Export Quality and International Trade: A Theoretical and an Empirical Analysis

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Abstract

This study explores the impact of export quality on the exports of a developing and a developed country. I developed a theoretical framework, using the two-country oligopolistic model with quality differentials in product. I find that enhancing export quality improves export performance of a country but it reduces domestic trade under certain conditions. I then test the theoretical findings empirically, using annual inter-country and intra-country trade data for 142 countries from 1963 – 2014 and by applying the gravity model of trade. I also use IMF's Export Quality Index and Unit Value of exports to estimate a two-stage gravity model to examine the effects of producer prices and exports quality on both exports and domestic trade. My empirical findings are consistent with my theoretical predictions. The empirical findings suggest that quality has a positive impact on international trade and a 1% increase in quality leads to an increase in total exports by 1.08%. A 1% increase in quality leads to a fall in intranational trade by 2.69%. The effect of improving export quality on the exports is more pronounced for OECD countries than the non-OECD countries. This study also discusses the policy measures that developing countries should take to compete effectively in the international market and break the cycle of over reliance on low quality export goods and achieve higher economic growth.

JEL Classifications: F10, F14, H20

Keywords: Export Quality, International Trade, Domestic Trade, OECD

1 Introduction

The importance of quality as a non-price dimension of exports for fostering growth in developing countries is gaining significant attention (Acharyya and Ganguly, 2023). Improving export quality not only enhances a country's export performance but is also pivotal for economic growth, particularly in developing nations. Henn et al. (2017) provide compelling evidence of a positive correlation between high-quality exports and economic development. They argue that higher quality varieties of existing goods contribute to improving comparative advantages, increasing productivity, and boosting revenues. Sutton and Trefler (2011), find that between 1980 and 2005 low-income countries (LICs) have moved into more "sophisticated" products that were predominantly produced by rich countries. However, within in these industries LICs are producing low-quality products due to which the diversification has not led to a big boost in GDP per capita (Henn et al., 2017).

Many studies have pointed out the importance of economic growth not just depends on the type of a product that they export but also on the quality (Hausmann et al., 2007, Hallak and Schott 2011, Henn et al. 2017) and that rich countries export and consume high quality products (Linder, 1961, Hallak, 2006). Schott (2004), Hallak (2006) and Hummels and Klenow (2005) used unit values as a proxy for product quality. Unit values may not be an accurate predictor of export quality as they can be driven by production costs differences hence, Khandelwal (2010) used price and market share as a measure of quality to account for both horizontal and vertical product differentiation in the United States using the data for HS10 level products. Using bilateral trade data for 166 countries over 1962 – 2014 and modifying Hallak's (2006) approach of measuring quality, Henn et al. (2017) found that quality upgrading is more rapid during the early stages of development. They focused on how liberal trade policies, FDI, institutional quality and human capital promote quality upgrading across various sectors of the economy though their impact varies by sector. However, these studies did not look at the impact of improvement in export product quality on international and intranational trade both empirically and theoretically. This is the gap in the literature that my paper tries to fill. The theoretical framework developed in this study shows that an increase in quality of the high-quality good will increase the exports of both the high-quality and the low-quality good, and will reduce domestic sales. I then test the theoretical findings empirically, using a bilateral trade dataset for 142 countries from 1963 – 2014 and by applying the gravity model of trade. The empirical findings of this study also confirm that improving export quality increases international trade but reduces intranational trade.

The concept of export quality encompasses both demand and supply aspects. As incomes in developed countries have increased over the decades, consumers have become more sensitive to quality rather than price variations. They tend to prefer higher quality goods, even at a higher price, over cheaper low-quality goods (Acharyya and Ganguly, 2023). Linder's (1961) hypothesis suggests that wealthier countries allocate a higher proportion of their income to high-quality goods compared to poorer countries, making them significant producers of high-quality products. Hallak

(2006) also finds that wealthier nations tend to have a stronger demand for high-unit-value imports, which is considered an indirect measure of export quality, and they tend to import more from countries that produce high-quality goods. Schott (2004) uses cross-sectional data across countries and industries, using price as a proxy for higher quality, to conclude that wealthier and more human- and capital-abundant economies tend to export higher-quality varieties.

Many studies indicate that exporters who sell higher quality goods at premium prices tend to be more successful and productive than those selling lower-quality goods. Tian et al. (2016) conducted a study on China's agri-food exports to 213 countries and found that exporters with higher product quality can capture more demand in the international market. In the presence of heterogeneous consumers, firms often differentiate their products by offering different quality levels and adjusting prices accordingly (Acharyya and Ganguly, 2023).

There is a need to explore more about the impact of quality on exports and its contribution in economic growth of a country. Previous studies have pointed out that export quality matters to capture international market (Papageorgiou et.al., 2019). This study also reinforces this by using aggregate bilateral trade data and complimenting the dataset with intranational trade and applying a gravity model. However, this study further investigates the impact of improving export quality on domestic trade. The contribution to the literature are the unique theoretical and empirical findings of this research that show that quality only matters for international trade but not for intranational trade.

The main research question that this study addresses is; i) how improving export quality impacts international and domestic trade (of both high-quality and low-quality goods) of a developed and a developing country? The study aims to add to the literature on export quality and trade by using a relatively newer dataset on export quality by IMF which includes the export quality of most low-income countries. Second, I propose a quantitative framework to estimate the impact of improving export quality on the export performance of developing countries.

The rest of the paper is structured as follows. In Section 2, I describe the dataset and the estimation strategy that I have used for the empirical analysis. In Section 3, I present a theoretical framework. Section 4 presents the results, Section 5 concludes.

2 Empirical Evidence

2.1 Data

I use annual bilateral trade data of 142 countries over the period of 52 years starting from 1963 – 2014 which was constructed by Fouquin and Hugot (2016). This dataset was complemented with observations for intra-national trade following Baier et al. (2016) approach by taking the difference between total domestic production and total export. Data for regional trade agreements (RTA) was constructed by Head et al. (2010) and retrieved from the Centre d'tudes Prospectives et d'Informations Internationales (CEPII). The GDP data from the World Development Indicators (WDI) has been used to calculate the Linder variable. IMF's Export Quality Index and Unit Value of exports are used as a measure of quality and export prices respectively. Data for both the variables is taken from the IMF's Export Quality and Diversification dataset, constructed by Henn et al. (2018) and covers over 800 export products, 166 countries from 1963 - 2014.[1] The quality index has values between 0 -1.2 where higher values of the quality index represent higher quality levels.

Table 1: Descriptive Statistics: Summary Statistics of Variables

	Obs	Mean	SD	Min	Max
X_{ijt}	1,523,462	6.12e+08	3.35e+10	0	9.65e+12
RTA	2,579,198	0.629	0.243	0	1
Linder	1,537,265	1.709	1.254	0	7.361
lnGDP	1,690,501	22.345	2.55	15.169	29.997
lnQuality	1,250,204	-0.250	0.253	-1.999	0.111
lnPrice	2,188,072	4.245	0.521	2.51	6.419
INTD	3,367,647	0.996	0.065	0	1

2.2 Estimation Strategy

This study uses the gravity model like the one suggested by Anderson and van Wincoop (2003) and Bergstrand et al. (2015). The gravity equation derived by Anderson and van Wincoop (2003) is:

$$X_{ij} = \left(\frac{E_j Y_i}{Y_w}\right)\left(\frac{t_{ij}}{P_j \Pi_i}\right)^{1-\sigma}, \quad s > 1 \tag{1}$$

Where X_{ij} represents the value of exports from country i to country j. E_j is the total expenditure in country j. Y_i is the sales of goods by country i at destination prices. Y_w is the world output. t_{ij} is the trade cost factors on exports from country i to country j. P_j and Π_i are inward and outward multilateral resistances, respectively. s represents the elasticity of substitution between the goods.

To estimate the impact of quality on exports, I have followed Paudel and Lahiri's (2023) 2-stage regression approach to separate out the relative and absolute effects. In the first stage, the gravity equation (2) is estimated using the Poisson pseudo-maximum likelihood (PPML) method suggested by Silva and Teneyro (2006) as it caters for potential endogeneity and bias produced by heteroscedasticity, multicollinearity and serial correlation (Álvarez et al. 2018). It can also include

[1]Henn et al. (2018) used unit values at the SITC 4-digit level and then normalized them into a price index for each 2-digit "sector".

zero export values that would've been otherwise excluded if ordinary least square (OLS) was used (Francois and Manchin 2013).

$$
\begin{aligned}
X_{ijt} = \exp\Big[&\beta_0 + \beta_1 \text{RTA}_{ijt} + \beta_2 \text{Linder}_{ijt} + \beta_3 \ln(\text{Quality}_{it}) * \text{INTD}_{ij} \\
&+ \beta_4 \ln(\text{Price}_{it}) * \text{INTD}_{ij} + \beta_5 \ln(\text{Price}_{it}) * \ln(\text{Quality}_{it}) * \text{INTD}_{ij} \\
&+ \mu_{it} + \theta_{jt} + \delta_{ij}\Big] + \epsilon_{ijt}
\end{aligned} \tag{2}
$$

X_{ijt} is the bilateral trade flows from country i to country j at time t. RTA is a binary dummy variable representing regional trade agreements between country i and country j at time t. It takes the value 1 when a regional trade agreement exists between the two countries; otherwise, it takes the value 0. $Linder_{ijt}$ is estimated by taking the absolute value of the difference between the log of GDP per capita of country i and j.[2] $\ln Quality_{it}$ represents the natural logarithm of a quality index, while $\ln Price$ is the natural logarithm of unit value of export and is used to control for the unit price in the quality index. $INTD_{ij}$ is a binary dummy variable that takes the value 1 in the presence of international trade and 0 otherwise.

The variables μ_{it}, θ_{jt}, and δ_{ij} represent exporter-time, importer-time, and pair-wise fixed effects, respectively. The inclusion of exporter-time and importer-time fixed effects is essential to account for changes in macroeconomic conditions or trade policies affecting trade flows that cannot solely be explained by GDP growth or cost differentials, as highlighted by Larson et al. (2018). Pair-wise fixed effects are employed to address endogeneity issues between the dependent variable and time-varying regressors such as RTA and $Linder$ (Kitenge and Lahiri, 2021). Finally, ϵ_{ijt} is the error term in the equation.

$$
\hat{\mu}_{it} = \beta_0 + \beta_1 \ln \text{GDP}_{it} + \beta_2 \ln \text{Quality}_{it} + \beta_3 \ln \text{Price}_{it} + \beta_4 \ln \text{Quality}_{it} * \ln \text{Price}_{it} + \sigma_i + \eta_t + \varepsilon_{it} \tag{3}
$$

Equation (3) is used to perform the 2nd stage OLS regression. $\hat{\mu}_{it}$ is the exporter-time fixed effects that I generated from my first regression analysis using the PPML and represent exports of country i at time t. $\ln \text{GDP}_{it}$ is the log of real GDP of country i at time t. $\ln \text{Quality}_{it}$ and $\ln \text{Price}_{it}$ are the log of export quality and log of unit price of exports of country i at time t, respectively. $\ln \text{Quality}_{it} * \ln \text{Price}_{it}$ is the interaction term between the log of quality and log of unit price of exports. σ_i are the country fixed effects, and η_t represents time fixed effects. ε_{it} is the error term.

[2] $|Linder_{ijt}| = |\ln GDPPC_{it} - \ln GDPPC_{jt}|$

3 Quantitative Model

In this section, I will talk about the theoretical model I developed. I have developed a partial equilibrium two-country oligopolistic model in which the home (developing) country produces a high quality and a low quality good but consumes only the low quality good. The developing country exports both the high quality and the low quality good to the foreign (developed) country that also produces the highest quality good. Each country produces a homogenous high quality good. I assume that the consumers get a higher marginal utility (MU) from the consumption of a high quality good i.e. $u_2 > u_1 > u_0$. There is a larger demand for high quality goods in the developed country than the developing country hence, I assume that the home (developing) country consumers only consume the low-quality good. The results suggest that an increase in quality of the high-quality good will increase the exports of both the high-quality and the low-quality good, and will reduce domestic sales.

3.1 Set-up

There are different ways that researchers have modelled product quality in oligopolistic models. Helpmand and Grossman (1991) develop a quality ladder model. Shaked and Sutton (1982) focus on the demand side demands for low-quality and high-quality products by incorporating quality in consumer utilities. Khun et al. (2020) use the second approach to analyze the demand behavior of adoptive parents in the U.S.A. In this paper, I also adopt this approach.

P_l represents the price of low quality good and P_h is the price of high quality good in the international market ($P_l < P_h$). Quantity of low quality and high quality good being produced in home country (developing) is q_l^H and q_h^H respectively. q_h^F represents the quantity of high quality good produced in the foreign country (developed country). Let y be the household income. As for the foreign country, there is a continuum identical consumption preferences but differing in incomes. Incomes are uniformly distributed over the interval [0, 1]. Each consumer has three choices: consumes one unit of the low-quality good, or consumes one unit of the high-quality good, or does not consumer either of the two. I denote the three scenarios by q, where q = 0, 1, 2, representing no consumption, consumption of the low-quality good, and consumption of the high-quality good, respectively.

I follow Pliskin, Shepard, and Weinstein (1980) and Shaked and Sutton (1982) to specify the utility function of a consumer as U(c, q) = c uq, where c is the consumption of other goods and services, uq is the sub-utility received from consuming one unit of the good with attribute q.

$$U(y_0, q_0) = U(y_0, -P_l, q_1), \tag{4}$$

Using (4) and then solving for y_0, we get:

$$y_0 = \frac{P_l u_1}{u_1 - u_0} \tag{5}$$

Let y^* be the income level such that a consumer is indifferent between high-quality and low-quality goods. Hence, at income level y^*, we have:

$$U(y^* - P_h, q_2) = U(y^* - P_l, q_1) \tag{6}$$

Using Equation (4) and then solving for y^*, we get:

$$y^* = \frac{P_h u_2 - P_l u_1}{u_2 - u_1} \tag{7}$$

The denominators of Equations (5) and (7) represent utility premia of low-quality and high-quality goods, respectively, while the numerators reflect additional costs associated with them. Given product prices and associated utilities, consumers with income $y_0 < y < y^*$ get higher utility from consuming low-quality good than consuming no good at all, that is, $(u_1 - u_0)y > P_l u_1$; hence, they prefer consuming low-quality good over no consumption at all. Consumers with income $y > y^*$ achieve higher utility from consuming one unit of high-quality good than one unit of low-quality good, that is, $[u_2(1 - u_1)]y > P_h u_2 - P_l u_1$; thus, they prefer high-quality good over low-quality good. Therefore, consumers with income $y_0 < y < y^*$ make up the demand for low-quality good (D_l), and consumers with income $y > y^*$ make up the demand for high-quality good (D_l^F), while the remaining consumers do not consume either of the two goods (D_0). The demand for low quality good in the foreign and home country is D_l^F and D_l^H, respectively. The world demand for low quality good is D_l.

$$D_l = D_l^H + D_l^F \tag{8}$$

$$D_0 + D_l^F + D_h^F = 1 \tag{9}$$

$$D_l^F = 1 - D_h^F - D_0 \tag{10}$$

Demand of low-quality good in-home country is:

$$D_l^H = a - bP_l + cP_h \tag{11}$$

Let c = 0 since the home country only consumes the low quality good.

The low quality good is produced only in the home country by only one firm, but the high-quality good is produced by two firms: one in the home country and one in the foreign country. The inverse demand functions for low-quality and high-quality goods are presented in equations (20) and (23), respectively.

$$\int_{y_0}^{y^*} 1\, dy = y^* - y_0 \tag{12}$$

$$D_l^F = \frac{P_h u_2 - P_l u_1}{u_2 - u_1} - \frac{P_l u_1}{u_1 - u_0} \tag{13}$$

$$D_l = \frac{P_h u_2 - P_l u_1}{u_2 - u_1} - \frac{P_l u_1}{u_1 - u_0} + a - bP_l \tag{14}$$

$$\int_{y^*}^{1} y\, dy = 1 - y^* \tag{15}$$

$$D_h^F = 1 - \frac{P_h u_2 - P_l u_1}{u_2 - u_1} \tag{16}$$

$$1 - D_h^F = \frac{P_h u_2 - P_l u_1}{u_2 - u_1} \tag{17}$$

Substituting (17) in (14) we get:

$$D_l = 1 - D_h^F - \frac{P_l u_1}{u_1 - u_0} + a - bP_l \tag{18}$$

$$\frac{P_l u_1}{u_1 - u_0} + bP_l = 1 - D_h^F - D_l + a \tag{19}$$

$$P_l = \frac{(1 - D_h^F - D_l + a)(u_1 - u_0)}{(u_1 + b(u_1 - u_0))} \tag{20}$$

$$P_l = e - fD_h^F - gD_l \tag{21}$$

$$f = \frac{u_1 - u_0}{u_1 + b(u_1 - u_0)} > 0, g = \frac{u_1 - u_0}{u_1 + b(u_1 - u_0)} > 0, e = \frac{(u_1 - u_0)(1 + a)}{u_1 + b(u_1 - u_0)} \tag{22}$$

Substitute (20) in (17) to get P_h

$$
\begin{aligned}
P_h =& \frac{u_0u_1 - u_1u_2 - u_1u_2b + u_0u_2b + u_1^2b - u_0u_1b}{u_2(u_1 + b(u_1 - u_0))} D_h^F \\
&+ \frac{-u_1(u_1 - u_0)}{u_2(u_1 + b(u_1 - u_0))} D_l \\
&+ \frac{au_1^2 - au_0u_1 - u_0u_1 + u_1u_2 + u_1u_2b - u_0u_2b - u_1^2b + u_0u_1b}{u_2(u_1 + b(u_1 - u_0))}
\end{aligned} \tag{23}
$$

$$
P_h = h - kD_h^F - mD_l \tag{24}
$$

$$
P_h = h - k(q_h^F + q_h^H) - mq_l^H \tag{25}
$$

$$
k = -[\frac{u_0u_1 - u_1u_2 - u_1u_2b + u_0u_2b + u_1^2b - u_0u_1b}{u_2(u_1 + b(u_1 - u_0))}] > 0 \tag{26}
$$

$$
m = \frac{u_1(u_1 - u_0)}{u_2(u_1 + b(u_1 - u_0))} > 0 \tag{27}
$$

$$
h = -[\frac{au_1^2 - au_0u_1 - u_0u_1 + u_1u_2 + u_1u_2b - u_0u_2b - u_1^2b + u_0u_1b}{u_2(u_1 + b(u_1 - u_0))}] \tag{28}
$$

The profit function of the firm producing high quality good in the home country is given in equation (29) where C_h^H is the cost of producing high quality good in the home country.

$$
\pi_h^H = P_h q_h^H - q_h^H C_h^H, \tag{29}
$$

The profit function of the firm producing low quality good in the home country is given in equation (30) where C_l^H is the cost of producing low quality good in the home country.

$$
\pi_l^H = P_l q_l^H - q_l^H C_l^H, \tag{30}
$$

Equation (31) presents the profit function of the foreign firm producing high quality good. C_h^F represents the cost incurred by the foreign firm when producing the high quality good.

$$
\pi_h^F = P_h q_h^F - q_h^F C_h^F, \tag{31}
$$

The First-Order Conditions (FOCs) of the three profit functions in equlibrium are:

$$
\frac{\partial \pi_h^H}{\partial q_h^H} = P_h - C_h^H + \frac{\partial P_h}{\partial q_h^H} q_h^H = 0 \tag{32}
$$

$$\frac{\partial \pi_l^H}{\partial q_l^H} = P_l - C_l^H + \frac{\partial P_l}{\partial q_l^H} q_l^H = 0 \tag{33}$$

$$\frac{\partial \pi_h^F}{\partial q_h^F} = P_h - C_h^F + \frac{\partial P_h}{\partial q_h^F} q_h^F = 0 \tag{34}$$

Where:

$$-k = \frac{\partial P_h}{\partial q_h^H} = \frac{\partial P_h}{\partial q_h^F} \tag{35}$$

$$-m = \frac{\partial P_h}{\partial q_l^H} \tag{36}$$

$$-f = \frac{\partial P_l}{\partial q_h^H} = \frac{\partial P_l}{\partial q_h^F} \tag{37}$$

$$-g = \frac{\partial P_l}{\partial q_l^H} \tag{38}$$

k > m and g > f as the direct effect is greater than the indirect effect.

Substituting the inverse demand function in equations (32), (33) and (34), we can solve for the three output levels, and then substituting these equilibrium output levels in the two inverse demand functions, we solve for the prices.

3.2 Comparative statistics

I shall now carry our a number of comparative static exercises in relation to the equilibrium just derived. I shall examine effect of the quality of products on the equilibrium values of outputs, prices, exports, and domestic trade. For this exercise, note that although quality is a binary variable in sense that I consider two products: one low-quality and another high-quality. However, the level of the quality of the high-quality variable is a continuous variable and it varies with the value of the preference parameter u_2, utility received by a consumer in the foreign country when they consume one unit of the high-quality good. That is, I shall consider an effect of a change in u_2 on the equilibrium values.

3.2.1 Effects of Quality

I now examine the effect of a change in u_2 on the equilibrium values. An increase in u_2 will increase the demand for the high-quality good and reduce that of the low-quality one, in the foreign country. This will increase the output (exports) and price of the high-quality good. The increase in the price of the high quality good will increase the demand of the low-quality good in the foreign country. If the net effect on the demand of the low-quality good is positive, its price and output will increase. This will increase the export of the low-quality good and reduce domestic trade of this good in the home country.

4 Results

In this section, I will test the findings of the theoretical part mentioned in section 3.2.1 present my results for the empirical analysis and the robustness checks. Table 2 presents the results of the PPML regression analysis for all four specifications. In the first 3 columns, I see what happens when I introduce *Linder*, *lnQuality***INTD* and *lnPrice***INTD* one by one. In column 4, I then introduce all of them along with a triple interaction term between *lnPrice*, *lnQuality* and *INTD*. All the coefficients are statistically significant and positive. The results show that quality has a positive impact on international trade and a 1 percent increase in quality leads to an increase in total exports by 1.08 percent. There is a positive relationship between price and international trade. A 1 percent increase in price increases the exports by 1.03 percent. As mentioned earlier, this could be because expensive products are usually associated with higher quality. Regional trade agreements impact international trade positively. An increase in the price leads to an increase in exports of high quality good as shown by the coefficient of the interaction term between *lnQuality*, *lnPrice* and *INTD*. Regional trade agreements impact international trade positively.

Table 3 presents the results of the second stage OLS regression analysis for domestic/intranational trade. In the first 3 columns, I see what happens when I introduce *lnGDP*, *lnQuality* and *lnPrice* one by one. In column 4, I then introduce all of them together along with an interaction term. Quality and price negatively impact domestic trade. A 1 percent increase in quality and price reduces domestic trade by 2.69 percent and 0.51 percent, respectively. The total effects of *lnQuality* and *lnPrice* on International and Intra-national trade are presented in Table 6.

Table 2: First Stage PPML Estimates

Dependent Variable (log): Total Exports	(1)	(2)	(3)	(4)
RTA	0.426***	0.271***	0.176***	0.173***
	(0.0586)	(0.0542)	(0.0516)	(0.0517)
Linder	-0.292***	-0.190***	-0.0867***	-0.0861***
	(0.0254)	(0.0250)	(0.0276)	(0.0279)
lnQuality*INTD		4.455***	3.633***	2.114***
		(0.424)	(0.419)	(0.782)
lnPrices*INTD			0.457***	0.489***
			(0.0363)	(0.0444)
lnPrices*lnQuality*INTD				0.390**
				(0.168)
Observations	1,113,248	851,574	845,830	845,830
R-square	0.9979	0.9978	0.9979	0.9979
Exporter*Time FE	Yes	Yes	Yes	Yes
Importer*Time FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Second-Stage OLS regression Estimates

Dependent Variable (log): ETFE	(1)	(2)	(3)	(4)
lnGDP	0.607***	0.626***	0.564***	0.578***
	(0.0077)	(0.0109)	(0.0113)	(0.0115)
lnQuality		-3.289***	-2.620***	-2.3122***
		(0.0324)	(0.0315)	(0.1532)
lnPrice			-0.178***	-0.133***
			(0.0163)	(0.021)
lnPrice*lnQuality				-0.090***
				(0.0353)
Observations	8,549	6,258	6,189	6,189
R-square	0.9886	0.9837	0.9866	0.9866
Exporter FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.0.1 Effects of Quality on OECD and Non-OECD countries

In this section, I look at the impact of export quality on the exports and domestic trade of OECD and non-OECD countries. In order to estimate the impact of quality on the exports and domestic trade of OECD and non-OECD countries I modify the equation (2) to include an interaction term between *lnQuality*, INTD and OECD as shown in equation (39). Similarly, a modified version of equation (3) for the second-stage OLS regression is shown in equation (40) with an interaction term between *lnQuality* and the OECD dummy. The OECD dummy takes the value of 1 if the exporting country is part of the OECD otherwise it takes the value 0. The results of the first-stage and second stage regression are shown in Table 4 and 5.

$$\begin{aligned} X_{ijt} = \exp\Bigg[&\beta_0 + \beta_1 \text{RTA}_{ijt} + \beta_2 \text{Linder}_{ijt} + \beta_3 \ln(\text{Quality}_{it}) * \text{INTD}_{ij} \\ &+ \beta_4 \ln(\text{Price}_{it}) * \text{INTD}_{ij} + \beta_5 * \ln(\text{Quality}_{it}) * \text{INTD}_{ij} * \text{OECD}_i \\ &+ \mu_{it} + \theta_{jt} + \delta_{ij}\Bigg] + \epsilon_{ijt} \end{aligned} \tag{39}$$

$$\hat{\mu}_{it} = \beta_0 + \beta_1 \ln \text{GDP}_{it} + \beta_2 \ln \text{Quality}_{it} + \beta_3 \ln \text{Price}_{it} + \beta_4 \ln \text{Quality}_{it} * \text{OECD}_i + \sigma_i + \eta_t + \varepsilon_{it} \tag{40}$$

The effect of improving export quality on the exports is more pronounced for OECD countries than the non-OECD countries. The total effects of export quality on exports for both OECD and non-OECD countries are shown in Table 6. A 1% increase in export quality increase exports of OECD countries by 3.18% and that of non-OECD countries by 0.79%. Quality has a negative impact on the domestic trade of both OECD and non-OECD countries. A 1% increase in export quality reduces domestic trade of OECD countries by 4.61% and of non-OECD countries by 2.24%.

Table 4: First Stage PPML Estimates

Dependent Variable (log): Total Exports	(5)
RTA	0.167***
	(0.5045)
Linder	-0.102***
	(0.0263)
lnQuality*INTD	3.023***
	(0.4595)
lnPrices*INTD	0.446***
	(0.3432)
lnQuality*INTD*OECD	4.778***
	(0.9147)
Observations	845,830
R-square	0.9979
Exporter*Time FE	Yes
Importer*Time FE	Yes
Pair FE	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Second Stage OLS Estimates

Dependent Variable (log): ETFE	(5)
lnGDP	0.564***
	(0.011)
lnQuality	-2.236***
	(0.0308)
lnPrices	-0.168***
	(0.0159)
lnQuality*OECD	-2.383***
	(0.2239)
Observations	6,189
R-square	0.9979
Exporter FE	Yes
Time FE	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.0.2 Total effects of Quality and Price

Table 6: Total Effects

	Intranational Trade				International Trade			
	(2)	(3)	(4)	(5)	(2)	(3)	(4)	(5)
Ln_Quality	-3.288754***	-2.620068***	-2.69309**		1.165931***	1.013028***	1.076782**	
Ln_Price		-0.1778905***	-0.514209**			0.2791984**	1.02841**	
Ln_Quality (OECD)				- 4.618456***				3.182612***
Ln_Quality (Non-OECD)				-2.235771***				0.787644***

4.1 Robustness

In this section, I provide the robustness check of the empirical results. As a robustness check, I ran the same regressions with 3-year intervals and the results remained consistent with the main results presented in Table 2 and 3. The results are reported in Table 7 and 8.

Table 7: First Stage PPML estimates with 3-year intervals

Dependent Variable (log): Total Exports	(1)	(2)	(3)	(4)
RTA	0.342***	0.289***	0.170***	0.167***
	(0.0544)	(0.0558)	(0.0526)	(0.0526)
Linder	-0.220***	-0.1852***	-0.0668***	-0.0657***
	(0.0245)	(0.0250)	(0.0276)	(0.0280)
lnQuality*INTD		4.667***	3.757***	2.042***
		(0.4547)	(0.4554)	(0.7841)
lnPrices*INTD			0.509***	0.544***
			(0.0342)	(0.0416)
lnPrices*lnQuality*INTD				0.453***
				(0.1699)
Observations	679,678	283,372	281,650	281,650
R-square	0.9983	0.9977	0.9979	0.9979
Exporter*Time FE	Yes	Yes	Yes	Yes
Importer*Time FE	Yes	Yes	Yes	Yes
Pair FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Second-Stage OLS regression with 3-year intervals

Dependent Variable (log): ETFE	(1)	(2)	(3)	(4)
lnGDP	0.628***	0.638***	0.576***	0 .590***
	(0.0098)	(0.0181)	(0.0185)	(0.0190)
lnQuality		-3.502***	-2.762***	-2.344***
		(0.0544)	(0.0519)	(0 .2575)
lnPrice			-0.229***	-0.185***
			(0.0271)	(0.0341)
lnPrice*lnQuality				-0.128**
				(0.0589)
Observations	4,977	2,152	2,129	2,129
R-square	0.9906	0.9851	0.9883	0.9881
Exporter FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5 Conclusion

In conclusion, this paper provides a comprehensive analysis of the impact of improving the export quality on international and domestic trade of a developing and a developed country. The theoretical framework shows that enhancing export quality improves export performance of a country but it reduces domestic trade under certain conditions. The empirical findings suggest that the product quality matters for international trade only and impacts exports positively. However, quality and domestic trade have a negative relationship. Higher quality and high prices reduce domestic trade. The positive effect of improving export quality on the exports is more pronounced for OECD countries than the non-OECD countries. They need to encourage investment in high-quality exporting sectors by improving business and governance indicators.

Considering the higher levels of public debt that EMDEs, and especially the LICs, have incurred following the COVID19 pandemic (IMF 2023; October 2023 World Economic Outlook), there is an imperative to diversify export strategies beyond merely relying on price competitiveness. Increasing high quality exports will lead to higher export earnings and help in improving the current account balance and alleviating the strain of burgeoning public debt. As the high-quality export sector grows, it will lead to increased investment in research and technology and human capital development. This, in turn, fosters long-term economic growth by enhancing productivity, innovation, skill development and more employment opportunities within the economy.

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Appendix

Additional details of the estimation strategy

The three First-Order Conditions (FOCs) of the profit function are:

$$\frac{\partial \pi_h^H}{\partial q_h^H} = P_h - C_h^H - kq_h^H = 0 \tag{41}$$

$$\frac{\partial \pi_l^H}{\partial q_l^H} = P_l - C_l^H - gq_l^H = 0 \tag{42}$$

$$\frac{\partial \pi_h^F}{\partial q_h^F} = P_h - C_h^F - kq_h^F = 0 \tag{43}$$

$$P_h - kq_h^H = C_h^H \tag{44}$$

$$P_l - gq_l^H = C_l^H \tag{45}$$

Applying Cramer's Rule:

$$\begin{bmatrix} G_{h1}^H & G_{h2}^H & G_{h3}^H \\ G_{h1}^F & G_{h2}^F & G_{h3}^F \\ G_{l1}^H & G_{l2}^H & G_{l3}^H \end{bmatrix} \begin{bmatrix} dq_h^H \\ dq_h^F \\ dq_l^H \end{bmatrix} = - \begin{bmatrix} G_{h4}^H \\ G_{h4}^F \\ G_{l4}^H \end{bmatrix} du_2$$

$$\frac{\partial \pi_h^H}{\partial q_h^H} = P_h - C_h^H + kq_h^H = 0 \tag{46}$$

$$G_{h1}^H = -2k \tag{47}$$

$$G_{h2}^H = -k \tag{48}$$

$$G_{h3}^H = -m \tag{49}$$

$$G_{h4}^H = \frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^H \tag{50}$$

$$\frac{\partial \pi_h^F}{\partial q_h^F} = P_h - C_h^F - kq_h^F = 0 \tag{51}$$

$$G_{h1}^F = -k \tag{52}$$

$$G_{h2}^{F} = -2k \tag{53}$$

$$G_{h3}^{F} = -m \tag{54}$$

$$G_{h4}^{F} = \frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^F \tag{55}$$

$$\frac{\partial \pi_l^H}{\partial q_l^H} = P_l - C_l^H - g q_l^H = 0 \tag{56}$$

$$G_{l1}^{H} = -f \tag{57}$$

$$G_{l2}^{H} = -f \tag{58}$$

$$G_{l3}^{H} = -2g \tag{59}$$

$$G_{l4}^{H} = \frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H \tag{60}$$

$$|P| = -G_{h4}^{H}(G_{h2}^{F}G_{l3}^{H} - G_{h3}^{F}G_{l2}^{H}) - G_{h2}^{H}(-G_{h4}^{F}G_{l3}^{H} + G_{h3}^{F}G_{l4}^{H}) + G_{h3}^{H}(-G_{h4}^{F}G_{l2}^{H} + G_{h2}^{F}G_{l4}^{H}) \tag{61}$$

$$\begin{aligned} |P| = &-\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^H\right)[4kg - mf] + k\left[2g\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^F\right) - m\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H\right)\right] \\ &- m\left[f\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^F\right) - 2k\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H\right)\right] \end{aligned} \tag{62}$$

$$\begin{aligned} |P| = &-\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^H\right)[4kg - mf] + [2kg\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^F\right) - mk\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H\right)] \\ &- [mf\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^F\right) - 2mk\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H\right)] \end{aligned} \tag{63}$$

$$
\begin{aligned}
|P| = & -4kg\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) + mf\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) \\
& + 2kg\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^F\right) - mk\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) - mf\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^F\right) \\
& + 2mk\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right)
\end{aligned} \tag{64}
$$

$$
|P| = -2kg\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) + mk\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) \tag{65}
$$

$$
\frac{dq_h^H}{du_2} = \frac{|P|}{|A|} = \frac{-2kg\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) + mk\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right)}{(-k)[6kg - 2mf]} \tag{66}
$$

$$
\frac{dq_h^H}{du_2} = \frac{|P|}{|A|} = \frac{2g\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) - m\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right)}{[6kg - 2mf]} \tag{67}
$$

$$
g = \frac{u_1 - u_0}{u_1 + b(u_1 - u_0)} > 0 \tag{68}
$$

$$
m = \frac{u_1(u_1 - u_0)}{u_2(u_1 + b(u_1 - u_0))} > 0 \tag{69}
$$

So $g > m$

$$
\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H > \frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H \tag{70}
$$

$$
\frac{dq_h^H}{du_2} = \frac{2g\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) - m\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right)}{[6kg - 2mf]} > 0 \tag{71}
$$

$$
\frac{dq_l^H}{du_2} = \frac{|Q|}{|A|} \tag{72}
$$

$$
|Q| = G_{h1}^H(-G_{h2}^F G_{l4}^H + G_{h4}^F G_{l2}^H) - G_{h2}^H(-G_{h1}^F G_{l4}^H + G_{h4}^F G_{l1}^H) - G_{h4}^H(G_{h1}^F G_{l2}^H - G_{h2}^F G_{l1}^H) \tag{73}
$$

$$|Q| = -2k\left[2k\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) - f\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^F\right)\right]$$
$$+ k\left[k\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) - f\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^F\right) - \left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right)(kf - 2kf)\right] \quad (74)$$

$$|Q| = -3k^2\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) + 2kf\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) \quad (75)$$

$$\frac{dq_l^H}{du_2} = \frac{|Q|}{|A|} = \frac{3k\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) - 2f\left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right)}{[6kg - 2mf]} \quad (76)$$

$$k > f, \frac{\partial k}{\partial u_2} < 0; \left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) > 0 \text{ and } \left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2}q_l^H\right) < \left(\frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2}q_h^H\right) \text{ so } \frac{dq_l^H}{du_2} < 0 \quad (77)$$

$$k = -\frac{(u_0u_1 - u_1u_2 - u_1u_2b + u_0u_2b + u_1^2b - u_0u_1b)}{u_2(u_1 + b(u_1 - u_0))} > 0 \quad (78)$$

$$\frac{\partial k}{\partial u_2} = -\frac{(u_1 + u_1b - u_0b)(u_1 + b(u_1 - u_0))}{[u_2(u_1 + b(u_1 - u_0))]^2} \quad (79)$$

$$\frac{\partial k}{\partial u_2} = -\frac{(u_1 - b(u_1 - u_0))(u_1 + b(u_1 - u_0))}{[u_2(u_1 + b(u_1 - u_0))]^2} < 0 \quad (80)$$

$$P_h = \frac{1}{u_2(u_1 + b(u_1 - u_0))}\left[D_h^F\left(u_1(u_0 - u_2) - u_2b(u_1 - u_0) + u_1b(u_1 - u_0)\right)\right.$$
$$\left. + D_l\left(-u_1(u_1 - u_0)\right) + au_1^2 - au_0u_1 - u_0u_1 + u_1u_2 + u_1u_2b - u_0u_2b - u_1^2b + u_0u_1b\right] \quad (81)$$

$$\frac{\partial P_h}{\partial u_2} = \frac{(u_1 + b(u_1 - u_0))\left[(u_1 + b(u_1 - u_0))D_h^F + u_1(u_1 - u_0)D_l - (u_1 + u_1b - u_0b)(u_1 + b(u_1 - u_0))\right]}{[u_2(u_1 + b(u_1 - u_0))]^2} \quad (82)$$

$$\frac{\partial P_h}{\partial u_2} = \frac{(u_1 + b(u_1 - u_0))}{[u_2(u_1 + b(u_1 - u_0))]^2}\left[(u_1 + b(u_1 - u_0))D_h^F + u_1(u_1 - u_0)D_l - (u_1 + b(u_1 - u_0))\right] > 0 \quad (83)$$

Total Derivative of prices:

$$dP_h = dkq_h^H + dq_h^H k \tag{84}$$

$$dP_l = dgq_l^H + dq_l^H g \tag{85}$$

$$\frac{dP_h}{du_2} = \frac{\partial P_h}{\partial u_2} - \frac{\partial k}{\partial u_2} q_h^H \tag{86}$$

$$\frac{dP_l}{du_2} = \frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H \tag{87}$$

$$\frac{dD_l^H}{du_2} = -b\frac{dP_l}{du_2} \tag{88}$$

$$\frac{dD_l^H}{du_2} = -b\left(\frac{\partial P_l}{\partial u_2} - \frac{\partial g}{\partial u_2} q_l^H\right) \tag{89}$$

Since $\frac{\partial P_l}{\partial u_2} > 0$ and $\frac{\partial P_l}{\partial u_2} > \frac{\partial g}{\partial u_2} q_l^H$, so $\frac{dD_l^H}{du_2} < 0$.

$$D_l = \frac{P_h u_2 - P_l u_1}{u_2 - u_1} - \frac{P_l u_1}{u_1 - u_0} + a - bP_l \tag{90}$$

$$P_l = \frac{(u_1 - u_0)(D_l - a)(u_1 + u_1 b - u_0 b) - P_h u_2 (u_1 - u_0)}{(u_0 u_1 - u_1 u_2 - b u_1 u_2 + b u_1^2 + b u_0 u_2 - b u_0 u_1)} \tag{91}$$

$$\frac{\partial P_l}{\partial u_2} = \frac{(u_1 - u_0)(D_l - a)(u_1 + b(u_1 - u_0)) + P_h(u_1 - u_0)(u_1 + b(u_1 - u_0)) + u_2(u_1 - u_0)(u_1 + b(u_1 - u_0))\frac{\partial P_h}{\partial u_2}}{(u_0 u_1 - u_1 u_2 - b u_1 u_2 + b u_1^2 + b u_0 u_2 - b u_0 u_1)^2} \tag{92}$$

$$\frac{\partial P_l}{\partial u_2} > 0 \tag{93}$$