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The Mediating Role of Firm Growth and TFP Growth in Export Quality-Trade Flows Nexus Evidence from Pakistani Firms

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Abstract

In today's interconnected global economy, product quality emerges as a critical determinant of international trade flows, directly aligning with the United Nations' Sustainable Development Goals (SDGs) decided to highlight worldwide inequalities (income and poverty). This study investigates the complex connection between export product quality and trade flows, specifically examining two key mediating factors: firm growth and total factor productivity growth. Using a Seemingly Unrelated Regression Model (SUR), data from non-financial firms listed on the Pakistan Stock Exchange over 21 years (1999-2020) is analyzed. The findings of this study explored that both firm growth and total factor productivity growth serve as significant mediators in the product quality-export flows, operating through both direct and indirect channels. This research contributes to understanding how firm-level factors influence the quality-trade relationship, providing insights for both policy development and corporate strategy in international trade. The results suggest that enhancing product quality, combined with firm growth and productivity improvements, can strengthen export performance and contribute to achieving sustainable development objectives.

Keywords: *Export Product Quality; Trade Flows; Firm Growth; Total Factor Productivity; Sustainable Development Goals; Seemingly Unrelated Regression*

JEL Classification: *F1, F12, F60*

1. Introduction

Challenges like income inequality and environmental degradation in an increasingly interconnected world know no borders. Recognizing this global interdependence, the UN established seventeen SDGs (Sustainable Development Goals) as a comprehensive road map for both developing and developed nations. The purpose of these goals is to provide a more equitable and sustainable world for both present and future generations by interconnecting across three vital social, environmental, and economic dimensions. The Economic Dimension connects goals for poverty elimination, gender equality, innovation, reduced inequality, sustainable cities, and global partnerships. These goals demonstrate how economic progress relies on multiple interconnected factors – innovation drives job creation, which reduces poverty, while gender equality unlocks new economic potential.

High-quality exports and international trade serve as powerful connectors across these dimensions. When companies produce higher-quality exports, they generate better incomes and jobs, linking economic growth with social progress. International trade creates bridges between nations, enabling knowledge exchange and technology transfer. Agricultural trade connects farmers to global markets, linking food security with economic opportunity. Labor standards in trade agreements connect worker welfare with economic development. The trade-SDG connection is particularly relevant for Pakistan, which was among the first nations to embrace the 2030 SDG agenda through unanimous parliamentary support. While the country has made strides by integrating SDGs into national policies and establishing monitoring frameworks, its journey

highlights how progress requires connecting multiple elements: political commitment, clear targets, proper funding, strong regulations, and accountability measures.

International trade and transactions can play a significant role in achieving the economic dimension of the SDGs. The quality of export Products is very important in determining international trade (Crinò et al., 2012; Linder, 1961). The quality-and-trade literature reviewed that the entry and survival of firms in international markets depend on the quality of exported products (Manova et al., 2017). High product quality captures larger market shares in domestic and international markets. Some recent studies (Fan et al., 2015; Hallak, 2006) increasingly point to the relationship between trade flows and export product quality. However, the impact of product quality on trade flow is not investigated. Moreover, the role of some mediators needs to be examined while determining the relationship between export flows and product quality. These mediators can help explain the direct and indirect effects in determining the relationship between two variables.

A firm's total factor productivity growth depends on the transfer of technological knowledge. The use of both domestic and international inputs is necessary to increase in total factor productivity (Grossman et al., 1995; Romer, 1994). Conventional trade theories mainly focused on absolute and comparative advantages, but new trade models emphasized mostly on intra-industry trade. New trade theory associated with Baldwin et al. (1989) stated that all firms export by producing a unique variety for consumers. Once a firm enters export markets, efficiency in productivity grows. Firms usually react to positive productivity shocks by employing more inputs and increasing the output level.

In literature, several factors recognized that determine the TFP of the firm, such as human capital, and R&D. Moreover, recent literature included firm heterogeneity as an essential element in international trade, which increases the efficiency in the production process by reallocating resources and reducing production, cost (Grossman & Helpman, 1995; Jajri, 2007; Y. Sheng et al., 2019). The theoretical background developed by Bernard et al. (1999) emphasizes the decision of exporting firms, which depends on productivity, profitability, location, size of a firm, and technological progress. Consequently, TFP differences between large and small firms are explained by their characteristics and returns. Even a small firm can also enjoy more benefits than a larger firm can if its characteristics provide high returns. The technical progress through human capital has different returns for small and large firms. Larger firms have a higher probability of getting high returns from innovations in the production process. The effect of human capital can also explain that skilled and trained workers can easily face and solve problems with better communication skills (Castany et al., 2005) Castany et al., 2005). Other factors that affect the Productivity of a firm are firm performance, availability of financial resources, sales growth, and production techniques (Cadot et al., 2018). So, the firm has efficient production expansion also leads to international business activities.

Firm growth, characterized by business expansion, profit generation, and revenue increases, represents a complex phenomenon in business dynamics. As Geroski (1995) famously noted, "Entry is easy but survival is not," highlighting the challenges firms face in both domestic and foreign markets. While Gibrat (1931) suggests that growth is independent of initial size, contemporary research by Keller et al. (2009), Morone et al. (2008) and Gupta et al. (2013) views it as multidimensional, measured through various indicators such as value-added, market value, workforce size, and sales, with sales being the primary metric (Barkham et al., 2012).

The significance of firm growth extends beyond individual businesses, creating job opportunities, developing sectoral linkages, and fostering market competitiveness (Carrizosa, 2007). Innovation plays a crucial role in this growth process, with firms investing in R&D to enhance their market presence (Yasuda, 2005). Morone and Testa (2008) identify four key innovation strategies: product innovation for quality improvement, process innovation for efficiency enhancement, managerial innovation for resource optimization, and marketing innovation for market responsiveness. These strategies, combined with R&D investments, enable firms to capture both domestic and international markets while ensuring sustainable growth and survival. However,

R&D expenditures are necessary only for the growth and survival of a firm. The firm can fully capture the local and international markets by adopting innovations and inventions.

The tendency of a firm for innovation is based on the firm's size. Existing literature highlighted the following innovative strategies (Morone & Testa, 2008). Product Innovation boosts growth by increasing the quantity and improving the quality of goods that are supplied in the market. Process Innovation increases the firm's growth by improving the techniques of production efficiency and reducing its prices. Managerial Innovation tries to utilize the resources efficiently and implement the new production process. Marketing Innovation enhances the development process, searching for new ideas, improving sales, and promoting the product that meets the market demand. By adopting these innovation strategies, the firm can grow and survive by increasing its sales. R&D investment is an important factor in increasing a firm's growth.

Some studies suggested a positive link between high quality of product and export flows (Piveteau et al., 2017). and financial constraints are faced by firms while improving the quality of products (Antoniades, 2015; Helpman et al., 2004), but these researches ignore trade flows. However, no single study investigated this relationship through mediators. In this context, the current study extended this relationship by introducing the role of different mediators. Therefore, based on the above-cited research, no single study has yet been found to explore the determinants of export quality and trade flows of Pakistan's economy. Only a few studies have investigated the effect of trade flow of Pakistani firms (Ahmed et al., 2016; Rashid et al., 2018; Wadho et al., 2018; Yeo et al., 2019), TFP (Adnan et al., 2020; Khan et al., 2024; Naeem et al., 2024; Siddique, 2022), firm's growth (H. Ahmed et al., 2011; Qasim et al., 2021; Rehan et al., 2019) separately. Consequently, there is only one study that examines the relationship between product quality and export flow in Pakistan (Saeed et al., 2023; Saeed et al., 2024). This relationship between product quality and trade flow can be explained more precisely when considering the direct and indirect role of mediators. In this study, two mediators are taken, like a firm's growth and total factor productivity growth, explaining their direct and indirect effects on product quality and trade flows.

Among other critical issues facing Pakistan's nation is the increasing trade deficit, which has grown over time. Historically, import bills dominate export earnings. Among others, one basic reason is the quality of products that are not up to international standards. Hence, to cope with this problem, product quality and its direct and indirect factors should be focused on a priority basis. In this regard, the recent study should prove fruitful that is to examine the role of mediators such as a firm's growth and a firm's total factor productivity growth on product quality through trade channels: both direct and indirect effects of the mediator are investigated. The rest of the paper is based on reviewed empirical and theoretical literature, the theoretical framework, estimation methodologies, variable descriptions, sources of data, and the conclusion.

2. Literature Review

Product quality is a primary determinant of success in international markets. High-quality exports enhance trade flows and economic growth, even among firms with varying productivity levels (Aw & Lee, 2017). Product quality acts as a mediator between trade strategies and international performance, influenced by market location, technical status, and firm strategies (Calantone & Knight, 2000). Higher product quality positively correlated with larger trade shares and economic growth (Hummels & Klenow, 2001; Hallak & Schott, 2008). Trade volume strongly correlates with economic growth in developing countries (Hesse, 2008; Buysse et al., 2018). Product diversification reduces risks and fosters growth, as a wider variety of exports improves trade resilience (Gozgor & Can, 2017; Haddad et al., 2010). When digital products are imported, the product quality of the firm increases, and further exports of that firm also increase (Zhang et al., 2023). The backward Global Value Chain positively affects the export quality of firms (Hoang et al., 2025). Many factors affect the product quality of exports in the nation. Strong institutions and reduced trade barriers, such as tariff reductions, enhance export quality and trade flows (Levchenko, 2007; L. Sheng et al., 2016). Institutions help

firms specialize in high-value sectors and improve quality by reducing production inefficiencies Ranjan & Acemoglu, 2007).

Export activities and product quality influence carbon emissions, with more substantial effects in high-income economies (Z. Wang et al., 2013). Trade openness and compliance with international standards significantly affect product quality and trade flow (Jäkel, 2013). High standards in production improve product quality and export volume, addressing market failures and enhancing competitiveness (Ferro et al., 2015). Regional trade agreements with simplified conditions promote market access and motivate quality improvement (Sun, 2021). Developing nations must emphasize meeting international standards to enhance export quality and grow economically (Curzi et al., 2012). Export diversification, aided by favorable policies, can further reduce trade risks and accelerate economic progress (Gozgor et al., 2017). a positive export demand shocks also significantly enhance the export quality of multi-product firms (L. Wang et al., 2024).

There are some macro determinants of product quality in Pakistan, such as GDP, trade flow, and R&D activities. Some important micro determinants like TFP, the firm's total assets, sales growth, and advertising also play important roles in improving product quality. Whereas, the exogenous factors that improve the product quality of exports (Saeed et al.). High-quality products also have a significant role in raising domestic as well as foreign sales of firms in Pakistan. So, export flows also increase as the quality of products improves. A Firm producing high-quality products can capture more market share in local and international markets. (Saeed et al., 2023). The R&D activities and firm heterogeneity are positive, but financial constraints hurt the connection between product quality and export flows (Saeed et al., 2024). Furthermore, literature is reviewed to explain the importance of mediators: the Firm's Growth and the Firm's TFPG.

2.1. Firm's TFP Growth

Total factor productivity is used to measure a firm's efficiency by utilizing inputs. It plays a critical role in improving firm performance, trade, and economic growth. Many supportive studies explain the determinants and impacts of TFP. A firm's performance and competitiveness are mainly dependent on the Growth TFP (Jajri, 2007). There are many internal, external, and social determinants of a firm's TFP. Internal factors are firm size, ownership type, worker qualifications, financial conditions, R&D expenditure, and management quality, etc (Sheng & Song, 2019). However, external factors for TFP growth are market size, trade openness, regulatory policies, and technological advancements (Hunjra et al., 2018). Some social and regional influences have a strong impact on a firm's productivity growth. Moreover, in Pakistan, the factors of TFP growth are FDI, physical capital, and human capital. All these factors are considered significant determinants of TFP growth (Ali et al., 2024; Bibi et al., 2024).

Trade openness has positive but challenging impacts on TFP growth. On the positive side, Trade liberalization promotes TFP growth through technology transfer, competition, and economies of scale (Haider et al., 2021). Foreign-owned firms and exporters generally demonstrate higher TFP due to better access to technology and markets (Bernard & Jensen, 1999). Sector-specific determinants like education, technical opportunities, and trade openness influence productivity (Saleem et al., 2019). However, Trade openness can cause fiscal imbalances due to reduced government revenue and higher corporate taxes, potentially hindering TFP (Wadho & Chaudhry, 2018). But in Pakistan, Trade openness has mixed impacts, often leading to fiscal challenges due to reduced revenue (Khan et al., 2024). There is a long-run positive relationship between TFP with human capital, trade openness, and FDI in Pakistan(Adnan et al., 2020). TFP and trade openness have positive effects on economic growth in Nigeria. Both the government and private sectors should provide incentives for research and development activities (Abdullahi et al., 2024). In Vietnam, international trade also has a positive impact, whereas FDI spillover negatively affects TFP growth (Nguyen et al., 2024). TFP is commonly measured as output per worker or through indices and cost functions. For measurement purposes, techniques include the production function, GMM estimation, and semi-parametric methods (Hummels et al., 2005).

The quality, trade, and productivity are positively linked with each other. High product quality enhances trade flows and export performance (Khandelwal, 2010; Verhoogen, 2008).TFP serves as a mediator

in the relationship between trade flow and export quality, influenced by financial constraints, firm heterogeneity, and R&D efforts (Piveteau & Smagghue, 2017). Quality improvements in products correlate with enhanced GDP and trade flows (Alcalá, 2016). Domestic firms improve product quality through advanced technologies and reallocation of resources (Fałkowski et al., 2019). Policies like tax cuts and subsidies positively influence TFP, while trade barriers like excise taxes hinder it (V. Ahmed & Shabbir, 2016). Developing economies benefit from trade openness and FDI for TFP growth (Maryam et al., 2018). Macroeconomic determinants such as regulatory policies, trade barriers, and financial constraints significantly affect TFP (Amin et al., 2020). Innovation and R&D drive TFP growth, enabling firms to enter international markets and adopt advanced technologies (N. Chen et al., 2016).

TFP, both human and physical capital, are major contributors to economic growth in Asian countries, including Pakistan (Amin & Khan, 2020). The productivity performance of Pakistan's firms is unsatisfactory, and now it is time for investors in Pakistan to shift their focus towards R&D activities and move towards modern production techniques (Shah et al., 2024). The firm size and return on assets have a positive link, but the cost of production and rate of interest are negatively related to total factor productivity (Khan et al., 2024). Agriculture TFP growth mainly depends on agriculture tractors, fertilizer consumption, farmers' education, moderate climate, and innovative distribution of seeds (Afzal et al., 2021; Usman et al., 2021). trade and financial liberalization, political and macroeconomic stability, also seem to be important factors in increasing GDP and TFP growth in Pakistan's economy (Siddique, 2022). This comprehensive review highlighted the multifaceted factors influencing TFP, with a particular focus on trade, innovation, and policy impacts. It underscored the need to explore moderating variables (e.g., financial constraints, heterogeneity, R&D expenditures) and mediating variables (e.g., firm growth and TFP growth) in future studies to better understand their role in linking product quality and trade flows.

2.2. Firm's Growth

Firm growth is a fundamental characteristic of organizations, with various resources available to foster expansion (Penrose et al., 2002). Numerous studies have examined the connection between a firm's growth and its size. Gibrat (1931) concluded that a firm's growth is unrelated to its size, a view supported by researchers such as S. Chen et al. (2008) and Wagner (2007). However, others have identified a negative relationship between growth and size, including Evans (1987), Hall (1986), and Mata (1994). Notably, Dunne et al. (1989) also contradicted Gibrat's law. Gibrat's law posits that a firm's growth is influenced by three factors: (i) the growth rate of the industry, (ii) the firm's initial size, and (iii) random growth fluctuations. According to this law, a firm's expected growth is tied to its starting size. However, studies on Danish firms (Audretsch et al., 2007; Bentzen et al., 2012) did not find support for Gibrat's law. Conversely, it has been observed that the law holds for medium-sized, large, and established firms (Barney, 2000; Becchetti et al., 2002; Fulton et al., 1989).

Many internal and external determinants influence the firm's growth. One is Entrepreneurial Skills, which leads to firm growth at a high level by using their Qualifications and expertise (Schumpeter, 2013). The adoption of advanced technologies accelerates growth. Availability of external finance significantly affects firm growth (Rajan et al., 2003). Geographic location and access to markets impact growth potential. The combination of Productivity and innovation is central to firm growth. Drive innovation and enhance sales growth, particularly in high-tech sectors (Liu et al., 2023). Higher productivity improves product quality, enhancing market competitiveness (Barkham et al., 2012).

Productive firms overcome trade barriers and achieve greater market share. Growth varies across firms based on size, age, and other characteristics. Smaller and younger firms tend to grow faster, benefiting from agility and innovation (Castany et al., 2005; Helpman et al., 2004). Larger firms sustain higher growth rates due to reduced financial constraints and economies of scale (Satpathy et al., 2017). Growth is measured through quantitative (e.g., revenue, sales) and qualitative (e.g., customer satisfaction, product quality) metrics. The share of high-growth firms declines among young and small firms but is relatively stable among large and old firms(Kim et al., 2024). Nowadays, firms are investing in Artificial intelligence projects. This investment has a positive impact on the firm's growth, this growth improves the firm's sales, employment, and market share. The

AI investment focused on product innovation by introducing new production ideas and technologies (Babina et al., 2024; Naeem et al., 2024).

In Pakistan, firm size has a moderating role between firm growth and Firm performance. The firm growth plays an important role in the GDP growth of Pakistan. This firm's growth depends on Research and Development Expenditures and High Technology Exports in the textile and food sectors (Abbasi et al., 2015; Bashir et al., 2024). Firm size, export status, quality of human capital, organizational form innovation, profitability, and leverage have a significant positive impact on firm growth in the Pakistani context (H. Ahmed & Hamid, 2011; Bashir et al., 2024; Hunjra et al., 2018). Government-business relationships and resources for innovation activities are also important factors for firm growth (Abbas et al., 2020; Mubeen et al., 2017).

3. Methodology and Model

Total factor productivity (TFP) plays a central role in economic growth theory. According to the exogenous growth theories (Solow,1956), TFP is an external and time-consuming process. This model states how an economy can respond to changes in investment, technological investment, and labor growth. This model still gives the leading framework to explain productivity and economic growth. A technological component is unexplained when labor and capital are accounted for. This growth component is called Solow Residual and is also known as the total factor productivity (TFP). For instance, their aggregate production function is given as:

$$Y = A_t F(K_t, L_t) \quad (1)$$

It can also be written in such a format.

$$Y = TFP.\, K^{\alpha}.\, L^{\beta} \quad (2)$$

In this equation, Y represents the firm's gross domestic product, while K and L denote the capital and labor inputs. By assuming that α+β=1, this equation can be rewritten in terms of the growth rate.

$$\dot{Y} = T\dot{F}P + \alpha\dot{K} + \beta\dot{L} \quad (3)$$

However, the endogenous growth models explain that TFP is a function of human capital and technical change occurs due to economic agents (Romer, 1986; Lucas, 1988). In their framework, the aggregate production function is given as:

$$Y = A_t(h) F(K_t, L_t) \quad (4)$$

Endogenous growth models propose that Total Factor Productivity (TFP) is influenced by human capital, and that technological change results from the actions of economic agents (Romer, 1986; Lucas, 1988). In their theoretical framework, the aggregate production function is expressed as follows:

$$Y = A_t(h, r) F(K_t, L_t) \quad (5)$$

In this equation, r represents the domestic R&D capital stock. Additionally, Grossman and Helpman (1994) and Coe and Helpman (1995) incorporated the role of trade openness into the endogenous growth model. They found that international trade positively affects TFP by facilitating technology transfer.

$$Y = A_t(h, r, o) F(K_t, L_t) \quad (6)$$

Where is the country's level of openness? Given the assumption that the TFP at any time takes the following Cobb–Douglas specification:

$$TFP_t = h_t^{\alpha}.\, r_t^{\beta}.\, o_t^{\gamma} \quad (7)$$

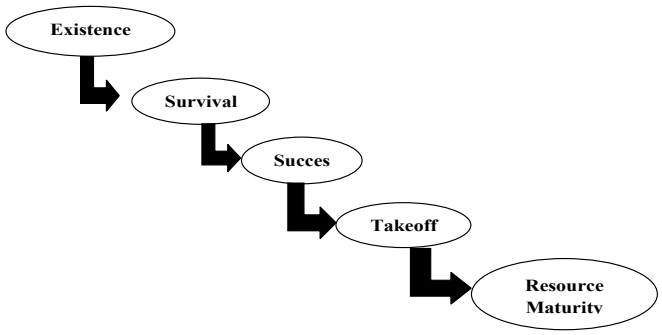
The TFP growth in each country is measured as

$$\ln\left(\frac{A_{i,j,t}}{A_{i,j,t-1}}\right) = \ln\left(\frac{Y_{i,j,t}}{Y_{i,j,t-1}}\right) - \alpha\ln\left(\frac{L_{i,j,t}}{L_{i,j,t-1}}\right) - \beta\ln\left(\frac{K_{i,j,t}}{K_{i,j,t-1}}\right) \quad (8)$$

Whereas, the term A is used for TFP

The second mediator, the firm's growth, has a significant effect on the survival of the firm, employment opportunities, and business activities of a firm at both domestic and foreign levels. A model was developed by Churchill and Lewis (1983), who explained the five stages of a firm's growth. At this level *(Existence)*, the firm first tries to set up its business by supervising all the business activities. At the second level *(Survival)*, the firm requires more capital to increase its sales. The business of the firm grows and expands. In the third stage *(Success)*, the firm earns more profit and has enough resources to invest in new projects. In the fourth stage *(Take off)*, the firm tries to increase its human capital and focuses on expansion and searching for new business opportunities. At the final stage *(Resource Maturity)*, now firmly put more attention towards improving quality and financial condition.

Figure 1: Five Stages of Firms' Growth



Note: *Resource (Churchill and Lewis, 1983)*

Broadly, two theoretical frameworks explain the firm's growth: The one framework states that the growth path can be sequential, linear, invariant, and deterministic (Greiner 1972; Kimberly 1979; Adizes 1979; Churchill and Lewis 1983; Hanks et al. 1993). The competitiveness of a firm is increasing at all stages of growth, and this competitiveness decreases if the firm is not upgrading its business. So the firm tries to put more focus on improving its capabilities (Casson 1982; Churchill and Lewis 1983; Chen et al., 2008). The second school of thought states that small enterprises can face sudden changes in their growth. The sequence of stages in the growth path of a small firm remains the same if some factors intervene suddenly (Aislabie 1992; Levie and Hay, 1998; Phelps et al. 2007).

Gibrat (1931) is the first who give a model for explaining firm growth. This model is based on 'The Law of Proportionate Effect'. Gibrat's Law is tested with a random walk specification:

$$z_{t,i} = \beta\ z_{t-1,i} + \varepsilon_{i,t} \quad (9)$$

Where $z_{t,\,i}$ denotes the log of the firm size. Hence, the firm growth is determined by the error term $\varepsilon_{i,t}$, and the validity of the restriction $\beta = 1$ suggests that the law holds. Whenever subtracting $z_{t-1,\,i}$ on both sides in Eq. 1 and defining $\gamma = \beta - 1$, the following equation is obtained.

$$\Delta z_{t,i} = \gamma\ z_{t-1,i} + \varepsilon_{i,t} \quad (10)$$

This model is estimated for cross-sectional data, and Gibrat's Law holds if the restriction $\gamma = 0$ and $\beta = 1$ is valid, which implies that the growth rate is sustained over time. Audretsch et al. (2004) argued that the autoregressive process at first order is not sufficient to fix the problem of autocorrelation. So second-order process is also considered:

$$\varepsilon_{t,i} = \rho\varepsilon_{t-1,i} + \omega\varepsilon_{t,i} + v_{t,i} \quad (11)$$

Adding this to the error term in Eq. 2, the following results are estimated:

$$\Delta z_{t,i} = (\beta - 1 + \rho)z_{t-1,i} + (\omega - \beta\rho)z_{t-2,i} - (\beta\omega)z_{t-3,i} + v_{t,i} \quad (12)$$

When (β, ρ, ω) is equal to (1, 0, 0), Gibrat's Law is considered to be fulfilled (Bentzen 2012).

3.1. Empirical Models

Now, empirical models for TFP growth and firm growth are designed in light of the objectives of the study. The effect of one mediator, TFPG, is used to examine the relationship between product quality and trade flow.

$$TFPG_{ft} = \rho_0 + \rho_1 PQ_{ft} + \acute{\rho_2} z_{7t} + \mu_{1i} + \lambda_t + e_{i,t} \quad (13)$$

$$EF_{ft} = \tau_0 + \tau_1 PQ_{ft} + \tau_2 TFPG_{ft} + \acute{\tau_4} z_{8t} + \mu_{2i} + \lambda_t + e_{i,t} \quad (14)$$

Hence, $\frac{\partial EF_{ft}}{\partial PQ_{ft}} = \tau_1$ shows the direct effect of export flow and quality product. While the multiplicative term of $PQft\frac{\partial TFPG_{ft}}{\partial PQ_{ft}}\frac{\partial EF_{ft}}{\partial TFPG_{ft}} = \rho_1\tau_2$highlights the indirect effect of the TFP growth channel.

The direct and indirect impact of product quality on firms' growth through the channel of trade flows is examined by estimating two equations (15 and 16). Which takes the following form.

$$FG_{ft} = \theta_0 + \theta_1 PQ_{ft} + \acute{\theta_2} z_{5t} + \mu_{1i} + \lambda_t + e_{i,t} \quad (15)$$

$$EF_{ft} = \delta_0 + \delta_1 PQ_{ft} + \delta_2 FG_{ft} + \acute{\delta_3} z_{6t} + \mu_{2i} + \lambda_t + e_{i,t} \quad (16)$$

Where $\frac{\partial EF_{ft}}{\partial PQ_{ft}} = \delta_1$ shows the direct effect of export flow and quality product, and multiplicative term $\frac{\partial EF_{ft}}{\partial PQ_{ft}} = \frac{\partial FG_{ft}}{\partial PQ_{ft}}\frac{\partial EF_{ft}}{\partial FG_{ft}} = \theta_1\delta_2$ shows the indirect effect through the channel of firm growth.

3.2. Descriptions of Variables and Data Source

The data is collected from annual financial statements of non-financial firms of the Pakistan Stock Exchange (PSX) for 1999 to 2020. The other macro variables are taken from the Pakistan Bureau of Statistics (PBS) and the World Development Indicators (WDI). The variables: product quality, firm's growth, and TFP growth are measured by using different methodologies, but export flows, trade flows, and FDI are taken from the above-mentioned sources.

3.3. Estimation Methodology

To check the mediation effect, we have used the SUR Model. The Seemingly Unrelated Regression (SUR) model is beneficial for checking interconnected relationships, cross-equation error relationships, and Estimation Efficiency. When error terms are correlated, SUR models give more appropriate estimates than OLS regressions. The SUR Model is not suitable due to computational complexity, large sample size requirements, and specification error. However, the data set of this study is large enough, and the models are correctly specified. Due to these reasons, the SUR model is used in this study. The seemingly unrelated equations model proposed by the sum allows for cross-sectional dependency. It focused on the efficiency level due to the disturbances correlation and estimated the linear equations system across country-specific equations. So, this system is called *seemingly unrelated.* Suppose the data are on each cross-section unit over T periods. Consider the following set of equations:

$$y_i = X_i\beta_i + \varepsilon_i \qquad i=1,2\ldots\ldots M$$

Traditionally, the two-step estimation process involves the following steps:

Conducting an OLS regression for the given system of equations to obtain consistent and unbiased estimates of the variance-covariance matrix of the error term.

Using the estimated variance-covariance matrix of the error term, a standard GLS estimator can then be applied:

$$\hat{\beta}^{SUR} = (\dot{X}\hat{\Omega}^{-1}X)^{-1}\dot{X}\hat{\Omega}^{-1}y$$

It is important to note that if the variance-covariance matrix of the error term is diagonal, the estimator will closely resemble the OLS estimator. In the case of long and narrow panel data, the SUR method can be used to capture potential heterogeneity in the slopes. The SUR method offers more efficient estimates by considering cross-equation dependence. This cross-equation dependence can be tested using the LM statistic (Breusch and Pagan, 1980).

$$LM = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{i,j}^{2}$$

Where $j2is$ the cross-sectional correlation coefficient:

$$\hat{\rho}_{i,j} = \frac{\sum_{t=1}^{T}\hat{\varepsilon}_{it}\hat{\varepsilon}_{jt}}{(\sum_{t=1}^{T}\hat{\varepsilon}_{it})^{\frac{1}{2}}(\sum_{t=1}^{T}\hat{\varepsilon}_{jt})^{\frac{1}{2}}}$$

The LM statistic is valid for fixed N as $T \to \infty$ and is asymptotically distributed as $\chi 2$ with N (N − 1)/2 degrees of freedom. The commands for analysis will be taken from1 Nguyen and Nguyen (2010). However, the new econometric methods are available for unbalanced panel data, which is an estimate of a system of equations. A procedure is developed by Biorn (2004) for the estimation of a Seemingly Unrelated Regression (SUR) model. According to Monte Carlo, the SUR technique is superior to the single equation for FE and RE estimators. The methodology presented by Biorn (2004) has many advantages, as this process controls firm heterogeneity and provides unbiased estimators. Furthermore, these estimates provide enough estimates and more efficient estimators (Biørn, 2014).

4. Results and Discussions

In mediation analysis, the effect is examined through which the independent variable (Product Quality) affects the dependent variable (export flow) by a mediating variable. There are two variables taken as mediating, namely growth in TFP of the firm ($TFPG_{ft}$) and the firm's growth (FG_{ft}). Table 1 explains the summary statistics of the Mediators, which are total factor productivity growth (TFPG) and firm growth (FG).

Table 1: Summary Statistics of Mediators: TFPG and FG

Variables	No of Obs.	Mean	St Dev.	Min	Max	P25	P50 (Median)	P75
PQ_{ft}	6877	60.45892	12.5936	0	100	53	60	68
EF_{ft}	3195	205.5074	43.0511	0.001059	429.0334	94.7516	508.1360	1971.90
$TFPG_{ft}$	6374	-0.0268	54.3079	-623.73	1605.34	-1.4251	0.6639	2.7272
FG_{ft}	5939	0.6023	0.0093	0	1	0.6024	0.6024	0.6024
FDI_{t}	7380	-19.1405	14.8652	-54.9200	-297.00	-23.5550	-17.0300	-78.850

TF_f	7380	30.4748	3.1893	25.3023	35.6813	27.6304	31.4856	32.9049
TA_{ft}	6783	9.3979	4.7903	0	100	8	8	9

Note: *where TFPG is for the total factor of productivity growth, and FG is for firm growth.*

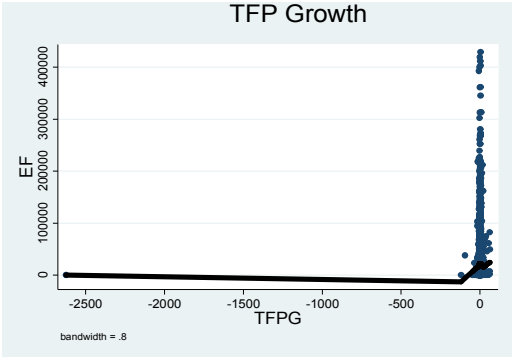
Table 1 describes the value of mean, Min-Max, median, and three percentiles (25th,50th, 75th). The values of the standard deviation show less volatility in $TFPG_{ft}$ and $FG_{ft.}$ We have normalized the variable FG_{ft} to keep it in one unit of measurement. Table 2 provides a correlation matrix for analysis of the role of mediators.

Table 2: Correlation Matrix for The Role of Mediators

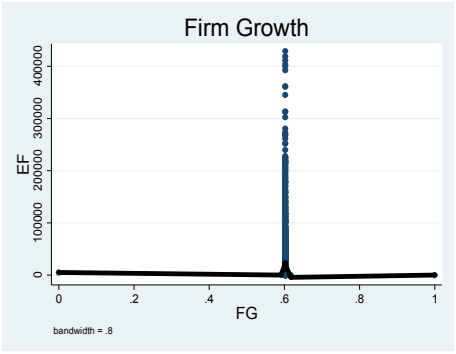
Variables	PQ_{ft}	EF_{ft}	$TFPG_{ft}$	FG_{ft}	FDI_t	TF_f	TA_{ft}
PQ_{ft}	1.0000						
EF_{ft}	0.3082	1.0000					
$TFPG_{ft}$	0.0232	0.0121	1.0000				
FG_{ft}	0.0123	0.0007	0.0151	1.0000			
FDI_t	-0.0036	0.0464	0.0210	0.0028	1.0000		
TF_t	0.0128	-0.0170	0.0428	0.0057	-0.4434	1.0000	
TA_{ft}	0.4238	0.4614	0.0108	-0.0027	0.0084	-0.0735	1.0000

Table 2 presents the correlation of mediator variables: $TFPG_{ft}$ and FG_{ft} under consideration. Both mediators $TFPG_{ft}$ and FG_{ft} have a positive and direct effect on the export flow, 0.023 and 0.012, respectively. Figure 2 plots the role of mediators in the relationship between EF and PQ. The horizontal axis measures the different mediators of analysis, and the vertical axis labels the variables of export flow.

Figure 42: Scatter Plot of the Mediators, TFPG and FG



a)TFP Growth



b) Firm Growth

Panel (a) shows that there is a positive link between export flow and $TFPG_{ft,}$ which indicates that TFP plays a role as a mediator. The marginal productivity increases if all factors of production perform efficiently. The efficient factor of production can increase their sale by producing a high-quality product. High-quality products ultimately increase the export flow of the firm as well as of the country (Haider et al., 2021; Satpathy et al., 2017; Shah et al., 2024).

Panel (b) describes a positive relationship between firm growth, which is our second mediator, and export flow. The firm's growth means that the sales of that firm are more than other firms. Such a firm can increase its domestic sales as well as its foreign sales. Hence, the export flow of the firm is also increased (Hart, 2000; Keller & Yeaple, 2009).

4.1. The Role of Total Factor Productivity Growth

The TFP growth is the first mediator whose role is investigated in the relationship between product quality and export flow. In this study, total factor productivity is measured by using the methodology presented by Olley

and Pakes (1996) and is afterward estimated to analyze the growth of TFP for analysis. Table 3(a) gives the estimates that are executed through two seemingly unrelated equations, namely Eq. 13 and Eq. 14. The results of Eq. 13 explained in column 1 suggested that TFPG has a positive and significant impact on product quality as an increase in product quality (10.6946) leads to an increase in the TFPG. These results are consistent with the studies of Nakao (1982), Verhoogen (2008), Alcala (2016), Nguyen and Vo (2024), and Siddique (2022), which found a positive relationship between $PQ_{ft}$and $TFPG_{ft}$. The estimates of the control variables (TA_{ft}, FDI_t, and TF_t) are significantly positive. In column 2, the estimates of Eq. 14 are presented. The estimate of PQ_{ft}(51.0872) is the same as in Eq. 13 and $TFPG_{ft}$ (4.0586) It is positive but insignificantly affects the export flow. These results are consistent with the results of the graphical and descriptive analysis done earlier. All control variables in this equation are positive and statistically significant. The main indicator to analyze the firm's performance. TFP is enhanced due to the use of good and efficient raw materials in the production process (Aghion et al., 2005). Productivity improvement is important in many aspects. A more productive firm can generate high revenue and profit. On the other hand, more productive firms can easily enter and also survive in international markets. These results are consistent with the studies (Khandelwal, 2010; Mitić et al., 2017; U. S. Khan et al., 2020). Such a role of TFPG Activities is first time in the export flow and product quality relationship.

Table 3(a): Estimates of the SUR Model for Role of Mediation

Variables	**Model 1**	**Model 2**
	$TFPG_{ft}$	EF_{ft}
PQ_{ft}	10.6946** (0.048)	51.0872*** (0.000)
$TFPG_{ft}$	----	4.0586 (0.678)
FDI_t	0.00201 (0.614)	0.0074*** (0.000)
TF_t	46.5320** (0.005)	67.8142*** (0.000)
TA_{ft}	83.4594 (0.904)	323.2060*** (0.000)
Note: P-values are given in parentheses. ***, **, and * show the level of significance at 1%, 5%, and 10% respectively.		

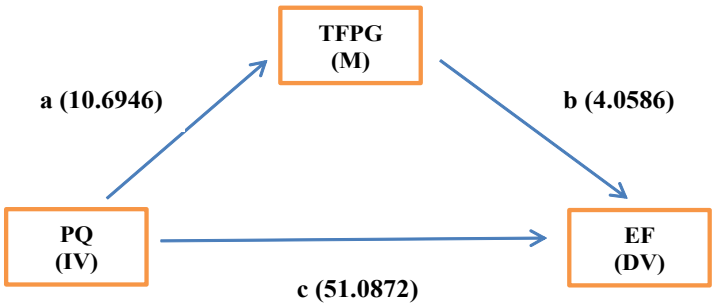
The result of Table 3(b) shows the mediation effects of $TFPG_{ft}$ on PQ and EF. The direct and indirect effects of the mediator $TFPG_{ft}$ are explained separately. The direct effect (51.0872) is positive and significant, but the indirect effect (43.4061) and total effect (94.4933) of TFPG are positive but statistically insignificant. The mediation effect (43.4910) is also positive, however insignificant, which indicates that the TFPG effect on the export flow is increasing with an increase in product quality. Our estimated results reveal that the growth of TFP has an immediate response to a firm's product quality and its effect on export flow, as a direct effect is positive and statistically significant. There is significant partial mediation.

Table 3(b): Mediation effect of $TFPG_{ft}$

$TFPG_{ft}$	Coefficient	z – value	P – value
Direct Effect	51.0872***	24.26	(0.000)
Indirect Effect (Mediation Effect)	43.4061	0.42	(0.671)
Total Effect	94.4933	0.94	(0.349)
Note: As mentioned above			

The Conclusion that can be drawn from the extended result is that TFPG plays the role of partial mediation in explaining the relationship between export flow and product quality. Figure 3 describes the link between export flow (Dependent Variable, DV), product quality (Independent Variable, IV), and TFP growth (Mediators, M). The effects of product quality are decomposed on the export flow of the firm (V) into direct and indirect effects.

Figure 3: The Link Product Quality, Export Flow, and TFP Growth



In Figure 3, the direct effect of PQ on EF is presented in arrow "c", and the indirect effect by mediating variable (TFPG) can be examined by the multiplication of terms (a) and (b) as $ab = (10.6946) * (4.0586) = 43.4061$. This indirect effect is verified in Table 3 (b). These estimates are obtained by estimating the SUR model suggested by Biørn (2004).

However, the positive and significant direct effect of PQ and EF concludes that TFPG plays the role of partial mediation. Because of, indirect, total, and mediation effects of TFPG, although positive, but insignificant. Consequently, TFPG is a partial mediator for explaining and strengthening the link between PQ on EF.

4.2. The Role of a Firm's Growth

The firm's growth is used as a second mediator to explain the relationship between product quality and export flow. The estimates of the SUR model in Table 4(a). These results are also obtained by estimating two seemingly unrelated equations (Eq. 15 and Eq. 16). Column 2 (Model 1) presents the estimated results of the empirical model (Eq. 15), which suggests that product quality (9.3817) is positive but statistically insignificant. Column 3 (Model 2) presents the estimated results where the estimates of PQ_{ft} *(32.3369)* have a positive and highly significant impact on the export flow. These results provide robustness with the findings of FG_{ft} *(11.1660)*graphical and descriptive analysis earlier. The estimates of all control variables for Eq. 15 are positive but insignificant. In column 2, the estimates of Eq. 16 are presented. These results are in line with the findings of (Babina et al., 2024; Kim et al., 2024). These studies found a positive association between a firm's growth and product quality. The firms can grow fast if they adopt knowledge of advanced techniques. The firm expands its business and grows well. Firms' growth leads to new job opportunities, knowledge of new techniques, entry, and survival in foreign markets. We measured the firms' growth through data on their sales (Coad & Tamvada, 2012; Yu, 2013).

Table 4 (a): Estimates of the SUR Model for Role of Mediation

Variables	Model 1	Model 2
	FG_{ft}	EF_{ft}
PQ_{ft}	9.3817 (0.866)	32.3369*** (0.000)
FG_{ft}	----	11.1660*** (0.000)
FDI_t	0.00531 (0.987)	0.0069*** (0.000)

TF_t	28.6940 (0.810)	117.6829*** (0.000)
TA_{ft}	0.3772 (0.999)	404.6546*** (0.000)
Note: As mentioned above		

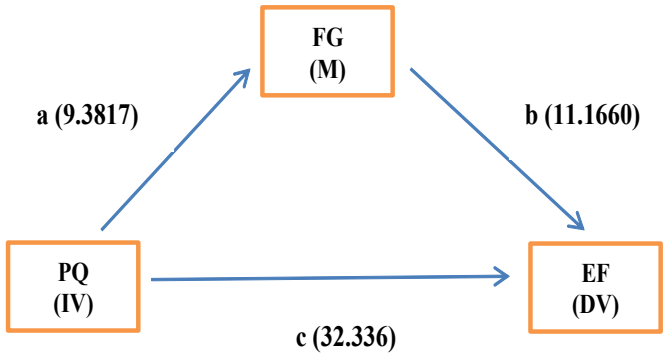
The result of Table 4 (b) explains the mediation effects of FG on PQ and EF. Here, the direct and indirect effects of the mediator FG_{ft} are explained separately. However, the indirect effect (10.4757) and the total effect (42.8094) of FG are positive but statistically insignificant. Similarly, the mediation effect is also positive but insignificant. Results indicate that the FG effect on the export flow is increasing with an increase in product quality. The insignificance of the indirect effect of FG provides a reason to agree on the potential role of mediators.

Table 4(b): Mediation effect of FG_{ft}

FG_{ft}	Coefficient	z – value	P – value
Direct Effect	32.3369***	26.03	(0.000)
Indirect Effect (Mediation Effect)	10.4757	0.17	(0.866)
Total Effect	42.8094	0.69	(0.492)
Note: As mentioned above			

Figure 4 describes the link between export flow (Dependent Variable, DV), product quality (Independent Variable, IV), and firm growth (Mediator Variable, MV). The effects of product quality are decomposed on the export flow of the firm (DV) into direct and indirect effects.

Figure 4: The Link Product Quality, Export Flow, and Firms' Growth



In the above figure, the direct effect of PQ on EF is shown by the arrow. $c = 32.336$" However, the indirect effect of PQ by mediating variable (FG) is captured by the multiplication of terms (a) and (b) as $ab = (9.38) * (11.16) = 10.47$, which is the same value presented in Table 4 (b).

However, the positive and significant direct effect of PQ and EF concludes that FG plays the role of partial mediation. Because indirect, mediation, and the total effect of FG are positive, but it is insignificant in all cases. Consequently, FG is acting as a partial mediator in determining the relationship between product quality and export flow. Here, it is concluded that the two mediators, TFPG and FG, play roles as partial mediators of export flow and product quality.

5. Conclusion and Policy Implications

The study examines the mediating effect of firms' growth and the total factor productivity growth on the positive relationship between Product quality and export flows. The quality of the product is a crucial factor that

positively influences export flows and ultimately trade flows of a country. The firms producing high-quality products can capture more market share in both domestic and international markets. The large firm size also determines the GDP growth and trade flow of an economy. The firm size is affected by firm growth and the total factor productivity growth positively. So, these two variables are taken as mediators in the relationship between product quality and trade flows. Good quality of products also increases the trade flows of Pakistan (Saeed et al., 2023). Based on this positive relationship, this study aims to examine the mediating effect of firms' growth and TFPG. To achieve the objective of the study, non-financial firms listed on the Pakistan Stock Exchange are taken. The Seemingly Unrelated Regression model is used for the period from 1999 to 2020, yearly.

The findings of the study suggested that firms' growth has a positive effect on export product quality. The direct mediating impact of firms' growth is statistically significant and positive. When product quality improves, firm growth increases. This high firm growth leads to enhanced export flow. However, the indirect effect of product quality through the firm's growth (mediator variable) remains positive but insignificant. It means that firm growth can play the role of a mediator in the quality and trade relationship. Secondly, the same findings came up when TFP growth was also considered as a mediator. The direct mediating effect of TFP growth is statistically significant and positive. High product quality leads to increased TFP growth, which ultimately increases export and trade flows. However, the indirect impact of product quality through the TFP growth (mediator variable) remains positive but insignificant. It concludes that TFP growth can play the role of a mediator in the export quality and trade relationship. Here, it concluded that both TFP growth and firm growth play the role of mediators in improving the link between product quality and export flow partially.

This study may prove beneficial for policy agents to make policies for the betterment of the export flow of Pakistan. The text outlines several policy guidelines to improve product quality and export performance in Pakistan. Policies should support firms in boosting sales and profits by focusing on production methods. This includes stable exchange rates, better political conditions, reduced tariffs, favorable trade agreements, and access to subsidized loans. Firms should also be managed by highly qualified individuals to ensure quality control. Product quality is essential for both domestic and international markets. Improving product quality can drive domestic sales and exports, which are vital for Pakistan's economic growth. The government should support research and development (R&D) and offer financial aid to cover the costs of quality improvements. Fourthly, reducing financial obstacles can help firms grow and improve product quality. Overall, the text emphasizes that a stable environment, improved management, R&D, and financial support are critical to boosting product quality and exports in Pakistan. The results of the study open some future directions for researchers in the economic field. A more rigorous analysis that is rigorous conducted to investigate the role of other relevant mediators may be done by using primary data.

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