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TRADE OPENNESS AND MANUFACTURING GROWTH OF ASIAN ECONOMIES: INVESTIGATING LINEAR AND NON-LINEAR EFFECT

[1]Banna Banik, [2]Tahsina Akter, [3]Chandan Kumar Roy & [4]Rabiul Hossain
[1]Crawford School of Public Policy, ANU College of Asia & the Pacific, Australian National University, Canberra, ACT, Australia
[2]Directorate of Secondary and Higher Education, Ministry of Education, Bangladesh
[3]Credit Guarantee Department, Bangladesh Bank, Dhaka, Bangladesh
[4]Foreign Exchange Policy Department, Bangladesh Bank, Dhaka, Bangladesh

[1]Corresponding author: banna.banik@yahoo.com

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ABSTRACT

This research delves into examining both the linear and non-linear impacts of trade openness on the growth of the manufacturing sector in 35 chosen Asian economies spanning the period from 2004 to 2022. The investigation aims to shed light on the dynamics and complexities of the relationship between trade openness and manufacturing growth within the specified timeframe. The study uncovers significant findings using linear and quadratic regression specifications derived from the production function framework of growth, panel data fixed effects models, two-stage least square (2SLS) method, and two-step difference and system generalized method of moments (GMM) estimation techniques. The study reveals both linear and non-linear relationships. The linear static and dynamic specifications show a positive and significant impact of trade openness on manufacturing growth. In contrast, the non-linear relationship indicates that, initially, additional trade openness has a positive effect on manufacturing value-added growth. However, after a certain level, additional trade openness leads to negative effects. This study makes valuable contributions to the existing literature by investigating a different perspective on the impact of trade openness on manufacturing growth in the Asian region, demonstrating both linearity and non-linearity, as well as optimality. The findings suggest that higher levels of trade openness offer opportunities for knowledge sharing, technological advancements, innovation, increased productivity, access to new capital goods, and attraction of foreign investment in the manufacturing sector. However, the study emphasizes the importance of specialization in producing high-quality goods and developing expertise to achieve sustained growth in the manufacturing sector.

Keywords: Trade openness, manufacturing growth, Asian economies, non-linear effects, quadratic regression.

INTRODUCTION

The development of free trade among World Trade Organization (WTO) members has played a significant role in increasing world trade volume and global GDP indices (WTO 2019). This growth can be attributed to favorable monetary policies, a stable financial system, and the relaxation of trade barriers on commonly traded products in major economies following the 2008-2009 global recessions. Asia, in particular, has experienced notable growth in exports and imports, contributing significantly to world imports (WTO 2019). However, recent trade tensions, such as the Cold Trade War between China and the USA, have introduced economic uncertainties that may lead to a slowdown, particularly in Asian economies. Policymakers in Asia are actively seeking effective policy tools to promote sustainable economic growth and prosperity in the region, focusing on the manufacturing sector as a key driver of development. The manufacturing sector stimulates growth through various channels, including the development of forward and backward linkage industries, technological know-how acquisition and dissemination, capital accumulation, savings incentives, and production cost efficiency gains (Weiss, 2005; Szirmai et al., 2013). Additionally, it contributes to human resource development through on-the-job training, utilization of domestic human capital and institutions, and the development and diffusion of information technologies and technical knowledge (Araujo et al., 2009; Su & Yao, 2016; UNIDO, 2013).

Numerous studies have identified trade openness as a crucial factor in determining manufacturing growth (Dawson, 2006; Edwards, 1992; Weinhold & Rauch, 1999). Trade openness encourages economic specialization, productivity growth, export capability, and overall manufacturing performance. It entails reducing trade barriers, integrating markets across countries, and engaging in cross-border trade (Fafowora, 1998; Kneller, Morgan & Kanchanahatakij, 2008). Greater trade integration expands market size, facilitates specialization, maximizes machinery utilization, fosters innovation, increases labor productivity, and reduces production costs, leading to reinvestment, capital accumulation, and development (Dawson, 2006; Edwards, 1992; Weinhold & Rauch, 1999). The effect of trade openness on manufacturing growth remains a topic of debate in empirical literature. Hossain et al. (2022) examined the effects of foreign direct investment and trade openness on economic growth amid crises in 30 Asian economies using the fixed-effects model, panel-corrected standard errors (PCSE), and generalized method of moments (GMM) estimations. They found that both FDI and trade openness contribute to boosting economic growth in Asian economies, and the effect is also persistent in the long run. Nguyen and Bui (2021) explored the impact of trade openness on the economic growth of ASEAN-6 countries during 2004-2019 by employing a fixed effects model for data analysis. The authors observed a significant impact of trade openness on economic growth. However, these studies analyzed the impact of trade openness on the growth of gross domestic product (GDP). The existing studies primarily focused on the linear relationship between trade openness and growth. They did not study the optimality of how much openness generates the highest level of growth, which is consistently missing in existing studies. We consider both linear and non-linear models to measure the potential impact of trade openness on manufacturing growth. Another significant contribution of the paper is the implication of both the two-stage least square (2SLS) method and the two-step difference and system generalized method of moments (GMM) in this analysis. We claim that these methods consider the endogeneity issue more accurately than the present studies have.

Trade openness contributes significantly to stabilizing Asian economies and promoting sustainable economic growth in the region. It further strengthens the growth in the manufacturing sectors by removing all trade barriers and inviting technological know-how, expertise, and raw materials from different parts of the world. So, it is essential to check whether the higher level of trade openness contributes to augmenting manufacturing growth and if there is any threshold level of openness to growth. Using panel data from selected 35 Asian economies over the years 2004-2022, we employ fixed effects (FE) models, two-stage least square (2SLS) method, and two-step difference and system generalized method of moments (GMM) estimation techniques on static and dynamic production function growth augmented linear and non-linear frameworks. This study demonstrates a significant and positive impact of trade openness on Asian manufacturing sector growth, revealing a positive effect up to a certain threshold, beyond which the marginal impact turns negative, contributing valuable evidence to the promotion effect of trade openness on manufacturing growth in Asian economies.

The remainder of this paper is structured as follows: Section 2 reviews existing theoretical and empirical literature on the topic. Section 3 outlines the methodology used in the study, including model specifications and data sources. Section 4 presents the empirical analysis of the impact of trade openness on manufacturing growth using the trade-growth model. Finally, Section 5 concludes the paper and discusses the potential implications of the research.

LITERATURE REVIEW

The relationship between trade openness and manufacturing growth has been extensively examined through trade-growth theories. Researchers have focused on three main issues related to international trade theories: the cross-border movement of goods, the degree and nature of benefits from international trade, and the economic impact of trade policy. The classical theory, theory of factor proportion, and product life cycle theory are among the theoretical frameworks used to analyze these issues (Djankov et al., 2002).

The classical trade theories, pioneered by Adam Smith (1776) and further developed by Ricardo (1817), emphasize the importance of specialization and division of labor in driving economic growth. According to these theories, countries should produce and export goods in which they have a comparative advantage, while importing goods that they have a disadvantage in producing (Djankov et al., 2002). However, these theories do not fully explain the source of differences in relative and absolute advantages. To address this limitation, the Heckscher-Ohlin (H-O) Theory, also known as the Factor Proportions Theory, focuses on the role of factors of production such as land, labor, and capital. The theory suggests that countries tend to manufacture and export goods that utilize their abundant resources, while importing goods that require resources in high demand but are scarce domestically (Djankov et al., 2002). However, the conclusions drawn from these classical theories have faced limitations in explaining the trade-growth relationship in the context of technological change, the rise of multinational corporations (MNCs), and changing business dynamics since the 1960s. To address these evolving factors, new international trade theories have emerged. One such theory is the product life cycle theory, which explains the expansion of MNCs in foreign markets and their trade patterns. According to this theory, firms initially trade goods in the local market and then expand to foreign markets as they mature and seek cost advantages (Vernon, 1966; Wells, 1968).

In the late 1980s, a new wave of rigorous analytical and theoretical studies focused on the impact of trade on growth. Grossman and Helpman (1990) found that a country's openness to trade significantly impacts technological change, leading to improved productivity and innovation. Rodrik (1992) argued that technological upgrading in manufacturing firms is positively associated with their market share, while Barro and Sala-i-Martin (1995) highlighted the positive effects of an open economy on long-run growth performance through knowledge sharing and attracting foreign direct investment. However, these new trade theories are not without criticism. Factors such as government rules, regulations, institutional quality, and comparative disadvantages in productivity growth can influence the relationship between trade openness and growth (Redding, 1999; Romer & Frankel, 1999).

When examining the impact of trade openness on manufacturing growth, it is essential to consider the role of government policies, regulations, and institutional quality (Weinhold & Rauch, 1999; Dawson, 2006). Trade openness can contribute to the development of the manufacturing sector by expanding market share, promoting economic specialization, and enhancing labor productivity (Harrison, 1996). However, empirical studies on the direct link between trade openness and manufacturing growth, especially for Asian economies, are relatively scarce and provide mixed evidence (Anyanwu et al., 1997; Dollar, 1992; Harrison, 1996; Dowrick & Golley, 2004). In short, the relationship between trade openness and manufacturing growth is a topic of significant interest among researchers and policymakers. While classical trade theories and new trade theories offer valuable insights, the specific context, government policies, and institutional factors play crucial roles in determining the outcomes. More research, particularly focused on Asian economies, is needed to provide a comprehensive understanding of the effects of trade openness on manufacturing growth.

METHODOLOGY AND MODEL SPECIFICATIONS

Based on the availability of data from 2004 to 2022, this study covers panel data on 35 selected Asian economies: Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, China PRC, Georgia, India, Indonesia, Iraq, Israel, Japan, Jordan, Kazakhstan, Korea, Rep., Kuwait, Kyrgyz Republic, Lao PDR, Lebanon, Malaysia, Mongolia, Myanmar, Nepal, Oman, Pakistan, Philippines, Russian Federation, Saudi Arabia, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Turkey, and Vietnam.

The empirical model used in this study to analyze the potential linear and non-linear effects of trade openness on manufacturing growth is based on the Aggregate Production Function (APF) framework. The APF framework, widely utilized in the literature examining the relationship between trade openness, investment, and growth, has been employed as the foundation of this empirical analysis (Bhagwati, 1978; Romer, 1990; Barro & Sala-i-Martin, 1995; Edwards, 1997; Roy et al., 2021). In our study, we extend the APF model by incorporating additional macroeconomic factors, including tariff rate (TR), financial development (FD), foreign direct investment (FDI), control of corruption (CC), and foreign exchange reserve (FR), to examine their impact on manufacturing growth alongside trade openness. By considering these variables, we aim to provide a comprehensive understanding of the relationship between trade openness and manufacturing growth while accounting for other relevant economic factors:

$$MG_{jt} = \beta_0 + \beta_1 TO_{jt} + \beta_2 TR_{jt} + \beta_3 FD_{jt} + \beta_4 FDI_{jt} + \beta_5 CC_{jt} + \beta_6 FR_{jt} + u_j + v_t + \varepsilon_{jt} \quad (1)$$

Where the main dependent variable MG_{jt} refers to manufacturing growth. We consider the manufacturing value-added (MVA) percentage share of GDP of the respective economy as the proxy of manufacturing growth (MG). MVA estimates the share of the manufacturing industry to the total output of a country and is also widely used as a parameter of the level of an economy's manufacturing sector (Bongsha, 2011).

TR_{jt} denotes the tariff rate, a widely accepted determinant of MG, which refers to the customs duties levied on goods imports that benefit domestic manufacturers and increase public income and revenue (WTO, 2015). Different categories of tariffs would significantly lead to a different level of trade growth restrictiveness. Merchandise with higher tariff rates would not typically be traded (Yanikkaya, 2003). Based on this study's theoretical foundation, reduced tariff rates tend to increase domestic production and stimulate the competitiveness of local manufacturing firms, which in turn increases export growth.

FD_{jt} refers to the level of financial development defined by domestic credit over GDP provided by the financial sector. A sound financial system is the prerequisite for long-term economic growth (Malik et al., 2006). Adequate financial support by the financial sector fosters innovative entrepreneurship, leading to technological advancement and economic growth. A country with a sound and stable FD has a steady impact on the manufacturing industry through its effect on manufacturing productivity. It facilitates in organizing funds from savings, accelerates the allocation of resources, boosts innovative actions of entrepreneurs, stimulates high return on investment, encourages portfolio diversification and specialization, and spurs economic and manufacturing growth (Greenwood & Jovanovic, 1990; Levine, 1997; Greenwood et al., 2010). Based on the above findings, we use domestic credit disbursed by the financial institutions (% of GDP) as a proxy of FD.

FDI_{jt} refers to the foreign direct investment (net inflow, % of GDP), a crucial determining factor of manufacturing output and economic growth. It promotes rapid industrialization in an economy and elevates the manufacturing sector's higher productivity by transferring technologies, physical capital, human capital, and technical know-how (Borensztein et al., 1998). We use foreign direct investment (% of GDP) as a proxy of FDI.

CC_{jt} is the control of corruption (estimate), collected from the Worldwide Governance Indicators database, is an important determinant of manufacturing firm growth. Studies report that corruption discourages entrepreneurial activity of doing business, private investment, and firm performance (Svensson, 2003; Bertrand et al., 2007; Banerjee et al., 2012). It is conventionally viewed as taking bribes by public officials at the border, increasing the cost of export and the expense of doing business. In addition, corruption creates a bureaucratic restriction on trade as manufacturing firms spend more time on bureaucratic negotiations (Kaufmann & Wei, 1999). Groot et al. (2004) found that higher levels of corruption restricted the bilateral trade of manufacturing goods. Thus, a higher level of control against corruption facilitates better manufacturing growth.

FR_{jt} refers to the foreign exchange reserve (natural logarithm of total reserves). Accumulating foreign exchange reserves contributes to manufacturing growth and firm performance by enhancing investment and capital productivity (Fukuda & Kon, 2010). Increasing foreign reserves reduces the cost of liquidity risk. It helps to catch the attention of the MNCs and foreign investors for more foreign direct investment because it enhances the credibility of the government of the FDI recipients. The scarcity of foreign exchange reserves hurts manufacturing companies as reserve scarcity reduces the firm's capability to obtain the required raw materials for their production process (Acquaah et al., 2011).

The notation j defines the respective country, and t is the data for the respective years. The notation u_j, v_t and ε_{jt} captures the country heterogeneity, the year effects and the model residuals, respectively. Data on control of corruption is obtained from Worldwide Governance Indicators (WGI), and data on all other variables are collected from the WDI database of the World Bank.

Later on, we extend our baseline model by adding up the square of trade openness (TO_{jt}^2)as an additional explanatory variable to discern whether there is a non-linear association between trade openness and manufacturing growth. The purpose of the insertion of the quadratic variable,TO_{jt}^2, is to detect the effect of different TO levels and capture a possible inflection point between the level of openness and manufacturing growth. The extended empirical model would be the following,

$$MG_{jt} = \beta_0 + \beta_1 TO_{jt} + \gamma_1 TO_{jt}^2 + \beta_2 TB_{jt} + \beta_3 FD_{jt} + \beta_4 FDI_{jt} + \beta_5 CC_{jt} + \beta_6 FR_{jt} + u_j + v_t + \varepsilon_{jt} \quad (2)$$

RESULTS AND DISCUSSIONS

Summary statistics and correlation matrix

Table 1 highlights the summary statistics. The highest average value is reported for *TO* variables, while control of corruption is found at the lowest value. The mean value of our dependent variable MG is 13.814, with a standard deviation of 7.16. For the variable TO, the mean value is 81.98, with a standard deviation of 38.30. FD shows the minimum and maximum range among all variables.

Table 1

Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Manufacturing growth (MG)	665	13.814	7.160	0.26	41.18
Trade Openness (TO)	658	81.977	38.298	0.167	220.407
Tariff Rate (TR)	665	7.595	5.053	0.32	32.47
Level of Financial Development (FD)	647	62.429	56.853	-59.351	281.398
Foreign Direct Investment (FDI)	653	3.835	5.641	-37.154	55.075
Control of Corruption (CC)	629	-0.437	0.732	-1.67	1.69
Foreign exchange reserve (FR)	653	23.277	2.380	17.576	28.992
Trade Freedom (TF)	655	69.765	12.945	0	89.4
Good Governance (GG)	630	-0.601	0.742	-2.23	1.11
Size of the economy (ES)	659	7.927	1.394	4.921	10.924
Natural resources rent (NR)	622	10.809	15.642	0.0008	74.131

Table 2 reports the matrix of the correlation of selected variables. The results show that trade openness variables are negative, and all other variables, such as TR, FD, FDI, CC, and FR reserve, are positively associated with manufacturing growth.

Table 2

Correlation Matrix

	MG	TO	TO (SQ)	TR	FD	FDI	CC	FR
MG	1.000							
TO	-0.103	1.000						
TO (SQ)	-0.107	0.958	1.000					
TR	0.127	-0.135	-0.103	1.000				
FD	0.415	-0.027	0.039	0.040	1.000			
FDI	0.008	0.298	0.256	-0.041	-0.079	1.000		
CC	0.060	0.052	0.041	-0.073	0.512	-0.136	1.000	
FR	0.291	-0.224	-0.173	-0.018	0.626	-0.206	0.325	1.000

The negative association between TO and manufacturing growth is beyond our expectations. We will justify their impact on manufacturing growth more empirically in the empirical section, where additional control variables or macroeconomic factors may provide our expected findings. Besides, the highest coefficient value is 0.41, and all other coefficients are acceptable, indicating that multicollinearity is minor. Moreover, the mean-variance inflation factor (VIF) of the analysis is found at 1.44, which is below 10, implying that a linear association between explanatory variables exists in our model, which is theoretically and empirically acceptable. So, multicollinearity is not a severe issue in our analysis.

EMPIRICAL FINDINGS AND DISCUSSIONS

Linear Effect of Trade Openness on Manufacturing Growth

In order to examine the impact of trade openness on manufacturing growth, our estimation procedure utilizes OLS, fixed effects (FE), and/or random effects (RE) models. The regression results for the linear baseline specification (Equation 1) are presented in Table 3. The variables in the regression are expressed in percentage form, except for the control of corruption variable, which is an index. Based on the Hausman specification test (Prob>chi2 = 0.00078), the FE method is deemed more suitable than RE for our analysis. The FE model, known for utilizing Within Group (WG) estimators, allows for controlling for missing and unobserved variables that are fixed over time but vary across economies, as well as missing and unobserved factors that are fixed across economies but vary over time. Notably, the FE model reveals a correlation between the residuals (ε_{jt}) and the independent variables [corr (u_i, Xb) = -0.2791]. The F-test statistic and p-value for the FE model are 6.94 and 0.0000, respectively, indicating that all estimates in the FE model significantly differ from zero, and the model fits the data well. The explanatory and control variables exhibit a notable explanatory power over the manufacturing growth variable, with all regression coefficients significant at least at the 5% level, except for the trade barrier variable, which is not significant (Columns 2 and 3). Furthermore, Prob>F of the time FE test is 0.0631, allowing us to reject the null hypothesis at the 10% level, implying that the estimates for all periods are jointly equal to zero and validating the inclusion of year FE in our analysis. Consequently, we present the regression findings with both time and country FE in Table 3 (Column 4). We have employed both the year and country effects in the fixed effects model in column 4, which accounts for the country and year-specific effects on the response variable. So, the initial discussion is primarily based on the findings from the year-FE model, which demonstrate that all coefficients achieve an acceptable level of statistical significance.

Based on the findings in Column 4, this study reveals that trade openness has a positive impact on manufacturing growth by facilitating the manufacturing process and stimulating investment. Trade serves as a crucial channel for transferring technology and knowledge, primarily through import and export activities, thereby enhancing manufacturing organizations' capabilities and growth prospects. Empirical analysis indicates that a 1% increase in the trade-to-GDP ratio leads to a 0.046% increase, on average, in manufacturing value added to GDP. These results align with established theories of trade and growth, such as the neoclassical models of Harrod-Domar and Grossman & Helpman (1990). Based on these theories, it can be concluded that trade openness facilitates manufacturing growth by enabling efficient resource allocation, providing access to a wider range of primary and intermediate raw materials, goods, and capital equipment, driving productivity improvements, and fostering access to advanced production technologies. A more open economy offers domestic manufacturers a larger market with an enhanced variety of goods, promoting manufacturing growth.

Table 3.

OLS, Random Effects and Fixed Effects Estimations for Linear Model
Dependent Variable: Manufacturing Growth

VARIABLES	(1) OLS	(2) RE	(3) FE	(4) Year-FE	(5) 2SLS-FE
Trade Openness (TO)	-0.0383***	0.0470***	0.0495***	0.0455***	0.0688***
	(0.0117)	(0.00589)	(0.00592)	(0.00629)	(0.0181)
Tariff Rate (TR)	0.152***	-0.0395	-0.0570	-0.0891**	-0.100**
	(0.0484)	(0.0362)	(0.0366)	(0.0371)	(0.0437)
Financial Development (FD)	0.000322***	0.0184***	0.0151**	0.0308***	0.0270***
	(7.66e-05)	(0.00620)	(0.00633)	(0.00783)	(0.00978)
Foreign Direct Investment (FDI)	0.122*	0.0417**	0.0392**	0.0367*	0.0188
	(0.0628)	(0.0196)	(0.0194)	(0.0194)	(0.0228)
Control of Corruption (CC)	-0.521	1.298***	1.456***	1.356***	1.198**
	(0.328)	(0.435)	(0.446)	(0.458)	(0.492)
Foreign Exchange Reserve (FR)	0.557***	-0.315**	-0.394***	0.778***	0.679**
	(0.150)	(0.144)	(0.147)	(0.283)	(0.300)
Constant	0.499	16.88***	19.01***	-6.985	
	(3.804)	(3.650)	(3.577)	(6.451)	
Observations	603	572	572	572	535
R-squared	0.137		0.190	0.229	0.222
Country Effect	No	No	No	Yes	Yes
Year Effect	No	No	No	Yes	Yes
Modified Wald (p-value)			0.0000	0.0000	
Pesaran CD (p-value)			0.0482	0.1361	
Anderson canon. corr. LM statistic/ p-value					68.15/0.0000
Cragg-Donald Wald F statistic					18.78
Sargan over-identification test statistic/ p-value					0.890/0.8279
Number of countries	35	35	35	35	35

Note: In parentheses std. errors are reported. *, ** and *** imply the statistical significant level of the estimators at the 10%, 5% and 1%, respectively. Hausman Specification test findings Prob>chi2 = 0.00078.

The control variables in our analysis exhibit the expected signs and are statistically significant. Specifically, the tariff rate (TR) has a negative effect on manufacturing growth. The results indicate that a 1% increase in the tariff rate leads to a decline in manufacturing value-added by 0.089%, on average. This finding aligns with theoretical foundations (Kwon, 2013; Furceri et al., 2018) that highlight how tariffs increase business costs and reduce manufacturing output and exports, thereby increasing default risk. Financial development (FD) has a positive and robust significant impact on manufacturing growth, with a coefficient of 0.0308. This result is consistent with previous studies by Raphael & Gabriel (2015), Ahad et al. (2008), and Aminu et al. (2019) that emphasize the positive association between domestic credit availability and manufacturing growth. Foreign direct investment (FDI) also shows a positive effect on manufacturing growth across different models. The injection of FDI into the economy reduces production costs and brings technological advancements, leading to increased manufacturing activities and output. A 1% increase in FDI inflows would raise manufacturing value-added by 0.037%. This positive relationship between FDI and output growth is supported by studies by Potterie and Lichtenberg (2001), Castejón and Wörz (2006), Govindaraju and Gopi (2009), and Doytch and Uctum (2011). Additionally, the control of corruption (CC) variable exhibits the expected positive sign, indicating that countries with better control of corruption facilitate firm performance, innovation, and cross-border trade. A 1 unit increase in the control of corruption indicator corresponds to a 1.36 unit increase in manufacturing value-added. This finding is consistent with research by Kaufmann and Wei (1999), Groot et al. (2004), and Athanasouli and Goujard (2015) that emphasize the positive impact of reduced corruption on various economic activities. Lastly, foreign exchange reserves (FR) have a positive impact on manufacturing value-added. A 1% increase in foreign exchange reserves leads to a rise of 0.778% in manufacturing value-added. This effect is economically plausible, as higher reserves attract FDI and contribute to export-led growth in the manufacturing sector (Polterovich & Popov, 2003). Empirical studies by Fukuda & Kon (2010) further support the notion that foreign reserve accumulation enhances investment, manufacturing, and overall economic growth.

While the econometric approach in Columns 3 and 4 shows a positive impact of trade openness (TO) on manufacturing growth (MG) based on the fixed effects (FE) estimates, it is premature to accept these conclusions due to several unresolved issues fully. These issues include potential measurement errors, omitted variables, endogeneity of the main explanatory variables, and the presence of simultaneous causality between TO and MG. It is important to address these issues to arrive at robust and conclusive findings. Furthermore, the trade-growth literature, as highlighted by Jung & Marshall (1985), Rodrik (1997), Berg (1996), and Harrison (1996), reports a bi-directional effect of trade on growth, adding complexity to the relationship. To tackle these challenges, we employ an instrumental variable approach by using specification (3) based on the trade and growth hypothesis to address endogeneity and establish a more rigorous analysis. The equation is as follows.

$$TO_{jt} = \alpha_1 GG_{jt} + \alpha_2 TF_{jt} + \alpha_3 ES_{jt} + \alpha_4 NR_{jt} \quad (3)$$

In our study, we consider the variables GG (good governance), TF (trade freedom), ES (size of the economy), and NR (natural resources rent) to examine their influence on trade openness (TO) and manufacturing growth. We argue that the process of instrumenting TO is valid for several reasons. Firstly, our selected instruments are appropriate and relevant. Factors such as good governance, trade freedom, a larger economy, and abundant natural resources are expected to impact trade openness positively. For instance, economies with higher levels of voice and accountability tend to have more effective trade policies and regulations, attracting greater trade activities (Mbogela, 2019). Additionally, a larger economy, proxied by GDP per capita, is found to have a significant positive impact on export performance (Roy & Xiaoling, 2020), thereby encouraging participation in international trade (Banik & Roy, 2020). Furthermore, economies with abundant natural resources are theoretically more open to international trade (Majumder et al., 2019). Secondly, our selected instruments are exogenous to errors in the model and only influence manufacturing growth through trade openness. Lastly, our model meets the requirements of under-identification, weak identification, and over-identification tests. We confirm the endogeneity of TO through the Davidson-MacKinnon test of exogeneity (F statistic 3.94, p-value 0.0478), as well as the Durbin–Wu–Hausman test, which shows the significance of the coefficient of residual. Therefore, we proceed to run a two-stage least squares (2SLS) fixed effects regression for our baseline model and present the findings in Column 5. The results support our hypothesis that trade openness promotes manufacturing growth. Compared to the baseline fixed effects model (Table 3, Column 4), the estimate of TO is quantitatively larger but similar in sign and level of significance. Specifically, a 1% increase in trade over GDP raises the manufacturing value-added (MVA) over GDP ratio of Asian economies by approximately 0.067 percentage points. This positive growth effect of trade openness aligns with the Harrod–Domar neo-classical growth model and our baseline estimation findings.

To ensure the robustness of the findings regarding the positive relationship between trade openness (TO) and manufacturing growth, we employ the fixed effects (FE) and instrumental variable-fixed effects (IV-FE) models on linear and static panel data regression (Equation 1). In order to further enhance the analysis, we extend the baseline static model to a dynamic specification using the widely accepted difference-GMM estimation technique proposed by Arellano & Bond (1991) and the system-GMM estimation technique introduced by Blundell & Bond (1998). The use of the GMM estimator is particularly suitable for our study due to the panel dataset's characteristics, with a large cross-section (N=35) and limited time length (T=19), fulfilling the essential requirements for applying the GMM technique. Additionally, the GMM estimator effectively addresses issues of endogeneity arising from bi-directional causality, unobserved country-specific heterogeneity, heteroskedasticity, and serial autocorrelation. To perform the GMM estimation, we employ appropriate instruments derived from the dataset, utilizing lagged differences for the level equation and lagged levels for the first difference equation, as Greene (2002) suggested. The dynamic specification of the static model (Equation 1) can be represented by the following equation where one period lag of manufacturing growth variable (MG_{jt-1}) is used as an explanatory variable.

$$MG_{jt} = \beta_0 + \lambda MG_{jt-1} + \beta_1 TO_{jt} + \beta_2 TB_{jt} + \beta_3 FD_{jt} + \beta_4 FDI_{jt} + \beta_5 CC_{jt} + \beta_6 FR_{jt} + u_j + v_t + \varepsilon_{jt} \quad (4)$$

Table 4 presents the results obtained from the dynamic growth framework using two-step difference and system GMM estimators. The sys-GMM estimator, which includes previous instruments and lagged differences of control variables, is considered more acceptable than the diff-GMM estimator in terms of standard deviation, indicating greater accuracy and robustness of the fitted values (Arellano & Bover, 1995; Blundell & Bond, 1998). Therefore, our discussion of the results in this section primarily relies on the sys-GMM estimators. Additionally, we address the presence of heteroskedasticity in our static fixed effects (FE) estimation by applying the Driscoll-Kraay (1998) technique to correct the standard error of the FE estimators. The results of the Driscoll-Kraay FE estimation for Equation 2 can be found in Column 1 of Table 4.

Consistent with our expectations and previous findings, all three models demonstrate a significant positive impact of trade openness (TO) on manufacturing growth. This result remains stable when compared to the results obtained from our static fixed effects (FE) and two-stage least squares (2SLS)-FE models. Although the coefficient of the trade barrier is still negative in the dynamic estimation, it is not statistically significant. Furthermore, the system generalized method of moments (GMM) estimator reveals that financial development (FD) has a positive and statistically significant effect on growth at a 1% level. The coefficient of 0.00783 indicates that a 1% increase in FD leads to a 0.0008% increase in manufacturing growth, consistent with our previous findings and the existing literature.

On the other hand, both the difference and system GMM estimations indicate a negative impact of foreign direct investment (FDI) on manufacturing growth, but the coefficient fails to achieve statistical significance at least at a 10% level. While the static FE and 2SLS-FE estimations demonstrate a positive relationship between control of corruption (CC) and manufacturing growth, the GMM estimations reveal an opposite sign for the corruption parameter, which is statistically significant at a 5% level. This negative effect of corruption aligns with existing literature. Similar to previous static models, foreign exchange reserves (FR) have a positive and significant effect on manufacturing growth at a 5% level, indicating that the accumulation of reserves promotes the growth of the manufacturing sector. To ensure the validity of the GMM estimator, we performed two diagnostic tests as suggested by Roodman (2011). The Arellano-Bond test for serial correlation shows significant first-order (AR1) serial correlation in the residual but insignificant second-order (AR 2) correlation, confirming that the autocorrelation assumptions are satisfied. The over-identifying restriction test, assessed through the Sargan and Hansen test, indicates a p-value higher than the 10% level, confirming the validity of the over-identification restriction assumption in both GMM estimation techniques.

Table 4.

Robustness check with Driscoll-Kraay (S.E), two-step difference and system GMM
Dependent Variable: Manufacturing Growth

VARIABLES	**(1) Driscoll-Kraay S.E**	**(2) Diff- GMM**	**(3) Sys-GMM**
Trade Openness (TO)	0.0455***	0.00800**	0.00525**
	(0.00739)	(0.00343)	(0.00241)
Tariff Rate (TR)	-0.0891***	-0.00779	-0.00203
	(0.0321)	(0.0210)	(0.0176)
Financial Development (FD)	0.0308***	-0.00201	0.00783***
	(0.00580)	(0.00307)	(0.00249)
Foreign Direct Investment (FDI)	0.0367	-0.0102	-0.000854
	(0.0362)	(0.00897)	(0.0137)
Control of Corruption (CC)	1.356***	-0.656**	-0.361**
	(0.376)	(0.254)	(0.135)
Foreign Exchange Reserve (FR)	0.778***	0.224*	0.144***
	(0.267)	(0.122)	(0.0457)
Manufacturing Growth (t-1)		0.905***	0.864***
		(0.0304)	(0.0252)
Constant	-9.951		-2.052*
	(6.727)		(1.1096)
Observations	572	492	527
Number of country	35	35	35
AR (1)		0.021	0.003
AR (2)		0.437	0.200
Sargan Test (*p*-value)		0.117	0.114
Hansen Test (*p*-value)		0.310	0.746
Instruments/groups		30/35	35/35

Notes: In parentheses std. errors are reported (Column 3 reports robust std. errors). Two-step difference GMM and system GMM estimator results are reported. *, ** and *** imply the statistical significant level of the estimators at the 10%, 5% and 1%, respectively.

Non-Linearity between Trade Openness and Manufacturing Growth

The study initially explores the non-linear relationship between trade openness (TO) and manufacturing growth using fixed effect estimation, controlling for year and country effects, in the modified production function Equation 3. Considering the endogeneity of TO, the study employs 2SLS-FE regression techniques with a similar instrumental variable set to estimate the effects. Additionally, diff-GMM analysis is used to account for heterogeneity, autocorrelation, endogeneity, and heteroskedasticity, using independent variables and lagged values of manufacturing growth (MG), total factor productivity (TF), education spending (ES), and natural resources (NR) as instruments. The findings from FE, 2SLS-FE, and GMM estimations are reported in Table 5. Table 5 demonstrates that trade openness has a positive effect on manufacturing growth with an acceptable level of statistical significance, consistent across all estimation techniques. The coefficients for the tariff rate indicate a negative impact on manufacturing value-added growth, and they are statistically significant (except in the GMM estimation) at the 5% level, confirming the expected negative association between trade barriers and manufacturing growth. The control variables show expected findings in FE estimation, with the same sign and level of significance as the baseline results on Table 3, Column 4. While foreign reserve is only significant in the GMM estimator, the positive sign of the remaining control variables' estimators confirms the expected positive relationship between financial development, foreign direct investment, control of corruption, and manufacturing growth.

Table 5

Non-linear relationship between TO and MG: FE, 2SLS-FE and panel GMM

Dependent Variable: Manufacturing Growth

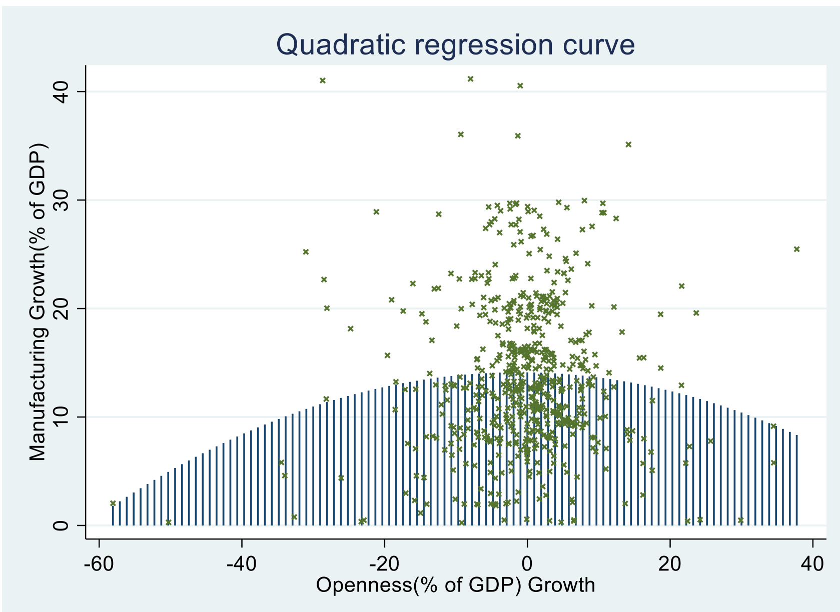
	(1)	(2)	(3)
VARIABLES	**Fixed Effects**	**2SLS-FE**	**Panel GMM**
Trade Openness (TO)	0.0790***	0.158***	0.0429**
	(0.0169)	(0.0558)	(0.0164)
Trade Openness Squared (TO^2)	-0.000160**	-0.000475**	-0.000165***
	(7.52e-05)	(0.000235)	(5.70e-05)
Tariff Rate (TR)	-0.0880**	-0.0979**	-0.0134
	(0.0370)	(0.0428)	(0.0170)
Financial Development (FD)	0.0328***	0.0363***	0.00235
	(0.00786)	(0.00872)	(0.00269)
Foreign Direct Investment (FDI)	0.0353*	0.0221	0.00453
	(0.0193)	(0.0209)	(0.0109)
Control of Corruption (CC)	1.234***	0.848	0.0245
	(0.460)	(0.539)	(0.233)
Foreign Exchange Reserve (FR)	0.891***	0.977***	0.382**
	(0.287)	(0.335)	(0.177)
Manufacturing Growth (t-1)			0.850***
			(0.0376)
Constant	-14.31**		
	(7.281)		
Observations	572	535	499
R-squared	0.235	0.212	
Year Effect	Yes	Yes	Yes
Country Effect	Yes	Yes	Yes
AR (1) (*p*-value)			0.021
AR (2) (*p*-value)			0.568
Sargan Test (*p*-value)		0.3904	0.246
Hansen Test (*p*-value)			0.401
Anderson canon. corr. LM statistic/ *p*-value		51.869/0.0000	
Cragg-Donald Wald F statistic		13.745	
No. of instruments/Groups			33/35
Number of countries	35	35	35

Notes: In parentheses, standard errors are reported (Column 3 reports robust std. errors). Panel GMM refers to the two-step Arellano-Bond (1991) difference GMM. *, ** and *** imply the statistically significant level of the estimators at the 10%, 5% and 1%, respectively.

The coefficients of trade openness (TO) and its squared term (Squared-TO) are the main focus of this analysis. The fixed effects estimators indicate that trade openness is a significant determinant that positively impacts manufacturing growth in Asian economies. This result holds true for both the 2SLS and diff-GMM estimation approaches. However, it is important to consider the average value of trade openness (TO) and its squared term (TO^2) together. The findings from all three regression models presented in Table 5 consistently demonstrate that the relationship between trade openness and manufacturing growth is non-linear. As trade flows (% of GDP) increase, the positive marginal effect on manufacturing value added is observed up to a certain level. Beyond that level, the marginal impact of trade openness turns negative, assuming a fixed quality of the product basket. The estimated coefficients of TO and TO^2 and their statistical significance provide evidence of this quadratic relationship. This quadratic behavior is further supported by the graphical representation of the quadratic regression curve between manufacturing value added and the growth of trade openness. Figure 1 shows the non-linear relationship between trade openness and manufacturing value-added growth, indicating a threshold beyond which the impact of trade openness on manufacturing growth diminishes.

Figure 1

Non-linear relationship between TO and manufacturing growth



The results of the regressions in Columns 1, 2, and 3 of Table 5 reveal that trade openness (TO) has a positive effect on manufacturing growth, albeit with a maximum threshold. Beyond this threshold, the estimated effect turns negative yet remains statistically significant. This implies that while increasing trade openness at lower levels can stimulate growth in the manufacturing sector, there is a point at which further expansion of trade no longer leads to manufacturing growth. The findings suggest that openness may have detrimental effects on manufacturing growth when economies specialize in producing inferior, quality goods. However, trade openness enhances the manufacturing sector when economies possess the capability and specialization to produce superior, quality goods that meet the international community's standards. This result aligns with the notion that the impact of trade openness on manufacturing growth is contingent upon the quality of exported goods, with higher-quality goods having a more pronounced effect (Huchet et al., 2018). The non-linear relationship between manufacturing growth and trade openness can be expressed through the following quadratic mathematical expression, which provides a theoretical basis for the observed results in this study.

$$MG_{jt} = \beta_1 TO_{jt} + \gamma_1 (TO)^2_{jt} \quad (5)$$

According to the coefficients β_1 and γ_1 presented in Table 5 (Column 2), the partial derivative (∂MG/∂TO) allows us to determine the maximum level of trade openness (TO) that leads to the highest manufacturing sector growth (MG), which is approximately 166.32% of GDP[1]. This means that Asian economies are expected to experience higher growth in the manufacturing sector when the trade value (total export and import as a percentage of GDP) reaches around 166.32 points. On the other hand, the minimum level of openness required for the impact of trade openness to start being positive is found to be 13.14% of GDP[2]. This implies that a certain level of trade openness is necessary for positive effects on manufacturing growth to emerge. Comparing the threshold level (166.32) with the mean of trade openness (81.98) from Table 1, it suggests that countries that have not yet reached the maximum point of openness can still expect trade openness to strengthen manufacturing growth. This reasoning aligns with the notion that as countries increase their level of trade openness, they gain access to larger markets, technological spillovers, and the opportunity to specialize in manufacturing goods of higher quality and value, which fosters economic growth and development.

Economic reasoning supports the idea that trade openness can enhance the manufacturing sector in several ways. By allowing countries to participate in global trade, trade openness promotes efficiency gains through specialization and comparative advantage. It enables access to a broader range of inputs, technologies, and ideas, stimulating innovation and productivity growth. Additionally, increased trade openness can attract foreign direct investment (FDI), facilitate knowledge transfer, and create economies of scale, all of which contribute to the expansion of the manufacturing sector. Therefore, the finding that higher levels of trade openness lead to increased manufacturing growth aligns with the theoretical and empirical understanding of the benefits of international trade for economic development.

CONCLUSIONS AND POLICY RECOMMENDATIONS

This paper analyzes the effects of trade openness on the manufacturing growth of 35 Asian countries from 2004 to 2022. To address key questions in international economics, we employ a linear regression model and utilize both fixed effects (FE) and two-stage least squares with fixed effects (2SLS-FE) estimation methods. The study examines whether trade openness (TO) facilitates manufacturing growth and investigates whether the relationship between openness and manufacturing growth is non-linear. The findings from the FE and 2SLS-FE methods confirm the hypothesis that trade openness has a positive and significant impact on manufacturing sector growth in the selected region. Additional analyses using two-step difference and system generalized method of moments (GMM) estimators strengthen the robustness of this finding.

Furthermore, a non-linear regression model is introduced to explore whether the relationship between trade openness and manufacturing growth exhibits a non-linear pattern. The FE estimators initially demonstrate that trade openness is a significant determinant that positively influences the manufacturing growth of Asian economies, and this result is consistent across the 2SLS and GMM estimation approaches. However, the negative and statistically significant coefficients of the trade openness squared term (TO^2) across different models (FE, 2SLS-FE, and GMM) indicate a non-linear relationship between trade openness and manufacturing growth, characterized by an inverted U-shaped curve. The results suggest that an increase in

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[1] $MG_{jt} = 0.158TO_{jt} - 0.000475\ (TO)^2_{jt} \Rightarrow \partial MG_{jt}/\partial TO_{jt} = 0.158 - 0.00095TO_{jt} = 0 \Rightarrow TO_{jt} = 0.158/0.00095 = 166.32$

[2] As TO_{jt}= 166.32, thus, f(TO)= $0.158TO_{jt} - 0.000475\ (TO)^2_{jt} \Rightarrow f(166.32)$= 13.14 (approx)

trade flows as a percentage of GDP has a positive marginal effect on manufacturing value added up to a certain level. However, beyond this threshold, the marginal impact of trade openness turns negative. This implies that while low levels of trade openness promote manufacturing growth, an excessive expansion of trade does not necessarily lead to further growth in the sector. The estimate suggests that openness might have an adverse impact on manufacturing growth when economies specialize in producing low-quality goods. On the other hand, when economies possess the capability and specialization to produce high-quality goods that meet international standards, trade openness positively enhances the manufacturing sector. This finding aligns with the idea that the higher the quality of exported goods, the greater the impact of trade on manufacturing growth (Huchet-Bourdon et al., 2018).

Based on these results, it is recommended that Asian economies focus on specialization in the trade of high-quality goods to maximize the benefits of openness for the growth of the manufacturing sector. This strategic approach would allow economies to capitalize on the positive effects of trade openness while ensuring that their export baskets meet the required standards and quality demanded by the international community. This strategy would enable economies to enhance the impact of trade on manufacturing growth and foster sustainable economic development.

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