THE ROLE OF MODERATORS ON PRODUCT QUALITY AND EXPORT FLOWS: THE CASE OF PAKISTAN

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ABSTRACT

High-quality products are always in demand for both local and international markets. The demand for such products can be increased by the product sales at a domestic level. It can also be helpful to increase the export flows of an economy and hence improve the trade flows. Other factors have a moderating role in determining the relationship between export product quality and trade flows. The objective of this study is to examine the role of moderating variables, which are used to check the strength of the above relationship. There are three variables: financial constraints, firm heterogeneity, and R&D activities are taken as moderators. For this purpose, the data is taken from annual financial reports of non-financial firms which are listed on the Pakistan Stock Exchange. Also, some country-level data is taken from the Pakistan Economic Survey. The objective of the study was achieved by using panel techniques Fixed Effect, Random Effect Model for the period of 1999 to 2020. It is found that firm heterogeneity and R&D activities have positive and financial constraints have negative but significant effects on strengthening the relationship between product quality and export flows. Based on our findings, the government should provide R&D funds and financial aid programs for new investors to improve product quality and increase their sales in local and international markets.

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INTRODUCTION

The quality of Products has a significant role in increasing the international business of a nation. International trading activities can be more beneficial for the country that puts more focus on the improvement of product quality (Amiti and Khandelwal, 2013); Fan et al. (2015)[1]. Firms can enter and then survive in foreign markets by upgrading their product quality (Silva and Carreira, 2012). Different moderators make the association strong between the quality of products and export flows. The moderating variables are very helpful in explaining the strength and significance of the correlation between the two variables. The nature and magnitude of the relationship can easily be understood. There are three moderators taken to examine the correlation between product quality and export flows: financial constraints, firm heterogeneity, and research and development activities.

Financial Constraints

External financing and funding are important factors in determining international trade. Differences in technology and economies of scale across countries will increase the demand for external finance. Financial development also affects the export patterns of a country's level of trade. Hence, Financially developed economies have a great volume of trade (Baldwin and Krugman, 1989; Kletzer and Bardhan, 1987). Exporting firms are mainly dependent on finances to meet their needs. Financial constraints are the costs of international business activities. There is a high fixed cost incurred when a firm enters a foreign market. These costs include the expense of collecting information about the foreign market, observing the needs and demands of foreign customers, producing different and new goods, marketing and packaging, and also providing transport services. The heavy entry cost is the main obstacle to the financial health of a firm with a high sunk cost; only the productive firm will easily export, or the firm that has more finances to face business costs. Therefore, financially constrained firms have faced a significant impact on the firm's decision to produce and export the product (Greenaway et al., 2007). Two export margins respond to financial constraints through the quality of products. Firstly, financial development is helpful to raise the product quality, which is sold by new firms (intensive margin). Second, financial constraints reduce the average quality as new entrants are less productive in the production process (extensive margin). Both margins have a strong effect on industries that are more vulnerable financially (Claessens and Laeven, 2003; Rajan and Zingales, 2003). Therefore, financial constraints may strongly affect international trading activities by slowing down the quality of products at the firm level. However, there is little empirical support found on the impact of financial constraints and output quality (Crino and Ogliari, 2015).

Firm's Heterogeneity

Heterogeneity is defined as the firms' differences in productivity, size, capital, and skill intensity (Melitz and Redding, 2015). It plays an important role in firms' reallocation of resources efficiently

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[1] Khandelwal (2010) used prices and market share as a proxy for product quality.

under trade openness. Large-size firms have more potential to upgrade product quality, which ultimately improves the trade flows (Satpathy et al., 2017). Moreover, exporter firms are often explored to be more productive than non-exporters. Firms can also maximize high profits and minimize costs by producing high-quality products (Sutton, 2001). Trade models of heterogeneous firms (Ricardo, 2017; Smith, 1937) predict that if product quality is high, a positive association could be observed between prices and productivity. However, in the absence of product quality, this relationship has been reversed. The literature also reports that exporting firms provide good quality products and sell at higher prices than non-exporting firms (Hallak and Sivadasan, 2013). However, firm heterogeneity has a significant effect in determining the relationship between product quality and trade flows.

Research and Development Activities

The basic argument about R&D concerns is the invention of new products that are transferred to international markets through trading activities. Transfer of Technology transfers is a powerful source to enhance productivity levels around the world (Frankel and Romer, 1999). The domestic and foreign R&D capital stock affects domestic total factor productivity positively. The more open countries can get more benefits from R&D capital stock. Knowledge spillovers[2] identify when new ideas are developed by one firm and adopted by other firms. The firms have full knowledge regarding new and advanced technologies that help produce high-quality products (Bayoumi et al., 1999). Trade openness is a significant channel for the transfer of technical knowledge between firms and countries. Knowledge can be transferred from developed to developing countries through the coordination of trading partners. The process of technology improvement through domestic research and development sectors is slower and more costly in developing countries as compared to developed countries. However, developing countries can improve their productivity by expanding trade with industrial countries that have knowledge-based production. Developing countries can enjoy the benefits of trade with industrial countries, as interaction with developed countries helps take ideas for improving their products (Schmitz and Knorringa, 2000). Investment in product innovation leads to improved product quality, which ultimately affects trading activities. Consequently, R&D also plays a supportive role in improving product quality and export flows.

There is a direct relationship between product quality and international trade flows (Alcalá, 2016; Piveteau and Smagghue, 2017). Few studies linked product quality with financial constraints that are faced by exporting firms (Antoniades, 2015; Ciani and Bartoli, 2015). And there are few studies on Pakistani firms have investigated the effects of trade flow (Ahmed and Shabbir, 2016; Khan, 2006; Rashid et al., 2021; Wadho and Chaudhry, 2018; Yeo and Deng, 2019), financial constraints (Ahmed and Shabbir, 2016; Rashid and Ashfaq, 2017), firm heterogeneity (Rashid et al., 2021), and Research and Development activities (Rashid and Ahmad, 2018; Rashid and Ashfaq, 2017; Saleem et al., 2019) separately. However, no empirical study has been carried out so far to explore the relationship between product quality and trade flow through moderators. In this context, this study has been extended by introducing the role of different moderators as financial constraints, firm heterogeneity, and R&D activities, on product quality and trade flow at Pakistan's firm level.

[2] Knowledge spillover is an exchange of ideas among individuals. these are non-rivalin nature

The trade deficit of Pakistan's economy worsens day by day. The bills for importing commodities are higher than export earnings. In this regard, the recent study should be helpful to overcome this issue by focusing on the improvement of product quality. The moderators play an important role in highlighting the relationship between product quality and trade flows. In this study, the effect of financial constraints, firm heterogeneity, and research and development activities as moderators are examined on the connection between product quality and trading flows. The rest of the paper comprises reviewed literature, theoretical framework, variables description, data sources, methodologies, empirical findings, interpretation of the result, and conclusion.

Product quality is a very important matter in determining the performance of a firm at the international level (Ghani, 2020). Several studies have analyzed the positive relationship between product quality and trade flows. High standards positively affect trade flow at the firm level (Chen and Juvenal, 2016). The firm maintains good Standards in production and increases the export volume by upgrading product quality. These standards lead to focusing on the issues of firms like market failure by improving product quality (Cadot et al., 2018; Can et al., 2022; Sun, 2021; Xiong and Beghin, 2014). Product quality has a significant role in the international trade of developed as well as developing countries. The developed countries exchange high-quality products with developing countries and boost the growth rate of exports (Curzi and Olper, 2012; Hu and Lin, 2016). However, developing countries have to pay more attention to meeting high standards of exporting goods (Ferro et al., 2015). Export product quality can be improved by promoting entrepreneurial innovation and green innovation (Liu et al., 2023; D. Zhang, 2022). Imports of digital products have a direct effect on export product quality. Digital imports can be improved through information-searching activities and technology spillovers (Zhang et al., 2023). Value-added tax reforms, a rise in the real per capita income, a reduction in income inequality, and poverty reduction can lead to improved product quality (He et al., 2023; Kong and Xiong, 2021). The theoretical analysis shows that export duration will have a significantly positive effect on firms' export product quality by promoting their productivity and innovation ability. There are moderators are financial constraints, firm heterogeneity, and R&D expenditures.

Financial Constraints

Financial constraints are the main limitation faced by any firm. Financially constrained firms countries cannot improve their product quality and afterward trade flows. Financial developments are used to overcome the effect of financial constraints. The financial constraint hypothesis explains the relationship between the availability of finances and the capability of export of firms (Manova, 2013). The best proxies of financial Constraints are investment cash flow, liquidity, firm size, age, and leverage ratios (Bhatti et al., 2013; Greenaway et al., 2007). Rajan and Zingales (2003) compared three standard indices of financial constraints (KZ -1997), WW (2006), and SA (2010)) and found KZ index (1997) is a more relevant measure of financial distress. The exporting firm can only survive in the international market if they have enough finance to bear the cost of export (Helpman et al., 2008). Financial constraints also play a role in the decision of a firm regarding financial activities. A multinational firm can raise and use funds in better ways. A firm with multinational activities

can be more productive and efficiently participate in international trade (Manova, 2013). Financing through foreign resources is costly for firms, so they try to utilize domestic financing resources like cash flows to enhance the competency of the banking sector (Amiti and Khandelwal, 2013). The concept of financial constraints is also examined in the context of Pakistani firms. Sheikh and Wang (2010) have explained the financing behavior of Pakistani textile firms; they found that the leverage ratio is negatively correlated with profitability, tangibility, and liquidity, but this ratio is directly correlated with the growth and size of the firm. Rashid and Ashfaq (2017) found that when cash volatility is high, financially constrained firms raise their cash holdings more than unconstraint firms in Pakistan. Availability of finance is the main factor for Pakistani firms to decide whether to export their product to international markets (Saeed and Sameer, 2015). Financial constraints lead to higher cash holdings and fewer innovations (Habib et al., 2021). There is also a strong connection between the attributes of the firm's owner and cash flow constraints (Bağır and Seven, 2021). The firm's decision to invest is also dependent on the financial behavior of the firm (de Guevara et al., 2021). It is also found that financing constraints are an important factor inhibiting the TFP of firms (Wong et al., 2023).

Firm's Heterogeneity

The heterogeneity of firms is explained in different aspects such as the sale, age, productivity, location ownership, financial conditions, and status of international business activities. Firms' heterogeneity is the main determinant of product quality and trade flows. Helpman et al. (2004) developed a dynamic industry model of trade, which shows that firms with different production levels can survive in an industry. Yeaple (2005) investigated various factors of heterogeneous firms deciding to export, such as sunk cost, firm size, and foreign ownership. They also showed that firms having more skilled laborers are more likely to export. Qureshi and Yousaf (2014) and Fan et al. (2015) analyzed the firm size, liquidity, age, and market share as are main determinants of heterogeneous firms. The firm size plays an important role in determining the export level of a firm. A large-sized firm can easily excess to international markets by exporting directly. The gain from trade is important for productivity if a firm is heterogeneous (Chung, 2019). The location of the exporting firm also matters. The firm is exporting to countries located at a distance by charging high prices as the firm included transportation costs in the price of export (Martin and Mejean, 2014). Learning by exporting can enhance productivity and export performance (Schmeiser, 2012). The productive firms can grow if the central bank adopts an expansionary monetary policy (Ferrari and Queirós, 2022). The trade cost of new exporting firms is much higher than old firms (Timoshenko, 2015). There is a significant relationship between the export product quality and the distance between partner countries (Curzi and Olper, 2012). The larger, more productive, and more profitable firms benefited more from the greater access to external finance, an indication of the role played by heterogeneous firms' adjustments to a macroeconomic shock (Bas and Berthou, 2021). And the COVID-19 shock has a strong negative effect on small and less productive, firms. So these firms have faced a larger decline in their sales (Brinatti and Morales, 2021). Firm heterogeneity is another important moderator of trade flow and product quality.

Research& Development Activities

R&D activities are more focused nowadays. This concept is based on the Solow growth model. Solow (1956) recognized economic growth as technological innovation. He argues that current technologies convert economic growth into technical change. And then Romer (1994) suggested that endogenous growth is made by adopting advanced technology. He found a significant association between human capital and technological growth. Technical advancement and innovations boost economic growth (Schumpeter, 2013). These changes are just affecting certain sectors and surroundings, and these innovations are unevenly distributed. Important determinants of R&D are different types of financial development. However, only FDI is a significant measure of financial development. The high foreign direct investment leads to improving the R&D sector.

Many determinants affect the R&D expenditures at the firm level. Few studies highlighted the determinants of R&D expenditures, such as the financial and organizational structure of a firm, costs of capital, cash flow, firm sales tax incentives, knowledge, machinery, equipment, training, and marketing (Hall and Lerner, 2010). The R&D investment activities are determined by the financial independence, size, and sale, resources of a firm (Bento, 2016). Mendi (2007) investigated how R&D expenditures can improve export product quality. Crinò and Epifani (2012) explained how R&D expenditures affect trade flows by reducing trade barriers and promoting export policies. Khan and Khattak (2014) found that improvement in the quality of the educational sector enhances R&D expenditures by promoting exports. The firm's decision to invest in innovative activities has a positive and significant effect on the productivity and exports of the firm. So, the export and innovation promotion policies are used to enhance the productivity of a firm (Cassiman et al., 2010). Investments in new technologies can lead to reducing the firm's cost, so the productivity of the firm is improved and increases the profit (Thatcher and Oliver, 2001). There is a significant relationship shown between R&D expenditure and a firm's productivity growth (Griliches and Mairesse, 2007; Scherer, 1982). The rate of return on R&D expenditure is higher for exporting firms than for non-exporting (Wakelin, 2001). R&D investment and innovation are used as the main determinants of firm growth (Klette et al., 2000). The labor productivity of a firm can be increased by investing in R&D activities and information technology investments (Khanna and Sharma, 2018). The role of R&D activities of the firm as moderators is also a very important moderator that explains the relationship between trade flow and product quality.

THEORETICAL FRAMEWORK AND MODEL DESCRIPTION FOR MODERATORS

This section provides the theoretical foundations for moderators such as Financial Constraints, Firm heterogeneity, and R&D activities through which product quality affects trade flows. Bernard et al. (2007) and Helpman et al. (2004) have developed firm-level models of intra-industry trade to stylize facts about exporting firms. Helpman et al. (2004)incorporated firm heterogeneity and credit constraints into a static model. Accordingly, large numbers of firms produce goods in each country and sector.

After a brief discussion of the theoretical background of the study, a further empirical model is designed. These models are based on three moderators: financial constraints, firm heterogeneity, and research & development activities are used to check the relationship between export quality and trade flows. First, this is a baseline model which examined the impact of product quality on export flows.

$$EF_{ft} = \alpha_0 + \alpha_1 PQ_{ft} + \alpha_2 FC_{ft} + \mu_i + \lambda_t + e_{i,t} \qquad (1)$$

Furthermore, the impact of three moderators is incorporated.

Role of Financial Constraints

The financial constraints and their interaction term are used in the model as follows.

$$EF_{ft} = \beta_0 + \beta_1 PQ_{ft} + \beta_2 FC_{ft} + \beta_3 \sum(PQ_{ft} * FC_{ft}) + \acute{\beta}_4 z_{2t} + \mu_i + \lambda_t + e_{i,t} \qquad (2)$$

Where, FC_{ft} is a financial constraint for firms, and β_3 represents its interconnection term with product quality. The term of $\frac{\partial EF_{ft}}{\partial PQ_{ft}} = \beta_1 + \beta_3 FC_{ft}$ shows the change in trade flow due to a change in product quality.

Role of Firm Heterogeneity

To analyze the impact of firm heterogeneity on product quality on trade flows, its interaction term is included which takes the following form.

$$tf_{i,t} = \gamma_0 + \gamma_1 tf_{i,t-1} + \gamma_2 q_{i,t} + \gamma_3 fh_{i,t} + \gamma_4 \sum(q_{i,t}*fh_{i,t}) + control_{i,t} + e_{i,t} \qquad (3)$$

Where FH_{ft} is firm heterogeneity and γ_3 represents its interconnection term with product quality. The term of $\frac{\partial EF_{ft}}{\partial PQ_{ft}} = \gamma_1 + \gamma_3 FH_{ft}$ explains the effect of firm heterogeneity on product quality.

Role of Research and Development Activities

The impact of R & D activities on product quality and trade flows is examined as follows:

$$EF_{ft} = \varphi_0 + \varphi_1 PQ_{ft} + \varphi_2 RD_{ft} + \varphi_3 \sum(PQ_{ft} * RD_{ft}) + \acute{\varphi}_4 z_{4t} + \mu_i + \lambda_t + e_{i,t} \qquad tf_{i,t} = \sigma_0 + \sigma_1 tf_{i,t-1} + \sigma_2 q_{i,t} + \sigma_3 rd_{i,t} + \sigma_4 \sum(q_{i,t}*rd_{i,t}) + control_{i,t} + e_{2t} \qquad (4)$$

Where RD_{ft} is research and development activities and φ_3 represent its interconnection term with product quality. This term $\frac{\partial EF_{ft}}{\partial PQ_{ft}} = \varphi_1 + \varphi_3 RD_{ft}$ describes the magnitude and direction of the relationship of R&D with the export flow and product quality.

Descriptions of Variables and Data Source

The source of data for this study is annual reports of financial statements of non-financial firms that are listed on the Pakistan Stock Exchange (PSX) from 1999 to 2020. The data sources for other country-level variables are the Pakistan Bureau of Statistics, World Development Indices, and the Pakistan Economic Survey. The Random Effect and Fixed Effect techniques are used to estimate the objective of the study. Table 1 presents the definition and construction of the variables under consideration.

Table 1. List of variables and sources.

Dependent Variable	Product Quality	Author's construction using the methodology of Manova and Yu (2017)
Independent variables	Export Flow	Annual Financial Statements of the Pakistan Stock Exchange (PSX)
	Financial Constraints	The financial constraints examined through KZ (1997), WW (2006), and SA (2010)
	Firm Heterogeneity	used proxy as size and leverage
	R&D Activities	used the proxy as intangible assets and patents at the firm level
Control variables	Foreign Direct Investment Trade Flow	World Development Indicators (WDI)
	Total Assets	Annual Financial Statements of the Pakistan Stock Exchange (PSX)

RESULTS AND DISCUSSION

In this section, the role of different moderators in the relationship between product quality and export flow is examined. These variables are used to check the significance and strength of the relationship between the two variables. Three moderators [3], namely, firm heterogeneity, R&D activities, and financial constraints are taken. Table 2 shows the summary statistics of the role of moderators in product quality and export flow.

Table 2. Summary statistics of the role of moderators.

Variables	No. of obs.	Mean	St. Dev.	Min	Max	p25	p50 (Median)	p75
PQ_{ft}	6877	60.4589	12.5936	0	100	53	60	68
EF_{ft}	3195	20.5574	43.0511	0.0159	42.9334	94.7516	108.1360	197.9070
FH_{ft}	6827	6.2028	0.8929	1.4149	8.8237	5.6810	6.1988	6.7713
FC_{ft}	2487	-60.5279	25.4148	-76.0327	272.1714	-435.090	-150.2848	-483.4318
RD_{ft}	6827	0.4996	0.9997	-47.4285	57.0242	0.3759	0.500	0.6479
FDI_t	7380	-19.1405	14.8651	-54.9200	-297.0000	-23.5550	-17.0300	-78.8500
TF_t	5535	5.9071	2.0510	1.63	8.6808	4.4775	5.9725	7.9791
TA_{ft}	6783	9.3977	4.7903	0	100	8	8	9

Note: Here, FH is firm heterogeneity, FC Is for financial constraints, and RD is for Research and development activities.

Table 3 describes the mean, median, minimum value, and maximum value. The percentile values explain the low (25th), medium (50th), and high (75th) level of variables. The values of the standard deviation form FH_{ft}, FC_{ft} and RD_{ft} are minimum, which implies that these variables are less volatile. The variables of PQ and TA are normalized. Table 3 provides a correlation matrix of product quality and trade flow in the presence of the moderator's effect.

Table 3 explains the correlation of moderators: firm heterogeneity, financial constraints, and R&D activities. It is found that there are positive relationships between all variables except FC_{ft} which negatively affects the remaining variables. If a firm has financial constraints, it discourages improvement of the product quality and export flow. Figure 1 plots the effect of moderators on export flow. The horizontal axis measures the role of different moderators of analysis like firm heterogeneity, financial

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[3] Baron and Kenny (1986) is the first one who introduces the concept of moderators and mediators variables.

constraints, R&D activities and while the vertical axis labels the variable product export flow.

Panel (a) shows that there is a positive relationship between firm heterogeneity and export flow. The heterogeneous firms are more likely to increase the export flow. Firms are heterogeneous in terms of size, sales, and productivity. As the sales of the firm increase, the firm can enter and sell its product into the export market (Bai et al., 2017; Gervais, 2015). Panel (b) explains the negative correlation between financial constraints and export flow. Financial constraints are hurdles faced by the firm in operating a business. If constraints are high, then the firm is unable to extend its business to the domestic and foreign markets(Chaney, 2016; Choi, 2018). Panel (c) indicates that R&D activities are positively affecting the export flow. The firm is involved more in R&D activities and has quick and easy access to new ideas and knowledge. Such firms are more likely to enter a foreign market (Castillejo et al., 2006; Klette and Griliches, 2000). After descriptive and graphical analysis, the role of all three moderators is investigated in detail. The fixed-effect model is used to examine the role of moderators. Based on the result of the Hausman test [4], it is decided that the fixed effect is a more appropriate estimation technique for this study.

Table 3. Correlation matrix of the moderators.

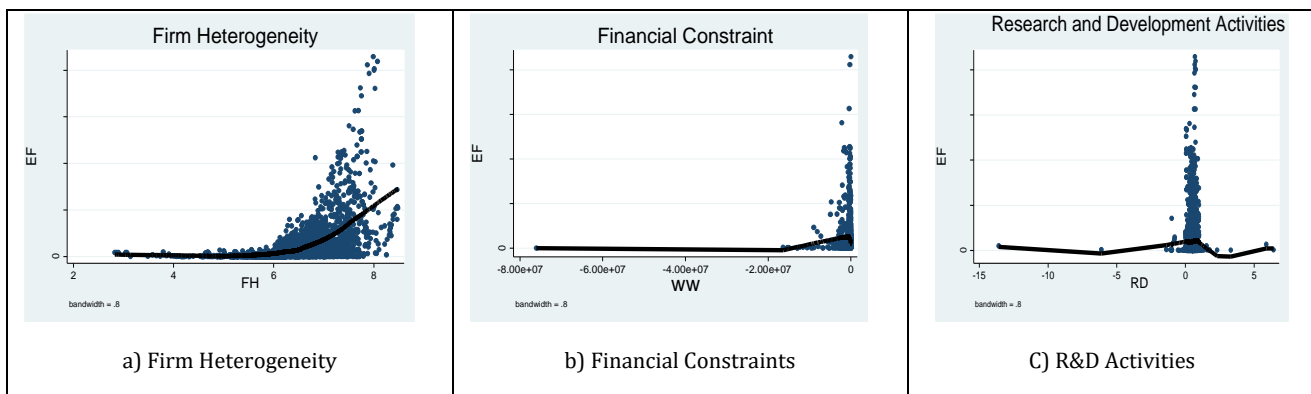| Variables	PQ_{ft}	EF_{ft}	FH_{ft}	FC_{ft}	RD_{ft}	FDI_t	TF_t	TA_{ft}
PQ_{ft}	1.0000							
EF_{ft}	0.2825	1.0000						
FH_{ft}	0.4557	0.4374	1.0000					
FC_{ft}	-0.0574	-0.0079	-0.0479	1.0000				
RD_{ft}	0.0483	0.0311	0.1480	-0.0740	1.0000			
FDI_t	-0.0103	0.0723	-0.0543	-0.0051	-0.0670	1.0000		
TF_t	-0.0059	-0.0346	-0.0086	0.0345	0.0391	-0.3835	1.0000	
TA_{ft}	0.4511	0.4093	0.6324	-0.1628	0.0703	0.0075	-0.0543	1.0000

Figure 1: Scatter plots for the moderators.

Role of Financial Constraints

Firstly, the role of financial constraint as a moderator is explained. Three indices are commonly used to measure financial constraints: that are KZ index, the WW index, and the SA index, which are constructed with the combination of different financial variables on the firm side. All financial constraints are estimated indices as KZ, SA, and WW. In the context of Pakistan's firms, only the Whited (2006) model is a more suitable measure to analyze the effect of financial constraints (Qasim et al., 2021; Rashid and Ashfaq, 2017). Whited (2006) index is specifically used to explain the characteristics of financial constraints. This index is constructed with the cash flow, total assets, long-term debt, sale growth, and industry growth. A firm with a high WW index means that more financially constrained firms are categorized with low dividends, low cash flow, low total assets, high leverage, low firm growth, and high industry sales growth.

Table 4(a) explains the coefficient of financial constraint (WW index), which is estimated for equation (2). The findings of the Hausman test explained that the fixed-effect model is more appropriate. Results indicate that the coefficients of and are positive and negative, respectively but are statistically significant. It means that PQ_{ft} (12.0224) forms a direct significant relationship with the export flow. However, the negative coefficient of FC_{ft} (-0.0473) shows that financially constrained firms are unable to enter the export market. These firms do not have enough resources to finance the production of a high-quality product and, hence, are unable to compete in the international market. Our results are in line with the study of Manova (2013), Hericourt and Poncet (2015), and Akram and Rashid (2018). However, when an interaction term is included in the model, the value of PQ ft (13.0224) increases, whereas the value of FC_{ft} (-

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[4] Hausman Test | 18.62***(0.000)

1.8009) decreases but remains significant. Hence, the interaction term ($PQ_{ft}*FC_{ft}$) enters the model positively (0.0278) and is statistically significant, which is complementarily between product quality and financial constraints [5].

Table 4(a). Role of financial constraints in product quality- trade flow nexus.

Variables	Fixed Effect Model	
PQ_{ft}	12.0224***	13.6754***
	(0.000)	(0.000)
FC_{ft}	-0.0473*	-1.8009**
	(0.022)	(0.005)
$PQ_{ft}*FC_{ft}$	-	0.0278**
		(0.012)
FDI_t	0.0197***	0.0192**
	(0.002)	(0.006)
TF_t	4.9407**	4.9107**
	(0.035)	(0.034)
TA_{ft}	44.6746*	45.0519*
	(0.096)	(0.089)
$Cons$	-1.1207***	1.1227***
	(0.000)	(0.000)
$Obs.$	1208	1208
$R\ Squared$	0.20	0.20
$No.\ of\ Firms$	184	184
$F.Stat.$	14.80***	13.74***
	(0.000)	(0.000)

Note: ***, **,*are 1%, 5%, and 10% levels of significance respectively.

The interaction term ($PQ_{ft}*FC_{ft}$) stands significant which implies that financial constraints play a moderator role in the relationship between the export flow and product quality. The interpretation will be accordingly provided with $FC_{ft}=0$ a one-unit increase in product quality, the expected value of export flow increases by 13.67 units while the value of $FC_{ft}=1$, while with a one-unit increase in *product quality*, the expected value of export flow increases by 0.0278 units. At the two different levels of financial constraints, there are two straight lines with different slopes. The parallel lines have the same slopes in the case of interaction effects telling no evidence for interaction effects. Interestingly, in this case, at the two levels of financial constraints, two straight lines were found with different slopes (13.67 and 0.0278), which verifies non-parallel lines. From the perspective of our problem, these lines indicate that the scale of the direct relationship between product quality and export flow depends on the level of financial constraints. The role of financial constraints in adjusting the export flow with product quality has not been previously analyzed in such a manner.
Next, the conditional effect of financial constraints is examined at low, medium, and high levels of financial constraints. The results of the conditional effect are presented in Table 4(b), which reveals that financial constraints are negative and significantly affect the export flow at low (25th), medium (50th), and high (75th) levels. However, the value of the coefficient is decreased as the level of financial constraints increases from low (-8.5569), medium (-9.8856), and high (-10.3612) levels. This indicates that the export flow of a firm decreases as the level of financial constraints increases from low, medium, and high levels.

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[5] Percentile Coefficients of Financial Constraints

Variable	N	p25	p50	p75
FC_{ft}	2487	-435090	-150284.8	-48343.18

Table 4(b). Conditional effects of financial constraints on export flow.

FC_{ft}	Coef	Z test	p − value
P Low	-8.5569***	3.69	(0.000)
P Medium	-9.8856***	4.40	(0.000)
P High	-10.3612***	4.61	(0.000)

Notes: ***, **,*are 1, 5, and 10 percent levels of significance respectively. P-low, P-high, and P-medium are the 25th, 50th, and 75th percentiles respectively.

Our results are consistent with previous empirical insights from Dinopoulos and Unel's (2011) example. These studies argued that a firm's export capacity decreases with the deepening of financial constraints. Findings reveal that financial constraints play a significant role as a moderator for the relationship between export flow and product quality. Hence, the final remark extracted from the result is that financial constraint plays the role of moderator in the relationship between product quality and export flow.

Role of Firm Heterogeneity
This section aims to analyze the role of our second moderator which is firm heterogeneity, in the product quality-trade flow nexus. The firm size is used as a proxy for firm heterogeneity (Cole et al., 2010; Helpman et al., 2008; Qureshi and Yousaf, 2014). Table 5(a) reports the estimated results of our empirical model (3). Findings reveal that the coefficients of both the PQ_{ft} (11.3224) and FH_{ft}(3.4475) are positive and statistically significant, which implies that the more the firm heterogeneity in its products the more would be exported. As the firm size increases, that firm can turn its sales toward the international market. These outcomes are similar to the result of the descriptive and graphical analysis investigated earlier. The coefficients of PQ_{ft} (34.26) and FH_{ft}(9.79) increases when the interaction term is incorporated into the model, and, the coefficient of the interaction term $PQ_{ft}*FH_{ft}$ (-16.1415) is negative and statistically significant. This reveals the substitutability of the independent variable PQ_{ft} and moderating variable FH_{ft}.

Table 5(a). Role of firm heterogeneity.

Variables	Fixed Effect Model	
PQ_{ft}	11.3224***	34.2637***
	(0.000)	(0.004)
FH_{ft}	3.4475**	9.7984**
	(0.018)	(0.024)
$PQ_{ft}*FH_{ft}$	-	-16.1415**
		(0.046)
FDI_t	0.0187***	0.0202***
	(0.000)	(0.000)
TF_t	71.6947***	66.7200***
	(0.003)	(0.004)
TA_{ft}	8.5307**	8.807**
	(0.007)	(0.005)
$Cons$	-1.4307***	-2.8407***
	(0.000)	(0.000)
$Obs.$	2709	2709
$R\ Squared$	0.26	0.28
$No.\ of\ Firms$	242	242
$F.Stat.$	13.35***	10.54***
	(0.000)	(0.000)

Notes Same as mentioned in Table 5 (a).

The interaction term ($PQ_{ft} * FH_{ft}$) stands significant which implies that firm heterogeneity plays a moderator role in the relationship between the export flow and product quality. The interpretation will be accordingly provided FH_{ft}=0 which implies that with a one-unit increase in product quality, the expected value of export flow increases by 34.26 units. Whereas the value FH_{ft} =1 indicates a *one-unit increase in* product quality, the expected value of export flow decreases by (-16.14) units. At the two different levels of firm heterogeneity, two straight lines have different slopes. The parallel lines have the same slopes in the case of interaction effects, which provide evidence for no interaction effects. Interestingly, in this case, at the two levels of firm heterogeneity, two straight lines are found with different slopes (34.26 and -16.14), which confirms that the lines are not parallel. In the context of our problem, these non-parallel straight lines indicate that the magnitude of the positive relationship between product quality and export flow depends on the level of firm heterogeneity. The role of firm heterogeneity in an adjustment of the export flow with product quality has not been previously analyzed in such a manner.

Furthermore, the conditional effect of firm heterogeneity is examined at a low, medium, and high level. Results presented in Table 5(b) show that is positive and significant relationship exists at low (25th), medium (50th), and high (75th) levels of firm heterogeneity; however, the value of the coefficients is decreased as the level of firm heterogeneity increases from low (11.41), medium (10.15), and high (8.73) levels. By comparing these coefficients, it is highest for the low level of firm heterogeneity, and the lowest for the highest level of heterogeneity is positive and significant, but the coefficient is decreased. This indicates that the export flow of a firm increases as the level of firm heterogeneity increases from low, medium, and high levels but with decreasing magnitude[6].

Table 5(b). Conditional effects of firm heterogeneity on export flow.

FH_{ft}	Coef	Z test	p − value
P Low	11.4125***	4.42	0.000
P Medium	10.1581***	4.02	0.000
P High	8.7391***	3.14	0.002

Note: Same as mentioned in Table 5 (b).

Our results are consistent with the received studies on the subject by Helpman et al. (2004)and Yeaple (2005). These studies came with the findings that firm heterogeneity poses a positive impact on export flow. The estimated results concluded that firm heterogeneity plays a positive and significant role as a moderator in the relationship between export flow and product quality.

The Role of Research and Development Activities

The R&D activities are taken as one of the moderators in this study. In this context, it is hypothesized that more expenditures on R&D activities lead to high and fast economic growth and quality production. The most commonly used proxy for a firm's R&D is intangible assets and patents (Ukpabio and Siyanbola, 2017); hence, the intangible assets are taken as the proxy of R&D activities. Table 6(a) shows the estimated results of our empirical model (Equation 4). The result shows that the coefficient of PQ_{ft} (11.5031) and RD $_{ft}$ (9.8412) are positive, which is statistically

significant. Results indicate that both variables, product quality and R&D activities have a direct significant impact on export flow. Next, the interaction term is introduced in the model to examine the impact of R&D on the dependent variable (Export Flow). The coefficients also increased PQ_{ft} (12.1416) and RD_{ft} (11.56) and remain significant. However, the coefficient for the interaction term product quality and R&D activities ($PQ_{ft} * RD_{ft}$) is negative (-21.11) and statistically significant. This indicates that the independent variable PQ_{ft} and moderating variable RD_{ft} are substitutes for each other. This implies that both have similar characteristics and can be used as an alternative to each other.

Table 6(a). Role of R & D activities.

Variables	Fixed Effect Model	
PQ_{ft}	11.5031***	12.14160***
	(0.000)	(0.001)
RD_{ft}	9.8412**	11.5697**
	(0.038)	(0.042)
$PQ_{ft} * RD_{ft}$	----	-21.1192**
		(0.052)
FDI_t	0.0212***	0.0214***
	(0.000)	(0.000)
TF_t	81.2775***	81.5944***
	(0.000)	(0.000)
TA_{ft}	7.0607**	7.0707**
	(0.005)	(0.005)
Cons	-1.3807***	-1.4307***
	(0.000)	(0.000)
Obs.	3101	3101
R Squared	0.22	0.24
No. of Firms	258	258
F. Stat.	74.48***	12.43***
	(0.000)	(0.000)

Note: Same as mentioned in Table 5 (a).

The interaction term PQ_{ft}*RD_{ft} stands significant which implies that R&D activities play a moderator role in the relationship between the export flow and product quality. The interpretation will be accordingly provided RD_{ft}=0 which implies that with a one unit increase in product quality, the expected value of export flow increases by 12.14 units. Whereas the value of RD_{ft} = 1, indicates a one unit increase in product quality, the expected value of export flow decreases by 11.56 units. At the two different levels of R&D activities, there were two straight lines with different slopes. Interestingly, in this case, there are two straight lines with different slopes (12.14 and 11.56), which confirms that the lines are not parallel. In the context of our problem, these non-parallel straight lines indicate that the magnitude of the positive relationship between product quality and export flow depends on the level of R&D activities. The role of R&D activities in the adjustment of the export flow with product quality has not been previously analyzed in such a manner[7].

Next, the conditional effect of R&D is investigated at a low, medium, and high level. The results are reported in Table 6(b), which shows that is positive and significant relationship exists at allow (25th), medium (50th), and high (75th) levels of R&D activities. The result depicts that all levels of R&D activities have a positive and significant effect on export flows; however, its effects decrease with an increase in its level. Consequently, the conditional effect of R&D expenditures at a low (11.39), medium (11.24), and high level (10.73) have a positive and highly

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[6] Percentile Coefficients of Firm Heterogeneity

Variable	N	p25	p50	p75
FH_{ft}	6173	13.12743	14.15285	15.30882

[7] Percentile coefficients of R&D Activities

Variable	N	p25	p50	p75
RD_{ft}	5145	13686	79717.04	309976

significant impact on export flow, but the estimated coefficient decreases as the level of the moderator is increased.

Table 6(b). Conditional effects of R & D activities on export flow.

RD_{ft}	Coef	Z test	$p-value$
P_{Low}	11.3973***	3.51	0.000
P_{Medium}	11.2498***	3.43	0.001
P_{High}	10.7357***	3.18	0.001

Note: Same as mentioned in Table 5 (b).

Our results are consistent with the studies of Crinò and Epifani (2012) and Bento (2016), which stated that export flow increases with an increase in R&D activities. The conclusion that can be drawn from the findings is that firm R&D activities play a moderator role in the relationship between product quality and export flow.

CONCLUSIONS AND POLICY RECOMMENDATIONS

Product quality plays a significant role in determining the export flow of a country. Firms that produce high-quality products should reap the potential gain from both domestic and international markets. This study examined the role of moderators in the relationship between product quality and export flow at the firm level. Three moderators are considered, namely, financial constraints, firm heterogeneity, and R&D activities. The findings reveal that financial constraints are hurdles in the process of improvement in the firm's product quality, as a moderator, it holds a negative sign that is statistically significant. In contrast, the estimates of our second moderator firm heterogeneity hold a positive and significant role in explaining the relationship between product quality and export flow. The R&D activities also play an important role in determining the link between export flow and product quality, as it holds a positive sign, which is statistically significant. Future studies can be done by the addition of other moderators to the link between export flow and product quality is a novel area of research.

REFERENCES

Ahmed, V., Shabbir, S. 2016. Trade & Transit Cooperation with Afghanistan: Results from a Firm-level survey from Pakistan. Sustainable Development Policy Institute. https://sdpi.org/sdpiweb/publications/files/Trade&Transit_Cooperation_with_Afghanistan_Results_from_a_Firm-level_survey_from_Pakistan_W-153.pdf.

Akram, M., Rashid, A., 2018. Financial turmoil, external finance and UK exports. J. Econ. Financ. 42, 651–681.

Alcalá, F., 2016. Specialization across goods and export quality. J. Int. Econ. 98, 216–232.

Amiti, M., Khandelwal, A.K., 2013. Import competition and quality upgrading. Rev. Econ. Stat. 95, 476–490.

Antoniades, A., 2015. Heterogeneous firms, quality, and trade. J. Int. Econ. 95, 263–273.

Bağır, Y., Seven, Ü., 2021. Financial constraints and productivity growth: firm-level evidence from a large emerging economy: Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Bai, X., Krishna, K., Ma, H., 2017. How you export matters: Export mode, learning and productivity in China. J. Int. Econ. 104, 122–137.

Baldwin, R., Krugman, P., 1989. Persistent trade effects of large exchange rate shocks. Q. J. Econ. 104, 635–654.

Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: Conceptual,

strategic, and statistical considerations. J. Pers. Soc. Psychol. 51, 1173.

Bas, M., Berthou, A., 2021. Financial development, reallocation and growth: Firm heterogeneity matters. World Econ. 44, 1205–1231.

Bayoumi, T., Coe, D.T., Helpman, E., 1999. R&D spillovers and global growth. J. Int. Econ. 47, 399–428.

Bento, A.R., 2016. Determinants of Firms' R&D Investment Decisions: A Cross Country Study. https://core.ac.uk/download/pdf/143409513.pdf.

Bernard, A.B., Jensen, J.B., Redding, S.J., Schott, P.K., 2007. Firms in international trade. J. Econ. Perspect. 21, 105–130.

Bhatti, A., Haque, M.E., Osborn, D.R., 2013. Is the Growth Effect of Financial Development Conditional on Technological Innovation? CGBCR Discussion Paper Series, Number 188, Available at http://dx.doi.org/10.2139/ssrn.2371637.

Brinatti, A., Morales, N., 2021. Firm Heterogeneity and the Impact of Immigration: Evidence from German Establishments. Available at: SSRN: https://ssrn.com/abstract=3881995 or http://dx.doi.org/10.2139/ssrn.3881995.

Cadot, O., Gourdon, J., Van Tongeren, F., 2018. Estimating ad valorem equivalents of non-tariff measures: Combining price-based and quantity-based approaches. OECD Trade Policy Papers. https://doi.org/10.1787/f3cd5bdc-en.

Can, M., Ahmed, Z., Ahmad, M., Oluc, I., Guzel, I., 2023. The role of export quality in energy–growth nexus: evidence from newly industrialized countries. J. Knowl. Econ. 14, 2811–2829.

Cassiman, B., Golovko, E., Martínez-Ros, E., 2010. Innovation, exports and productivity. Int. J. Ind. Organ. 28, 372–376.

Castillejo, J.A.M., Barrachina, M.E.R., Llopis, A.S., Llopis, J.A.S., 2006. The decision to invest in R&D: a panel data analysis for Spanish manufacturing. Int. J. Appl. Econ. 3, 80–94.

Chaney, T., 2016. Liquidity constrained exporters. J. Econ. Dyn. Control 72, 141–154.

Chen, N., Juvenal, L., 2016. Quality, trade, and exchange rate pass-through. J. Int. Econ. 100, 61–80.

Choi, B., 2020. Financial development, endogenous dependence on external financing, and trade. Economica, 87, 530-587.

Chung, J.H., 2019. Firm heterogeneity, misallocation, and trade. Auburn University, Department of Economics. https://web.stanford.edu/~chungjh/Jonghyun_Chung_JMP.pdf.

Ciani, A., Bartoli, F., 2015. Export quality upgrading under credit constraints: DICE Discussion Paper. https://www.econstor.eu/handle/10419/112742.

Claessens, S., Laeven, L., 2003. Financial development, property rights, and growth. J. Finance 58, 2401–2436.

Cole, M.A., Elliott, R.J.R., Virakul, S., 2010. Firm heterogeneity, origin of ownership and export participation. World Econ. 33, 264–291.

Crinò, R., Epifani, P., 2012. Productivity, quality and export behaviour. Econ. J. 122, 1206–1243.

Crino, R., Ogliari, L., 2015. Financial Frictions, Product Quality, and International Trade. CEPR Discussion Paper No. DP10555, Available at SSRN: https://ssrn.com/abstract=2599527.

Curzi, D., Olper, A., 2012. Export behavior of Italian food firms: does product quality matter? Food Policy 37, 493–503.

de Guevara, J.F., Maudos, J., Salvador, C., 2021. Effects of the degree of financial constraint and excessive indebtedness on firms' investment decisions. J. Int. Money Financ. 110, 102288.

Dinopoulos, E., Unel, B., 2011. Quality heterogeneity and global economic growth. Eur. Econ. Rev. 55, 595–612.

Fan, H., Lai, E.L.-C., Li, Y.A., 2015. Credit constraints, quality, and export prices: Theory and evidence from China. J. Comp. Econ. 43, 390–416.

Ferrari, A., Queirós, F., 2022. Firm heterogeneity, market power and macroeconomic fragility. Available at: SSRN: https://ssrn.com/abstract=3466783 or http://dx.doi.org/10.2139/ssrn.3466783.

Ferro, E., Otsuki, T., Wilson, J.S., 2015. The effect of product standards on agricultural exports. Food Policy 50, 68–79.

Frankel, J.A., Romer, D.H., 1999. Does trade cause growth? Am. Econ. Rev. 89, 379-399.

Gervais, A., 2015. Product quality and firm heterogeneity in international trade. Can. J. Econ. Can. d'économique 48, 1152–1174.

Ghani, M.R.A., 2020. The relationship between product quality, e-service quality and brand image on customer satisfaction: Preliminary investigation in Perlis. Int. J. Bus. Manag. 4, 43–54.

Greenaway, D., Guariglia, A., Kneller, R., 2007. Financial factors and exporting decisions. J. Int. Econ. 73, 377-395.

Griliches, Z., Mairesse, J., 2007. R&D and Productivity Growth: Comparing Japanese and US Manufacturing Firms: University of Chicago Press.

Habib, A., Costa, M.D., Jia, J., 2021. Determinants and consequences of financial constraints: a review of the empirical literature. https://hdl.handle.net/102.100.100/551319.

Hall, B.H., Lerner, J. 2010. The financing of R&D and innovation Handbook of the Economics of Innovation (Vol. 1, pp. 609-639): Elsevier. https://doi.org/10.1016/S0169-7218(10)01014-2.

Hallak, J.C., Sivadasan, J., 2013. Product and process productivity: Implications for quality choice and conditional exporter premia. J. Int. Econ. 91, 53–67.

He, D., Wang, Y., You, K., 2023. Market entry and the dynamics of export product quality: Evidence from Chinese manufacturing firms. Econ. Anal. Policy 78, 692-706.

Helpman, E., Melitz, M., Rubinstein, Y., 2008. Estimating trade flows: Trading partners and trading volumes. Q. J. Econ. 123, 441–487.

Helpman, E., Melitz, M.J., Yeaple, S.R., 2004. Export versus FDI with heterogeneous firms. Am. Econ. Rev. 94, 300–316.

Héricourt, J., Poncet, S., 2015. Exchange rate volatility, financial constraints, and trade: Empirical evidence from Chinese firms. World Bank Econ. Rev. 29, 550–578.

Hu, C., Lin, F., 2016. Product standards and export quality: Micro evidence from China. Econ. Lett. 145, 274–277.

Khan, J., Khattak, N.U., 2014. The significance of research and development for economic growth: The case of Pakistan. https://mpra.ub.uni-muenchen.de/id/eprint/56005.

Khan, T.S., 2006. Productivity growth, technological convergence, R&D, trade, and labor markets: Evidence from the French manufacturing sector. IMF Working Paper No. 06/230, Available at SSRN: https://ssrn.com/abstract=941292.

Khandelwal, A., 2010. The long and short (of) quality ladders. Rev. Econ. Stud. 77, 1450-1476.

Khanna, R., Sharma, C., 2018. Testing the effect of investments in IT and R&D on labour productivity: New method and evidence for Indian firms. Econ. Lett. 173, 30–34.

Klette, T.J., Griliches, Z., 2000. Empirical patterns of firm growth and R&D investment: a quality ladder model interpretation. Econ. J. 110, 363–387.

Klette, T.J., Møen, J. Griliches, Z., 2000. Do subsidies to commercial R&D reduce market failures? Microeconometric evaluation studies. Res. Policy 29, 471-495.

Kletzer, K., Bardhan, P., 1987. Credit markets and patterns of international trade. J. Dev. Econ. 27, 57–70.

Kong, D., Xiong, M., 2021. Unintended consequences of tax incentives on export product quality: Evidence from a natural experiment in China. Rev. Int. Econ. 29, 802–837.

Liu, L., He, K., Qiao, Y., Fu, P., Meng, Q., 2023. Entrepreneurship and Export Product Quality Improvement. Sustainability 15, 12315.

Manova, K., 2013. Credit constraints, heterogeneous firms, and international trade. Rev. Econ. Stud. 80, 711–744.

Manova, K., Yu, Z., 2017. Multi-product firms and product quality. J. Int. Econ. 109, 116-137.

Martin, J., Mejean, I., 2014. Low-wage country competition and the quality content of high-wage country exports. J. Int. Econ. 93, 140–152.

Melitz, M.J., Redding, S.J., 2015. New trade models, new welfare implications. Am. Econ. Rev. 105, 1105–1146.

Mendi, P., 2007. Trade in disembodied technology and total factor productivity in OECD countries. Res. Policy 36, 121–133.

Piveteau, P., Smagghue, G., 2017. The Impact of Chinese Competition along the Quality Ladder (No. 509). Society for Economic Dynamics. https://www.freit.org/EIIT/2017/selected/piveteau.pdf.

Qasim, S., Rizov, M., Zhang, X., 2021. Financial constraints and the export decision of Pakistani firms. Int. J. Financ. Econ. 26, 4557–4573.

Qureshi, M.A., Yousaf, M., 2014. Determinants of profit heterogeneity at firm level: evidence from Pakistan. Int. J. Commer. Manag. 24, 25–39.

Rajan, R.G., Zingales, L., 2003. The great reversals: the politics of financial development in the twentieth century. J. financ. econ. 69, 5–50.

Rashid, A., Ahmad, F., 2018. Financial Development, Innovation, and Economic Growth: The Case of Selected Asian Countries. Kashmir Econ. Rev. 27, 1750009.

Rashid, A., Ashfaq, M., 2017. Financial constraints and corporate cash holdings: an empirical analysis using firm level data. Ann. Financ. Econ. 12, 1750009.

Rashid, A., Muneeb, A., Karim, M., 2021. The exports–exchange rate volatility nexus in Pakistan: do financial constraints and financial development matter? Int. J. Emerg. Mark. ahead-of-p. https://doi.org/10.1108/IJOEM-04-2020-0348

Ricardo, D., 2017. On foreign trade 200 Years of Ricardian Trade Theory (pp. 233-268): Springer. https://link.springer.com/chapter/10.1007/978-3-319-60606-4_20.

Romer, P.M., 1994. The origins of endogenous growth. J. Econ. Perspect. 8, 3–22.

Saeed, A., Sameer, M., 2015. Business groups and financial constraints: evidence from Pakistani group affiliated firms. J. Dev. Areas 355–361.

Saleem, H., Shahzad, M., Khan, M.B., Khilji, B.A., 2019. Innovation, total factor productivity and economic growth in Pakistan: a policy perspective. J. Econ. Struct. 8, 1–18.

Satpathy, L.D., Chatterjee, B., Mahakud, J., 2017. Firm characteristics and total factor productivity: Evidence from Indian manufacturing firms. Margin J. Appl. Econ. Res. 11, 77–98.

Scherer, F.M., 1982. Inter-industry technology flows and productivity growth. Rev. Econ. Stat. 627–634.

Schmeiser, K.N., 2012. Learning to export: Export growth and the destination decision of firms. J. Int. Econ. 87, 89–97.

Schmitz, H., Knorringa, P., 2000. Learning from global buyers. J. Dev. Stud. 37, 177–205.

Schumpeter, J.A., 2013. Capitalism, socialism and democracy. Routledge, UK.

Sheikh, N.A., Wang, Z., 2010. Financing behavior of textile firms in Pakistan. Int. J. Innov. Manag. Technol. 1, 130.

Silva, F., Carreira, C., 2012. Measuring firms financial constraints: a rough guide. Notas Económicas.36.

Smith, A., 1937. The wealth of nations [1776] (Vol. 11937). https://bxscience.edu/ourpages/auto/2018/10/23/5489 4030/Adam%20Smith%20Excerpt%20Student%20%20co py%20_1_.pdf.

Solow, R.M., 1956. A contribution to the theory of economic growth. Q. J. Econ. 70, 65-94.

Sun, J., 2021. Do Higher-Quality Regional Trade Agreements Improve the Quality of Export Products from China to "One-Belt One-Road" Countries? Asian Econ. J. 35, 142–165.

Sutton, J. 2001. Technology and market structure: theory and history. MIT press.

Thatcher, M.E., Oliver, J.R., 2001. The impact of technology investments on a firm's production efficiency, product quality, and productivity. J. Manag. Inf. Syst. 18, 17–45.

Timoshenko, O.A., 2015. Product switching in a model of learning. J. Int. Econ. 95, 233–249.

Ukpabio, M., Siyanbola., 2017. Technological innovation and performance of manufacturing firms in Nigeria. Int. J. Innov. Res. Adv. Stud. 4, 10–19.

Wadho, W., Chaudhry, A., 2018. Innovation and firm performance in developing countries: The case of Pakistani textile and apparel manufacturers. Res. Policy 47, 1283–1294.

Wakelin, K., 2001. Productivity growth and R&D expenditure in UK manufacturing firms. Res. Policy 30, 1079–1090.

Whited, T.M., 2006. External finance constraints and the intertemporal pattern of intermittent investment. J. Financ. Econ. 81, 467–502.

Wong, Z., Chen, A., Taghizadeh-Hesary, F., Li, R., Kong, Q., 2023. Financing constraints and Firm's productivity under the COVID-19 epidemic shock: evidence of A-shared Chinese companies. Eur. J. Dev. Res. 35, 167–195.

Xiong, B., Beghin, J., 2014. Disentangling demand-enhancing and trade-cost effects of maximum residue regulations. Econ. Inq. 52, 1190–1203.

Yeaple, S.R., 2005. A simple model of firm heterogeneity, international trade, and wages. J. Int. Econ. 65, 1–20.

Yeo, A.D., Deng, A., 2019. The trade policy effect in international trade: case of Pakistan. J. Econ. Struct. 8, 43.

Zhang, D., 2022. Environmental regulation, green innovation, and export product quality: What is the role of greenwashing? Int. Rev. Financ. Anal. 83, 102311.

Zhang, H., Liu, Q., Wei, Y., 2023. Digital product imports and export product quality: Firm-level evidence from China. China Econ. Rev. 79, 101981.