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Non-Linear Impact of Textile and Clothing Manufacturing on Economic Growth: The Case of Top-Asian Economies

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Abstract
The potential contribution of the textile sector is not limited to the local economy but it also represents a country's image in the global market. It carries the initial boom for most emerging nations in their journey towards improved economic growth. The present study employs Quantile on Quantile regression, which is a unique methodology and has the tendency to establish the relationship between variables that are non-linear in nature across various quantile distributions. Moreover, the method stated helps in explaining the asymmetric response in the quantiles of economic growth of the countries studied caused by the quantiles of the textile and clothing industry. The quarterly data ranges from 1990 to 2018, and findings therefrom endorse the presence of a positive relationship between TTC and economic growth in all Asian Countries studied. In addition to this, the direction of the relationships in the quantiles was also evaluated by Granger causality, which revealed the presence of bidirectional causal effects in all countries, excluding Japan, Pakistan and Turkey, where it was found as uni-directional. Lastly, based on the findings, the government and policy making institutions are recommended for the introduction of certain programs that will incentivize and provide subsidies to potential investors, thus relaxing the competition for new entrants in the TTC sector.

Key words: *textile and clothing manufacturing, economic growth, Asian economies, quantiles.*

Introduction

The development of a country's economy vastly relies on industrial growth. The role of industrialisation is substantial to encourage local and international investment in the economy, leading to generating development spillovers and enhancing the country's economic growth. The benefit of industrial progress is associated with its contribution to enhancing productivity, followed by increased prosperity in the country [2]. To avail sustained growth, countries are required to identify key industries that can benefit diverse income groups, contain higher machinery output, show lower expenditures, and have room for technological adoptions [3].

The textile sector is considered the backbone of a country's course of development. The textile and apparel industry plays a substantial part in the industrial progress of nations as it offers tools to actualise economic stability. The significance of this sector towards the nourishment of humankind as well as social and economic progress is extensively highlighted in existing literature [4]. The benefits of the textile industry are linked to the industry's potential for increasing manufactured exports and foreign exchange, which could lead to augmenting a country's economic growth, particularly in low-income nations [5]. Likewise, the socio-economic assistance of the textile industry is attributed to its tendency to increase employment amongst low-income groups and offer business opportunities to skilled individuals, especially females [6]. It also encourages human mobility from rural to urban areas in search of jobs and commercial opportunities, leading to enhancing capital mobility in the economy and strengthening poverty alleviation [7-8].

The textile sector does not only benefit the local economy but also assists in integrating the country's economy with the World's. It carries an initial boom for most emerging nations in their journey towards improved economic growth. The simplicity of entry into this field and the anomalous high wages in advanced nations have made positive conditions for businesses to enter the low cost textile sector in emerging nations. In this regard, emerging nations together have accumulated more than half of global textile export [5]. Given the labor-intensive propensity of the textile industry, the emphasis of numerous developing countries is centered on expanding the regional and global integration of the textile sector to intensify its benefits for labour abundant emerging economies. Several Asian economies dominate the textile industry around the World. In terms of manufacturing as well as exports, the textile industry of China is the largest in the world, encompassing an export turnover of 266.4 billion dollars. Moreover, the countries of India, Bangladesh, Hong-Kong, Vietnam, Pakistan and Japan also hold noticeable positions in textile manufacturing and export around the globe. The influential factors that help to sustain the Asian economies' international textile dominance are attributed to their cheaper manufacturing, labour-extensive industrial structure, quality of material, labour productivity and technological adaptions [9].

Considering the aforementioned advantages and contribution made by the textile sector in the economic development and stability of a country, the present study is motivated to investigate the nonlinear relation between textile & clothing and the

economic growth of top Asian economies that contain an advanced textile sector. The countries selected include China, India, Bangladesh, Vietnam, Pakistan, Turkey, South Kora, Hong Kong, Indonesia and Japan. Since most of the economies studied in the present investigation have high reliance on their textile products and generate major revenues from their exports, despite being highly competitive because of having similar operating conditions, including industrial infrastructure in general and labour and workforce conditions in particular, a slight improvement in the policies enforced may result in greater competitiveness along with increased revenue generation. Similarly, the economic conditions of developing economies are also vulnerable to currency fluctuations, political conditions, and trade wars, which can disrupt the linear relation between the variables and provide room for non-linear behaviours in the time-series. In response, the present study has employed Quantile on Quantile regression, which is a unique methodology and capable of recognising non-linear relationships among the variables studied in numerous quantile distributions. Moreover, to the best of the authors' knowledge, the present study is the first of its kind in identifying the nonlinear relationship between textile and economic growth across numerous quantiles. Moreover, as opposed to the traditional approach of recognising linear causality, the current study is also unique in evaluating the causality between the textile-growth link overall as well as eleven different quantiles of the distribution. Therefore, by employing the aforementioned method, the pioneered asymmetric behaviour can be established among the quantiles of TTC and economic growth in the context of Asian countries.

In other words, the findings of the present will help in establishing a presence of a relation that is non-linear in nature among the TTC and economic development. Moreover, the findings from the present study will contribute to the literature by identifying the exclusive conditions and properties of the market which strengthen and/or deteriorate the relationship between TTC and economic development. Moreover, the present study offers various policy implications based on the findings which will help government institutions in exploring the potential contribution of the TTC sector to the economic development of the country. The remainder of the study is arranged as follows: The next section presents a review of the relevant literature which summarises the foundations for the nature and type of relationship among the variables studied, followed by a section which discusses the methodology employed, with subsequent estimations, the generation of findings based thereupon, and their respective discussion and interpretations, whereas the last section concludes by offering various policy implications, along with recommendations accordingly.

Literature review

Theoretical background

The era of industrial revolution emerged in the 18th century and emphasised the significance of specialisation in the sectors that can avail economy of scale, mass production and skill spillovers to boost economic development [10]. The first industrial revolution was initiated in Britain; however, it rapidly spread around the World, with initial focus on iron, coal and textile, leading to increased exports in the specialised industrial sectors [11-13]. The notion behind industrial revolution tended to encourage agricultural economies to focus on industrialisation and urban development [14]. Since then, the benefits of industrial revolution have improved economies in terms of technological, socio-economic and cultural aspects. Moreover, the psychological advantage that resulted from industrial revolution is attributed to a country's confidence in its ability to utilise resources and master the production process to deliver utmost efficiency.

Theoretically, the industrial process is advanced through multiple factors that ultimately carry a positive impact on a country's growth. In this regard, the classical growth theory of Adam Smith emphasised the production side, stating that labour productivity and augmented trade resulting from specialisation and rising returns to scale led to improved economic growth [15-17]. Since the textile and garment industry in several Asian economies is labour-intensive, the supreme focus of the governments on labour productivity, trade revenues generated from textile exports and economies of scale enable those countries to achieve product quality leading to amplified growth. Moreover, the benefit of textile to the economy is also translated through generating greater employment opportunities, particularly in several emerging economies. In this regard, a country's focus on trade policy is also crucial by placing higher emphasis on export competences to uphold the capabilities of job creation in the textile sector.

With time, the improvement in textile processes, labour skills and technological innovations lend support to the concept of the endogenous growth model, stressing the nourishment of human capital, technical progress and free-market trade [18-19].

Empirical studies

Several studies in the existing literature analysed the significance of industries, such as manufacturing [20-22], agriculture [23-25], transportation [26-28], mining [29-31], telecommunications [32, 33] etc. for economic development. However, the role of TTC in influencing EG is scarcely examined in the current literature. Moreover, Islam, Khan and Islam [34] stated that the strength of textile growth is largely influenced by other aspects, such as global recession, that negatively impact growth. Also, the study found that unfavourable trade policies with greater inclination to imports negatively affect the influence of textile on growth. Moreover, the high cost of production and energy also affects textile manufacturing and thus varies the magnitude of its impact on the country's growth process.

Despite the recent emphasis on disaggregate industrial advancement and its changing impact on a country's growth process, only a limited series of literature has discussed the impact of the textile sector on economic development. Among them, Makinde et al. [4] studied the relationships between textile industry growth and the economic development of Nigeria. Relying on the method of data collection through archives, print media, interviews and electronic media, the outcome of the study concluded that declining trends in the textile industry have a negative impact on Nigeria's growth process. Specifically, the results highlighted that the import of textile products, technological limitations, agricultural collapse and power shortages are the key factors that deteriorate the Nigerian textile sector, having adverse effects on the country's economic growth.

For Bangladesh, Hasan et al. [35] examined the role of the textile industry in affecting the economic growth of the

country. In doing so, the authors used data from the period of 2004 to 2014. The findings of the study were that the textile sector of the country plays a crucial part in the country's economic development by increasing the country's export revenue by 85 percent and providing job opportunities for 1.5 million people. Similarly, Keane and te-Velde [5] examined the link between the textile sector and economic growth in thirty-two emerging countries. The results of the investigation allowed to conclude that the textile and garment sector is significant in influencing countries' development. The study established that in the short-term, the positive impact of the textile sector is attributed to generating more jobs and foreign investment. However, in the long-term, the textile industry, along with investment, and institutional and government policies, can boost the economic growth of developing economies.

In China, Chan and Au [36] studied the factors influencing the textile export of the country from the period of 1985 to 2004. The outcome of the study established that the economic growth of the country measured by GDP and GDP per capita is significant to improve Chinese textile export. Besides this, the results reported the significant impact of the exchange rate in conducting the country's textile export, stating that devaluation of domestic currency is likely to carry a positive impact on textile industry exports from China.

Linking the textile industry to financial development, Cuyvers, Soeng and Vanden Bulcke [37] analysed the link between foreign investment in textile and the garment industries of Cambodia in affecting the country's development, output and global competitiveness. To do this, the authors utilised data from the period 1994 to 2001. The outcome of the empirical results reported that improvement in the country's comparative advantage is much more closely linked to foreign investment in the garment industry than to investment in the textile sector. Similar results are reported for improvement in the exports of the country. In another study, Hanif and Jafri [38] examined the association between financial advancements and textile growth in Pakistan. In doing so, the study utilised data from the period of 1974 to 2004. The outcome of the investigation stated that foreign investment plays a crucial role in boosting the country's textile sector and can bring a positive effect on economic growth. Specifically, the findings documented that external finance is significant in influencing textile growth in Pakistan and has a positive impact on the growth process.

Likewise, Chan, Au and Sarkar [39] analysed the contributing factors of textile export in India. In doing so, the study utilised data from the period of 1985 to 2005. The outcome of the study reported that population growth is significant in influencing Indian textile export. Moreover, the growth of the Indian economy measured by GDP and GDP per capita also had a positive impact on the country's textile exports. Finally, from the results for the exchange rate, it was established that the devaluation of local currency augments textile export by offering cheaper textile goods to exporters.

In Vietnam, Vu and Pham [40] studied the textile industry and its comparative advantage over the competitive Chinese textile sector. Utilising the Generalized Double-Diamond Approach, the findings stressed that the global competitiveness of Vietnam is lower than that of the Chinese industrial sector in terms of associated industrial conditions and the Factor Environment. However, the findings supported the comparative advantage of Vietnam's textile sector through the improved textile and garment export and ease of business. The study concluded that by maintaining the strength of the Vietnamese textile sector and overcoming the associated industrial conditions and Factor Environment disadvantages, the country could substantially boost its economic growth through its textile industry.

Moreover, Sharma and Dhiman [41] studied textile trends in the Indian economy by focusing on the factors that can influence textile export in India. The outcome of the study reported that cost of labor is significant in influencing Indian textile export. Specifically, the results highlighted that an increase in labour cost resulted in declined export revenues. Besides this, the study found that economic growth is also significant to improve the export of the textile sector. Likewise, the results for the exchange rate established that an increase in the exchange rate is likely to enhance Indian textile export as it will allow the exporter to gain higher revenue through lower cost of textile purchases. Similarly, Tandon and Reddy [42], while investigating the textile industry of India, established that improvements in credit and labor skills could result in improved textile quality, which can enhance the tendency of the textile sector to augment economic growth of India.

Methodology

The present study employs a unique methodology of regression based on Quantiles-on-quantiles (QQ), as discussed by Sim and Zhou [43]. With the help of this technique, exact quantiles of TTC can be explored which significantly affect the quantiles of economic growth (GDP). The existence of a nonlinear relationship between TTC and GDP in earlier investigations justifies the application of the QQ approach for the purpose of explaining the relation between the variables studied. In comparison, the computation of Ordinary Least Square Regression revolves around assumptions and generates results based on information derived from particular values. Moreover, this makes it more complex to explain the relationship on the basis of a coefficient based on the mean. The data are comprised of multiple components, hence QQ regression is appropriate in terms of explaining relationships at different component levels of data of the variables studied [43].

The conventional method of quantile regression has the limitation of explaining and predicting the effects of the independent variable (IV) at different quantile levels of the dependent variable (DV), which results in unexplained variation. The present methodology of QQ regression, as discussed by Sim and Zhou [43], is an extension of the earlier quantile regression, which has the capability of addressing unexplained variation. It actually is the combination of typical initial quantile prediction and non-parametric assumptions. Moreover, it explains the variation in greater detail by evaluating the effects of the quantiles of the IV with the quantiles of the DV, thus explaining the relationships at different quantile levels of both IV and DV, which is further helpful in explaining the problem of interdependency.

In the present study, the one model approach discussed and proposed by Sim and Zhou [43] is employed, which itself is based on explaining the different levels of situations. Therefore, based on the demonstration of the τ-quantile of the GDP, which is based on quantile quali-

Table 1. *Results of descriptive statistics.* ***Source:*** *Own estimation.* ***Note:*** *TTC = Textile and clothing, EG = Per capita of gross domestic product.*

Countries	Mean	Min	Max	St. Dev	JB-Test	P-Value
Panel A: TTC						
Bangladesh	38.385	19.798	51.043	9.556	11.318	0.000
China	11.183	9.975	14.793	1.393	61.787	0.000
Hong Kong	22.345	4.703	35.970	7.746	15.485	0.000
Indonesia	14.108	9.786	21.339	3.549	30.397	0.000
India	10.499	7.193	15.474	2.434	28.636	0.000
Japan	2.850	1.585	4.744	1.144	35.203	0.000
South Korea	7.173	3.463	13.816	3.499	32.857	0.000
Pakistan	29.244	26.129	33.329	2.786	14.634	0.000
Turkey	17.590	14.344	26.577	2.704	371.298	0.000
Vietnam	17.512	9.812	21.828	3.935	20.807	0.000
Panel A: EG						
Bangladesh	671.624	411.165	1203.216	232.755	41.040	0.000
China	3256.093	729.161	7754.962	2205.333	37.306	0.000
Hong Kong	27599.390	18251.020	38784.760	6530.385	34.372	0.000
Indonesia	2723.897	1707.818	4284.653	752.403	34.144	0.000
India	1105.309	575.502	2104.163	455.579	34.318	0.000
Japan	43327.920	38074.460	48919.560	2962.855	13.458	0.000
South Korea	17780.560	8464.937	26761.940	5647.178	24.042	0.000
Pakistan	919.442	742.013	1196.594	129.051	26.452	0.000
Turkey	9816.220	6709.091	15026.710	2630.620	35.218	0.000
Vietnam	1039.463	433.284	1964.476	457.400	25.450	0.000

ties, the following model is proposed, which shows the τ-quantile of TTC_t as an element of GDP_t explained by TTC_t.

$$GDP_t = \beta^{\tau}(TTC_t) + \mu_t^{\tau} \quad (1)$$

Since the present study has a single IV, which is TTC, there should also be a single equation. Moreover, as there is an absence of a historical record of the linkage between GDP-TTC, $\beta^{\tau}(.)$ is therefore considered as unknown. Moreover, the residual term is represented by μ_t^{τ} with a zero τ-quartile. Considering the Taylor extension of $\beta^{\tau}(.)$, around EXP^{τ}, the transformation into a linear equation is shown in ***Equation (2)*** below:

$$\beta^{\varphi}(TTC_t) \approx \beta^{\varphi}(TTC^{\tau}) + \\ + \beta^{\varphi'}(TTC^{\tau})(TTC_t - TTC^{\tau}) \quad (2)$$

Table 2. *Results of correlation between Textile & Clothing and Economic Growth.* ***Source:*** *Own estimations.*

Countries	Correlation	P-value
Bangladesh	0.923	0.000
China	0.952	0.000
Hong Kong	0.874	0.000
Indonesia	0.792	0.000
India	0.953	0.000
Japan	0.745	0.000
South Korea	0.882	0.000
Pakistan	0.943	0.000
Turkey	0.842	0.000
Vietnam	0.959	0.000

The dual indexing of $\beta^{\varphi}(TTC^{\tau})$ and $\beta^{\varphi'}(TTC^{\tau})$ in φ and τ denotes that both $\beta^{\varphi}(TTC^{\tau})$ and $\beta^{\varphi'}(TTC^{\tau})$ are functions of both φ and τ. Therefore, ***Equation (2)*** can be re-written as:

$$\beta^{\varphi}(TTC_t) \approx \beta_0(\varphi,\tau) + \\ + \beta_1(\varphi,\tau)(TTC_t - TTC^{\tau}) \quad (3)$$

By substituting ***Equation (3)*** into the initial model of QQ, we obtain:

$$GDP_t = \frac{\beta_0(\varphi,\tau) + \beta_1(\varphi,\tau)(TTC_t - TTC^{\tau})}{*} + \mu_t^{\tau}. \quad (4)$$

Lastly, since it is extremely critical to transmit data persistence in the situation involving the application of non-parametric methods, the selection of an appropriate bandwidth is also crucial. The bandwidth reflects the area across a particular region or goal, whereas the spread of the region summarises the overall trend and behaviour of the data; hence, it should be considered that if a shorter bandwidth is selected, it can generate comparatively higher coefficients with higher regions. Therefore, following the recommendations by Sim and Zhou [43], the present study selected the bandwidth as stated; hence, the measurement of the bandwidth is h = 0.05. Moreover, the QQ results in a structural break in the outcome, therefore the application of the QQ is extremely appropriate as it helps in explaining the relation between IV and DV at different levels, including high, medium and low. In the context of the present study, the relation between TTC and GDP can be better established because of the explanation across the different level of quantiles.

Results and discussion

In the present study, annual data of TTC were taken which represent the % of value added by manufacturing and per capita of GDP (in constant US$) for the Asian Countries that lead TTC exports and fall in top ten rankings. The data comprised yearly figures from 1990 to 2018. Moreover, by employing the quadratic match technique, the yearly data were transformed into data based on quarters. The aforementioned technique is highly recommended whenever there is a change in the frequency of the data, as in the present study, and is accordingly recommended in various other similar studies. Moreover, the data are extracted from the database managed by the World Bank. The natural logarithm of the values was taken so that the comparison of the variable studied becomes easier and a logical conclusion can be drawn accordingly.

Table 1 summarises results of the descriptive statistics, where the average of both variables studied i.e. TTC and GDP are found positive among all the countries studied. The highest mean value of TTC is shown by Bangladesh, which is 38.385%, followed by Pakistan, which has 29.244%, and Hong Kong – 22.345%. respectively. On the contrary, the lowest average TTC values are found for Japan (2.285%), South Korea (7.173%), and India (10.499%). China, Indonesia, Vietnam and Turkey have medium TTC values, which are 11.183%, 14.108%, 17.512 and 17.590%, respectively. Contrarily, the highest mean value for per capita of GDP is shown by Japan (43327.920%), followed by Hong Kong (27599.391%) and South Korea (17780.561%), whereas the lowest mean value of per capita of GDP is in the case of Pakistan (919.442), Vietnam (1039.463), India (1105.309) and Indonesia (2723.897). Moreover, a medium average value of per capita of GDP is in the case of Turkey (9816.220), China (3256.093) and Indonesia (2723.897). In addition, the findings of the JB test are also applied to confirm the normality of both TTC and GDP in all ten Asian textile exporting countries. The outcomes of JB t allow to conclude that both factors

show a non-normal distribution in all countries, representing a healthy existence of nonlinear relation in the dataset, which encourages to utilise various quantile estimates as it allows to achieve structural break, asymmetry and non-linearity in the framework.

Moreover, we examined the correlation between per capita of GDP and TTC among the countries studied. Estimations of correlation values among the variables studied are summarised in ***Table 2***. Values of the coefficient of the correlations are found to be significant at a 1% level of significance for all the countries, indicating a positive relation between EG and TTC in all top Asian countries. The highest correlational coefficient is found in the context of Vietnam (0.959), followed by India (0.953), and China (0.952), whereas the lowest correlational value is for Japan (0.745), Indonesia (0.792) and Turkey (0.842), respectively. Moreover, the medium value of correlation between textile manufacturing and economic growth is in the context of Pakistan, Bangladesh, South Korea and Hong Kong, with a coefficient of correlation of 0.943, 0.923, 0.882 & 0.874, respectively.

In the next step, a unit root test was applied across the quantiles to evaluate the stationary level among the variables studied of all the countries investigated. ***Table 3*** summarises the results of the unit root test on quantiles, summarising the alpha level denoted by the α(τ) value and t-stats value. Moreover, the table also summarises across the quantiles ranges, from 0.05 to 0.95, respectively. Findings from the unit root quantile confirm the absence of stationary across all the quantile levels among the variables studied. It implies that both TTC and GDP have different behaviour in terms of integration among all the ten Asian TTC manufacturing countries. On the other hand, the nonlinear relationship in a longer period of time was also evaluated by employing quantile cointegration among the TTC and GDP, the results of which are summarised in ***Table 4***. The table summarises the values of α and δ at 3 different levels of significance separately, which are 1%, 5% and 10%, respectively. The results confirm the presence of a nonlinear relation in the longer period of time among all the Asian TTC manufacturing countries studied. In the following stage, QQ regression was applied to evaluate the role of TTC manufacturing in GDP in the

Table 3. *Quantile unit root test.* ***Source:*** *Own estimation.*

Quantile	Bangladesh				China				Hong Kong				Indonesia				India			
	TTC		GDP		TTC		GDP		TTC		GDP		TTC		GDP		TTC		GDP	
	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats
0.05	0.924	0.053	0.896	-0.118	0.851	-1.439	0.912	-0.269	0.897	-0.538	0.916	-0.105	0.904	-0.341	0.902	-0.231	0.898	-1.613	0.924	0.622
0.10	0.924	0.161	0.903	-0.153	0.933	0.350	0.913	-0.327	0.904	-1.871	0.924	0.028	0.909	-1.495	0.908	-0.760	0.910	-2.257	0.923	0.834
0.20	0.921	-1.239	0.893	-2.568	0.914	-0.930	0.914	-2.247	0.902	-2.366	0.917	-0.668	0.912	-1.901	0.918	-0.465	0.907	-1.827	0.923	1.471
0.30	0.923	-0.413	0.899	-2.483	0.909	-1.768	0.916	-2.383	0.904	-2.173	0.920	-0.438	0.914	-1.704	0.914	-1.203	0.917	-1.988	0.921	1.489
0.40	0.922	-1.146	0.909	-1.857	0.910	-1.572	0.920	-1.421	0.904	-2.039	0.925	-1.112	0.918	-1.710	0.913	-1.818	0.918	-1.633	0.922	0.779
0.50	0.922	-2.450	0.910	-2.608	0.909	-1.454	0.921	-1.047	0.905	-2.191	0.920	-2.393	0.918	-1.770	0.912	-2.196	0.918	-1.852	0.921	-0.653
0.60	0.921	-1.350	0.908	-2.291	0.907	-1.480	0.921	-0.969	0.906	-1.047	0.920	-1.178	0.913	-1.847	0.912	-1.822	0.918	-1.911	0.919	-1.441
0.70	0.921	-2.030	0.899	-2.209	0.903	-1.767	0.920	-0.986	0.906	-1.391	0.918	-0.881	0.912	-1.806	0.912	-1.742	0.918	-2.030	0.916	-0.946
0.80	0.921	-1.867	0.872	-1.300	0.886	-1.828	0.924	0.373	0.907	-1.541	0.917	-0.663	0.914	-1.805	0.912	-1.070	0.908	-2.153	0.910	-0.423
0.90	0.922	-0.106	0.853	-0.745	0.904	-0.438	0.927	0.142	0.898	-1.821	0.902	-0.713	0.909	-0.741	0.919	-0.127	0.907	-0.899	0.820	-1.824
0.95	0.915	-0.636	0.797	-0.976	0.906	-0.259	0.923	-0.009	0.895	-0.617	0.897	-0.405	0.905	-0.509	0.877	-0.367	0.908	-0.622	0.701	-1.807
Quantile	**Japan**				**South Korea**				**Pakistan**				**Turkey**				**Vietnam**			
	TTC		GDP		TTC		GDP		TTC		GDP		TTC		GDP		TTC		GDP	
	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats	α(τ)	t-stats
0.05	0.926	0.061	0.908	-0.223	0.899	-0.589	0.902	-0.363	0.902	-0.406	0.924	0.013	0.895	-0.679	0.879	-0.582	0.932	0.306	0.909	-0.083
0.10	0.925	0.198	0.909	-1.347	0.917	-0.683	0.913	-1.283	0.901	-1.084	0.939	0.326	0.899	-0.923	0.883	-1.342	0.931	0.689	0.917	-0.378
0.20	0.924	0.845	0.916	-0.946	0.918	-0.897	0.916	-2.098	0.902	-1.923	0.923	0.044	0.901	-1.107	0.888	-1.700	0.922	-0.207	0.916	-0.608
0.30	0.924	0.561	0.916	-1.113	0.918	-1.117	0.921	-1.394	0.907	-1.577	0.925	0.268	0.902	-1.674	0.892	-1.531	0.919	-1.550	0.917	-0.982
0.40	0.923	-0.183	0.918	-1.704	0.920	-1.461	0.921	-1.648	0.913	-1.788	0.920	-0.584	0.916	-1.833	0.913	-1.856	0.919	-1.952	0.917	-1.576
0.50	0.920	-1.309	0.918	-2.142	0.922	-0.369	0.921	-2.235	0.911	-1.933	0.918	-0.864	0.919	-1.499	0.915	-2.246	0.918	-1.744	0.917	-1.421
0.60	0.920	-2.294	0.918	-1.987	0.924	0.226	0.921	-1.919	0.905	-2.277	0.914	-1.894	0.920	-1.512	0.917	-2.074	0.917	-1.825	0.917	-2.023
0.70	0.921	-0.544	0.918	-1.082	0.921	-0.514	0.921	-1.186	0.894	-1.941	0.910	-2.249	0.913	-1.513	0.911	-2.406	0.916	-1.448	0.916	-1.284
0.80	0.915	-0.948	0.924	0.126	0.918	-1.344	0.922	-0.249	0.895	-1.792	0.900	-2.040	0.911	-1.574	0.908	-2.092	0.910	-1.978	0.911	-1.023
0.90	0.886	-0.925	0.914	-0.464	0.922	-0.059	0.910	-0.866	0.896	-1.810	0.899	-0.341	0.917	-0.336	0.891	-0.728	0.908	-0.620	0.896	-1.000
0.95	0.862	-1.146	0.897	-0.271	0.922	-0.021	0.919	-0.173	0.892	-0.932	0.899	-0.218	0.917	-0.147	0.873	-0.763	0.901	-0.756	0.862	-0.551

Table 4. Quantile cointegration test. ***Note:*** *In this table quantile cointegration is presented, as discussed by Xiao (2009), for the logarithms of TTC and GDP.*

Model	Coefficient	Supremum norm value	Critical value at 1%	Critical value at 5%	Critical value at 10%
	Bangladesh				
GDP_t vs. TTC_t	α	15537.016	7488.374	5590.634	1962.007
	δ	3114.345	1634.219	915.727	798.829
	China				
GDP_t vs. TTC_t	α	21003.652	6422.419	3513.000	1724.546
	δ	5716.403	2141.355	1276.497	919.742
	Hong Kong				
GDP_t vs. TTC_t	α	12765.091	8392.555	5126.559	3441.570
	δ	7488.571	4326.138	2539.374	1108.454
	Indonesia				
GDP_t vs. TTC_t	α	28809.503	8393.548	5653.898	3123.682
	δ	16308.623	6494.698	3771.477	1962.499
	India				
GDP_t vs. TTC_t	α	19661.144	10053.210	7172.409	5503.535
	δ	8300.645	5770.465	2821.704	1724.903
	Japan				
GDP_t vs. TTC_t	α	16856.433	9295.806	7001.038	4606.804
	δ	10100.717	5064.511	2943.323	1545.582
	South Korea				
GDP_t vs. TTC_t	α	14545.004	6740.736	3105.312	1108.284
	δ	7487.596	4046.429	2627.805	1157.552
	Pakistan				
GDP_t vs. TTC_t	α	11485.096	3114.882	1148.466	700.516
	δ	4043.451	1148.618	839.271	531.569
	Turkey				
GDP_t vs. TTC_t	α	25374.086	13261.262	9296.110	6592.296
	δ	14955.911	8481.084	6593.244	4813.536
	Vietnam				
GDP_t vs. TTC_t	α	22970.193	6229.763	2296.932	1401.032
	δ	8086.901	2297.236	1678.541	1063.138

context of all top ten TTC manufacturing countries studied.

Figure 1 depicts a graphical representation of the analysis of quantile on quantile regression performed. In ***Figure 1***, we have a diagram for every country, where the x-axis represents TTC, GDP per capita is on y-axis, and the cross-tabulated coefficient of the variables studied is shown on the z-axis. The outcomes of QQ estimations clarify that the impact of TTC on GDP, especially in the case of Bangladesh. The discoveries affirm that the impact of TTC on GDP is significant across all the quantiles. Besides this, the impact of TTC on GDP is perceptible in the high quantiles of TTC and GDP (for example, 0.85-0.95), suggesting that the most extreme degree of TTC manufacturing boosts GDP in the Bangladeshi economy.

On the other hand, the results further suggest that TTC also enhances the GDP at low quantiles (i.e. 0.05-0.25) of both variables. On account of China, the findings confirm a positive and noteworthy effect, seen from TTC to GDP. The textile and growth relation offers positive qualities for the various numbers of quantiles, suggesting a positive impact of TTC on GDP. Indeed, a near huge effect with a positive sign was seen in the area that consolidates low quantiles of TTC (for example 0.05-0.25), which is related to the medium quantiles of GDP (for example 0.45-0.65). In summary, the results confirm that textile and clothing manufacturing help to enhance economic growth in China.

The effect of TTC on EG is found to be positive and significant in the context of **Japan**, **India**, **Pakistan**, **Indonesia** and **Vietnam**. The findings claim that the impact of TTC on GDP is noteworthy and substantial in the overall group of quantiles. In addition, the influence of TTC on GDP is noticeable in the low quantiles of TTC and GDP (for example 0.05-0.55), suggesting that low manufacturing of textile and clothing exerts a positive change in the per capita GDP. Technically speaking, the outcomes of QQ suggest that a low increase in TTC manufacturing induces a positive change in the economic growth of Asian countries. In the case of **Hong Kong,** the discoveries affirm a positive and significant impact from TTC to GDP. The textile and development affiliation offers positive characteristics for the different quantities of quantiles, highlighting the positive effect of TTC on GDP. Without a doubt, quite a substantial impact with a positive sign was found in the area that solidifies high quantiles of TTC (for instance 0.75-0.95), related to the low quantiles of GDP (for instance 0.05-0.25).

In summary, the outcomes affirm that the textile and apparel industry helps to improve economic development in Hong Kong. The effect of the textile and apparel industry on economic growth is also positive but interesting in the case of **Turkey** and **South Korea.** The findings confirm that a positive and important impact is observed from TTC to GDP. The textile and growth relationship provides positive features for the various groups of quantiles, highlighting the positive effect of TTC on GDP. In addition,

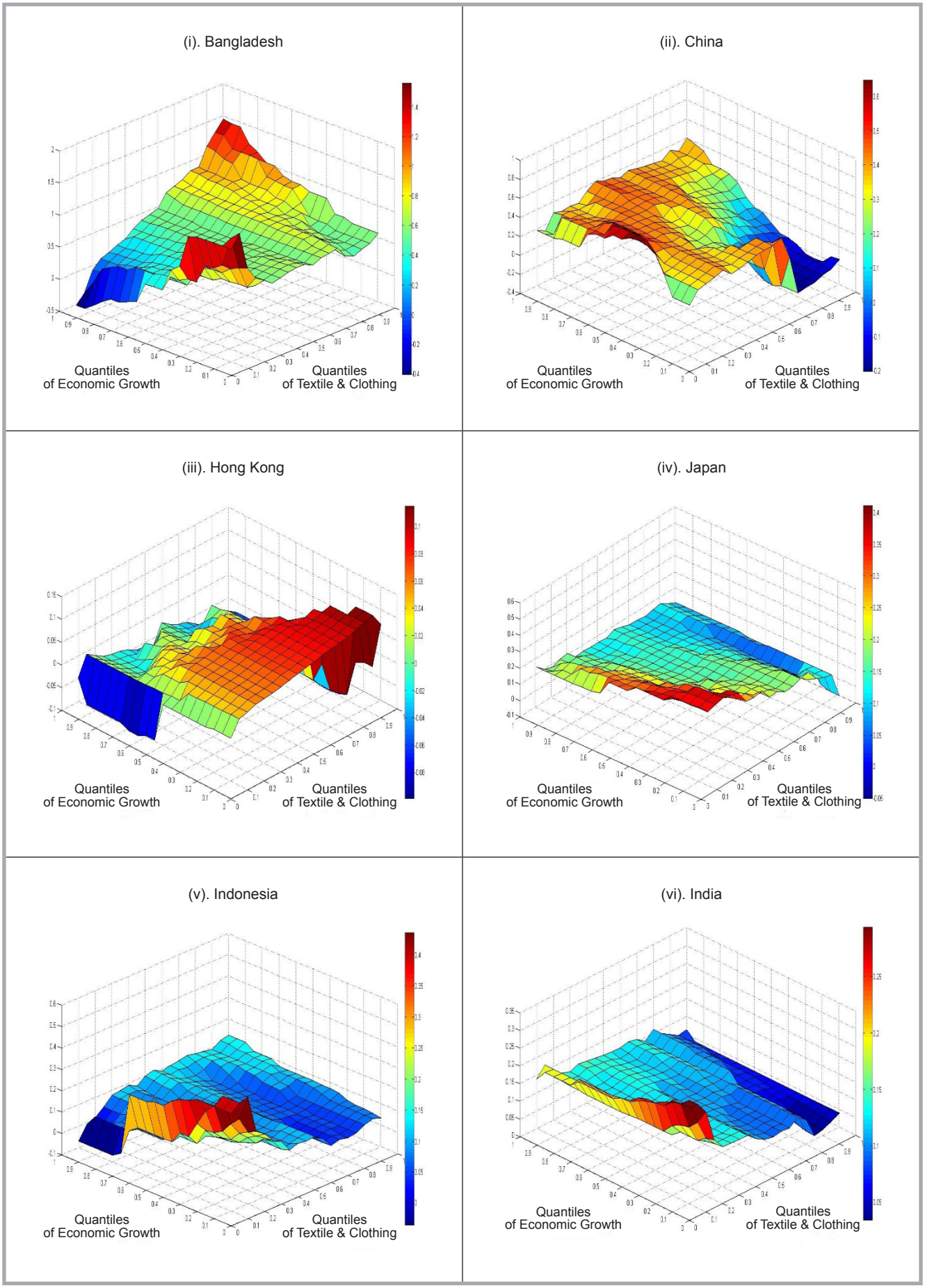

Figure 1. *Graphical representation of estimations of quantile on quantile regression.* ***Note:*** *The colour bar explains the size of the coefficient, and the blue (red) colour bar explains the lowest (highest) impact of TTC on EG in the top ten Asian countries.*

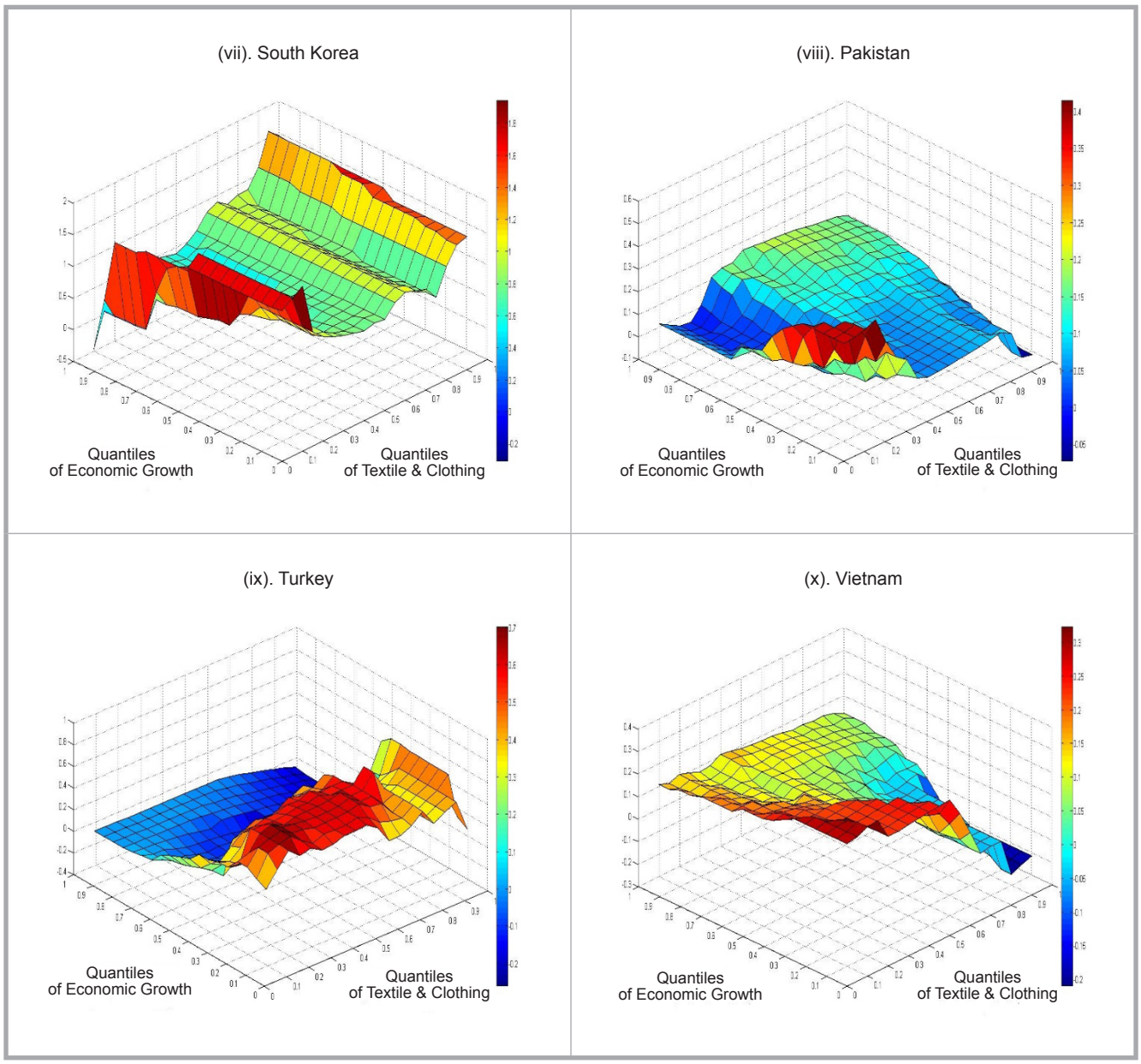

Figure 1 (continued). *Graphical representation of estimations of quantile on quantile regression.* ***Note:*** *The colour bar explains the size of the coefficient, and the blue (red) colour bar explains the lowest (highest) impact of TTC on EG in the top ten Asian countries.*

quite a huge impact with a positive sign was found in the area that solidifies lower-middle quantiles of TTC (for instance 0.15-0.65), related to the low quantiles of GDP (for instance 0.05-0.45). In conclusion, the outcomes affirm that the textile and apparel industry helps to improve economic development in the South Korean and Turkish economies.

In the last step, we utilised Granger-causality in quantiles presented by Troster et al., [44] and Sanusi et al., [45] vto examined the causal connection between textile manufacturing and economic growth in all top Asian economies. The findings of Granger-causality in quantiles are shown in ***Table 5***. The results show that changes in TTC do Granger cause changes in GDP at the 5% level of significance for overall quantiles.. Besides this, focusing around the significance value, it is seen that TTC does Granger-cause GDP in all the ten main Asian nations, except Japan. Moreover, the findings of Granger-causality in quantiles affirm a bidirectional causal relation between TTC and GDP in all the nations where the causality runs from TTC to GDP and GDP to TTC, except for Japan, Pakistan and Turkey. In the case of Pakistan and Turkey, we found a uni-directional causal relationship between TTC and GDP, where the causality runs from TTC to GDP, but not the reverse. On the contrary, a uni-directional causal connection was reported from the estimations of Granger causality among the variables studied in the context of Japan, where the causality runs from GDP to TTC.

Discussion and conclusion

The textile sector is considered the backbone of a country's course of development. The textile and apparel industry plays a substantial part in the industrial progress of nations as it offers tools to actualise economic stability. The significance of this sector for the nourishment of humanity as well as social and economic progress is extensively highlighted in the existing literature. The benefits of the textile industry are linked to

Table 5. *Results of quantiles granger causality.* ***Source:*** *Own estimation.*

Model	0.05-0.95	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95
	Bangladesh											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	China											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Hong Kong											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Indonesia											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	India											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Japan											
ΔTTC_t to ΔGDP_t	0.284	0.135	0.284	0.363	0.575	0.674	0.692	0.532	0.324	0.250	0.194	0.103
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	South Korea											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Pakistan											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.521	0.293	0.467	0.584	0.663	0.522	0.402	0.382	0.281	0.242	0.192	0.163
	Turkey											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.321	0.593	0.631	0.732	0.893	0.999	0.999	0.902	0.812	0.739	0.692	0.542
	Vietnam											
ΔTTC_t to ΔGDP_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ΔGDP_t to ΔTTC_t	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

the industry's potential for increasing manufacturing exports and foreign exchange, which could lead to augmenting a country's economic growth, particularly in low-income nations. Likewise, the socio-economic assistance of the textile industry is attributed to its tendency to increase the employment of low-income groups and offer business opportunities to skilled individuals, especially females [46-47].

Similarly, the economic conditions of developing economies are also vulnerable to currency fluctuations, political conditions and trade wars, which can disrupt the linear relation between the variables and provide room for non-linear behaviors in the time-series. Therefore, a unique methodology is employed in the present study, which is QQ regression, which has the capability to capture the presence of nonlinear relationships among the variables studied across the various quantiles. In other words, in the context of the present study, the asymmetric behviour of the relationships in EG caused by TTC was explained by the application of QQ regression, which led to the generation of results at different quantile levels among the ASIAN countries studied.

The results generated from the application of the QQ method show the positive nature of the impact on the EG of all top Asian countries, because of TTC manufacturing. Moreover, a causal relationship of a bi-directional nature is also confirmed in quantiles by Granger causality among all the economies studied, excluding Japan, Pakistan and Turkey, where the direction of the relationship is found to be one way, which is uni-directional. This implies the significance of the textile sector in building a sound economic structure through attracting greater employment, investment and export ventures. However, concern in this regard can be an increase in the consumption of textile, which is often likely to put a negative burden on the environment. To resolve this issue, it is recommended that utilisation of green technologies in processes and energy efficiency can resolve this negative association with textile, and along with maintaining its positive role in boosting economic growth, the industry can only be beneficial for sustainable development. Lastly, based on the findings, government and policy making institutions are recommended for the introduction of certain programs that will incentivise and provide subsidies to potential investors, thus relaxing the competition for new entrants in the TTC sector, which will further help local parties to absorb the fluctuations of the currency and seize the potential gain in terms of exports.

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