Equity	12	1.000	287	0.9547	0.0453
innovation Funded by Bank	12	0.25	287	0.2753	-0.0253
Innovation Funded by Government	12	0.000	287	0.0174	-0.0174
Innovation Funded by Research Groups	12	0.000	287	0.0035	-0.0035
Family-Owned Firm	12	0.25	287	0.0209	0.2291***
Proprietorship	12	0.000	287	0.0035	-0.0035
Privately Owned Firm	12	0.1667	287	0.0105	0.1562***
Publicly Owned Firm	12	0.000	287	0.0105	-0.0105
Buy New Technology	12	0.4167	287	0.669	-0.2523*
Make New Technology	12	0.25	287	0.1359	0.1141
Innovate to Increase market share	12	0.4167	287	0.1568	0.2599**
innovate to increase export	12	0.000	287	0.007	-0.007
innovate to increase competition	12	0.0000	287	0.0139	-0.0139
Innovate to increase the quality	12	0.0833	287	0.0105	0.0729**
Innovate for cost reduction	12	0.000	287	0.0035	-0.0035
Planning to innovate in	12	0.5833	287	0.5087	0.0746

	Firms Innovate in Business Model		Firms Do not Innovate in Business Model		
Variables	**Observations**	**Mean (1)**	**Observations**	**Mean (2)**	**Mean Difference (mean 1- Mean 2)**
Next 12 months innovation led to Increase in revenues	12	0.4167	284	0.6725	-0.2559*
Innovation led to decrease in cost	12	0.4167	284	0.4261	-0.0094
Innovation led to increase in quality of the Product	12	0.6667	283	0.7314	-0.0648
Innovation led to decrease in Price of Final Product	12	0.6667	283	0.7314	-0.0648

Robust standard errors in brackets are clustered at firm level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A2: Statistical difference between the firms innovating in the Area of Marketing Strategy and the firms not innovating in the Area of Marketing Strategy

	Firms Innovate in marketing		Firms Do not innovate in Marketing		
Variables	**Observations**	**Mean (1)**	**Observations**	**Mean (2)**	**Mean Difference (mean 1-Mean 2)**
Approximate Number of Workers	25	120	274	154.927	-34.927
Firm's Age	25	21.84	256	24.4492	-2.6092
Textile Sector	25	0.08	274	0.3102	-0.2302**
Surgical Sector	25	0	274	0.0182	-0.0182
Automobile Sector	25	0.4	274	0.2409	0.1591*
Lightening Sector	25	0.52	274	0.4307	0.0893
Dummy=1 if the Firm Exports	24	0.375	262	0.4771	-0.1021
Proportion of Output Exported	25	16.68	274	24.7609	-8.0809
Innovation Funded by Equity	25	0.88	274	0.9635	-0.0835*
innovation Funded by Bank	25	0.24	274	0.2774	-0.0374
Innovation Funded by Government	25	0.000	274	0.0182	-0.0182
Innovation Funded by Research Groups	25	0.000	274	0.0036	-0.0036
Family-Owned Firm	25	0.000	274	0.0328	-0.0328
Proprietorship	25	0.000	274	0.0036	-0.0036
Privately Owned Firm	25	0.04	274	0.0146	0.0254
Publicly Owned Firm	25	0.00	274	0.0109	-0.0109
Buy New Technology	25	0.76	274	0.6496	0.1104
Make New Technology	25	0.12	274	0.1423	-0.0223
Innovate to Increase market share	25	0.16	274	0.1679	-0.0079
innovate to increase export	25	0.000	274	0.0073	-0.0073
innovate to increase competition	25	0.00	274	0.0146	-0.0146
Innovate to increase the quality	25	0.000	274	0.0146	-0.0146
Innovate for cost reduction	25	0.000	274	0.0036	-0.0036
Planning to innovate in Next 12 months	25	0.48	274	0.5146	-0.0346
innovation led to Increase in revenues	25	0.68	271	0.6605	0.0195
Innovation led to decrease in cost	24	0.4167	272	0.4265	-0.0098
Innovation led to increase in quality of the Product	25	0.68	270	0.7333	-0.0533
Innovation led to decrease in Price of Final Product	25	0.68	270	0.7333	-0.0533

Robust standard errors in brackets are clustered at firm level.
*** p<0.01, ** p<0.05, * p<0.1

Table A3: Statistical difference between the firms Engaging in Process Innovation and the firms not Engaging in Process Innovation

	Firms Innovate in Process		Firms Do not innovate in Process		
Variables	Observations	Mean (1)	Observations	Mean (2)	Mean Difference (mean 1- Mean 2)
Approximate Number of Workers	25	144	274	152.7372	-8.7372
Firm's Age	22	19.0455	259	24.6564	-5.6109
Textile Sector	25	0.16	274	0.3029	-0.1429
Surgical Sector	25	0	274	0.0182	-0.0182
Automobile Sector	25	0.44	274	0.2372	0.2028**
Lightening Sector	25	0.4	274	0.4416	-0.0416
Dummy=1 if the Firm Exports	20	0.4	266	0.4737	-0.0737
Proportion of Output Exported	25	11.12	274	25.2682	-14.1482*
Innovation Funded by Equity	25	0.92	274	0.9599	-0.0399
innovation Funded by Bank	25	0.2	274	0.281	-0.081
Innovation Funded by Government	25	0.000	274	0.0182	-0.0182
Innovation Funded by Research Groups	25	0.000	274	0.0036	-0.0036
Family-Owned Firm	25	0.000	274	0.0328	-0.0328
Proprietorship	25	0.04	274	0.000	0.0400***
Privately Owned Firm	25	0.04	274	0.0146	0.0254
Publicly Owned Firm	25	0.04	274	0.0073	0.0327
Buy New Technology	25	0.64	274	0.6606	-0.0206
Make New Technology	25	0.12	274	0.1423	-0.0223
Innovate to Increase market share	25	0.24	274	0.1606	0.0794
innovate to increase export	25	0.000	274	0.0073	-0.0073
innovate to increase competition	25	0.000	274	0.0146	-0.0146
Innovate to increase the quality	25	0.000	274	0.0146	-0.0146
Innovate for cost reduction	25	0.000	274	0.0036	-0.0036
Planning to innovate in Next 12 months	25	0.56	274	0.5073	0.0527
innovation led to Increase in revenues	24	0.625	272	0.6654	-0.0404
Innovation led to decrease in cost	24	0.375	272	0.4301	-0.0551
Innovation led to increase in quality of the Product	23	0.7391	272	0.7279	0.0112
Innovation led to decrease in Price of Final Product	23	0.7391	272	0.7279	0.0112

Robust standard errors in brackets are clustered at firm level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A4: Statistical difference between the firms Engaging in Product Innovation and the firms not Engaging in Product Innovation

	Firms Innovate in Product		Firms Do not innovate in Product		
Variables	**Observations**	**Mean (1)**	**Observations**	**Mean (2)**	**Mean Difference (mean 1-Mean 2)**
Approximate Number of Workers	141	149.2908	158	154.4304	-5.1396
Firm's Age	141	23.2624	158	24.0316	-0.7692
Textile Sector	141	0.4397	158	0.4367	0.003
Surgical Sector	137	0.4818	149	0.4564	0.0254
Automobile Sector	141	25.6631	158	22.6772	2.9859
Lightening Sector	141	0.9787	158	0.9367	0.0420*
Dummy=1 if the Firm Exports	141	0.2695	158	0.2785	-0.009
Proportion of Output Exported	141	0.0213	158	0.0127	0.0086
Innovation Funded by Equity	141	0.00	158	0.0063	-0.0063
innovation Funded by Bank	141	0.0142	158	0.0443	-0.0301
Innovation Funded by Government	141	0.00	158	0.0063	-0.0063
Innovation Funded by Research Groups	141	0.00	158	0.0316	-0.0316**
Family-Owned Firm	141	0.0071	158	0.0127	-0.0056
Proprietorship	141	0.6454	158	0.6709	-0.0255
Privately Owned Firm	141	0.078	158	0.1962	-0.1182***
Publicly Owned Firm	141	0.1348	158	0.1962	-0.0615
Buy New Technology	141	0.0071	158	0.0063	0.0008
Make New Technology	141	0.0071	158	0.019	-0.0119
Innovate to Increase market share	141	0.0071	158	0.019	-0.0119
innovate to increase export	141	0.00	158	0.0063	-0.0063
innovate to increase competition	141	0.4681	158	0.5506	-0.0825
Innovate to increase the quality	140	0.6	156	0.7179	-0.1179**
Innovate for cost reduction	141	0.3262	155	0.5161	-0.1899***
Planning to innovate in Next 12 months	140	0.6643	155	0.7871	-0.1228**
innovation led to increase in revenues	140	0.6643	155	0.7871	-0.1228**
Innovation led to decrease in cost	141	149.2908	158	154.4304	-5.1396
Innovation led to increase in quality of the Product	141	23.2624	158	24.0316	-0.7692
Innovation led to decrease in Price of Final Product	141	0.3546	158	0.2342	0.1204**

Robust standard errors in brackets are clustered at firm level.
*** p<0.01, ** p<0.05, * p<0.1

Table A5: Statistical difference between the firms Engaging in Technological Innovation and the firms Engaging in Technological Innovation

	Firms Innovate in Technology		Firms Do not Innovate in Technology		
Variables	**Observations**	**Mean (1)**	**Observations**	**Mean (2)**	**Mean Difference (mean 1- Mean 2)**
Approximate Number of Workers	95	155.7895	204	150.2451	5.5444
Firm's Age	88	25.1818	193	23.7772	1.4046
Textile Sector	95	0.2842	204	0.2941	-0.0099
Surgical Sector	95	0.0211	204	0.0147	0.0063
Automobile Sector	95	0.2211	204	0.2696	-0.0486
Lightening Sector	95	0.4737	204	0.4216	0.0521
Dummy=1 if the Firm Exports	92	0.4674	194	0.4691	-0.0017
Proportion of Output Exported	95	26.3053	204	23.0515	3.2538
Innovation Funded by Equity	95	0.9579	204	0.9559	0.002
innovation Funded by Bank	95	0.3158	204	0.2549	0.0609
Innovation Funded by Government	95	0.0105	204	0.0196	-0.0091
Innovation Funded by Research Groups	95	0.0105	204	0.000	0.0105
Family-Owned Firm	95	0.0421	204	0.0245	0.0176
Proprietorship	95	0.000	204	0.0049	-0.0049
Privately Owned Firm	95	0.0105	204	0.0196	-0.0091
Publicly Owned Firm	95	0.0105	204	0.0098	0.0007
Buy New Technology	95	0.6947	204	0.6422	0.0526
Make New Technology	95	0.2316	204	0.098	0.1335***
Innovate to Increase market share	95	0.1684	204	0.1667	0.0018
innovate to increase export	95	0.0105	204	0.0049	0.0056
innovate to increase competition	95	0.0316	204	0.0049	0.0267*
Innovate to increase the quality	95	0.0211	204	0.0098	0.0112
Innovate for cost reduction	95	0.0105	204	0.000	0.0105
Planning to innovate in Next 12 months	95	0.5684	204	0.4853	0.0831
innovation led to Increase in revenues	95	0.7895	201	0.602	0.1875***
Innovation led to decrease in cost	95	0.5895	201	0.3483	0.2412***
Innovation led to increase in quality of the Product	95	0.8421	200	0.675	0.1671***
Innovation led to decrease in Price of Final Product	95	0.8421	200	0.675	0.1671***

Robust standard errors in brackets are clustered at firm level.
*** p<0.01, ** p<0.05, * p<0.1

Appendix B

Table B1: Process Innovation & Business Modelling Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Process innovation	-0.221**	-0.076	-0.207**
	[0.089]	[0.116]	[0.085]
Business Modelling	-0.258***	-0.005	-0.281***
innovation	[0.053]	[0.049]	[0.067]
Process and Business	0.138***	0.006	0.120***
Modelling Innovation	[0.038]	[0.026]	[0.040]
Constant	0.029	-0.275	-0.369
	[0.316]	[0.292]	[0.332]
Observations	283	282	283
R-squared	0.191	0.233	0.191

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in brackets are clustered at firm level.
*** p<0.01, ** p<0.05, * p<0.1

Table B2: Product Innovation & Process Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Product Innovation	-0.152	-0.079	0.217
	[0.167]	[0.135]	[0.186]
Process Innovation	-0.045	-0.018	0.076
	[0.097]	[0.076]	[0.142]
Production and	0.041	0.006	-0.144**
Process Innovation	[0.067]	[0.042]	[0.073]
Constant	0.278	-0.309	0.273
	[0.416]	[0.367]	[0.528]
Observations	283	282	283
R-squared	0.163	0.233	0.180

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B3: Process Innovation & Marketing Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Process Innovation	0.041	-0.031	-0.046
	[0.090]	[0.100]	[0.100]
Marketing Innovation	0.306***	0.055	0.343***
	[0.112]	[0.122]	[0.114]
Process and Marketing	-0.163***	-0.035	-0.157***
Innovation	[0.052]	[0.052]	[0.055]
Constant	0.312	-0.316	-0.004
	[0.341]	[0.332]	[0.348]
Observations	283	282	283
R-squared	0.178	0.234	0.175

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B4: Technological Innovation & Business Modelling Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Technological	0.158	0.149	0.036
Innovation	[0.179]	[0.156]	[0.129]
Business modelling	0.240	0.068	-0.123
Innovation	[0.145]	[0.124]	[0.150]
Technological and	-0.140**	-0.040	0.021
Business Modelling	[0.070]	[0.054]	[0.075]
Innovation			
Constant	0.593*	-0.343	-0.134
	[0.345]	[0.322]	[0.361]
Observations	283	282	283
R-squared	0.173	0.233	0.170

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B5: Technological Innovation & Product Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Technological Innovation	-0.309**	-0.056	-0.132
	[0.151]	[0.091]	[0.154]
Product Innovation	-0.284*	-0.195	-0.411**
	[0.155]	[0.128]	[0.175]
Technological and Product	0.180**	0.102*	0.144*
Innovation	[0.084]	[0.061]	[0.085]
Constant	0.524	-0.439	-0.610
	[0.440]	[0.318]	[0.384]
Observations	283	282	283
R-squared	0.168	0.235	0.174

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B6: Technological Innovation & Process Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Technological Innovation	-0.073	0.071	-0.133
	[0.108]	[0.124]	[0.103]
Process Innovation	-0.161	-0.017	-0.771***
	[0.194]	[0.187]	[0.165]
Technological and	0.060	-0.024	0.463***
Process Innovation	[0.142]	[0.077]	[0.110]
Constant	0.424	-0.303	-0.556
	[0.387]	[0.312]	[0.349]
Observations	283	282	283
R-squared	0.163	0.233	0.197

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B7: Technological innovation & Marketing Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Technological Innovation	-0.035	0.097	-0.174
	[0.125]	[0.138]	[0.125]
Marketing Innovation	-0.067	-0.009	-0.577***
	[0.131]	[0.191]	[0.136]
Technological and	0.005	-0.011	0.267***
Marketing Innovation	[0.069]	[0.085]	[0.068]
Constant	0.292	-0.458	-0.201
	[0.336]	[0.326]	[0.345]
Observations	283	282	283
R-squared	0.166	0.234	0.187

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B8: Marketing Innovation &Business Modelling Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Marketing Innovation	-0.039	-0.002	-0.021
	[0.101]	[0.095]	[0.103]
Business Modelling	-0.002	0.020	-0.085
Innovation	[0.064]	[0.046]	[0.071]
Marketing and Business	-0.005	-0.012	0.005
Modelling Innovation	[0.032]	[0.028]	[0.034]
Constant	0.276	-0.364	-0.067
	[0.315]	[0.315]	[0.332]
Observations	283	282	283
R-squared	0.166	0.233	0.170

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B9: Market Innovation & Product innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Marketing Innovation	-0.066	-0.045	0.122
	[0.104]	[0.066]	[0.110]
Product Innovation	-0.006	-0.026	0.019
	[0.108]	[0.076]	[0.139]
Marketing and	0.005	0.004	-0.067
Product Innovation	[0.040]	[0.024]	[0.044]
Constant	0.246	-0.447	-0.127
	[0.420]	[0.361]	[0.501]
Observations	283	282	283
R-squared	0.166	0.233	0.175

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B10: Business Modelling Innovation & Technological Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Business Modelling	-0.010	0.002	-0.090*
Innovation	[0.054]	[0.031]	[0.049]
Technological Innovation	-0.008	0.100	0.062
	[0.127]	[0.105]	[0.137]
Technological and Business	-0.025	-0.015	0.010
Modelling Innovation	[0.021]	[0.013]	[0.023]
Constant	0.307	-0.458	-0.067
	[0.338]	[0.329]	[0.355]
Observations	283	282	283
R-squared	0.166	0.234	0.171

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table B11: Business modelling Innovation & Product Innovation

Dependent Variables	Revenue Increase	Increase in Price	Cost Decrease
Business modelling	-0.011	0.004	-0.073
Innovation	[0.054]	[0.031]	[0.051]
Product Innovation	0.060	0.022	-0.124*
	[0.095]	[0.047]	[0.067]
Business Modelling and	-0.020	-0.013	-0.014
Product Innovation	[0.017]	[0.011]	[0.019]
Constant	0.454	-0.310	-0.474
	[0.398]	[0.290]	[0.324]
Observations	283	282	283
R-squared	0.166	0.233	0.179

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

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