

## Asian Economic and Financial Review

ISSN(e): 2222-6737

ISSN(p): 2305-2147

DOI: 10.18488/journal.aefr.2021.118.591.602

Vol. 11, No. 8, 591-602.

© 2021 AEISS Publications. All Rights Reserved.

URL: [www.aessweb.com](http://www.aessweb.com)



## EXPLORING MANUFACTURING FIRMS' ABSORPTION CAPACITY OF IMPORTED TECHNOLOGY IN PAKISTAN



Mirajul Haq<sup>1</sup>  
Asghar Ali<sup>2\*</sup>  
Iftikhar Ahmad<sup>3</sup>

<sup>1</sup>Assistant Professor, International Institute of Islamic Economics (IIIE), International Islamic University, Islamabad, Pakistan.

<sup>2</sup>Assistant Professor, Applied Economics Research Centre (AERC), University of Karachi, Karachi, Pakistan.

Email: [asgharplus7861@gmail.com](mailto:asgharplus7861@gmail.com)

<sup>3</sup>Assistant Professor, Pakistan Institute of Development Economics (PIDE), Islamabad, Pakistan.



(+ Corresponding author)

### ABSTRACT

#### Article History

Received: 19 January 2021

Revised: 7 June 2021

Accepted: 5 July 2021

Published: 3 August 2021

#### Keywords

Firms  
Absorption capacity  
Pakistan  
Imported technology.

#### JEL Classification:

D24; O32; O33; L25.

In existing literature there is a general consensus that the only effective and compelling approach for developing countries to enhance the capacity of their production units is by exposure to foreign technology. However, literature on the subject has outlined some conditions necessary to reap the potential gains of imported technology in their production process. For instance, it endorses that a country's potential gain of imported technology revolves around the capacity of the production units of country to observe and capably utilize imported technology in their production process. In this context, this study aims to explore how Pakistan's manufacturing firms incorporate imported technology in its production process. To meet the objective of the study, we collected data from 86 large scale manufacturing firms across the country to quantify the absorption capacity of manufacturing firms. The evidence seen from the field survey shows that, on average, 60% of the workers are technical workers, which is a good sign. Regarding the awareness of firms towards R&D the responses were surprising, as few firms were focusing on this critical component and most of the entrepreneurs are reluctant to invest in the R&D sector.

**Contribution/Originality:** This paper contributes to existing literature on the subject in two different ways. First, as far as the case of Pakistan is concerned, no such study has been carried out to measure and investigate the absorptive capacity of manufacturing firms. Second, unlike previous studies, this study used two diverse approaches to quantify the absorptive capacity and examines the subject more thoroughly. The paper found that 60% of the large scale manufacturing firms in Pakistan showed an improved absorption capacity by employing greater number of technical workers. However, the major constraint to introduce efficient imported technologies in manufacturing is the entrepreneurs' reluctance to invest in the R&D, which limits their absorption capacity. This is an aspect that need special attention from the policy makers.

## 1. INTRODUCTION

Manufacturing firms that comprise the supply side of the economy play a vital role in the growth and development of any economy. However, the potential contribution of firms is associated with new technological adoption, labor force efficiency, modernization, and R&D expenditure. In general, it is also believed that firms'

growth not only depends on technological changes but also needs the workers' skills and capability to adopt technological changes (Jiangtao, Zheng, Deng, & Zhou, 2019; Keller, 2004; Narula, 2004). The skills and efficiency of workers is considered by industrialists as a driving force for industrialization. For instance, Narula & Criscuolo (2002), Narula (2004), and Keller (2004) argue that a smaller number of skilled, experienced, trained and educated workers are more favorable for the industrial sector rather than a large number of unskilled, inexperienced and illiterate workers. The one commonly acceptable justification for the enhancement of firms' absorptive capacity is the use of new technology in its production process. This entails critical consideration towards a precise conception that how much of a firms' absorptive capacity is important for a developing country such as Pakistan that mainly depends on imported technology. This study investigates to what extent production firms in Pakistan are capable of using foreign knowledge and imported technology in their production processes.

Within the endogenous growth framework, several studies have reached a consensus that a country's potential gain through technological diffusion revolves around its capacity to include foreign knowledge and technology in its production processes. In this context, a group of empirical studies have emphasized the importance of a country's absorption capacity in order to yield the potential gain of imported technology. However, the related studies suggested and analyzed different components of absorptive capacity. For instance, some studies underlined investment in education and human capital to improve absorptive capacity (Harrison & Hanson, 1999; Jiang, Jiao, Lin, & Xia, 2019; Keller, 2004; Narula & Criscuolo, 2002; Narula, 2004), whereas some others are more specific about investment in R&D to expand a country's absorptive capacity (Barro & Sala-i-Martin, 1995; Danquah, Ouattara, & Quartey, 2018; Eaton & Kortum, 1996; Griffith, Stephen, & John, 2003; Howitt, 2000; Kobarg, Stumpf-Wollersheim, & Welpé, 2018; Stephen & Edward, 1991), and technological infrastructure (Antoio & William, 2019; Chuang & Hsu, 2004; Kaja & Slavec, 2017; NSB, 2008). There are also studies which define absorption capacity in term of social infrastructure, national orientation, and provisions of government incentives (Henry, Kneller, & Milner, 2009; Jiangtao et al., 2019; Marianne & Einar, 2016). However, the related literature on the subject does not have a solely optimistic view. For instance, Stephen & Edward (1991) and Barro & Sala-i-Martin (1995) argued that "the effective cost of innovation and technology adoption falls when a country is further away from the world technology frontier". On the other hand, Eaton & Kortum (1996), Harrison & Hanson (1999), and Howitt (2000) argued that if a country falls farther behind the world's technological frontier, every successful technology adoption results in a comparatively larger improvement. Based on this contrast of opinions, this study examines how Pakistan's firms absorb imported technology in their production processes. In Pakistan, manufacturing is the most important sub-sector of the industrial sector that holds an important place in the growth and development of Pakistan's economy. However, the production processes of most of the manufacturing firms depend on imported technology. Subsequently, we collected data from 86 large scale manufacturing firms across Pakistan. To quantify the absorption capacity of manufacturing units, we used two diverse approaches, first, the proportion of technical workers of manufacturing units against its administrative staff, and second, R&D expenditure of the manufacturing units. Thus, the paper makes a contribution and examine the subject more thoroughly by using two diverse approaches to quantify the absorptive capacity. The rest of the study is organized as follows: Section 2 presents the profile and structure of the large-scale manufacturing units of Pakistan, namely textile, sugar, cement, and automobile industries; Section 3 describes the methodology applied in order to meet objective of the study; Section 4 presents the findings from the field survey; and Section 5 contains the conclusion.

## 2. PAKISTAN'S INDUSTRIAL SECTOR PROFILE AND STRUCTURE

In Pakistan, the manufacturing sector is the most important sub-sector and comprises 65.4% of the industrial sector. The manufacturing sector holds an important place in the growth and development process of Pakistan's economy, which contributes 13.5% to GDP and provides 15.3% employment to the labor force (Government of Pakistan, n.d). Table 1 presents the performance and contribution of overall (industrial) and sub (manufacturing)

sectors to Pakistan's economy, and Figure 1 shows the corresponding trend lines. The trend lines indicate that both the performance and contributions of the industrial and manufacturing sectors abruptly declined from positive in the 2007/2008 fiscal year to negative in the 2008/2009 fiscal year. The poor performance in 2008/2009 is mainly due to the global financial crisis coupled with a stark energy crisis, technological breakdown, and political instability.<sup>1</sup> However, from the 2009/2010 fiscal year both sectors caught positive momentum and had an impressive growth of more than 5% each in the 2016/2017 fiscal year.

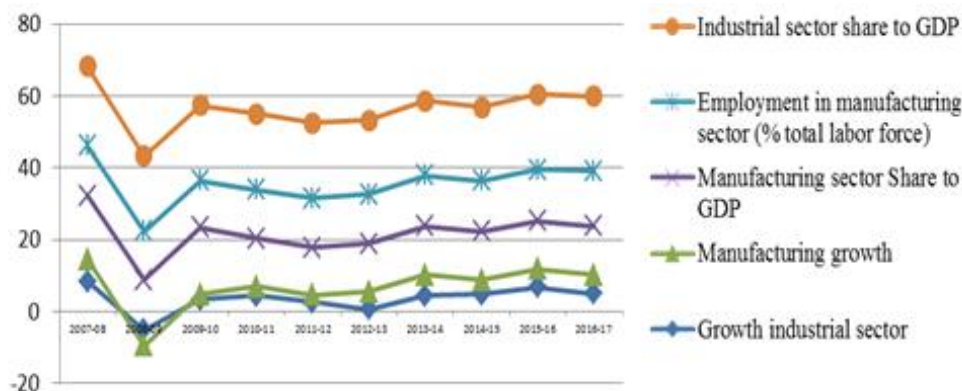


Figure 1. Trend graph of the performance and contribution of industrial and manufacturing sectors.

Table 2 presents a list of manufacturing units operating in Pakistan's economy. Table 2 shows the categorization of industries operating under manufacturing sector, and keeping the scope of the study in mind, we selected five of the largest industrial units based on the Quantum Index of Manufacturing (QIM) classification. The upcoming sections present the structure and profiles of these five industrial units.

### 3. METHODOLOGY

This section discusses the methodology used to calculate firms' absorption capacity and how it translates into technological spillovers. It presents the definitions and construction of variables under consideration, and also provides details about the data, data sources, and sampling techniques.

#### 3.1. Data and Quantification

In order to examine the absorptive capacity, we collected data from selected manufacturing firms. To achieve this, we designed a questionnaire and split it into three sections – production level, technological spillover, and absorptive capacity. This empirical model was developed on the basis of major subsections of the questionnaire. The output, or production, of an industrial plant (unit) illustrates its performance. Therefore, we collected firsthand data in order to capture the output performance, including production level, sales, and actual output production in two different regimes – before and after liberalization. In a similar way, we focused on capturing the technological spillover on the basis of domestic or foreign technology in a manufacturing firm. Moreover, to assess and gauge the role of absorption capacity of any manufacturing firm, the absorption capacity has been captured through the quality of its technical workers (labor force quality) and R&D investment (internal R&D efforts of the firm). Respondents were asked about labor force productivity, technical education, experience, skill, indoor or outdoor training, foreign labor, and foreign trainer within premises.

<sup>1</sup> Assassination of the ex-Prime Minister, Benazir Bhutto, on December 27, 2007.

Table 1. Performance and contribution of industrial and manufacturing sectors.

Year	GDP Growth	Industrial Growth	Manufacturing Growth	Manufacturing Sector Share of GDP (%)	Employment in Manufacturing Sector (% total labor force)	Industrial Sector of GDP	Share of Manufacturing Sector in Industrial Sector	Industry Value Added (% of GDP)	Industry Value Added (annual % growth)
2007-08	5.8	8.5	6.1	17.7	13.9	22.1	---	21.13	7.73
2008-09	0.4	-5.2	-4.2	18.2	13.6	20.9	---	22.33	8.47
2009-10	2.6	3.4	1.4	18.6	13	21	---	20.2	-5.21
2010-11	3.63	4.5	2.5	13.4	13.5	21.2	---	20.58	3.42
2011-12	3.84	2.6	2.1	13.2	13.6	21	---	21.23	4.51
2012-13	3.7	0.7	4.8	13.4	13.8	20.5	63%	22.05	2.55
2013-14	4.14	4.53	5.65	13.6	14.1	20.8	64.92	21.05	0.75
2014-15	4.24	4.81	3.9	13.6	14.2	20.3	65.4	20.98	4.53
2015-16	4.71	6.8	5	13.5	14.16	21.02	64.71	19.96	4.81
2016-17	5.25	5.02	5.3	13.5	15.3	20.9	63.8	---	---

Table 2. List of manufacturing units in Pakistan.

S. No	Manufacturing Unit	S. No.	Manufacturing Unit
1	Textile industry	13	Rubber and plastic products industry
2	Sugar industry	14	Paper and board industry
3	Cement industry	15	Surgical industry
4	Manufacturing of engineering goods and other machinery and equipment	16	Information technology and communication
5	Automobile industry	17	Steel industry
6	Chemical industry	18	Recycling
7	Leather industry	19	Sports industry
8	Food, beverages & tobacco	20	Rubber products
9	Electrical machinery and equipment	21	Fertilizer industry
10	Glass and ceramics industry	22	Vegetable ghee and cooking oil industry
11	Telecoms industry	23	Fashion industry
12	Oil and gas industries		

### 3.2. Data and Data Source

The objective of the study is to analyze the impact of imported technology on firms' output performance and to explore the role of firms' absorptive capacity in coping with imported technology in their production processes. The survey was conducted on companies that adopt new technology, either domestic or imported. The samples have drawn in large scale manufacturing firms that have adopted imported technology. Primary data was collected from 86 large scale manufacturing firms in the Punjab, Khyber Pakhtunkhwa, and Sindh provinces of Pakistan. These manufacturing firms were carefully chosen from 13 different industrial zones of Pakistan. These included steel mills, textile mills, flour mills, feed plants, and pharmaceuticals. In total, 110 firms were visited, however, only 86 provided complete information. The snowball sampling technique was adopted to select the firms; see Table 3, which presents the industrial zones and manufacturing firms that were surveyed.

**Table 3.** Zonal share of field survey.

Industrial Zone	No. of Manufacturing Units Surveyed
Islamabad/Rawalpindi	14
Rawat	13
Faisalabad	12
Lahore	8
Gujranwala	8
Bahawalpur/Bahawalnagar	7
Hattar	5
Nowshera	4
Hayatabad	4
Karachi	3
Gadoon industrial zone	3
Gujrat	3
Hasan Abdal/Wah Cantt.	2

## 4. FINDINGS AND DISCUSSION

With the help of the collected data, the study examined how much the manufacturing firms of Pakistan benefit from foreign knowledge-based technologies (imported technology) and, if foreign technology is deployed in Pakistan's industrial sector, how efficiently is it utilized? This section covers the firms' output performance and discusses the factors that explain the output performance of the sample firms. Specifically, the technology profiles of the firms are discussed and what technology has been installed (imported, local, or mixed). In addition, we looked at how promptly the firms replace technology and to what extent the replacement technology affects output performance and quality improvement. Absorption capacity has also been measured using different methods, and its impact on output performance has been discussed.

### 4.1. Nature of the Product Market

In the field survey, it was observed that almost half of the sample firms produce goods for both domestic and foreign markets. It is evident from a number of studies on the subject (Antoio & William, 2019; Keller, 2004; Narula & Criscuolo, 2002), and from our survey, that the firms producing goods for export tend to utilize unique and uncommon methods and technologies, keeping in mind the requirements and standards of international markets. The firms were asked about the markets that they target. The results indicated that out of the 86 firms, 46% target both local and foreign markets; however, the share of exports of these firms was not sufficient. Among the rest of the firms, 5% were only producing goods for export and the remaining 49% were producing goods for domestic markets (see Figure 2).

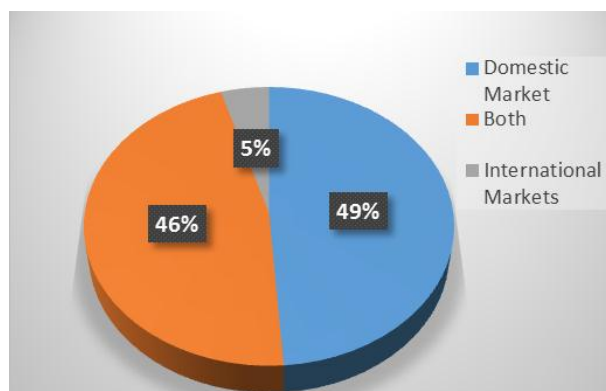


Figure 2. Market ratio.

Table 4 presents the classification of the sample firms with respect to the share of production for each market.

Table 4. Products for foreign and domestic markets.

No. of Firms	Percentage for International Markets	Percentage for Domestic Markets
14	5% to 10%	90% to 95%
14	15% to 25%	75% to 85%
7	30% to 40%	60% to 70%
5	70% to 80%	20% to 30%

The statistics presented in Table 4 indicate that 14 firms export 5% to 10% of their output to international markets, whereas 90% to 95% of their total output is being supplied to domestic markets. Similarly, another 14 firms supply 15% to 25% of their output to international markets, whereas 75% to 85% of their output is supplied to domestic markets. Out of the total, seven firms supply a significant amount, between 30% to 40% of its production to international markets, and the remaining five firms export a large portion (70% to 80%) of their output.

#### 4.2. Foreign Technologies

Being a developing country, Pakistan predominantly relies on imported technologies. Therefore, an important area to examine was whether domestic firms utilize foreign or domestic manufactured technologies. The survey results show that among the 86 firms only seven (8%) use domestic manufactured machinery in their production processes. Among the sample industries, chemical and cooking oil are the industries that depend on domestic technologies the most, and 45 firms (52%) exclusively utilize imported technologies. Out of the total, 34 (40%) of the sample industries use both domestic and foreign technologies (see Figure 3). However, foreign technology under this category of firms does not directly engage in the production process, rather, it plays its role indirectly in the form of generators, boilers, and environmentally benign procedures.

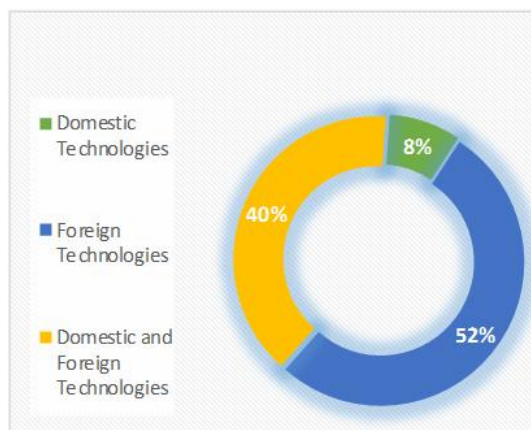


Figure 3. Nature of technology installed.

4.3. Recent Technology Installation

A firm is said to be innovative and technologically absorptive when it frequently engages in technological opportunities (Criscuolo & Narula, 2008; Mingyong, Shuijun, & Qun, 2006; Narula, 2004). This refers to a situation in which a firm usually gets opportunities to a great extent in installation, replacement or maintenance of machineries, or setting up new modifications into the existing machines (Criscuolo & Narula, 2008). This phenomenon has been captured by inquiring about recent installation of new technologies in recent past (5 to 10 years). Our sample data shows that many firms (75%) have installed new technologies, while 25% rely on older machines. Among these, 22 firms intend to upsurge their production units through new technologies and achieve what they intended. Hence, their production increased at a range of 3% to 300%. On the other hand, a large number of firms installed new technologies to just improve the quality of their existing levels of production, which is beneficial for the firms as far as quality and standards are concerned. Figure 4 illustrates the provided information to make it more conclusive.

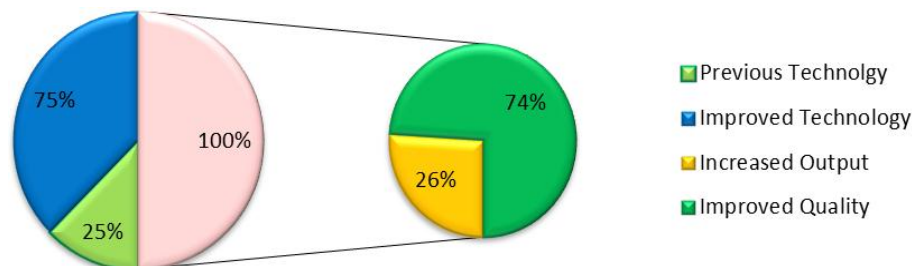


Figure 4. The impact of new technologies and its impacts on output and quality.

4.4. Absorption Capacity

A firm can only harvest potential gains from the installed technology if it has sufficient capacity to absorb it (Criscuolo & Narula, 2008; Danquah et al., 2018; Mingyong et al., 2006). Such a firm is considered to be robust in terms of knowledge, innovation, and well-skilled and qualified labor. These firms are capable of saving time and costs and are able to bring innovations into their production methods to increase both quality and variety.

4.5. Proportion of Technical Workers

To investigate the extent to which the firms are able to cope with imported technology, the absorption capacity of domestic firms was important to analyze. The absorption capacity of a firm can be captured by several proxies which have been empirically tested and are globally accepted. According to the first method, the ratio or proportion of technical workers was examined and compared to the number of administrative staff. The results indicate that a firm is likely to possess a higher level of absorption capacity when the number of technical workers is greater than the number of administrative staff.

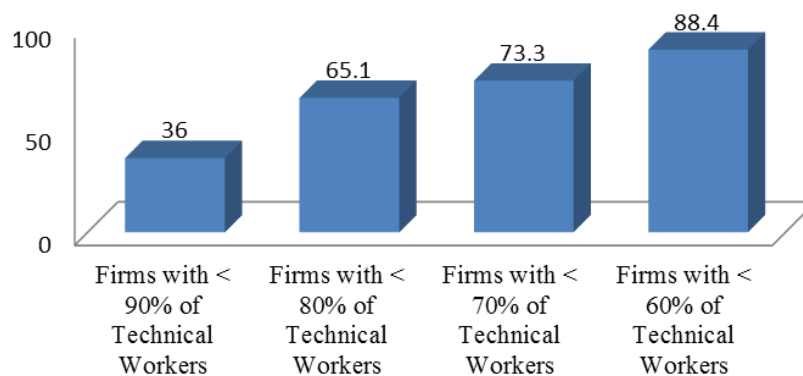


Figure 5. Proportion of technical workers.

One thing which is pertinent to note here is that most of the domestic technical labor is skilled by experience, not by qualification. The proportion of technical labor in the sample industries was remarkable. Among 86 firms, 76 firms (88.4%) had more than 60% technical labor compared to administrative staff. Out of these 76 firms, technical labor makes up 70% in 73 firms, and 80% in 63 firms. Finally, 31 firms comprised more than 90% technical workers (see Figure 5). However, the situation became distorted when we discovered that more than 70% of technical workers in 22 firms were not capable of absorbing foreign imported technology. The remaining 64 firms seem to have the ability to adopt foreign technology (see Figure 6). Another point to note is that when the firms were asked if the installation, replacement, or deployment of foreign technology is carried out by their own labors, the answer was negative. The preeminent reason reported by almost every such firm involved in technological opportunity was that newly imported foreign technology is costly for domestic investors, so in order to protect the company, the installation of new technology is included in the contract during its purchase. Therefore, the delivery of equipment or machinery happens after the installment and first operation of the newly purchased technology. This practice is carried out by the foreign laborers and is followed throughout Pakistan due to initial complications and precautions using newly installed machinery. Hence, the next questions regarding the potential of technical workers were asked: “*Though the contracts are put in place to reduce risks, are the domestic laborers capable enough to get the job done?*” and “*Can the laborers install, replace, or repair the foreign technology?*” The results were satisfactory; for instance, 72 firms (83.7%) identified the potential of their laborers as capable enough to install and run the newly purchased technology. This is a good indication that most firms have the capability to easily adopt foreign technology.

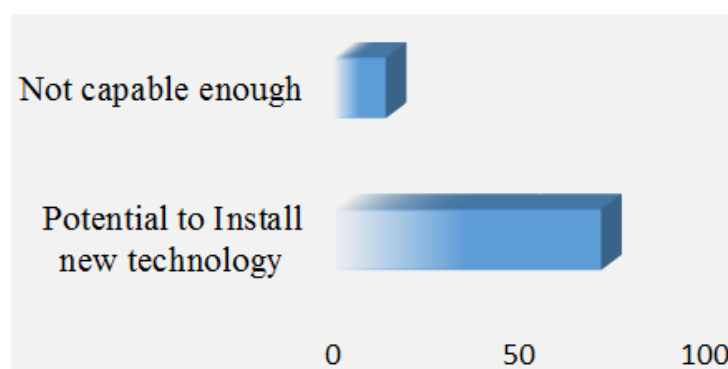


Figure 6. Adoption capability of domestic labor.

#### 4.6. Research and Development Expenditure

Another prominent indicator of the absorption capacity of a firm, which we usually go through in empirical studies, is to check whether the firm is involved in research and development (R&D) activities or not. The more a firm invests in its R&D sector, the more the firm is considered to be absorptive. These firms are able to bring innovation to their existing products, hence, they can modify their methods of production resulting in cost efficiency or increased production. During this exercise, the firms may fail and end up wasting their assets, but eventually they do succeed. In the short run, having a specified quota for R&D is certainly considered as an extra cost for the firms, but there are long-run benefits which cannot be anticipated.

To examine this, the firms were asked about their R&D expenditure. The responses indicate that awareness campaigns should be organized to encourage firms to invest in R&D. Nearly half of the sample industries do not invest in R&D, and among the 86 firms only 45 (52%) currently invest 1% to 10% of their profits in R&D. Out of these firms, more than 20 of them invest 5% annually in R&D, which is a substantial figure.

Additionally, we found that some firms did not specify any quota for research and development but were still conducting seminars or trainings for their labor force, which is a sign of R&D spend. Therefore, specifying a quota for R&D and spending on R&D-related activities without specifying a quota are two different things. Therefore,



other than these 45 firms that specify a quota for R&D, we found a reasonable number of firms spending on R&D-related activities, such as conducting, or participating in, seminars.

Accordingly, the next question asked was about participating or conducting R&D-related seminars. Only four firms were identified that did not have a designated quota for R&D but still they conducted R&D-related seminars internally. On the other hand, 60 firms (70%) were managing to send their technical laborers to participate in seminars and were investing a great deal in their training. This was the case for locally organized seminars. Fifty eight firms (58%) were able to send their technical workers abroad to participate in technical seminars.

From the above discussion, we can conclude that firms have little awareness of the long-term benefits they can gain from investing in R&D, which can prove to be a huge hurdle for our industries in their development. Thus, the firms reacted adversely when they were asked about consulting any third party or other research-oriented bodies, such as consultants or universities, to improve their overall performance. This behavior is destructive for the industrialization process of Pakistan, and these findings will hopefully help our industrial sector to improve the current prevailing situation.

#### 4.7. Role of Absorption Capacity in Transmitting the Effect of Technology on Firms' Output Performance

To further examine the insights, this section primarily focuses on the role that absorptive capacity has on output performance. As the objective of the study is not restricted to analyzing the impact of technology on economic growth, the role of domestic laborers' in the absorption of technology is the second objective, which certainly plays a vital role in transforming the effects of technology into economic growth. Therefore, first, we present the effects of technology on firms' output growth, then we incorporate the aspect of absorption capacity in this nexus. The absorption capacity of any firm can either be captured by measuring the proportion of technical laborers against that of non-technical laborers, or it can be examined by analyzing the overall knowledge of the firm. Both of these approaches were employed to investigate the absorption capacity of domestic laborers. Similarly, to capture any technological spillover, two types of variable were designed to meet the task. First, we focused on recently installed technology, and the second, in a broader sense, examines the nature of technology employed irrespective of any time domain.

##### 4.7.1. The Impact of Technology on Firms' Output Performance

To analyze the impact of technology on output performance, we concentrated on providing evidence using some descriptive tools, namely a cross tabulation approach. The results indicate that among the firms which have recently installed technology (during the last 5–10 years), 8.4% of them did not increase their output, i.e., the impact of this innovation did not significantly affect their output performance. This is due to that fact that in many cases new technologies are usually installed for the purpose of quality improvements rather than increased quantity.

On the other hand, out of 86 firms, 65% reported that recent technology installation has brought benefits in terms of output. The results clearly indicate that the installation of recent technologies enables the firms to flourish. Table 5 below presents the impact of the installation of recent technology on output performance.

Table 5. Adaptation of recent technology and firms' output performance (cross tabulation).

Firm Growth			Recent Tech		Total
			No Recent Tech	Recent Tech Installed	
	No Sales	Count	3	7	10
		% of Total	3.6%	8.4%	12.0%
	Sales Occurrence	Count	19	54	73
		% of Total	22.9%	65.1%	88.0%
Total		Count	22	61	83
		% of Total	26.5%	73.5%	100.0%

A similar analysis was carried out to analyze the technological spillover impact on firms' output performance. A cross table of output against imported technology is presented Table 6. We achieved almost same results as in the case of recently installed technology. For instance, the results indicate that among the sample size of 83 variables, only 6% of firms have reported the ineffectiveness of foreign technology on the firm's growth. On the other hand, 84.3% of the firms have reported the effectiveness of foreign technology, which has benefited production in terms of both quality and quantity.

However, 3.6% of the firms reported an increased output (sales) without adaptation of foreign technology. The one possible justification is that the cooking oil industry in Pakistan relies on domestic technology and cannot depend on foreign technology; however, the firms are still growing without any imported technology.

**Table 6.** Firm output performance and imported technology (cross tabulation).

Firm Growth		Imported Technology		Total
		Not Imported	Imported Technology	
No Sales	Count	5	5	10
	% of Total	6.0%	6.0%	12%
Sales Occurrence	Count	3	70	73
	% of Total	3.6%	84.3%	88%
Total	Count	8	75	83
	% of Total	9.6%	90.4%	100%

After analyzing the effect of technology on output performance, we then discuss the role of domestic labor in technology and firms' output growth.

#### 4.8. The Role of Absorption Capacity in the Nexus of Technology and Output Performance

Absorption capacity is a term which encompasses the overall capabilities of any firm. This is either analyzed by measuring the proportion of employed labor or by the firm's knowledge, and we have analyzed both perspectives. Keeping the proportion of labor under consideration, the results indicate that after incorporating the effect of technical labor, 67% of firms reported a growth in performance when technology is employed. It is pertinent to note here that, considering the results in Table 5, we found that 65% of firms benefited in terms of growth after installing recent technologies. Here, the results are almost the same, with an increase of only 2%, which shows that technological labor force increases output effectiveness of recent technology by only 2% (see Table 7).

**Table 7.** Firm growth and recent technology with the role of technical labor (cross tabulation).

Firm Growth			Recent Technology		Total
			No Recent Tech	Recent Tech Installed	
No Sales	Tech labor	Count	3	7	10
		% of Total	30.0%	70.0%	100.0%
	Total	Count	3	7	10
		% of Total	30.0%	70.0%	100.0%
Sales Occurrence	No Tech labor	Count	1	5	6
		% of Total	1.4%	6.8%	8.2%
	Tech labor	Count	18	49	67
		% of Total	24.7%	67.1%	91.8%
	Total	Count	19	54	73
		% of Total	26.0%	74.0%	100.0%

## 5. CONCLUSION

The study analyzed the absorptive capacity of Pakistan's manufacturing firms and how they absorb imported technology into their production processes. From the evidence extracted from the field survey, we discovered that most of the firms cannot meet international standards in their products, and therefore only supply to domestic

markets. We observed that almost all firms utilize both domestic and foreign technologies, and the firms that have installed technology from abroad are more focused towards quality improvement than quantitative benefits. Conversely, there are few firms that have installed entire plants from abroad, namely steel mills, plastic manufacturing industry, and the feed industry. The products of these firms are relatively exceptional as far as the quality international standards are concerned. Regarding absorption capacity, the evidence from the field survey exhibits that, on average, in the sample manufacturing firms, 60% of the workers are technical workers, which is a good sign. Subsequently, to observe the awareness of firms towards research and development, they were asked about R&D expenditure. The responses were surprising as few firms were focusing on this critical component, which happens to be the main driver of development in any firm. This situation is both alarming and distressing. The sustainability and growth of any firm depends on this segment. In some cases, ignorance towards the maintenance of installed equipment was also observed, which highlights the undervaluation of the impact of technological improvement. The results and findings were not satisfactory, and we hope that these results will portray clear options for firms, whether to sustain and develop, or to produce for a certain period and then shut down.

**Funding:** This study received no specific financial support.

**Competing Interests:** The authors declare that they have no competing interests.

**Acknowledgement:** All authors contributed equally to the conception and design of the study.

## REFERENCES

- Antoio, K. W., & William, L. (2019). Absorptive capacity, technological innovation capability and innovation performance: An empirical study in Hong Kong. *International Journal of Technology Management*, 80(2), 107-148. Available at: <https://doi.org/10.1504/ijtm.2019.10021421>.
- Barro, R. J., & Sala-i-Martin, X. (1995). *Economic growth*. New York: McGraw-Hill.
- Chuang, Y.-C., & Hsu, P.-F. (2004). FDI, trade, and spillover efficiency: Evidence from China's manufacturing sector. *Applied Economics*, 36(10), 1103-1115. Available at: <https://doi.org/10.1080/0003684042000246812>.
- Criscuolo, P., & Narula, R. (2008). A novel approach to national technological accumulation and absorptive capacity: Aggregating Cohen and Levinthal. *The European Journal of Development Research*, 20(1), 56-73. Available at: <https://doi.org/10.1080/09578810701853181>.
- Danquah, M., Ouattara, B., & Quartey, P. (2018). Technology transfer and national efficiency: Does absorptive capacity matter? *African Development Review*, 30(2), 162-174. Available at: <https://doi.org/10.1111/1467-8268.12321>.
- Eaton, J., & Kortum, S. (1996). Trade in ideas Patenting and productivity in the OECD. *Journal of international Economics*, 40(3-4), 251-278.
- Government of Pakistan. (n.d). Pakistan economic survey (2015, 2016, 2017). Finance Division, Economic Advisors Wing.
- Griffith, R., Stephen, R., & John, V. R. (2003). *R&D and absorption capacity: From Theory to Data*. Institute for Fiscal Studies: WP01/03.
- Harrison, A., & Hanson, G. (1999). Who gains from trade reform? Some remaining puzzles. *Journal of development Economics*, 59(1), 125-154.
- Henry, M., Kneller, R., & Milner, C. (2009). Trade, technology transfer and national efficiency in developing countries. *European Economic Review*, 53(2), 237-254. Available at: <https://doi.org/10.1016/j.euroecorev.2008.05.001>.
- Howitt, P. (2000). Endogenous growth and cross-country income differences. *American Economic Review*, 90(4), 829-846. Available at: <https://doi.org/10.1257/aer.90.4.829>.
- Jiang, M. S., Jiao, J., Lin, Z., & Xia, J. (2019). Learning through observation or through acquisition? Innovation performance as an outcome of internal and external knowledge combination. *Asia Pacific Journal of Management*, 1-29.
- Jiangtao, H., Zheng, R., Deng, H., & Zhou, Y. (2019). Green supply chain collaborative innovation, absorptive capacity and innovation performance: Evidence from China. *Journal of Cleaner Production*, 241.

- Kaja, R., & Slavec, A. (2017). The interplay of decentralization, employee involvement and absorptive capacity on firms' innovation and business performance. *Technological Forecasting and Social Change*, 120, 195-203. Available at: <https://doi.org/10.1016/j.techfore.2016.12.017>.
- Keller, W. (2004). International technology diffusion. *Journal of Economic Literature*, 42(3), 752-782.
- Kobarg, S., Stumpf-Wollersheim, J., & Welppe, I. M. (2018). University-industry collaborations and product innovation performance: The moderating effects of absorptive capacity and innovation competencies. *The Journal of Technology Transfer*, 43(6), 1696-1724. Available at: <https://doi.org/10.1007/s10961-017-9583-y>.
- Marianne, S., & Einar, R. (2016). How firms collaborate with public research organizations: The evolution of proximity dimensions in successful innovation projects. *Journal of Business Research*, 69(3), 1250-1259. Available at: <https://doi.org/10.1016/j.jbusres.2015.09.006>.
- Mingyong, L., Shuijun, P., & Qun, B. (2006). Technology spillovers, absorptive capacity and economic growth. *China Economic Review*, 17(3), 300-320. Available at: <https://doi.org/10.1016/j.chieco.2006.04.005>.
- Narula, R., & Criscuolo, P. (2002). *A novel approach to national technological accumulation and absorptive capacity: Aggregating Cohen and Levinthal*, Research Memoranda 018. Meastricht: MERIT.
- Narula, R. (2004). *Understanding absorptive capacities in an innovation system context: Consequences for economic and employment growth*. MERIT Research Memorandum 2004-003.
- NSB. (2008). *Science and engineering indicators 2008*. Arlington, VA: National Science Board.
- Stephen, L. P., & Edward, C. P. (1991). Technology adoption and growth. NBER Working Papers 3733: National Bureau of Economic Research, Inc.

*Views and opinions expressed in this article are the views and opinions of the author(s), Asian Economic and Financial Review shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.*