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# IMPACT OF INNOVATION ON PAKISTAN'S GDP: THE MEDIATING ROLE OF SME GROWTH

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## Abstract

Pakistan can attain economic growth comparable to that of China, Malaysia, and Thailand thanks to its advantageous position, sizable market, and developments in productivity and innovation. With 38.5% of the workforce employed and 19.2% of the country's GDP coming from agriculture, Pakistan's economy depends heavily on this sector. The study analyzed economic indicators in Pakistan, focusing on GDP, Research and Development Expenditures (RDE), High Technology Exports (HTE), and the role of Small and Medium Enterprises (SMEs). Using secondary data from the World Development Indicators (WDI) 2024 and Pakistan Economic Survey (2000–2021), the analysis employed E-Views 12, SPSS 29 and Amos 29 to examine SME growth as a mediator. The study revealed significant direct effects of RDE on SME growth, while HTE's effect was not significant. Indirect effects showed that RDE positively impacted SMEs, but HTE's impact was not significant. A strong correlation between SMEs, RDE, and GDP highlighted SMEs' critical role in GDP growth. Policymakers are advised to promote R&D and high-tech exports to foster SME growth and economic development.

**Keywords:** Innovation; Research and development Expenditures; High technology Export, SMEs, GDP.

## Introduction

Pakistan's strategic location and large market size, along with advancements in productivity and innovation, enable it to achieve economic growth similar to that of China, Malaysia, and Thailand (Bitabarova, 2018). Agriculture plays a crucial role in Pakistan's economy, contributing 19.2% to its GDP and employing 38.5% of the workforce. Although the sector supports 65-70% of the population, it faces significant challenges, including limited arable land, climate change, water shortages, and urban-to-rural migration, all of which hinder its growth potential (Aslam, 2016).

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Maximizing agricultural output requires the adoption of innovative methods and techniques, which can enhance the economy through collaboration with the manufacturing and services sectors. However, challenges such as climate change, water scarcity, and rising costs remain significant. Pakistan's natural resources, including oil, gold, gas, and coal, present additional economic opportunities (Kader et al., 2017). In 1947, Pakistan had only a few industries, but today, it boasts a diverse industrial base, with manufacturing accounting for 17% of the economy. The cotton textile industry is a major player, employing 19% of the workforce in large-scale industries and contributing over 60% of exports during the 1999-2000 period. Other important sectors include food processing, chemicals, tobacco, steel, and cement (Rauf et al., 2015).

Small-scale and family-owned businesses, despite their prevalence, account for only 6% of the economy. In 1999, industrial production saw a growth of 3.8%. Since the 1960s, the industrial sector has consistently contributed between 19% and 25% of total revenue, peaking at 24.5% in 2004 (Marques & Couto, 2017). Nearly 20% of Pakistan's industrial output comes from factories and construction, which have employed about 1 in 5 workers since the 1980s, reaching a peak of 1 in 4 in 2004. Despite efforts to diversify, textiles and sugar remain dominant, leaving production vulnerable to weather conditions and global price fluctuations (Tang, 2023). In 2022, Pakistan's industrial sector experienced a growth of 7.2%, primarily driven by manufacturing, which constitutes about two-thirds of the industry. Large-scale manufacturing (LSM) companies, which make up nearly half of the sector, contributed 74% to this growth, with a significant 10.4% increase in the Quantum Index of Manufacturing (QIM) from July to March. (Mastoi et al., 2022).The government is focused on expanding the export and industrial sectors. Cottage and small-scale industries contribute approximately 6% to GDP. In 1980, the industrial sector employed 17% to 20% of the workforce, which increased to 25% by 2004 while contributing 19% to GDP. Logistical challenges add 30% to production costs, negatively impacting overall economic performance. (Nag, 2022).

**Rationale of the study**

Some of these challenges include high density in foreign markets within low technology exports and low GDP research and development intensity. The research focuses on how and how far innovation and SME growth explain economic development, presenting a useful reference for policy measures among the gaps.

**Problem Statement**

Thus, it has been found that SMEs have a large potential in Pakistan, but they are used insufficiently mainly because of poor innovation and technology implementation. The current literature lacks studies embracing SMEs while analyzing the relationship between innovation and GDP. Nonetheless, this research seeks to fill this gap by establishing the total impact of innovation on GDP through SME development.

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## Research Questions

1. How does research and development expenditure impact SME growth in Pakistan?
2. What is the effect of high-technology exports on SME growth?
3. How do SMEs mediate the relationship between innovation and GDP growth?

## Research Objectives

1. To analyze the impact of research and development expenditure on SME growth in Pakistan.
2. To evaluate the influence of high-technology exports on SME growth.
3. To examine the mediating role of SMEs in the relationship between innovation and GDP.

## Theoretical Framework

This research is anchored on the innovation-led growth theory, which presupposes that innovation is central to the growth of any economy. The framework builds upon the review of literature where analysis of SME growth by examining R &D expenditures and high-technology exports affecting GDP is central (Aliasghar et al., 2020; Baiashvili & Gattini, 2020).

## Significance of the Study

The paper, therefore, extends the knowledge in the literature on innovation and economic growth by examining the role of SMEs in mediating this relationship. The conclusions can benefit policymakers because they establish a basis for developing policies for innovation and SME growth. This study also fills a research gap in the context of Pakistan's economy, as relatively few investigations examine innovation, SMEs, and GDP simultaneously.

## Literature Review

SMEs play a crucial role in the trade of goods and raw materials, the distribution of products from larger companies, the expansion of domestic services, and the facilitation of technology acquisition, all of which contribute to poverty reduction (Bauer et al., 2017). Open innovation is recognized for its broad applications across both financial and non-financial services, promoting learning within firms by integrating external expertise and providing access to valuable knowledge and tacit information. Furthermore, open innovation leverages economies of scale and scope in research and development while effectively distributing risks among collaborating firms(Vuong et al., 2020).

A study on food SMEs in Flanders, Belgium, revealed that resource constraints prompted these companies to favor outbound open innovation over inbound strategies. The main challenges they faced included issues related to

technology, finances, and human resources, making external collaboration crucial for product development and growth. (Sadat & Nasrat, 2020). Additionally, the study tackles the data gap concerning SMEs by exploring how organizational learning influences innovation and performance in the textile industry. By surveying 92 enterprises and employing structural equation modeling, the research found a positive correlation between organizational learning capacity and innovative performance.(Tambosi et al., 2020).

The study compared the small and medium-sized enterprises (SMEs) sector in Pakistan with that of other developing countries. This sector is vital to Pakistan's economy, significantly contributing to its growth and development. It plays a key role in economic revitalization, technological innovation, and providing sourcing opportunities for larger firms, all of which promote social progress. The potential of these enterprises has facilitated the development of both rural and urban areas, creating employment opportunities, reducing poverty, generating income, and fostering business growth throughout the country (Oyelana & Adu, 2015).SMEs exhibit varying performance across different sectors, contributing over 60% of both value-added output and employment in the services industry. While large firms dominate the manufacturing sector, SMEs still reap the benefits of economies of scale despite facing capital constraints. In countries like Mexico and Germany, both small and large manufacturing firms make significant contributions(Tõnurist, 2018). In contrast, SMEs in Zambia have experienced adverse effects from globalization, challenging the prevalent belief that developing countries universally benefit from it. This study highlights the necessity of a deeper understanding of globalization's impact on SMEs in such contexts and suggests that policies should be formulated to address these challenges(Mwika et al., 2018). Furthermore, a 2015 study utilizing GMM and 2SLS techniques examined Vietnam's economic growth and inflation from 1986 to 2013, finding that higher inflation negatively affects GDP, with Vietnam's inflation rate recorded at 7% (Karki et al., 2020).

In Serbia, a study utilized an autoregressive distributed lag model to analyze economic growth, unemployment, and inflation from 2007 to 2014. The findings indicated that price stability is crucial for economic growth and established a cointegration relationship between inflation and growth (Malenković, 2023). Similarly, another study examined the impact of small and medium-sized enterprises (SMEs) on economic growth in Pakistan, employing time series data from 1990 to 2019 and the autoregressive distributed lag-bounds cointegration approach. This research assessed both the short-term and long-term effects of SMEs on economic growth (Manzoor, Wei, & Siraj, 2021). Additionally, a study on economic development and foreign direct investment (FDI) in developing countries from 2000 to 2014 found that while the money supply positively influences growth, FDI has a negative short-term effect. In the long run, growth is primarily driven by domestic investment and human capital. (Akpan & Eweke, 2017; Khoshnevis Yazdi et al., 2017).

The study on Nigerian SMEs employed the autoregressive distributed lag method to investigate the factors affecting their performance. Net exports and interest rates negatively impact SMES's success in the short and long term. (Sitharam & Hoque, 2016). The literature review identifies significant gaps in research concerning economic growth, innovation, and the performance of SMEs. Current

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studies, such as those by (Ahmad & Ahmad, 2018; Salman et al., 2018), primarily concentrating on specific regions within Pakistan, limiting their broader applicability. Furthermore, longitudinal studies are scarce, with notable exceptions like (Manzoor, Wei, & Sahito, 2021). The impact of digital innovation and specific skill types on SMEs remains underexplored. While other contexts acknowledge the influence of external economic factors (Sitharam & Hoque, 2016) , their effects on Pakistani SMEs have not been adequately studied. Addressing these gaps through more qualitative and sector-specific research could provide valuable insights.

## Conceptual Framework

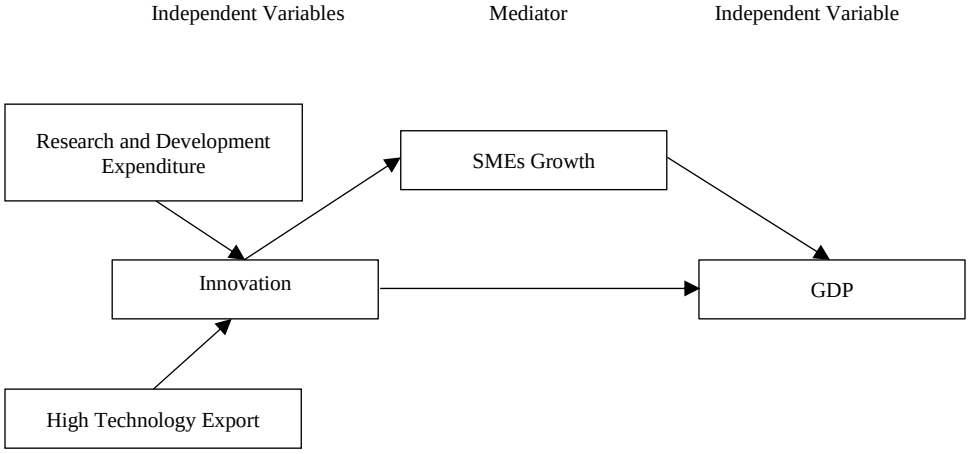



Figure 01: Conceptual framework

Source: The conceptual framework based on these studies, like (Aliasghar et al., 2020; Baiashvili & Gattini, 2020; Gokmenoglu et al., 2015; Manzoor, Wei, & Siraj, 2021; Maradana et al., 2017; Paul & Sharma, 2019)

## Research Methodology

Econometric techniques and estimation methods were used to analyze the data, focusing on the impact of innovation on Pakistan's GDP and the mediating role of SME growth from 2001 to 2021. The quantitative analysis relies on annual data from the World Development Indicators (WDI) (2024) to achieve the study's objectives.

## Model Specification

This study employed the adapted model formulated by Fumo and Biswas (2015), Murthy and Okunade (2016), Sbia et al. (2017), and Li et al. (2023).

$$SME = \alpha_0 + \alpha_1 R\&DE_t + \alpha_2 HTE_t + \alpha_3 GDP_t + u_t \quad (1)$$

$$GDP_t = \beta_0 + \beta_1 R\&DE \times HTE_t + SME_t + \varepsilon_e \quad (2)$$

Where $RDE \times HTE$ represent “innovation”

## Variables

| Table 01: Details of Variables | | |
|---|---|---|
| S# | Variable | Symbols |
| 1 | GDP (current US$) | GDP |
| 2 | Research and development expenditure (% of GDP) | $R\&DE_t$ |
| 3 | High-technology exports (% of manufactured exports) | $HTE_t$ |
| 4 | SMES Growth | $SMES_t$ |

Source: World Development Indicators (WDI) (2024)

## Results and Discussion

### Unit Root Test Results

Table 02 presents the results of the Augmented Dickey-Fuller (ADF) Unit Root Test. The results indicate that GDP is stationary at the level, while R&DE, HTE, and SME are non-stationary at the level but become stationary after first differencing. This suggests that the null hypothesis of non-stationarity for these variables can be rejected.

| Table 02: Augmented Dickey-Fuller (ADF) test Results | | | | | |
|---|---|---|---|---|---|
| Variable | Level | | 1st Difference | | Decision |
| | t-Statistic | p-value | t-Statistic | p-value | |
| $GDP_t$ | -4.7111 | 0.0071 | ……. | …… | Stationary at level |
| $R\&DE_t$ | -1.3969 | 0.5629 | -4.1888 | 0.0047 | Stationary at 1st difference |
| $HTE_t$ | -2.1586 | 0.226 | -3.453 | 0.0217 | Stationary at 1st difference |
| $SME_t$ | -2.3397 | 0.1701 | -6.387 | 0.0001 | Stationary at 1st difference |

### Regression Results: Impact of Innovation on the GDP of Pakistan with Mediating Role of SME Growth

### Impact of Innovation (R&DE) on SME Growth

Table 03 shows a moderate correlation between R&D expenditure (RDE) and SME growth; however, this relationship lacks statistical significance. Although the model suggests a possible connection, there is insufficient evidence to confirm the significant impact of RDE on SME growth.

### Impact of R&DE and SME Growth on GDP Growth of Pakistan

Table 03 demonstrates that GDP is significantly affected by both R&D expenditure (RDE) and the growth of SMEs. While RDE negatively impacts GDP, SMES growth has a positive influence. Furthermore, RDE directly restricts SME growth; however, this effect becomes positive and significant when mediated, consistent with findings from previous studies, including those by (Mishra et al., 2019).

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| Table 03: Impact of Innovation on the GDP of Pakistan with Mediating Role of SMEs Growth | | | | | | |
|---|---|---|---|---|---|---|
| SMES | Model Summary | | RDE | GDP | SMES | |
| R | R-sq | MSE | F-stat | Df1 | Df2 | p-value |
| 0.3002 | 0.901 | 0.7678 | 1.8821 | 1 | 19 | 0.1816 |
| | Coefficient | SE | t-statistics | p-value | LLCI | ULCI |
| Constant | 7.5108 | 0.4505 | 16.6705 | 0 | 6.5677 | 8.4539 |
| RDE | 1.7655 | 1.2869 | 1.3719 | 0.1861 | -0.9282 | 4.4593 |
| | | | | | | |
| GDP | Model Summary | | RDE | GDP | SMES | |
| R | R-sq | MSE | F-stat | Df1 | Df2 | p-value |
| 0.8975 | 0.8055 | $1.578\times10^{12}$ | 37.2691 | 2 | 18 | 0 |
| | Coefficient | SE | t-statistics | p-value | LLCI | ULCI |
| Constant | -3700.3 | $8.075\times10^{10}$ | -4.5355 | 0.0003 | -5419 | -1991.7 |
| RDE | -3063.3 | $6.117\times10^{10}$ | -4.9504 | 0.0001 | -4357.4 | -1.74×1011 |
| SMES | $8.563\times10^{10}$ | $1.040\times10^{10}$ | 8.2332 | 0 | $6.378\times10^{10}$ | $1.075\times10^{11}$ |

**Note:** LLCI stands for the lower limit confidence interval, and ULCI stands for the upper limit confidence interval

## Regression Results: Impact of Innovation (HTE) and SME Growth on the GDP Growth of Pakistan

### Impact of HTE on SME Growth

Table 04 shows that High Technology Exports (HTE) have a minimal impact on SMEs' growth, providing limited explanatory power. The overall model is not statistically significant, although the constant term is significant. This indicates that while HTE contributes to SME growth, its influence in this context is not substantial.

### Impact of HTE and SME Growth on GDP Growth

| Table 04: Impact of Innovation on the GDP of Pakistan with Mediating Role of SMEs Growth | | | | | | |
|---|---|---|---|---|---|---|
| SMES | Model Summary | | HTE | GDP | SMES | |
| R | R-sq | MSE | F-stat | Df1 | Df2 | p-value |
| 0.3787 | 0.1434 | 0.7228 | 3.1803 | 1 | 19 | 0.905 |
| | Coefficient | SE | t-statistics | p-value | LLCI | ULCI |
| Constant | 5.372 | 1.5254 | 3.5238 | 0.0023 | 2.181 | 8.563 |
| HTE | 1.5003 | 0.8413 | 1.7833 | 0.0905 | -0.2606 | 3.2612 |
| | | | | | | |
| GDP | Model Summary | HTE | GDP | SMES | | |
| R | R-sq | MSE | F-stat | $Df_1$ | $Df_2$ | p-value |
| 0.766 | 0.5868 | 3.353×1021 | 12.7792 | 2 | 18 | 0.0004 |
| | Coefficient | SE | t-statistics | p-value | LLCI | ULCI |
| Constant | -4327.1 | $1.335\times10^{11}$ | -3.2027 | 0.0049 | -7.08E+11 | -1486.2 |
| HTE | $8.773\times10^{10}$ | $6.190\times10^{10}$ | 1.4171 | 0.1735 | -4273.31 | $2.178\times10^{11}$ |
| SMES | $6.179\times10^{10}$ | $1.562\times10^{10}$ | 3.9549 | 0.0009 | $2.896\times10^{10}$ | $9.462\times10^{10}$ |

Table 04 illustrates a positive relationship between High Technology Exports (HTE), SME growth, and GDP. Notably, SME growth has a more substantial impact on GDP than HTE. However, HTE does not directly and significantly affect SME growth, as indicated by the non-significant p-value. Instead, HTE positively and significantly influences SMEs indirectly, suggesting that other factors mediate its effect.

## Normality Test Results

The figure shows the results of the Jarque -Bera test, which shows that residuals are normally distributed.

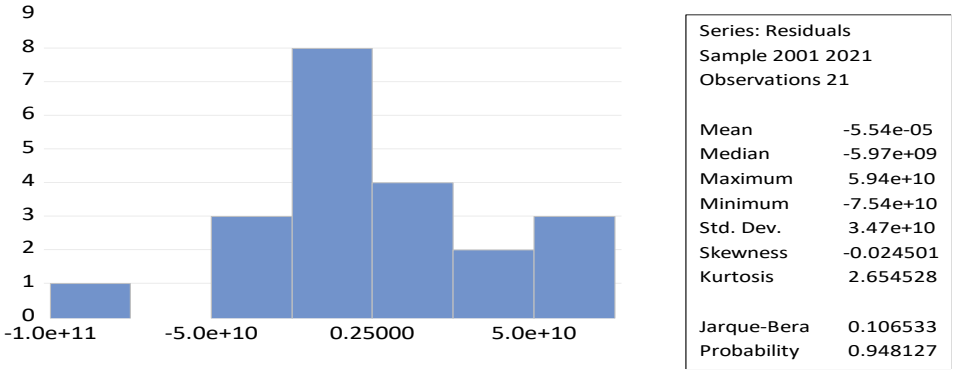



Figure 02 Jarque-Bera test results

Figure 02 indicates that the null hypothesis of normality cannot be rejected, supporting the conclusion that the data conform to a normal distribution, in line with the findings of (Ott & Held, 2019).

## Diagnostic Test Results

Table 05 shows no significant serial correlation or residual heteroskedasticity, with high p-values supporting. (Astivia & Zumbo, 2019; Bhatti et al., 2023).The Ramsey RESET test confirms that the model is correctly specified, indicating no significant non-linearities or omitted variables.

**Table 05: Diagnostic Tests Result**

| Test with Null Hypotheses | Test Statistics | Statistics | P-value | Decision |
|---|---|---|---|---|
| Breusch-Godfrey Serial Correlation LM Test | F-Statistics | 0.98046 | 0.9072 | Cannot Reject Ho |
| Breusch-Pagan-Godfrey Heteroskedasticity Test | F-Statistics | 0.165095 | 0.9184 | Cannot Reject Ho |
| Ramsey RESET Test | t-Statistics | 0.854925 | 0.4052 | Cannot Reject Ho |
| | F-statistics | 0.730897 | 0.4052 | |
| | Likelihood ratio | 0.938037 | 0.3328 | |

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## Stability Test Results

Figures 03 and 04 show the Cumulative Sum (CUSUM) and CUSUM Square tests, both of which remain within the 5% significance level, confirming model stability and robustness.

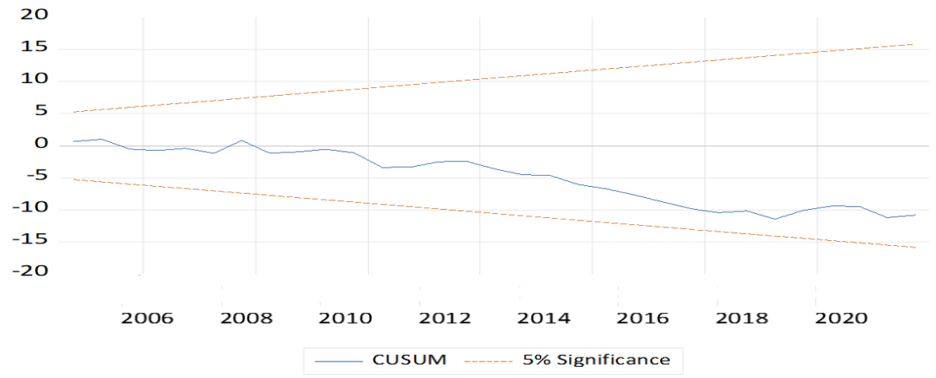



Figure 01 CUSUM Test

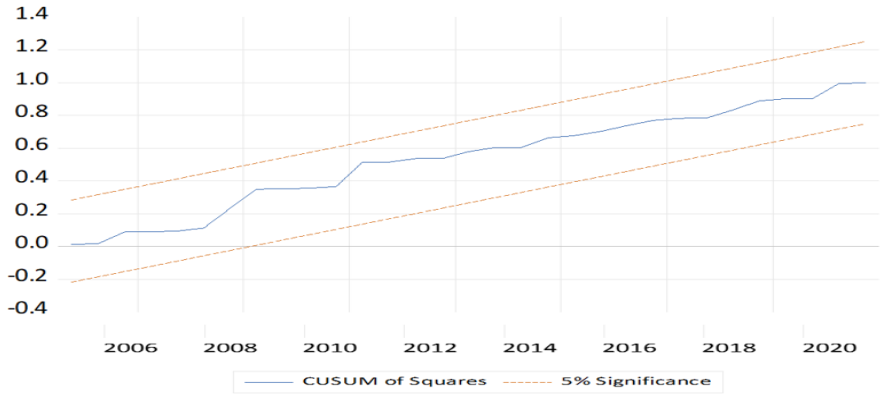



Figure 04 CUSUM of squares Test

## Granger Causality Tests

Table 06 summarizes the Granger causality tests. Maziarz (2015) researched various economic indicators. The results indicate that the null hypothesis cannot be rejected for the RDE-GDP pair, aligning with findings from (Rusdiana et al., 2020). Similarly, the GDP-RDE pair shows no evidence of causation, consistent with (Zayas-Márquez & Ávila-López, 2022). For the HTE-GDP relationship, the null hypothesis is also upheld, as noted by(Rahman et al., 2022) Additionally, the GDP-HTE pair demonstrates a lack of causation. Across all other combinations, including SMEs and various HTE-RDE pairs, there is consistent evidence supporting the null hypotheses. Overall, these findings suggest limited support for Granger causality among the variables examined.

| Table 06: Granger Causality Test Results | | | |
|---|---|---|---|
| Null Hypotheses | Observations | F-Statistics | Prob |
| RDE does not Granger Cause GDP | 19 | 0.1656 | 0.849 |
| GDP does not Granger Cause RDE | | 1.86555 | 0.1913 |
| HTE does not Granger Cause GDP | 19 | 2.38787 | 0.1281 |
| GDP does not Granger Cause HTE | | 2.74153 | 0.0989 |
| SMES does not Granger Cause GDP | 19 | 1.8917 | 0.1874 |
| GDP does not Granger Cause SME | | 0.33548 | 0.7206 |
| HTE does not Granger Cause RDE | 19 | 0.57278 | 0.5766 |
| RDE does not Granger Cause HTE | | 0.17465 | 0.8416 |
| SME does not Granger Cause RDE | 19 | 1.03753 | 0.38 |
| RDE does not Granger Cause SME | | 0.03203 | 0.9685 |
| SME does not Granger Cause HTE | 19 | 0.9979 | 0.3934 |
| HTE does not Granger Cause SME | | 0.18492 | 0.8332 |

## Conclusion

The regression analysis explores the relationships between SMEs, RDE, HTE, and GDP in Pakistan. While RDE shows a moderate correlation with SMEs, this relationship is not statistically significant, indicating a limited direct impact. The link between HTE and SMEs remains unclear; however, RDE significantly directly affects SME growth. Furthermore, RDE positively influences SMEs indirectly, while HTE's indirect influence is not statistically significant. Both SMEs and RDE are crucial contributors to GDP, highlighting the importance of SMEs. Policymakers should prioritize R&D investments and support high-tech exports; the analysis recommends that to improve growth, the nation's economy should be improved by developing policies that promote the development of SMEs, encouraging high-tech exports through trade alliances, and supporting innovation through R&D.

## Recommendations

1. Policies must strive to encourage research and development to encourage innovation.

2. High-technology exports should be increased; therefore, trade alliances and incentives should be formed.

3. Facilitation of SMEs should be increased in order to improve their capability for innovation and competitiveness.

4. More empirical studies should be conducted to investigate the effects of innovation on SMEs' performance, taking into consideration the sector of origin of different kinds of innovation to inform policy intervention.

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