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RESEARCH PAPER

Effect of technological innovation on firm's performance: mediating effect of competitive advantage: a study on manufacturing firms operating in Ethiopian industrial parks

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ABSTRACT

Goal: This study aims to examine the relationship between technological innovation and the performance of manufacturing firms operating in Ethiopian industrial parks through the mediating effect of competitive advantage.

Design/Methodology/Approach: A mixed research-methods approach and an explanatory research design were applied to explore the relationship between the variables of the study. By using the non-probability sampling technique, the researchers collected data from 382 top and middle managers and purified it through Confirmatory Factor Analysis. To examine the effect of technological innovation and test the hypothesis, this study employed Structural Equation Modeling (SEM).

Result: The findings supported that technological innovation positively and significantly influences firms' performance ($b = 0.483$, $p<0.001$) and competitive advantage ($b = 0.583$, $p<0.001$). Moreover, it is exposed that competitive advantage influences firm performance ($b = 0.379$; $p<0.001$). Thus, the result demonstrated that the proposed partial mediation model was accepted because the relationship between the constructs was statistically significant. The result confirms that improving technological innovation enables increased product quality and process efficiency, which leads to minimizing operational costs and offering quality products that improve firms' success.

Limitations: The proposed model may not be generalized due to one-time data collection. Thus, it should be implemented in other business environments. The study is also limited to publicly owned industrial parks. Hence, future studies can incorporate privately owned industrial parks.

Practical Implication: This study reveals that firm managers must give attention to technological innovation and develop differentiated competitive advantages to improve firm performance. Further, policymakers are suggested to establish systematic monitoring and evaluation for effective technology transfer and knowledge spillover between local employees and foreign employees.

Originality/value: This study adds value to the current body of knowledge by addressing the mediating effect of competitive advantage in the relationship between technological innovation and firm performance.

Key Words: Technological Innovations; Product innovations; Process innovations; Competitive advantage; Firm Performance.

1 INTRODUCTION

Today, the global competitive business environment has been rapidly changing due to intense competition, increasing changes in consumers' preferences, and a shorter product life cycle. In response to this dynamic environment, technological innovation has become a global issue for

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business firms (Ukpabio et al., 2017).
Innovation is a vital driver of competitiveness and business performance (Jordao & Novas, 2017). Regardless of their size, all firms use their resources to add customer value and meet the firm's goals by using creative innovation strategies (Qui & Yu, 2020). Technological innovation enables firms to respond to external changes to gain and sustain competitive advantage and thereby increase competitiveness (Huseyin et al., 2016). Technological development empowers manufacturing firms to reduce production costs, shorten production process times, and improve firms' productivity (Kasongo et al., 2023).

Besides, the nexus between technological innovation and business achievement is inconclusive and ranges from positive to negative (Moskovich, 2020; Onufrey & Bergek, 2020). Technological innovation improves productivity, which further improves the overall firm's achievement (Nanhong, 2023; Asghar et al., 2023). Further, through investing in research and development of products and processes, firms can enhance their profitability (Ben-Khalifa, 2023). They argue that greater success in technological innovations leads to a superior chance of outcompeting firms with fewer technological innovations. Accordingly, despite many studies that confirmed the positive association among the constructs, some investigations revealed that innovation cannot directly affect business performance (Kusuma et al., 2021; Riswandari et al., 2023). This lack of consistency in the relationship between the constructs is due to the fact that innovation success involves a combination of different resources, such as human, financial, technological, and organizational capabilities, that may impose limitations on the relationship (Trinugroho et al., 2022).

Beside, competitive advantage, which is manifested through imitability, durability of products, and ease of matching (Correia et al., 2020), is perceived as the heart of a firm's performance (Almulhim, 2020; Zhang & Zhang, 2022) and is considered a weapon that enables firms to beat their competitors. Accordingly, firms with higher technological innovation are capable of gaining a competitive edge and congruously yielding the latest great-quality products quickly and at a lower price than competitors that put them in a higher market position (Wanaswa et al., 2021). Mugo and Macharia (2020) underscored that technological innovation affects the competitive edge.

Further, in economic structural transformation, the manufacturing sector is considered a driver of economic development because it creates job opportunities, generates export earnings, and contributes to the GDP of countries (Cimini, 2020). In the manufacturing sector, the development of technological innovations shaped competitiveness (Dachs et al., 2019). They stressed that in the manufacturing sector, technological innovation is a strategic driver for competitiveness. Jin and Choi (2019) explained that in the manufacturing sector, technological innovations linked to products, processes, and services aim to lower the costs of production. Further, it was found that technological innovations affected the performance large manufacturing firms (Do et al., 2023).

In the past few decades, Ethiopia has undergone progressive technological transformation. On the other hand, in Ethiopian industrial parks, studies on technological innovation are not yet well studied. Prior studies did not assess this issue, and there is a research gap that needs to be addressed, particularly in Ethiopian industrial parks. Therefore, conducting studies on how technological innovation influences firms' performance is imperative to know the extent of innovation practice in the Ethiopian manufacturing context.

1.1 Statement of the problem

In the manufacturing sector's dynamic business environment, companies face stiff competition and fierce rivalry continuously (Akpoviroro et al., 2021). Thus, to survive in the market, firms should adopt or develop strategic tools such as technology innovation (Merono-Cerdan & Lopez-Nicolas, 2013). Large-scale manufacturing industries are prone to high degrees of technological innovation capabilities and stiff competition from their competitors (Ahmad et al., 2019).

The Ethiopian government aims to foster technological innovation, which will flourish and play a key role in spurring economic growth. Consequently, Ethiopia has recently launched an industrial park strategy as a policy tool to improve the role of the manufacturing industry in economic contribution with the objectives of enhancing technological innovations and improving technology transfer and knowledge spillover between local employees and foreign companies, as stated in Industrial Parks Proclamation No. 886/2015 (FDRE, 2015). In this proclamation, the light manufacturing firms operating in industrial parks were supposed to have high potential for providing innovative technologies and believed that they could transfer this knowledge to local employees in order to sustain the industrial park's development in the long run.

However, most firms in Ethiopia's IPs operate on a "cut-and-make" basis, in which Ethiopian manufacturing enterprises focus on the labor-intensive, which uses less innovative technologies and is less skilled (World Bank, 2022). Further, technology transfer is highly limited to lower-level employees found at operational activities. This gives insight into the fact that highly sophisticated technologies were dominated by foreigners, which may constrain the sustainability of firms.

Moreover, the joint venture between local firms and investors is so limited that it inhibits technology transfer, which imposes constraints on overall performance (UNIDO, 2018). Additionally, according to UNCTAD (2020), 93% of Ethiopian manufacturing enterprises' sources of technological innovation, like the acquisition of machinery, equipment, and know-how, are imported from abroad. This high reliance on imported technologies has an effect on the sustainability of business performance. Furthermore, many of Ethiopia's manufacturing companies innovations, particularly in the leather and textile sectors, are not new to the international market; this shows that firms in Ethiopia use more familiar technologies than innovative ones (Wakeford et al., 2017) due to limited research and development. Moreover, the sector is known for its low-tech experience, scarcity of skilled workers in the sector, and low speed in technological innovation and knowledge transformation (UNDP, 2018; Chebo & Wubatie, 2020). Thus, it is possible to argue that technological innovation faced constraints that directly or indirectly influenced firms' performance.

Moreover, despite the manufacturing sector being one of the governments prioritized economic sectors, how technological advancement influences the sector's success in the context of industrial parks has not yet been studied. Few studies, such as Kassa and Getnet (2022) and Ayinaddis (2023), examined how innovation is related to performance by emphasizing MSEs. Further, Bezawit and Kenenisa (2019); Fesseha and Bizuayehu (2019); and Worku et al. (2023) conducted studies in selected IPs in Ethiopia. However, they did not address the issues of how technological innovations affect firms' achievement. Further, since industrial parks have been launched recently, there has been a quite scanty study on IP's performance, and much is not known about the topic under study. Hence, the purpose of the current study was to analyze the effect of technological innovations on firms' performance in an Ethiopian industrial park context. Further, the study investigates whether the link between technological innovations and performance is mediated by competitive advantage.

2 LITERATURE REVIEW

2.1 Technological Innovation

The notion of innovation was introduced by Schumpeter (1934). It was conceptualized as innovation that makes changes through imaginative destruction. In this process, innovative technologies replace old ones by continuously creating new elements. Through research and seminars, the concept is defined as "*the process of introducing new or significantly improved products (goods or services), or a process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations with the aim of improving firm performance*" (OECD, 2005, p. 46).

Despite an abundance of innovation classifications and approaches, there are some common, basic typologies within the term innovation. Innovation can be radical, discontinuous, or incremental (Dodgson et al., 2008). Also, to explain the level of newness of a specific innovation, it was categorized into macro- and micro-approaches (Garcia, 2002). Further, according to the OECD (2018), the most widely used typologies of innovations are business innovations. Accordingly, it offers a comprehensive definition of business innovation, outlining innovation as *"implementation of a new or significantly improved product or business process (or combination thereof), a new marketing method, or a new organizational method in business practices, workplace organization, or external relations that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm" (OECD, 2018, p. 68).*

Though the typologies of innovations are broad and varied, in this study's context, product and process innovations were taken as technological innovations, and organizational and marketing innovations were taken as non-technological innovations (OECD, 2005, 2018; Maine et al., 2012; Mothe & Nguye, 2012). Consequently, Bodlaj et al. (2018) elaborated on the types of innovation as technological (product and process innovation) and non-technological (marketing and organizational). Technological innovation involves new product development, while non-technological innovation involves strategy, leadership, culture, climate, collaboration, and organizational and environmental evolutions (Siriram, 2022). Vo-Thai (2021) stated that technological innovations are usually associated with product and process innovation, while non-technological innovations are related to organizational and marketing innovations (Rajapathirana & Hui, 2018; Tavassoli & Karlsson, 2021). Moreover, despite the importance of non-technological innovation, some literature shows that manufacturing firms seek technological innovation to highly accelerate product development and value creation, creating a competitive advantage relative to their rivals and magnifying their performance, which makes them competent in the international market (Ramadani et al., 2019; Snihur & Wiklund, 2019; Rajapathirana & Hui, 2018; Coad et al., 2019). Thus, it is essential to examine how the technological innovation aspect affects the performance of manufacturing firms, particularly in the context of those operating Ethiopian industrial parks. In this study, product and process innovations were discussed.

2.2 Product technological innovation

"Product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components, and materials, incorporated software, user friendliness, or other functional characteristics" (OECD, 2005, p. 48). Product innovation includes the addition of new functions, significant improvements to performance specifications, and quality such as durability, reliability, economic efficiency, affordability, convenience, and user friendliness. Further, product innovation encompasses the launch of innovative or original goods and facilities in order to create new-fangled markets and consumers (Wan et al., 2005). Further, Laryea and Ibem (2014) expressed it as the discovery of technology and knowledge that results in the adoption and diffusion of products. According to Ukpabio et al. (2017), product innovation is the result of making and offering improved and new products to the market with enhanced performance that distinguishes one firm from their competitors.

2.3 Process technological innovations

"Business process innovation is the implementation of a new or significantly improved production or delivery method for one or more business functions that includes a significant change in techniques, equipment, and/or software" (OECD, 2005, p. 49). It is ways of producing or developing products, new or improved logistics, materials, and new production processes using technological capability (Ukpabio et al., 2017). It is the application of a new or improved technical process or the acceptance of newfangled machines or know-how in product development (Oke et al., 2007). Moreover, process innovation is highly manifested through the execution of different operational actions intended for cost reduction, increasing quality of production, and improving the logistics process of a firm, which enables firms to improve their performance (Wadho & Chau, 2018; Lee et al., 2019). Improving process innovations contributes to making operational processes efficient and makes human resources more productive (Pino et al., 2016).

2.4 The relationship between the variables

2..4.1 Technological innovations and performance

Prior studies exposed the existence of an association between technological innovation (product and process) and performance. Accordingly, studies show that innovation enables the success of performance (Bocquet et al., 2017). Further (Lee et al., 2019; Del-Carpio & Miralles, 2021) revealed that innovation related to products and processes lets companies develop resourceful manufacturing methods, increase yields, and add customer value, all of which contribute to production success. Additionally, product innovation opens opportunities for innovative firms to use the "first mover" advantage (Hult et al., 2004). This can safeguard firms from external competitors' threats that will contribute to the improvement of performance. Similarly, studies carried out by Hajar (2015) and Akpoviroro et al. (2021) confirmed that technological innovation has an association with performance. Thus,

H1: Technological innovation has an effect on a firm's performance.

2.4.2 The relationship between technological innovations and competitive advantage

In a highly dynamic business environment, technological innovation contributes to achieving a differentiated advantage. Firms may own potential bundles of resources. These resources need technological innovations that transform firms' potentials into economic advantage, which enhances the competitiveness of firms (Setyawati et al., 2017). In order to win in the intense market competition, innovation, which is a driver of unique advantage, is highly needed (Chen et al., 2014). As stated by Ryu (2016), innovative firms develop a competitive edge that enables them to satisfy their customers. Moreover, the main reason firms apply innovations is to gain a better competitive edge and increase business performance (Gunday et al., 2011). Additionally, in manufacturing firms, if both technological innovations—product and process innovations—are advanced at the same time (Lin et al., 2013), their effect on firms' operations can create competitive advantages, and firms' performance can be greater compared to their rivals. Technological innovation is the driver of contemporary competitive edge that enables firms to overcome the problems related to achieving sustainable competitive advantage (Wanaswa et al., 2021). Ali et al. (2023) found that green innovation has a positive relationship with competitive advantage. Thus, technological innovation is connected with launching new products and improving the production process, which enhances a firm's competitiveness (Baran & Zhumbaeva, 2018). Additionally, previous works by Ntshangase et al. (2018), Hendayana et al. (2019), Mulyono et al. (2020), and Rambe and Khaola (2023) found a positive association between technology innovation and competitiveness. Thus,

H2: Technological innovation has an effect on competitive advantage.

2.4.3 Competitive advantage and Performance

Rahman and Ramli (2014) argue that improvement in practices in competitive advantage dimensions leads to improvement in firms' performance. Further, Ploenhad et al. (2019) found that competitive advantage could be the main reason that directs the business towards high performance. Studies reveal that competitive advantage develops from the value that companies can create for customers in terms of their price, product excellence, reliability in product delivery, time to market, and innovation in product (Purnomo et al., 2022; Mukhsin & Suryanto, 2022). They claim that effectively developing and implementing competitive advantage components enhances performance. Further, Islam and Qamari (2021) found that firms' differentiated advantages improve their achievement. This argument is supported by Quynh and Huy (2018), who argue that to achieve competitive advantage, firms must excel in their customer value creation, which improves their performance. Similarly, competitive advantage makes firms exclusive to rivals (Udriyah et al., 2019). Generally, previous studies confirmed a positive association between the constructs (Wanjiru et al., 2019; Falahat et al., 2020; Miziriri et al., 2020). Hence, the higher CA leads to the better achievement of the company. Conversely, the lower CA of a company leads to poorer performance (Herman et al. 2018). From the above reviews, competitive advantage has an influence on both financial and non-financial business performance. This indicates a positive link among the constructs. Consequently:

H3: Competitive advantage has an effect on a firm's performance.

2.4.4 Mediating effect of competitive advantage

Successful innovation creates difficulty in the imitation of new processes and products by competitors. This creation of obstacles is a source of a of a firm's competitiveness that leads to higher performance (Wingwon, 2012). Sakchutchawan et al. (2011) also argued that when companies implement innovations, they can create a competitive advantage that in turn affects performance. Further, technology transfer simplifies the transition of hard and soft copy skills, which improves productivity (Mgendi et al., 2019). Thus, technology transfer facilitates the production of goods and services, which are inimitable core competencies of rivals, which improves the firm's advantage over rivals (MacIvers & Lennicka-hall, 2018). Also, technological innovation is positively associated with product quality (Shi et al., 2018). Rambe & Khaola (2023) stated that technology transfer is a determinant factor for accentuating superior gain. Further, the authors found that product quality, which is part of CA, influenced the link between competitiveness and technology transfer. Also, Susanti (2023) revealed that competitive advantage acted as an intervening variable among product innovation and business achievement. Moreover, Purnomo et al. (2022) confirmed that the link between innovation and technological innovation was mediated by competitive advantage. In a nutshell, technological improvements enhance product quality and process efficiency and then improve the competitiveness of a firm. Therefore:

H4: Competitive advantage mediates the link between technological innovations and a firm's performance.

3 METHODOLOGY

3.1 Research design

In order to develop trust in the results of the study, following scientific procedures contributes towards achieving the intended goal of the study (Park et al., 2020). This study collected data through a cross-sectional survey strategy, which is a quantitative research methodology. To explain how the predictor variables affected the response variable, an explanatory study design was used.

3.2 Study population and sampling design

As a target, firms operating in Ethiopian public IPs were included. Accordingly, in this study, the researcher purposefully selected Oromia Region, Addis Abeba City Administration, and Sidama Region, which have more experienced manufacturing industrial parks. Consequently, Bole Lemi-1, Hawassa, and Adama IPs were purposefully selected. The selection of industrial parks is based on different reasons. First, in terms of ownership, they are all publicly developed and administered parks. Second, all of them have at least more than five years of manufacturing experience. Third, they are found among the top-performing publically owned IPs (e.g., Hawassa IP and Bole Lemi-1). Fourth, in terms of types of products, they are mainly engaged in textiles, apparel, and garments. Fifth, from a marketing strategy standpoint, they are mainly export-oriented. Thus, from ownership (management of IPs), operating experience, actual performance, types of products, and market strategy they follow, they are similar. Thus, the finding can be concluded from a publicly owned light manufacturing firm's performance operating in Ethiopian industrial parks. Further, the selection of firms from each IP was based on their operating experience. Accordingly, from the three industrial parks, 28 firms participated, excluding those with less than three years of operating experience.

Consequently, employees of manufacturing firms in three selected industrial parks were taken as the population of the study. Further, sample size was determined using the statistical approach proposed by Krejcie and Morgan (1970) for a finite target population. Accordingly, 382 sample sizes were determined. After determining the number of samples, the researcher has chosen non-probability sampling or purposive sampling techniques. The rationale behind selecting purposive sampling is that to evaluate firm performance, all employees may not give adequate information concerning the firms in the industrial parks. Thus, the study focused on individuals who could provide adequate data by using the non-probability or purposive sampling technique. Because this strategy can increase the richness of the data, it can more clearly illuminate the phenomenon being studied. Accordingly, surveys were administered to a purposeful sample of 382 senior managers and middle managers found at different positions. The researcher delineated respondents as those holding management positions because the type of topic and questionnaires incorporated in the study needed their attention. The researcher believed that these respondents were most knowledgeable and provided in-depth information about the overall performance of the firms.

3.3 Procedures of data collection

Items that can be managed by the respondents were designed to ask employees of selected industrial parks. Consequently, data collection instruments were tested by professional experts. Then, after incorporating their comments, pre-tests were also carried out with manufacturing experts to make sure that all the questionnaires were relevant. Based on their feedback, the items were modified. Finally, items were disseminated personally to concerned employees. Further, after questionnaire distribution, to maximize the response rate, the researcher continuously followed up on the progress of data collection by exchanging information personally with the contact person and by email and phone. Data were collected at a convenient time at the respondents' workplace. Accordingly, 382 questionnaires were distributed, and 339 of them were collected, yielding a response rate of 88.74%. However, during the cleaning the returned items, 13 of them were considered unqualified for the study and eliminated. Thus, the remaining 326 questionnaires were subjected to the study analysis, and the survey response rate was 85.34%. Some of the remaining items were not returned. Others were excluded due to a lack of complete information. Thus, according to Bagozzi and Yi (2012), to conduct analysis using structural equation modeling, 100 respondents are adequate, and 200 respondents are more preferable.

3.4 Measurement instrument

The study's measurement scales were adopted from earlier approved measures. Previously validated items were primarily used to adopt item scales for each indicator. The study used a survey questionnaire using a Likert-style scale. Technological innovation and competitive advantage were measured using scales that ranged from 1 (strongly disagree) to 5 (strongly agree). The performance of firms is measured relative to their competitors over the last five years, with 1 = very low and 5 = very high. Technological innovation that contains two dimensions is measured using a 10-item scale, which is adopted from previous studies (OECD, 2005; Nabila et al., 2023; Ahmad et al., 2019; Gunday et al., 2011). Competitive advantage that comprises three dimensions is measured using a 15-item scale that is adopted from previous studies (Puspaningrum, 2020; Tinoco et al., 2019; Talaja et al., 2017; Udriyah et al., 2019). Further, the performance of firms operating in Ethiopian industrial parks is measured using seven items adopted from Singh et al. (2019); Kiveu et al. (2019); Hooley et al. (2005); Pratono (2016); Iragena and Mulyungi (2017); and Endashaw et al. (2020). The data collection period took four months, from April to August 2023. To examine the research hypothesis, structural equation modeling using AMOS software was applied.

Five academics with expertise in management, marketing management, and related experiences were asked to examine the questionnaire prior to the main survey. Thus, several tweaks, such as sentence structure and question wording, were incorporated to guarantee the questionnaire was able to gather the necessary information. To ensure that the questionnaire was pertinent, a pilot study of the questionnaire was then carried out. Then, thirty-five conveniently chosen middle- and upper-level manufacturing managers participated in the pilot study. Their feedback led to modifications to the items. Scale reliability testing was done using the results of the pilot study. According to the results of the scale reliability test, every item used to gauge technological innovation and firm performance was deemed to be appropriate.

3. 5 Measurement model assessment

3.5.1 Confirmatory factor analysis (CFA) for technological innovation

Through the assessment of psychometric properties, data purification and validation were conducted using CFA. Consequently, two-level consecutive approaches were used. Accordingly, a lower-order or first-order measurement model assessment was conducted. Further evaluation was conducted to determine how lower-order constructs were loaded on the second order. This means that identified indicators for second-order constructs in the first phase need to be put in SEM to examine the hypothesis (Sarstedt et al., 2019).

A. First order CFA of technological innovations

Technological innovation evaluated with 5 product innovation indicators and 5 process innovations indicators (observed variables). Figure 1 depicts the factor loadings of technological innovation.

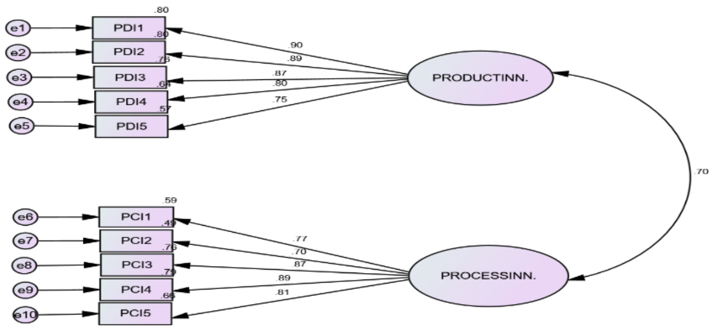

Figure1 - Measurement model for technological innovations

The CFA model examines measurement items. Consequently, the factor loadings of PDI1, PDI2, PDI3, PDI4, and PDI5 are (.90, .89, .87, .80, and .75) in order. Similarly, the regression weights of PCI1, PCI2, PCI3, PCI4, and PCI5 are (.77, .70, .87, .89 and .81) consecutively. Accordingly, the standardized regression weights observed in indicators fulfilled the minimum threshold, which is 0.5. Moreover, the covariance among the constructs is 0.70. Further, model re-specification was made by looking at the standardized factor loadings, standardized residuals, and model modification indices. Consequently, the model evaluation was met because all the standard loadings were higher than 0.5 thresholds. Moreover, the following Figure 2 indicates the improved model re-specification.

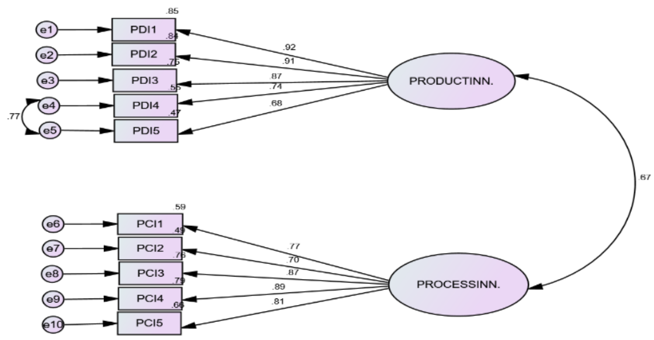

Figure 2 - Re-specified measurement model of technological innovations

The result shows that χ^2=38.164; DF=26; P-value=0.058; CMIN/DF=1.468; RMR=0.33; GFI=0.977; NFI=0.987; RFI=0.977; IFI=0.966; TLI=0.992; CFI=0.996; RMSEA=0.038; with a PCLOSE value of 0.770. The result shows that all the indices fit well.

B. Second order CFA for technological innovation

Second order examines how much first order (product and process innovations) constructs loaded on second order (technological innovations).

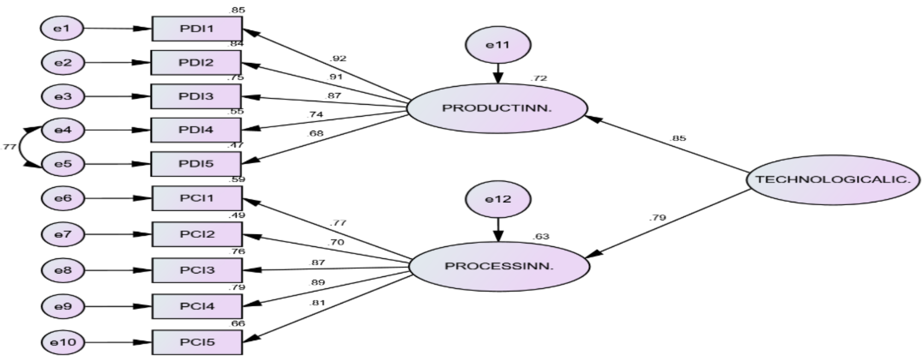

Figure 3 - Measurement model for technological innovations (Second order CFA).

The result shows that χ^2=54.205; DF=42; P-value=0.098; CMIN/DF= 1.291; RMR= 0.28; GFI= 0.972; NFI= 0.982; RFI= 0.972; IFI= 0.966; TLI= 0.994; CFI=0.966; RMSEA=0.030; with a PCLOSE value of 0.940. The result shows that all the indices fit well.

3.5.2 Measurement model for competitive advantage

C. First order model for competitive advantage

Competitive advantage is measured in terms of product quality, cost advantage, and the firm's responsiveness. The factor loadings of CA1, CA2, CA3, and CA4 are 0.93, 0.95, 0.68, and 0.65 consecutively. Further, the loadings of CA5, CA6, CA7, and CA8 are 0.77, 0.83, 0.83, and 0.78. Further, CA9, CA10, CA11, and CA12 have regression weights of 0.84, 0.88, 0.85, and 0.81, respectively.

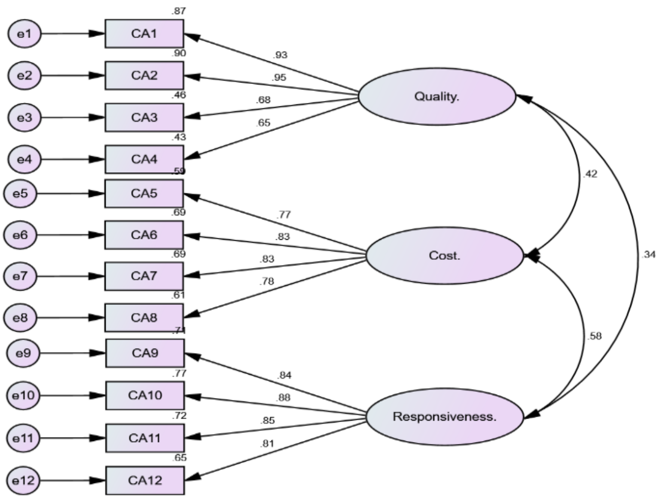

Figure 4 - Measurement model for competitive advantage (First Order CFA)

All the factor loadings are greater than the threshold of 0.5. Further, 4 Product quality advantage items, 4 Cost advantage items, 4 Firm Responsiveness items meet or exceed the ideal loading threshold of 0.7. Figure 5 shows the factor loadings of competitive advantage.

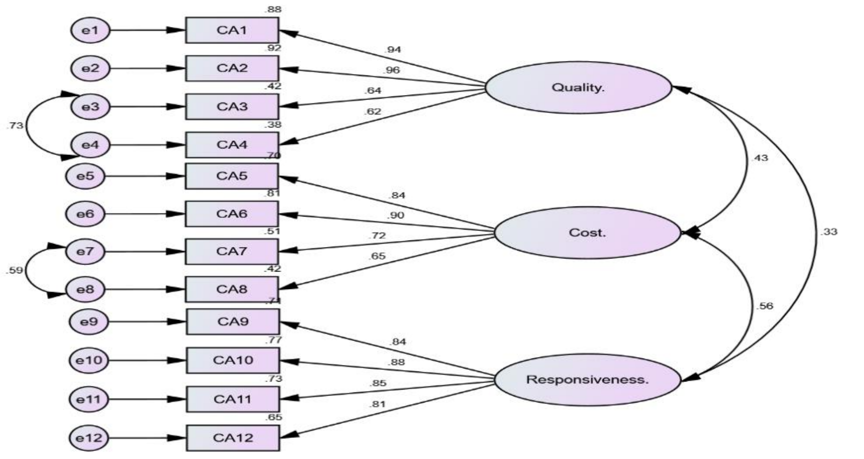

Figure 5 - Respecified Competitive Advantage Measurement Model (AMOS) output

The result shows that χ²=32.446; P-value=0.0544; CMIN/DF=0.954; RMR=0.024; GFI=0.983; NFI=0.981; TLI=1; CF=1; RMSEA=0.000; with a PCLOSE value of 0.995. Thus, the result shows the first-order CFA of competitive advantage met the standard.

D. Second oerder model for competitive advantage

This second order model development was conducted to see how much the quality, cost and responsiveness loaded to or explains competitive advantage.

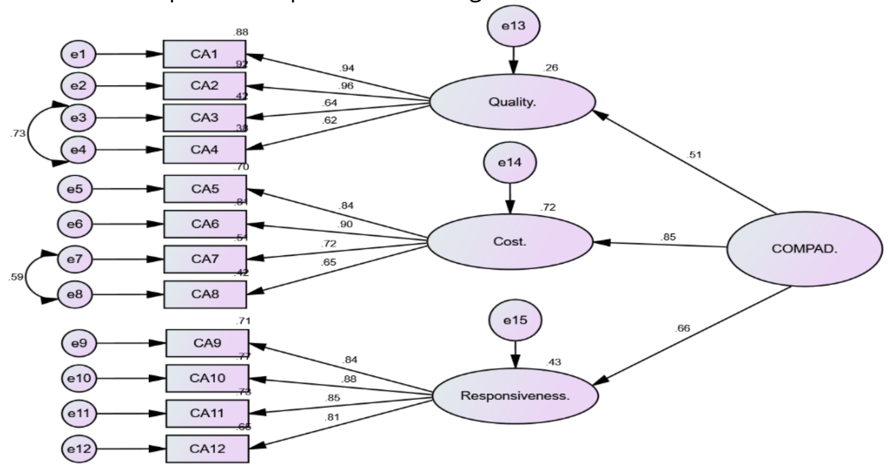

Figure 6 - Measurement Model for Competitive advantage (Second order model).

The result shows that χ² = 32.446, P-value = 0.0544, CMIN/DF = 0.954, RMR = 0.024, GFI = 0.983, NFI = 0.981, TLI = 1; CFI = 1; RMSEA = 0.000, with a PCLOSE value of 0.995. So, the model is well fitted to the standard.

3.5.3 Measurement model for firm performance

E. First order CFA for firm performance

The current study used both financial and marketing performance. Accordingly, profit, sales revenue growth, and sales volumes were considered as indicators of financial performance. In addition, from marketing perspectives, market share, customer satisfaction, and export growth were considered. The standardized regression weights of FP1, FP2, FP3, FP4, MP1, MP2, and MP3, were, 0.85, 0.85, 0.68, 0.61, 0.90, 0.98, 0.85 respectively. Thus, they were satisfied with the minimum factor loading of 0.5. Figure 7 presents the standardized factor loadings of items with their factors. Accordingly, since the first model marginally fit with the standard, to improve the model, re-specification was made. Consequently, Figure 7 presents the fitted model to the standard.

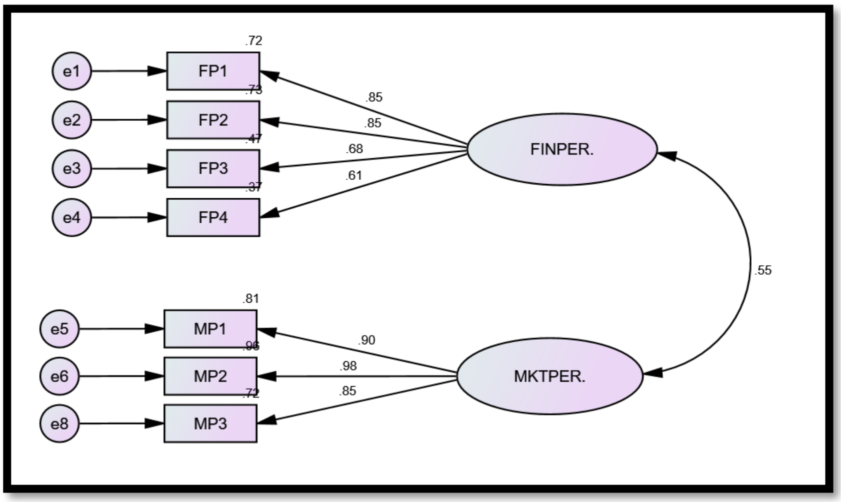

Figure 7 - First-order model for firm performance

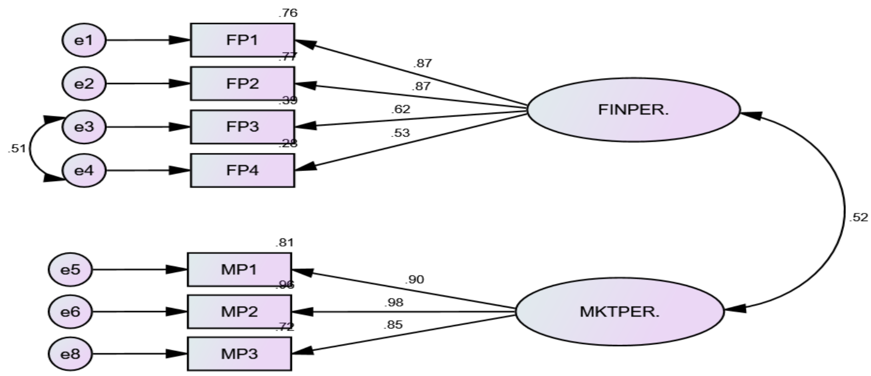

Figure 8 – Respecified measurement model for firm performance

Accordingly, the final model shows χ² =18.911; P-value 0.091; CMIN/DF = 1.576; DF = 12; RMR = 0.011; GFI = 0.984; NFI = 0.990; TLI = 0.994; CFI = 0.966; RMSEA = 0.042; with a PCLOSE value of 0.602. Based on the Model Fit Indices, the CFA result confirmed that all the indices are within the prescribed limit (well fitted to the standard), and the data collected can be used for further analysis.

F. Second order CFA for firm performance

Figure 8 depicts the second link between firm performance and its indicators.

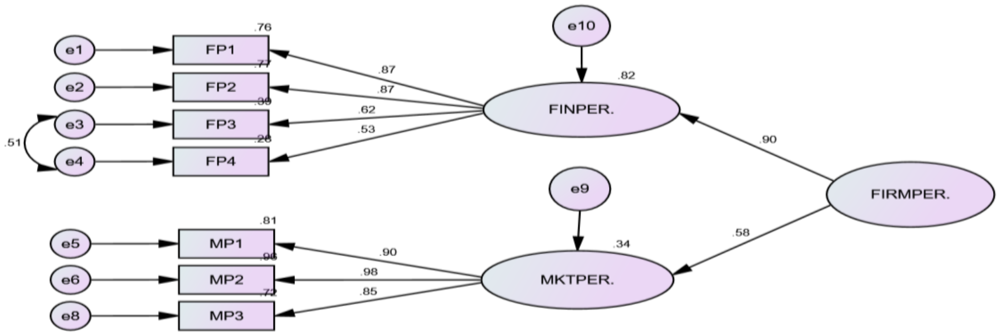

Figure 9 – Measurement model for firm performance (Second order CFA*)*

Chi-square = 16.546, DF = 10, P = 0.085 (insignificant), CMIN/DF = 1,655, RMR = 0.11, GFI = 960, NFI = 0.990, RFI = 0.979, IFI = 0.996, TLI = 0.991, CFI = 0.996, RMSEA = 0.045, PCLOSE = 0.540. All model indices fit with the standard.

4 RESULTS

Both descriptively and inferential analysis was conducted.

4.1 Descriptive data analysis

All constructs are measured on a five-point Likert scale. Table 1 shows the mean values for the main variables are higher than 3, which is above average. Further, the small values of the standard deviation of the variables reveal the low scattering of the variables.

Table 1 - Descriptive analysis for all constructs

Description of variables	Mean	Std. deviation
Technological Innovation	3.8957	.70457
Firm's Competitive Advantage	3.4899	.49978
Firm Performance	4.4784	.39797

4.2 Inferential data analysis

To examine the research hypothesis, structural equation modeling and path analysis were employed. Before conducting, structural model, reliability tests using Cronbach's alpha and composite reliability; construct validity using Average Variance Extracted and discriminant validity were conducted. Further, the measurement model, the structural model, and the overall model were confirmed.

4.3 Reliability test

The internal consistency of the indicators was evaluated. From the result, it is confirmed that the Cronbach alpha estimates of product innovation, process innovation, quality, cost, responsiveness, financial performance, and marketing performance are 0.95, 0.935, 0.922, 0.90, 0.935, 0.905, and 0.967 consecutively.

4.4 Composite reliability (CR)

In addition to Cornbrash's alpha value, the study examined the CR of each variable. Table 2 shows that the composite reliabilities of product innovation, process innovation, quality, cost, responsiveness, financial performance, and marketing performance are 0.9249, 0.8950, 0.8843, 0.8767, 0.9092, 0.8386, and 0.9363 consecutively. Thus, this data fits the required ideal threshold of 0.7.

4.5 Construct validity test

In this study, convergent and discriminant validity were examined. Accordingly, the result shows that all costructs have > 0.5 loadings. The result reveals that standardized estimates for product innovation, process innovation, quality, cost, responsiveness, financial performance, and market performance are all greater than the 0.5 recommended thresholds. Further, the AVC for product innovations, process innovations, quality, cost, responsiveness, financial performance, and market performance are 71.23%, 63.96%, 62.57%, 0.66.30%, 0.6447%, 56.99%, and 75.49%, respectively. Since the values of AVE are higher than the required 50% threshold (Fornell & Larcker, 1981), the model is allowed to proceed with the next step of analysis. Thus, the constructs have convergent validity, and they are considered appropriate for further analysis. Table 2 presents the results of AVEs, of which all are greater than the 50% recommended threshold.

Table 2 - Psychometric properties of measurement scales

Research Constructs	Indicators	Factor Loadings	Cronbach's Alpha Value	Composite Reliability	Average Variance Extracted	Square root of AVE
Technologica						
Product innovation	PDI1	0.90	0.95	0.9249	0.7123	0.844
	PDI2	0.89				
	PDI3	0.87				

	PDI4	0.81				
	PDI5	0.75				
Process innovation	PCI1	0.77	0.935	0.8950	0.6396	0.7997
	PCI2	0.70				
	PCI3	0.87				
	PCI4	0.89				
	PCI5	0.81				
Competitive						
Quality	CA1	0.93	0.922	0.8843	0.6257	0.719
	CA2	0.95				
	CA3	0.68				
	CA4	0.65				
Cost	CA5	0.77	0.90	0.8767	0.6630	0.814
	CA6	0.83				
	CA7	0.83				
	CA8	0.78				
Responsiveness	CA9	0.84	0.934	0.9092	0.6447	0.8029
	CA10	0.88				
	CA11	0.85				
	CA12	81				
Firm						
Financial Performance	FP1	0.85	0.905	0.8386	0.5699	0.7549
	FP2	0.85				
	FP3	0.68				
	FP4	0.61				
Marketing Performance	MP1	0.90	0.967	0.9363	0.8309	0.9115
	MP2	0.98				
	MP3	0.85				

Source: Authors' data calculation, 2024.

4.6 Discriminant validity test

Discriminant validity can be measured through cross-factor loading methods and comparing AVE with squared correlations (Fornell & Larcker, 1981). Hence, the square root of the AVE of technological innovations, competitive advantage, and firm performance was greater than the squared multiple correlations among the variables. Thus, there is no DV problem.

Table 3 - Discriminant validity

	Correlations						
	PDI	**PCI**	**Quality**	**Cost**	**Responsiv**	**Financial Per**	**Market Per**
Product Innovation	**0.844**						
Process Innovation	.657**	**0.7997**					
Product Quality	.308**	.240**	**0.719**				
Cost Advantage	.354**	.363**	.527**	**0.814**			
Firm Responsiveness	.432**	.434**	.454**	.641**	**0.8029**		
Financial Firm Performanc	.416**	.427**	.342**	.300**	.366**	**0.7549**	
Market Firm Performance	.387**	.413**	.328**	.403**	.438**	.515**	**0.9115**

Source: Authors' data analysis, 2024, SPSS and AMOs output.

4.7 Correlation Analysis

In order to know whether there is a relationship among the constructs, correlation analysis was conducted. Consequently, technological innovation has a positive and significant association with performance ($r = 0.544$, $p<0.05$) and competitive advantage ($r = 0.563$, $p<0.05$). Furthermore, competitive advantage is positively associated with performance ($r = 0.533$, $p<0.05$). Moreover, the VIF values are less than 3. Thus, there is no problem with collinearity among the constructs.

Table 4 - Correlation analysis

Correlations[b]					
	Technological Innovation Capability	Firm's Competitive Advantage	Firm Performance	Tolerance	VIF
Technological Innovation	1	.563**	.544**	.510	1.960
Firm's Competitive Advantage	.563**	1	.533**	.590	1.694
Firm Performance	.544**	.533**	1		
**. Correlation is significant at the 0.01 level (2-tailed).					
b. Listwise N=326					

**. Correlation is significant at the 0.01 level (2-tailed), N=326.
Source: Authors' data analysis, 2024, SPSS output.

4.8 Analysis of structural model and hypothesis test

In analysis of hypothesis test, first the direct effect of variance in technological innovation was examined. Thus, to examine the direct effect, standardized regression weight was derived from AMOS software. Table 5 shows the beta coefficient (0.71) for direct effect. This shows a substantial effect with P-value less than 0.001(two tailed).

Table 5 - Standardized regression weight for direct effect of technological innovation.

Path			Total effect estimate
FIRMPER.	<---	TECHNOLOGICALI.	.705
FINPER	<---	FIRMPER.	.736
MKTPER	<---	FIRMPER.	.700
PRODUCTINN	<---	TECHNOLOGICALI.	.793
PROCESSINN	<---	TECHNOLOGICALI.	.829

Source: Authors' data analysis, 2024, SPSS and AMOS output.

Moreover, the AMOS graphics output illustrated modeling path of direct effect.

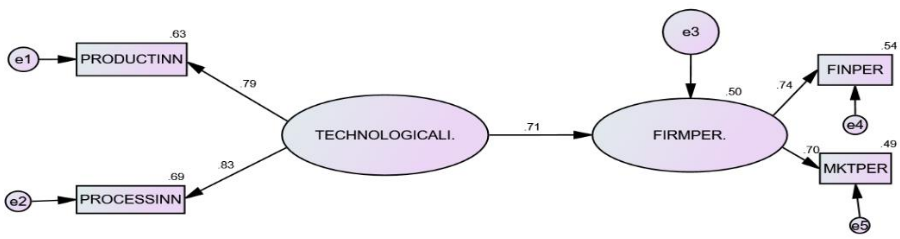

Figure 10 - Total effect of technological innovation on firm's performance

The model fit result shows Chi-square=0.118; DF=1; P-value=0.731; CMIN/DF=0.118; RMR=0.001; GFI=1.000; NFI=1; RFI=0.998; IFI=1; TLI=1; CFI=1; RMSEA=0.000 with PCLOSE 0. 818. Thus, all indices have fulfilled the required threshold. The result indicates that without the mediating variable, the direct effect of TI on FP is significant and meets the first criterion. This reveals that when a technological innovation goes up by 1, a firm's performance approximately goes up by 0.71. Thus, this result supports hypothesis 1. This gives insight into the fact that improving technological innovations and enhancing technology transfer play a vital role in improving performance.

4.9 Indirect effect analysis (after adding competitive advantage as mediator)

To test the mediation analysis, the study applied the principles of Baron and Kenny (1986). In this model of mediation, technological innovation is an independent variable (X), competitive advantage is the mediator (M), and firm performance is DV. Accordingly, the first variance in technological innovations (X) should significantly influence firm performance. To ensure this requirement, the total effect was estimated in the model. Second, variance in technological innovation should influence competitive advantage; this is this is the mediating variable (M). Third, competitive advantage (M) must influence firm performance (Y). Fourth, the indirect effect of variance in technological innovation on firm performance must be estimated by multiplying the two coefficients of the two paths (paths from IV to M and from M to DV). Finally, technological innovation's total effect on a firm's performance was computed as the sum of the direct and indirect effects. It is expected that as a mediator CA enters the model, the beta coefficient for the direct effect of technological innovation decreases. Figure 10 was presented when CA entered the model as a mediating variable between technological innovation and performance.

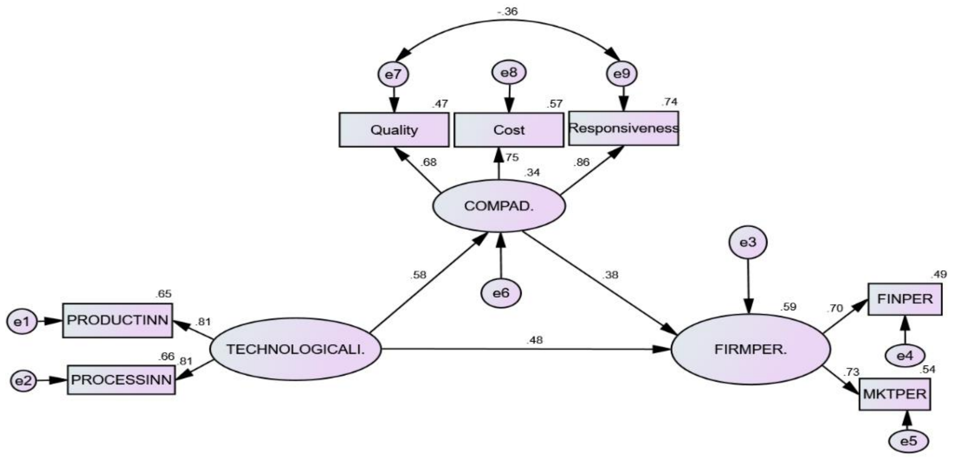

Figure 11 - Structural regression Model by AMOS (standardized estimate)

The model fit result shows Chi-square = 16.151; DF = 10; P-value = 0.095; CMIN/DF = 1.651; RMR = 0.010; GFI = 0.987; NFI = 0.980; RFI = 0.959; IFI = 0.992; TLI = 0.984; CFI =.992; RMSEA = 0.044; PCLOSE = 0.563. All model fit indices met the required threshold.

As indicated in figure 10, the beta coefficient linking technological innovation to firm performance is reduced from 0.71 to 0.48. The result revealed that despite the beta coefficient decreasing from 0.71 to 0.48, the value is still positive and significant. Further, the finding shows that competitive technological innovation influences performance indirectly.

Table 6 - Standardized regression weights of technological innovation effect on firm's performance with mediator

			Estimate	P-value	Result
COMPAD.	<---	TECHNOLOGICALI.	.583	***	Significant
FIRMPER.	<---	TECHNOLOGICALI.	.483	***	Significant
FIRMPER.	<---	COMPAD.	.379	***	Significant
MKTPER	<---	FIRMPER.	.733		
PRODUCTINN	<---	TECHNOLOGICALI.	.808		
PROCESSINN	<---	TECHNOLOGICALI.	.814		
FINPER	<---	FIRMPER.	.702		
Quality	<---	COMPAD.	.684		
Cost	<---	COMPAD.	.752		
Responsiveness	<---	COMPAD.	.861		

*** is significant at p<0.001(2-tailed), N=326.

The result revealed that TI positively and significantly (b = 0.538, p<0.001) affected competitive advantage. It confirms that as technological innovation goes up by 1 unit, competitive advantage also goes up by 58.3 percent. Similarly, TI positively and significantly affected FP (b = 483, p<0.001). It indicates that when technological innovations improved by 1 unit, firms' performance improved by 48.3 percent. Furthermore, competitive advantage influenced (b = 0.379, p<0.001) performance. This shows that when competitive advantage goes up by 1 unit, a firm's performance also goes up by 37.9 percent.

In general, from mediation analysis, the standardized regression estimates revealed technological innovation has significant and positive effects on both CA and firms' performance. Further, CA also positively influences performance. Thus, TI has both direct and indirect influences on FP. From the result, even after competitive advantage was added to the model as a mediator, despite the beta coefficient being reduced, the estimated value of direct influence is statistically substantial. Thus, the link between TI and performance is partially mediated by CA.

4. 10 Examining mediation (by AMOS)

Shrout and Bolger (2002) stressed that bootstrap tests are powerful in detecting the sampling distribution of mediated effects. From AMOS output, the standardized indirect effect of technological innovations on FP via competitive advantage was estimated to be 0.221. The bootstrap result using a 95% confidence interval using two tailed significance (bootstrap confidence) is significant at b = 0.221, p = 0.000. Moreover, the upper and lower bounds of the confidence interval were analyzed using standardized direct effects. Consequently, applying a two sided bias corrected bootstrap confidence interval for the mediated influence of technological innovations on firms' performance revealed that 0.072 and 0.199 are the lower and upper end points. This confirmed that between 0.072 and 0.199, there is no zero. Thus, since there is no zero between the lower and upper bounds of the confidence interval, it can be concluded that TI significantly indirectly affects FP. Further, the total effect of technological innovation and the mediated effect through competitive advantage were calculated. Accordingly, the standardized direct effect is 0.483. The standardized indirect effect is the result of a*b (0.583*0.379 = 0.220957). Thus, the total effect is 0.483 + 0.221 ~0.704. Therefore, the total effect of technological innovations on FP is significant (b = 0.704, p<0.001).

Table 7 - Summary of indirect effect

Relationship	Standardized total effect		Standardized direct effect		Standardized indirect effect				Conclusion
	Estimate	P-value	Estimate	P-value	Estimate	P-value	Lower bound	Upper bound	
Technological innovation→ Competitive advantage →Firm Performance	0.704	P<0.001	0.483	P<0.001	0.221	P<0.001	0.072	0.199	Partial mediation

Table 8 - Summary of Hypothesis

Hypothesis	Relationship	Finding	Decision
Hypothesis1	Technological innovation affects firm's performance	Positive and significant	Accepted
Hypothesis2	Technological innovation affects firm's competitive advantage	Positive and Significant	Accepted
Hypothesis3	Competitive advantage affects firm's performance	Positive and Significant	Accepted
Hypothesis4	Competitive advantage mediates the relationship between technological innovations and firm's performance	Positive and significant	Accepted

5 DISCUSSION

The finding confirmed that technological innovation affected firm performance directly and indirectly. Further, CA acted as a partial mediator variable between TI and FP. The finding indicates that technological innovations and competitive advantage jointly explain 59% of the variance in a firm's performance, and the remaining 41% is accounted for by extraneous variables that are not incorporated in this research.

Further, application significantly improved or new technological innovation that takes place through product and process innovation improves competitive advantage. This finding is supported by studies by Gurlek & Tuna (2017) and Kamboj & Rahman (2017), in which they confirmed that technological innovations can improve competitive advantage and firm performance. In technological innovation, products that were new on the market were less focused. In order to enhance technological innovation, it needs to make or improve products that are unique to the market and competent. Also, in process innovation, firms need to improve their innovativeness by using the latest methods and machines that are more efficient and effective, which can increase their productivity. Thus, in order to perform better than competitors, firms in industrial parks need to apply technological innovations. Innovative firms are more productive than their competitors (Mezid & Melese, 2022). Studies such as Munsung and Stephens (2020) and Ferreira et al. (2020) of supported that CA is a main strategy of firms that enables them to quickly respond to internal and external global competition. In Ethiopia, technology innovation heavily relies on imported technologies. Practically, the managers confirmed a low level of product and process innovation. Further, technological transfer was mainly focused on labor-intensive rather than highly skilled knowledge. This shows that practically, firms have been performing poorly on technological performance. In the Ethiopian context, firms need to understand the key role of technological innovations and competitive advantage, which makes them unique among international competitors. Finally, it was confirmed that CA partially mediates the link between technological innovation and firm performance, which confirmed the finding of Novitasari and Agustia (2023) indicating that when firms improve their competitive advantage, they improve their performance. Vafaei et al. (2019) found that innovation has a positive and significant impact on competitive advantage. This enables firms to create excellent customer needs and get a competitive advantage over their competitors, thereby improving their success. Similarly, Abdulrab et al. (2021) revealed that technological orientation has a significant and positive effect on firm performance, which confirmed the current study.

6 CONCLUSION

The main purpose of the current study is to analyze the influence of TI on FP in the context of Ethiopian industrial parks. The finding revealed that technological innovation (product and process innovations) affected competitive advantage, indicating that improving technological innovations enhances manufacturing companies' achievement. Further, CA partially influenced the link between technological innovations and FP. Thus, from the findings, the researcher inferred that to realize CA, TI plays a paramount role, specifically in manufacturing firms. Hence, firms can achieve success by applying technological innovations that could bring a competitive advantage, which further improves business performance. Moreover, weak domestic research and development performance, low domestic innovations, weak technology transfer, knowledge spillover between foreign and local firms that inhibits technology transfer and low cooperativeness are some constraints firms have been facing. Overall, firms operating in industrial parks can leverage their competitive advantages, such as product quality, cost minimization, and fast responsiveness, by using technological innovation that shortens the production process and enhances product differentiation compared to their competitors. Thus, by coordinating the link between these constructs, firms can achieve sustained economic performance.

6.1 Recommendations

Depending on the result, this study suggests some recommendations. Policymakers need to note that technological innovation is a vital determinant in enhancing the effectiveness of firms operating in IPs. Thus, policymakers need to formulate technological innovation as a strategic tool for improving CA and FP. Further, in order to optimize the importance of technological innovations, there should be thorough follow-up concerning technology transfer and knowledge spillover. Research and development institutions are a key for generating new ideas, product and process innovations, and technology transfer, which leads to productivity. However, excessive reliance on imported R&T (technology), particularly for export-oriented firms, may expose them to the risk of export. Thus, the government needs to encourage and capacitate research and development institutions in terms of finance, inter-firm interaction, and experience sharing so that firms' performance and sustainability will be improved. It needs to establish a strong monitoring system that enables technology transfer at a higher or more knowledge-intensive level in line with the national innovation system. Moreover, to increase knowledge transfer from international or multinational companies to local firms, encouraging subcontracting and joint- ventures can improve knowledge transfer. Finally, it would be better if the government encouraged and provided incentives for innovators as a means of inspiring product and process innovation, particularly for domestic firms.

6.2 Implications and limitations

Theoretically, the finding contributes to a deeper understanding of how the embeddedness of technological innovation enhances manufacturing firms' performance. Moreover, it gives insights into how the inclusion of competitive advantage magnifies firm performance. Thus, researchers can use this extended research model as the basis for related studies. Additionally, this study gives a foundation for managers operating in industrial parks to effectively implement advanced technologies to enhance their performance and be competent in the international market. On the other hand, the study used one-time data, which can influence the generalizability of the findings.

Thus, forthcoming studies are encouraged to use longitudinal data. This study tested only competitive advantage as an intervening variable. Thus, other future studies can use other mediating and moderating variables to see how firm performance is improving.

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