



Technological Advancement and Its Impact on International Trade Dynamics: A Comprehensive Study of Bangladesh

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KEYWORDS

Technological Advancement
Digital Transformation
Technology Growth Correlation

ABSTRACT

This research delves into the intricate relationship between technological advancement and international trade dynamics in Bangladesh, a nation experiencing a burgeoning number of internet users and technological immersion. Analyzing data from a sample of 25 firms across diverse sectors, the study unveiled a potent correlation between technological adoption and firm growth. Notably, large firms in the Ready-Made Garments (RMG) and IT sectors demonstrated pronounced technological integration, positively influencing their trade growth. In contrast, the agriculture (AGRI) sector presented unique challenges, with medium and small enterprises perceiving technological assimilation as a significant barrier. Regression analyses reinforced technological adoption as a paramount determinant of growth, elucidating approximately 91.2% of the variance in firm growth rates. Despite the overarching positive trajectory, the research underscores variances in technological impact across sectors and firm sizes. Conclusively, while technology emerges as a catalyst for growth in Bangladesh's international trade, its uniform adoption and consequent benefits necessitate tailored strategies and infrastructural enhancements.

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1. INTRODUCTION

The dynamics of international trade have dramatically changed in Bangladesh, a developing South Asian economy, largely as a result of technological advancements. As the digital era unfolds, approximately 13–15% of Bangladesh's population actively uses the internet, paving the way for new business avenues and opportunities. This digital surge is reflected in the nation's trade landscape, with exports soaring to \$59.28 billion in 2022, up from \$40.73 billion in 2018. Concurrently, imports have seen a hike, touching \$96.17 billion in 2022 (World Bank, 2023). This research delves into the intricate relationship between technological progress and international trade in Bangladesh. By considering a diverse array of firms across different sectors and sizes, the study aims to decode the nuanced interplay between technological adoption and trade growth rates. Through a comprehensive empirical analysis, the research seeks to offer insights and recommendations, potentially shaping the future trajectory of Bangladesh's international trade landscape.

The objectives of the study are:

To investigate the impact of technological advancement on the international trade dynamics of Bangladesh.

1. To assess the relationship between technological adoption levels and the growth of international trade in various sectors.
2. To explore the perceptions, experiences, and insights of key stakeholders regarding the role of technology in trade.
3. To determine the challenges and barriers faced by firms in adopting technology for their international trade operations.
4. To evaluate the extent to which technological adoption correlates with trade metrics like volume, market diversity, and export efficiency.
5. To provide recommendations based on the research findings that can guide policymakers, business leaders, and other stakeholders in maximizing the benefits of technology in trade.

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2. LITERATURE REVIEW

The intricate relationship between technological advancements and international trade dynamics is a frequently explored topic in economic literature. Over the past few decades, the role of technology in shaping global trade, especially in developing countries like Bangladesh, has garnered increasing attention.

2.1 Historical context and global trends

Historically, technology has been a driving force behind trade expansion. Irwin (2003) noted that technological advancements, ranging from the steam engine to the internet, have consistently reduced trade costs, enabling markets to grow and become more integrated. Baldwin (2017) further emphasized that technology, particularly digitalization, has been a catalyst for the fourth industrial revolution, transforming the dynamics of international trade through e-commerce, digital services, and supply chain innovations.

2.2 Technology and Trade in Developing Countries

For developing countries, the nexus between technology and trade offers unique opportunities and challenges. According to the World Bank (2019), technological advancements can help developing nations bypass traditional growth stages, allowing them to leapfrog into advanced economic activities. The ready-made garments (RMG) industry in Bangladesh serves as a testament to this. As posited by Ahmed (2019), technology-driven improvements in production processes, supply chain management, and market access have played a pivotal role in positioning Bangladesh as the second-largest apparel exporter globally.

2.3 Sectoral Impacts

Different sectors, however, demonstrate varied susceptibilities to technological integration. The RMG sector's success story contrasts with the agricultural sector's slower tech integration pace. Rahman (2017) highlighted that while the Bangladeshi agriculture sector has immense potential, technology adoption remains limited, primarily due to infrastructural constraints, a lack of awareness, and financial barriers. On the other hand, the information technology (IT) sector, which is inherently tech-centric, presents a different narrative. As observed by Shahiduzzaman & Alam (2014), the IT sector in Bangladesh has witnessed exponential growth, with tech parks, software development, and IT-enabled services driving exports and creating employment opportunities.

2.4 Challenges in Tech Integration

Although there are clear advantages, the use of technology in trade processes is not without its difficulties. Bakaul (2018) highlighted the importance of many obstacles, including inadequate infrastructure, poor digital literacy, and regulatory limitations, within the context of Bangladesh. According to Jahur (2020), small and medium companies (SMEs) are often confronted with impediments that have a disproportionate impact, impeding their ability to effectively use technology for the purpose of trade expansion.

2.5 Future Prospects

As Bangladesh strides into the future, the role of technology in shaping its international trade dynamics will be more pivotal than ever. The global trade landscape is rapidly evolving, with digitalization, e-commerce, and advanced manufacturing technologies redefining traditional trade norms.

For Bangladesh, harnessing these technological innovations offers not just competitive advantages but also a pathway to sustainable economic growth. The potential to expand into new markets, streamline supply chains, and foster innovation presents immense opportunities (Ismail, 2020). However, realizing this potential necessitates proactive investments in digital infrastructure, education, and policy reforms. Embracing these technological trends will not only solidify Bangladesh's position in global trade networks but also catalyze its transition to a digitally-driven economy, fostering inclusivity, innovation, and resilience in an ever-changing global milieu (Hussain et al., 2017).

3. TECHNOLOGICAL ADVANCEMENT IN BANGLADESH

Technological advancement in Bangladesh has seen a remarkable surge in the last decade, positioning the country as a budding hub for innovation in South Asia. As of recent data, internet penetration in Bangladesh has soared past 50%, with over 100 million users actively connected, a testament to the digital transformation the nation has been undergoing (BTRC, 2021). The Ready-Made Garments (RMG) sector, which contributes to more than 80% of the nation's exports, is undergoing a phase of modernization with the inclusion of automation, artificial intelligence, and digitized supply chain management systems (Hasan et al., 2016). Furthermore, the agriculture sector, the backbone of the nation's economy, has also seen substantial technological inclusion with smart farming, precision agriculture, and mobile-based agricultural advisory platforms being launched.

The IT and telecommunications sectors in Bangladesh have been pivotal in this growth trajectory. Since the inception of the Digital Bangladesh initiative in 2009, there has been a concerted push towards creating a knowledge-based economy. The initiative primarily focuses on ensuring government services are available to citizens universally through digital means, thereby promoting transparency, accountability, and efficiency in the public service sector (Waliullah, 2020). The rise of the business process outsourcing (BPO) industry and software development in Bangladesh has not only contributed to economic growth but also spurred the establishment of several tech parks, fostering innovation and startups.

The Bangladeshi government, recognizing the transformative potential of technology, has been proactive in its endeavors. The "High-Tech Park Act, 2010" aims to establish 28 high-tech parks by 2021, creating more than 200,000 jobs (Ministry of Science and Technology, 2010). Moreover, to bolster ICT education and training, the government, under the Leveraging ICT for Growth, Employment, and Governance (LICT) project, has trained over 30,000 IT professionals and facilitated the employment of more than 20,000 graduates in the IT industry (World Bank, 2018). Financially, the government's partnership with international agencies, such as the World Bank, has seen investments of over \$400 million in projects to further the IT infrastructure, digital governance, and e-services (World Bank, 2019).

4. INTERNATIONAL TRADE IN BANGLADESH

4.1. Export of Bangladesh

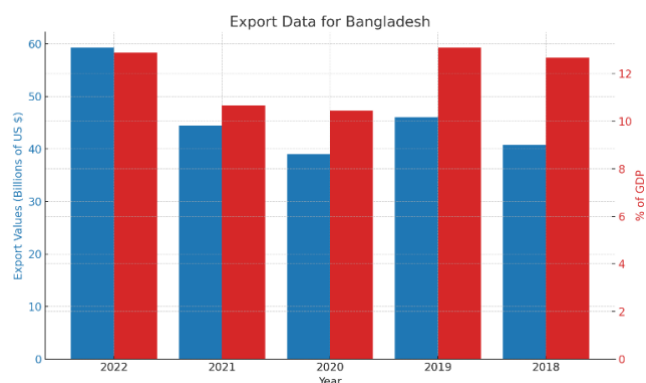


Fig.1. Export data of Bangladesh

Over the span of five years, from 2018 to 2022, Bangladesh's export sector witnessed notable fluctuations. In 2018, exports stood at \$40.73 billion, accounting for 12.67% of the GDP. This value saw a slight dip in 2019 to \$39.05 billion but surged to \$45.99 billion the same year, contributing 13.09% to the GDP (World Bank, 2023). However, 2020 brought challenges as exports shrank to \$39.05 billion, making up 10.44% of the GDP. The COVID-19 pandemic's effects on the world economy could be to blame for this. A remarkable rebound was observed in 2021, with exports soaring to \$44.39 billion and constituting 10.66% of the GDP. The growth continued into 2022, when exports jumped to \$59.28 billion, which was 12.88 percent of the GDP (IMF, 2022). This growth pattern shows how strong and flexible Bangladesh's export sector is, showing that it has the potential to do well in the changing global market.

4.2. Import of Bangladesh:

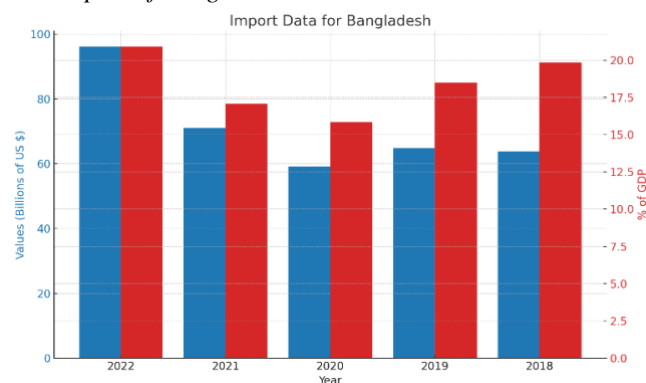


Fig.2. Import of Bangladesh

The dynamic trend in imports from Bangladesh from 2018 to 2022 reflects changes in the country's consumption and investment preferences. The value of all imports in 2018 was \$63.76 billion, or 19.84% of GDP. In 2019, this contributed 18.48% less to GDP, but was somewhat higher at \$64.92 billion. Imports fell to \$59.18 billion in 2020, accounting for 15.83% of GDP (IMF, 2023) because to the worldwide pandemic. However, 2021 marked a significant resurgence as imports escalated to \$71.02 billion, representing 17.06% of the GDP. The increasing curve exhibited a heightened magnitude in the year 2022, when imports surged to an astounding value of \$96.17 billion, constituting 20.90% of the Gross Domestic

Product (GDP). The observed rise in figures may suggest strong domestic demand, possible investments in infrastructure or industry, or the accumulation of vital products (World Bank, 2023). In general, the imported data highlights the increasing economic status of Bangladesh and its capacity to actively participate in global trade dynamics.

5. METHODOLOGY

The methodology outlines the research techniques, tools, and procedures used to address the research topic: The Role of Technological Advancement on the International Trade of Bangladesh.

5.1. Research Design

The research design for the study titled "Technological Advancement and Its Impact on International Trade Dynamics: A Comprehensive Study of Bangladesh" is primarily quantitative. The research was conducted with the aim of investigating the relationship between technical progress, measured by the rates at which enterprises adopt technology, and the dynamics of international commerce, assessed by firms' growth rates. In order to collect data, a systematic and methodical approach to data collecting was used via the use of structured questionnaires that included preset answer options. After the gathering of data, a statistical analysis was performed in order to extract meaningful insights and verify the hypothesis. The research methodology used in this study adheres to known research procedures as outlined by Creswell and Creswell (2017) and Sekaran and Bougie (2016).

5.2. Data Collection Methods

In this research, data collection was primarily achieved through a structured questionnaire designed to understand the impact of technological developments on global trade dynamics. According to Bryman (2016), the survey incorporated both closed and open-ended questions, along with Likert scales, enabling the gathering of both quantitative and qualitative insights. The research concentrated on firms within Bangladesh's apparel manufacturing, farming, and IT industries. Fowler (2013) notes that the questionnaire was distributed through various online platforms and digital channels. To ensure a high response rate and gather extensive information, monthly reminders were issued to prospective participants. According to Dillman et al. (2014), the use of the electronic distribution technique not only sped up the process of collecting data but also made the procedures of data management and analysis more efficient. Top of Form

5.3. Sampling Technique

Stratified random sampling was used to choose a sample that was statistically representative of the many different kinds and sizes of businesses in Bangladesh. Due to the study's emphasis on the ready-made garments (RMG), agriculture (AGRI), and IT industries, this methodology was especially important. Large, medium, and small businesses were divided into their own categories depending on their respective industries and sizes. A fair and representative sampling was achieved by selecting samples at random from each grouping. In order to make the study's results more applicable to a wider audience, this method was essential for capturing the differences across sectors and companies. The research involved 25 different sectors, providing a comprehensive analysis of the relationship between technological advancement and foreign trade dynamics in Bangladesh. This data collection

method aligns with established research standards, as outlined by Thompson (2012).

5.4. Data Analysis

The data analysis for this study was methodically executed in multiple stages to decipher the relationship between technological adoption and growth rates among firms in Bangladesh. Initially, descriptive statistics were utilized, extracting essential metrics like frequencies, percentages, mean values, and standard deviations to outline the general trends and patterns in the responses. Crosstabulation then facilitated a deeper exploration of the interactions between variables such as firm size, sector, and technological adoption levels. The core of the analysis hinged on Pearson's correlation and a linear regression model, which illuminated the strength, direction, and predictive power of the relationship between the two primary variables of interest. Furthermore, a residual analysis ensured the assumptions of the regression were met. The entire analysis was performed using the statistical software SPSS (Field, 2013). Engaging a total of 25 firms, this comprehensive analysis provided critical insights into the nexus between technology and trade dynamics in Bangladesh.

5.5. Ethical Considerations

Ethics played a central role in the execution of this research. Prior to participation, individuals were thoroughly acquainted with the study's aims and the nature of their involvement. The emphasis was placed on ensuring the utmost confidentiality of data collected. Participants provided their agreement through written informed consent, signifying their understanding and voluntary participation. The research strictly adhered to established ethical standards, ensuring that personal details or business-sensitive information remained undisclosed. Every step of the research process was marked by a commitment to upholding the trust and rights of the participants, ensuring both transparency and integrity (ESRC, 2021).

6. EMPIRICAL ANALYSIS

6.1. Survey Respondent data

Table 1. What is the size of your firm?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Large	9	36.0	36.0	36.0
	Medium	8	32.0	32.0	68.0
	Small	8	32.0	32.0	100.0
	Total	25	100.0	100.0	

Table 1 showcases the distribution of firms by size among the respondents in a study on technological advancement and its impact on international trade dynamics in Bangladesh. Of the 25 respondents, 36% are from large firms, 32% from medium-sized firms, and another 32% from small firms. This indicates a balanced representation of different-sized firms in the sample.

Table 2. In which sector does your firm operate?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	RMG	10	40.0	40.0	40.0
	AGRI	8	32.0	32.0	72.0
	IT	7	28.0	28.0	100.0
	Total	25	100.0	100.0	

Table 2 presents the sectoral distribution of firms in a study exploring technological advancement's effect on international trade dynamics in Bangladesh. Of the 25 respondents, 40% operate in the Ready-Made Garments (RMG) sector, 32% in Agriculture (AGRI), and 28% in Information Technology (IT). Cumulatively, the results provide insights across major sectors, reflecting a comprehensive overview of Bangladesh's trade dynamics in relation to technology.

Table 3. On a scale of 1 to 5, how would you rate the level of technological adoption in your firm?

		Low	Avg	High	Very High	Total
Large	RMG		0	1	3	4
	AGRI		2	0	0	2
	IT		0	1	2	3
	Total		2	2	5	9
Medium	RMG	0	0	2		2
	AGRI	3	1	0		4
	IT	0	0	2		2
	Total	3	1	4		8
Small	RMG	2	2			4
	AGRI	2	0			2
	IT	0	2			2
	Total	4	4			8
Total	RMG	2	2	3	3	10
	AGRI	5	3	0	0	8
	IT	0	2	3	2	7
	Total	7	7	6	5	25

The crosstabulation table 3 presents' data on firms from three sectors (RMG, AGRI, and IT) in Bangladesh, categorizing them by their size (large, medium, or small) and their self-rated level of technological adoption (low, average, high, or very high). Large firms in the RMG sector predominantly rate their tech adoption as "very high," whereas those in AGRI have an even spread between "low" and "very high." Large IT firms mostly lean towards "high" and "very high" technological adoption. Medium-sized firms in AGRI largely rate their adoption as "low," contrasting with RMG and IT firms, which are frequently rated as "high." Small firms, irrespective of sector, predominantly rate their tech adoption as "low" or "average." This data suggests that firm size and sector both influence technological adoption rates in Bangladesh, with larger firms, especially in the RMG and IT sectors, tending towards higher technological adoption.

Table 4. What barriers have you encountered in integrating technology into your trading operations?

		Not a barrier	Light Barrier	Average Barrier	Barrier	Major barrier	Total
Large	RMG	1	3	0	0		4
	AGRI	0	0	1	1		2
	IT	2	1	0	0		3
	Total	3	4	1	1		9
Medium	RMG		1	1	0		2
	AGRI		0	0	4		4
	IT		1	1	0		2
	Total		2	2	4		8
Small	RMG			4	0	0	4
	AGRI			0	0	2	2
	IT			1	1	0	2
	Total			5	1	2	8
Total	RMG	1	4	5	0	0	10
	AGRI	0	0	1	5	2	8
	IT	2	2	2	1	0	7
	Total	3	6	8	6	2	25

Table 4 offers a cross-tabulation of firms, categorized by size, sector of operation, and the barriers they face in integrating technology into their trading operations. Large firms in the Ready-Made Garments (RMG) sector predominantly view technological integration as a light barrier, while those in IT face minimal to no barriers. On the other hand, medium-sized firms in the agricultural (AGRI) sector find it a significant barrier. Small firms in RMG overwhelmingly view it as an average barrier. Overall, technological barriers seem more pronounced in the AGRI sector and among medium and small firms. This suggests that while technological advancements are reshaping international trade dynamics, the level of impact and associated challenges are uneven across sectors and firm sizes in Bangladesh.

Table 5. On a scale of 1 to 5, how has technology adoption impacted your international trade?

		Very negatively	Negatively	Average	Positively	Very positively	Total
Large	RMG	0	0	1	3		4
	AGRI	1	1	0	0		2
	IT	0	0	3	0		3
	Total	1	1	4	3		9
Medium	RMG	0	1	1			2
	AGRI	3	1	0			4
	IT	0	0	2			2
	Total	3	2	3			8
Small	RMG	0	0	3	1		4
	AGRI	1	1	0	0		2
	IT	0	0	1	1		2

	Total	1	1	4	2		8
Total	RMG	0	0	4	3	3	10
	AGRI	1	5	2	0	0	8
	IT	0	0	1	6	0	7
	Total	1	5	7	9	3	25

Table 5 presents a cross-tabulation of the impact of technology adoption on international trade among firms of different sizes across three sectors in Bangladesh: RMG (ready-made garments), AGRI (agriculture), and IT (information technology). Large firms, especially in the RMG sector, report the highest positive impact, with 4 firms stating a "very positive" effect. Meanwhile, medium-sized firms in the AGRI sector seem to have faced challenges, with three firms experiencing "very negative" effects. Interestingly, small firms across all sectors predominantly report an "average" impact. In total, technology's positive influence (with "positively" and "very positively" combined) is most pronounced in the RMG sector, whereas the AGRI sector has felt both benefits and drawbacks. The IT sector, despite its inherent technological nature, has varied results, with a majority noting a neutral or "average" impact. This suggests that while technological advancements can enhance international trade prospects, the effects are not uniformly positive and can vary based on the sector and firm size in Bangladesh.

Table 6. Is there a significant relationship between technology adoption rate and trade growth rate?

		No	Yes	Total
Large	RMG	0	4	4
	AGRI	1	1	2
	IT	0	3	3
	Total	1	8	9
Medium	RMG	0	2	2
	AGRI	3	1	4
	IT	0	2	2
	Total	3	5	8
Small	RMG	0	4	4
	AGRI	2	0	2
	IT	0	2	2
	Total	2	6	8
Total	RMG	0	10	10
	AGRI	6	2	8
	IT	0	7	7
	Total	6	19	25

Table 6 presents a cross-tabulation of firms based on their size, sector of operation, and whether there's a significant relationship between technology adoption rate and trade growth rate. For large firms, the majority (8 out of 9) believe there's a significant relationship, especially in the RMG and IT sectors. Medium-sized firms are more divided, with a slight preference (5 out of 8) for believing in the relationship, though those in the AGRI sector predominantly don't see the connection. Small

firms, like their larger counterparts, largely (6 out of 8) perceive a relationship with the RMG sector entirely in agreement. Overall, out of the 25 firms surveyed, 19 believe there is a significant correlation between technology adoption and trade growth. This data suggests that as Bangladesh progresses technologically, a majority of its firms across sizes and sectors anticipate that tech advancements will play a pivotal role in shaping international trade dynamics.

Table 7. How has the integration of technology in business impacted the trade growth rate?

		Being Very Low	Low	Average	High	Being Very High	Total
RMG	Large		0	0	1	3	4
	Medium		0	0	2	0	2
	Small		1	3	0	0	4
	Total		1	3	3	3	10
AGRI	Large	0	0	2			2
	Medium	0	4	0			4
	Small	1	1	0			2
	Total	1	5	2			8
IT	Large			0	1	2	3
	Medium			0	2	0	2
	Small			2	0	0	2
	Total			2	3	2	7
Total	Large	0	0	2	2	5	9
	Medium	0	4	0	4	0	8
	Small	1	2	5	0	0	8
	Total	1	6	7	6	5	25

Table 7 presents a cross-tabulation of firms based on their size, the sector in which they operate, and their perception of how technological integration has influenced trade growth rates. In the Ready-Made Garments (RMG) sector, most large firms perceive the impact as being 'high' or 'very high', whereas small firms predominantly view it as 'low'. In the agriculture (AGRI) sector, medium-sized firms mostly report a 'Low' impact, while in the IT sector, the perception of impact is more evenly distributed across sizes, with a slight inclination towards 'High' or 'Very High' for large firms. Overall, large firms, especially in the RMG and IT sectors, seem to have a more positive perception of technology's impact on trade growth, suggesting that these sectors in Bangladesh might be reaping significant benefits from technological advancements in the context of international trade.

6.2. Descriptive Statistics Analysis:

Table 8. Descriptive Statistics of Growth Rate and Technological Adoption Rate in Different Sectors.

		Mean	Std. Deviation	N
Growth rate		3.32	1.180	25
Technological Adoption Rate in the Firm		3.36	1.114	25

The data from Table 8 elucidates key metrics across three distinct sectors, focusing on growth rate and technological adoption rate within firms. The mean growth rate stands at 3.32 with a standard deviation of 1.180, based on 25 observations. This suggests a moderate level of growth, albeit with some variability. Concurrently, the technological adoption rate manifests a mean value of 3.36 and a standard deviation of 1.114, also from 25 observations. This indicates that firms are somewhat proactive in embracing technology, but the standard deviation reveals there is room for improvement. Both metrics are pivotal for sectoral comparisons and provide foundational insights for strategic decision-making.

6.3. Correlation analysis

Table 9. Correlation between Growth Rate and Technological Adoption Rate in Firms

		Growth rate	Technological Adoption Rate in the Firm
Pearson Correlation	Growth rate	1.000	.955
	Technological Adoption Rate in the Firm	.955	1.000
Sig. (1-tailed)	Growth rate	.	.000
	Technological Adoption Rate in the Firm	.000	.
N	Growth rate	25	25
	Technological Adoption Rate in the Firm	25	25

The data from Table 9 provides compelling evidence of a strong positive relationship between growth rate and technological adoption rate in firms across three sectors. With a Pearson correlation coefficient of 0.955, it is evident that as firms are more inclined towards adopting technology, they also tend to experience higher growth rates. This correlation is statistically significant, as indicated by the one-tailed significance level of 0.000, which essentially nullifies the likelihood that this relationship is due to random chance. Given that the number of observations (N) for both variables is 25, the sample size is sufficiently robust to support these findings. This correlation underpins the critical interdependence between technological agility and business growth, providing invaluable insights for stakeholders involved in strategic planning and operational optimization.

6.4. Regression analysis

Table 10. Model Summary^a

Model	R	R Square	Adjusted Square	R Std. Error of the Estimate
1	.955 ^a	.912	.908	.358

Table 11. ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	30.484	1	30.484	237.221	.000 ^b
	Residual	2.956	23	.129		
	Total	33.440	24			

The model summary and ANOVA tables present statistical results examining the relationship between the technological adoption rate of the firm (predictor) and the growth rate (dependent variable) in the context of understanding technological advancement and its impact on international trade dynamics, particularly in Bangladesh. The model has a very high R value of 0.955, indicating a strong linear relationship between the predictor and the dependent variable. This is further emphasized by an R² value of 0.912, suggesting that approximately 91.2% of the variance in the growth rate can be explained by the technological adoption rate of the Firm. The adjusted R² of 0.908 is very close to the R², indicating a minimal penalty for model complexity. The standard error of the estimate is 0.358. The ANOVA table reports a highly significant F-statistic (237.221) with a p-value of 0.000, reinforcing that the predictor is a significant determinant of the growth rate. The strong relationship and significance affirm the substantial influence of technological adoption on growth, aligning with the study's aim to understand its role in shaping international trade dynamics for Bangladesh (Hair, 2009).

Table 12. Residuals Statistics for Linear Regression Analysis

	Min	Max	Mean	Std. Deviation	N
Predicted Value	1.94	4.98	3.32	1.127	25
Residual	-.956	1.056	.000	.351	25
Std. Predicted Value	-1.221	1.473	.000	1.000	25
Std. Residual	-2.666	2.947	.000	.979	25

Table 12 presents a linear regression analysis examining the relationship between the growth rate (dependent variable) and the technological adoption rate in firms. The constant term (or intercept) is -0.081, but it is not statistically significant ($p = 0.731$), indicating that when technological adoption is zero, the predicted growth rate is not meaningfully different from zero. For every unit increase in the technological adoption rate, the growth rate increases by approximately 1.012 units. This relationship is statistically significant ($p < 0.001$) and strong, as indicated by the standardized coefficient (Beta = 0.955) and the high t-value (15.402). This suggests that technological adoption plays a crucial role in influencing the growth rate within the context of Bangladesh's international trade dynamics.

7. RESULTS AND DISCUSSIONS

The current research's findings, which delve deep into the nexus between technological advancement and international trade dynamics in Bangladesh, echo and, in some cases, diverge from prior academic explorations on the subject. Let's contextualize these findings amidst the broader scholarly landscape.

- The discovery of a strong correlation between technological adoption and growth rates, with a Pearson correlation coefficient of 0.955, is consistent with the global narrative, where countries and firms that have embraced technological advancements have experienced accelerated growth trajectories (Bughin & Zeebroeck, 2017). This underpins the premise that in today's interconnected world, technology isn't just an enabler but a critical competitive advantage.
- Sectoral discrepancies in technological assimilation, especially the contrasting narratives between RMG, IT, and AGRI sectors, provide intriguing insights. Prior research has often highlighted the RMG and IT sectors as early adopters of technology due to their inherent global exposure and the nature of their operations (Salman et al., 2023). However, the challenges faced by the AGRI sector in Bangladesh resonate with similar challenges faced by agricultural sectors in other developing nations (Ferdous et al., 2021). Technological barriers, infrastructural constraints, and a lack of awareness have been cited as recurrent impediments.
- The regression analysis showed that technology plays a big part in how trade works. This is supported by global studies that show how integrating technology has been linked to higher productivity, efficiency, and market reach (Ciuriak & Ptashkina, 2018).
- However, the variability that the standard deviations and residuals in our regression models highlight suggests a complex landscape. Aghion & Howitt (2008), who highlighted the differentiated impact of technological advancements based on organizational and sectoral contexts, agreed that while technology acts as a catalyst, its impact is not always positive.
- From an implications standpoint, this research underscores the urgent need for sector-specific interventions, especially for the lagging AGRI sector. The benefits reaped by the RMG and IT sectors can serve as blueprints for technological integration, but they must be contextualized to address the unique challenges and opportunities of each sector.

8. RECOMMENDATIONS

Based on the comprehensive analysis presented above, the following recommendations are proposed to maximize the potential benefits of technological adoption in the international trade domain of Bangladesh:

- *Sector-specific strategies:* It is evident that while sectors like RMG and IT are benefiting significantly from technological adoption, the agriculture sector is lagging. Tailored technological strategies are recommended for sectors based on their unique challenges and opportunities. For instance, introducing agri-tech solutions, such as precision farming and digital supply chain management,

can optimize production and distribution in the AGRI sector (Schwab, 2018).

- *Capacity-building in small and medium enterprises (SMEs)*: SMEs, especially in the AGRI sector, perceive technological integration as a challenge. Targeted capacity-building programs can enhance their technological prowess. This can be achieved through workshops, training sessions, and collaborations with tech providers (UNCTAD, 2021).
- *Investment in Research and Development (R&D)*: A consistent investment in R&D can lead to the discovery of sector-specific technological solutions. The government and private institutions can jointly fund R&D initiatives, ensuring that the technological solutions developed are aligned with the local challenges and opportunities of Bangladeshi firms (OECD, 2019).
- *Public-private partnerships*: Collaboration between the government and private tech enterprises can expedite the technological transformation. Such partnerships can lead to subsidized technology solutions for firms, especially SMEs, thereby leveling the playing field and ensuring equitable growth (Klijn & Koppenjan, 2000).
- *Infrastructure development*: While technological solutions are crucial, their implementation requires robust infrastructure. Efforts should be directed towards developing digital infrastructure, including high-speed internet, data centers, and reliable electricity, especially in remote areas (World Bank, 2016).
- *Regulatory framework*: A conducive regulatory environment can foster technological adoption. Streamlined processes, tax incentives for tech adoption, and clear guidelines can incentivize firms to embrace technology (Gunningham et al., 2004).
- *Awareness and education*: A significant barrier to tech adoption is the lack of awareness and skills. National campaigns highlighting the benefits of tech adoption, coupled with education programs at the school and university levels, can prepare the next generation of entrepreneurs to be tech-savvy (Anderson & Dron, 2011).
- *Leveraging international collaborations*: Collaborating with countries that have successfully integrated technology into their trade dynamics can offer insights and best practices. Exchange programs, joint ventures, and tech summits can be platforms for such collaborations (European Commission, 2019).

9. LIMITATIONS OF THE STUDY

Despite the rigorous methodology and comprehensive analysis undertaken in this study, there are certain inherent limitations that should be acknowledged. Firstly, the research is confined to three sectors in Bangladesh: ready-made garments (RMG), agriculture (AGRI), and information technology (IT). While these sectors are pivotal, the findings might not be generalizable to other sectors of the economy. Secondly, the study's reliance on self-reported data through questionnaires can introduce biases, as respondents might have subjective interpretations of questions or might provide socially desirable answers. Thirdly, the sample size of 25 firms, though diverse, might not capture the entire spectrum of experiences and nuances within these sectors. Additionally, the cross-sectional nature of the data doesn't allow for tracking changes over time, which might be crucial given the rapid pace of technological

advancements. Lastly, external factors influencing international trade dynamics, such as geopolitical events, global economic conditions, or regulatory changes, were not deeply explored in this study, which might impact the relationship between technological advancement and trade dynamics.

10. CONCLUSION

In conclusion, the research underscores the pivotal role of technological advancement in shaping the international trade dynamics of Bangladesh. As the nation experiences an increase in internet usage and technological immersion, its trade parameters are simultaneously evolving. The study revealed a strong correlation between firms' technological adoption and their growth trajectories, especially pronounced in sectors like ready-made garments and IT. However, it's vital to note the differential impact across sectors, with agriculture presenting unique challenges. While large enterprises have swiftly embraced technology, propelling their growth, medium- and small-scale enterprises, especially in specific sectors, still grapple with integration hurdles. As Bangladesh stands on the cusp of a digital revolution, it is imperative to recognize and address these variances. Tailored strategies, infrastructural development, and sector-specific technological solutions can ensure that the benefits of technological advancements are equitably distributed, reinforcing Bangladesh's position in the global trade arena.

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