THE RELATIONSHIP BETWEEN EXPORT STRUCTURE AND ECONOMIC PERFORMANCE: AN EMPIRICAL ANALYSIS FOR SELECTED G-20 COUNTRIES

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ABSTRACT

In this study, the relationship between export structure and economic growth in the last 11 countries (in terms of foreign trade volume) of G-20 was studied using a non-parametric approach. The study analyzes the relationship between skill-and-technology intensive manufacturing industry exportation and economic growth based on variables such as human capital and institutional quality. In demonstrating the difference between the growth rates of the countries in question (and in examining the role of skill-and-technology-intensive export), the Li-Racine (2004) Generalized Kernel Estimation Method has been used. The foreign trade goods categorized according to their technological intensity in the paper were classified in accordance with the United Nations Comtrade Harmonized System (4-digit). The last 11 countries of the G-20 in terms of foreign trade volume are the following: Turkey, Italy, India, Mexico, Indonesia, Canada, Australia, Argentina, Brazil, Southern Korea, and Russia. The analysis covers the time period of 1995-2010. The results of non-parametric analysis methods reveal, just as parametric analysis results do, that there exists a positive and meaningful relationship between economic growth and the export of skill-and-technology-intensive goods for most countries.

Keywords: Export Structure, Economic Performance, Nonparametric Analysis, G-20 Countries.

JEL Classifications: C14, F41, F43

İHRACAT YAPISI VE EKONOMİK PERFORMANS ARASINDAKİ İLİŞKİ: SEÇİLMİŞ G-20 ÜLKELERİ İÇİN AMPİRİK BİR ANALİZ

ÖZ

Bu çalışmada G-20 üyesi ülkelerden dış ticaret hacmine göre son 11 ülke için ihracat yapısı ile ekonomik büyüme arasındaki ilişki parametrik olmayan yaklaşımdan hareketle incelenmiştir. Çalışma, yetenek ve teknoloji yoğun imalat sanayi ihracatı ile ekonomik büyüme arasındaki ilişkiyi beşeri sermaye ve kurumsal kalite gibi değişkenlerden hareketle analiz etmektedir. Söz konusu ülkeler arasındaki farklı büyüme performanslarının ortaya konmasında yetenek ve teknoloji yoğun ihracatın rolünün incelenmesinde Li-Racin (2004) genelleştirilmiş Kernel Tahmin Yöntemi kullanılmıştır. Genişletilmiş modelde bu ülkeler için ekonomik performansı etkileyen diğer faktörleri kontrol etmek için finansal sermayeye ulaşım ve dış piyasalara giriş değişkenleri de kullanılmıştır. Makalede teknoloji yoğunluğuna göre ayrıştırılmış dış ticarete konu mallar United Nations Comtrade Harmonized System 4-digite göre sınıflandırılmıştır. G-20 grubunun dış ticaret hacmine göre son 11 ülkesi olan Türkiye, İtalya, Hindistan, Meksika, Endonezya, Kanada, Avusturalya, Arjantin, Brezilya, Güney Kore ve Rusya için yapılan analiz 1995-2010 dönemini kapsamaktadır. Parametrik analiz sonuçlarına benzer şekilde parametrik olmayan analiz yöntemi ile elde edilen sonuçlar da ekonomik büyüme ile yetenek ve teknoloji yoğun malların ihracatı arasında pozitif ve anlamlı bir ilişki olduğu yönünde kanıtlar sunmaktadır.

Anahtar Kelimeler: İhracat Yapısı, Ekonomik Performans, Parametrik Olmayan Analiz, G-20 Ülkeleri.

JEL Sınıflandırması: C14, F41, F43

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1. Introduction

The transformation of export structure can lead to the emergence of different economic performance results among countries. As the world economy globalizes, policies towards foreign trade usually shift from capital-and-labor intensive export to an axis which would facilitate skill-and-technology intensive export. Export plays a major role in the economic development of countries, and in sustaining their growth. In the year of 2010, Turkey exported to 248 countries and its trade volume surpassed 350 billion dollars. The primary goal for the year 2023, which will be a celebration of the 100th year of the Turkish Republic, is to reach 500 billion dollars in export and 1 trillion dollars in total trade volume. When we take other economic goals into consideration as well, the ultimate goal for Turkey is to be among the 10 greatest economies of the world. For the attainment of this goal, it is of vital importance to determine which of the G-20[1] countries we are to out compete and how this is to be done. When we look at the picture from an economic perspective, we can see that one of the important indicators that Turkey will be among the top 10 of the G-20 countries in 2023 is the transformation which will take place in export structure.

While Turkey's export is still predominated by labor-intensive and relatively low-tech sectors, it is seen that the top sectors in global export are those which boast advanced technology, intensive technology, and high added value. Nevertheless, the transformation which took place in the export structure is remarkable. When we check the technological structure of Turkish export between years 2002-2010, this transformation is clearly seen. While the share of low-tech export dependent on natural resources was 63% in 2002, in 2010 this share regressed to 56%. In contrast, the share of mid-to-high technology export increased from 37% in 2002 to 44% in 2010. In other words, the technological level of Turkish exportation increased 20% in the last eight years. When we think of the global export environment, we may consider this transformation of export structure to be an important step in attaining the 2023 exportation goal.

There is very limited empirical literature that examines the relationship between export structure and economic growth. In this area, the most cited studies are; Sun and Heshmati (2010), Jarreau and Poncet (2011), Basu and Das (2011),

[1] The creation of the G-20, widely accepted as the fundamental platform of economic collaboration, was decided on 25 September 1999, in a G-7 Meeting of Finance Ministers and Central Bank Governors in Washington. The G-20 platform, which brings together developed countries and the "rising market economies" (of which Turkey has always been one, since its foundation), consists of the following: USA, Germany, Argentina, European Union, Australia, Brazil, China, Indonesia, France, Southern Africa, Southern Korea, India, UK, Italy, Japan, Canada, Mexico, Russia, Saudi Arabia, and Turkey. The World Bank and the IMF also participate in the meetings on a higher level. The G-20 countries stand for 90% of the world economy, 80% of global trade, and two thirds of the global population. As such, they are of great importance for the global, economic, and financial system.

Kinuthia (2013), and Kadochnikov and Fedyunina (2013). Sun and Heshmati (2010) evaluate the effects of international trade on China's economic growth through examining improvement in productivity. Both econometric and non-parametric approaches are applied based on a 6-year balanced panel data of 31 provinces of China from 2002 to 2007. This study demonstrates that increasing participation in the global trade helps China reap the static and dynamic benefits, stimulating rapid national economic growth. Both international trade volume and trade structure towards high-tech exports result in positive effects on China's regional productivity.

Jarreau and Poncetz (2012) consider the effect of export sophistication on economic performance using regional variations in China over the period 1997-2009. The province level, there is substantial variation in export sophistication controlling for the level of development, and that this difference in turn matters for growth. Their results suggest that these gains are limited to ordinary export activities undertaken by domestic firms. The results show that the contribution of assembly trade and foreign entities must be distinguished when one wants to measure the true improvement in the country's technology level and its contribution to economic growth.

Basu and Das (2012) examine the relationship between skill and technology intensive manufacture exports and gross domestic product per capita, controlling for institutional quality and human capital in 88 developing countries using nonparametric methodology for the period of 1995-2007. This study uses the Li-Racine (2004) generalized kernel estimation methodology to examine the role of skill and technology content of the exports in understanding differential level of economic performance across countries and country groups. The results show that the skill and technology content of the exports increase, the impact on GDP per capita increases positivity and significantly as well, after controlling for other policy variables.

Kinuthia (2013) investigates the factors behind changes in their export structures and thereby explaining their economic growth patterns for the period 1962-2011 using the example of Kenya and Malaysia. The study uses the Haussmann et al. (2007) approach and uses data on export products for both countries. The results reveal evidence of s systematic process of economic diversification in Malaysia, accompanied by specialization in the production of sophisticated goods needed by the rich countries, unlike in Kenya. This study also finds a clear relationship between the export structure and growth in Malaysia but not in Kenya.

Kadochnikov and Fedyunina (2013) investigate the relationship between export structure and economic growth in Russian regions in the 2003-2008 period. The empirical analysis presented in the paper confirms that the density of the product space around the products for which a region had a comparative advantage determined the economic development in Russian regions. They conclude that the presence of a local related variety of industries in a region is one of the most important regional factors in economic development.

In this study, the relationship between export structure and economic growth in the last 11 countries (in terms of foreign trade volume) of G-20 was studied using a non-parametric approach. The data was drawn from the years 1995-2010. The chapter that follows the introduction explains the empirical methodology involved i.e. non-parametric density estimation, kernel prediction method, and institutional quality index. The third chapter mentions the data set and sources. The fourth chapter introduces the empirical model that contains parametric and non-parametric forms, after which there is a discussion of the analysis results and the macroeconomic political suggestions which may be inferred from these results.

2. Empirical Methodology

In this chapter, the non-parametric density functions of the variables used in the model are identified using Li-Racine (2004) Generalized Kernel Estimation methodology. The theoretical framework is also explained. In addition, the creation of the institutional quality indices of the relevant countries through the method developed by Nagar and Basu (2002) is explained.

2.1. Non-Parametric Density Estimation

In order to explain how the probability density functions of the variables used in the basic and expanded models are obtained, let us assume that $X \in \Re$ is a random variable. At the point $x \in \Re$, the estimator of the probability function of the random variable X is as shown in equation 1.

$$\hat{f}(x) = \frac{1}{n}\sum_{i=1}^{n} K(x_i, x, h) \tag{1}$$

In the equation above, X is a continuous random variable, $K(.)$ is a Gauss kernel density function, and h is a smoothing parameter obtained via a cross-proof method. When $X = x$, $f(x)$ denotes the probability density function and $F(x)$ denotes cumulative density function. The non-parametric and naive (pure, essential) estimation of $f(x)$ while taking into account h, the softening parameter, is given below in equation 2.

$$\hat{f}(x) = \lim_{h\to 0}[F(x+h)/2 - F(x-h)/2]/h \tag{2}$$

According to equation 2, the non-parametric density estimation of $\hat{f}(x)$ is equal to $1/h$, that is to say, to the probability of X in the $[x - h/2, x + h/2]$ interval. To put it in other words, $\hat{f}(x)$ is equal to the expression $1/h$, which is the probability of the expression $(X - x)/h$ in the interval $[-1/2, 1/2]$. Following the methodology indicated by Silverman (1986), we may define the identity function in equation 3.

$$I(.) = \begin{cases} 1 \;\; if \; -0.5 \; \leq \frac{X_i - x}{h} \leq 0.5 \\ 0 \qquad\qquad otherwise \end{cases} \quad (3)$$

As for the non-parametric density function, we may rewrite it in equation 4.

$$\hat{f}(x) = \frac{1}{nh}\sum_{i=1}^{n} I\left(\frac{X_i - x}{h}\right) \quad (4)$$

Because the graph of the density function obtained via equation 3 is not a smooth curve, the identity function *I(.)* is replaced with a *K(.)* kernel density function, as shown in equation 5.

$$K(\psi_i) = \frac{1}{\sqrt{2\pi}} \, exp\left(-\frac{1}{2}(\psi_i)^2\right) \quad (5)$$

$$\psi_i = \left(\frac{X_i - x}{h}\right) ; \; \int_{-\infty}^{+\infty} K(\psi)\partial\psi = 1$$

The non-parametric density function is shown in equation 6.

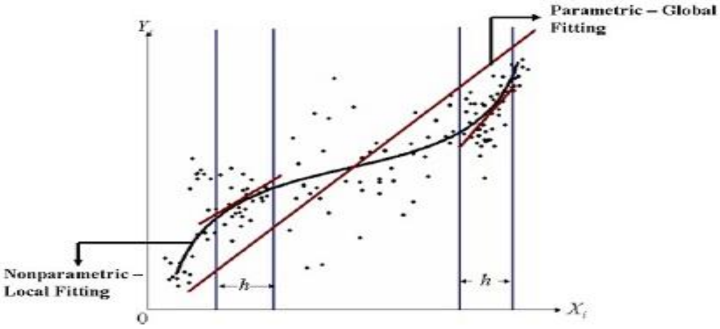
$$\hat{f}(x) = \frac{1}{nh}\sum_{i=1}^{n} K(\psi_i) \quad (6)$$

It is a well-known fact in relevant literature that kernel selection does not have a statistically significant impact on estimation activity. However, the *h* interval to be determined is critical, because low *h* values will lead to over-smoothing of results, whereas high *h* values will cause under-smoothing. In order to estimate the density function of equation 5, an optimal *h* value which would minimize the error sum of squares of $\hat{f}(x)$ is to be selected.

2.2. Kernel Prediction Method

The main principle behind the non-parametric estimation technique is to apply the smoothing parameter *h* around every observation of the data set and to guess the relationship between the variables (in the value interval that the *h* smoothing parameter can assume). A kernel density function *K(.)* is used to add a high weight to the points close to the *h* interval (and a low weight to the points that are distant). This way, the regression relationship is estimated in a piecemeal or interval-by-interval fashion, as demonstrated in Figure 1. One of the advantages of the non-parametric estimation method is that the method makes it possible to estimate the *β(.)* slope coefficients of the *m*(.) regression function (Basu and Das, 2011).

Figure 1: Nonparametric Estimation Analysis Framework



Source : Basu ve Das, 2011, p.4.

The relationship between dependent variable y_i (GDP) and dependent variable x_i (skill level, technological components of the production goods, institutional quality index, enrolment ratio) can be expressed as the conditional momentum $E(y_i|x_i)=m(x_i)$, provided that $(E(yi|xi)<\infty)$. When the real functional form is not known, parametric specifications are considered invalid (even complex forms such as trans log functions). When compared with parametric methods, non-parametric methods are more effective in capturing the non-linear relationship of the system emphasized. Thus, the problem of false modeling is eliminated as well.

In this study, the relationship between export structure and GDP was examined through the use of the generalized kernel estimation method developed by Li and Racine. Equation 7 shows the fundamental regression model.

$$y_i = m(x_i) + \varepsilon_i \qquad (7)$$

Equation 7 shows the i^{th} *observation* of the dependent variable y_i (GDP), the country-time observation index of x_i N countries, and the time interval T. Also, *m(.)* is expressed as an unknown smoothing regression function with the argument $x_i=[x_i^c,x_i^u]$. Also demonstrated here is a continuous variable vector (low, mid and high level skill-and-technology intensive production, institutional quality index, enrolment ratio) whose size is x_i^c $NT\times k$, an unsorted discrete variable vector (country influence) whose size is x_i^u $NT\times 1$, and an error term vector whose size is ε_i $NT\times 1$. Following the Li-Racine methodology, we take a first-degree Taylor expansion around the xj value found in equation 7, and obtain equation 8 as below.

$$y_i \approx m(x_j) + (x_i^c + x_j^c)\beta(x_j) + \varepsilon_i \qquad (8)$$

Here, $\beta(x_j)$ shows the partial derivative of $m(x_j)$ with respect to x^c. The equation which estimates $\delta(x_j)$ at $(\delta(x_j) \equiv [m(x_j)\ \beta(x_j)])$ is found below, in equation 9.

$$\hat{\delta}(x_j) = \begin{pmatrix} \hat{m}(x_j) \\ \hat{\beta}(x_j) \end{pmatrix} \tag{9}$$

$$= \left[\sum_i K_{\hat{h}} \begin{pmatrix} 1 & (x_i^c - x_j^c) \\ (x_i^c - x_j^c) & (x_i^c - x_j^c)(x_i^c - x_j^c) \end{pmatrix} \right]^{-1} \sum_i K_{\hat{h}} \begin{pmatrix} 1 \\ (x_i^c - x_j^c) \end{pmatrix} y_i$$

$$K_{\hat{h}} = \prod_{s=1}^{q} \hat{h}_s^{-1} w\left(\frac{x_{si}^c - x_{sj}^c}{\hat{h}_s}\right) \prod_{s=1}^{r} l^u\left(x_{si}^u, x_{sj}^u, \hat{\lambda}_s^u,\right) \tag{10}$$

The $K_{\hat{h}}$ found in equations 9 and 10 is a generalized kernel function originally proposed by Pagan and Ullah (1999) and widely used today. *w* is a standard normal product kernel function with window width *hs= hs(NT)* associated with the s^{th} component of x^c. The kernel function l^u is a variation of Aitchison and Aitken (1976) kernel function which equals one if $x_{si}^u = x_{sj}^u$ and λ_s^u otherwise (Basu and Das, 2011).

It is well known that in non-parametric studies, the band width of the estimate (h, λu) is of vital importance. This methodology allows for the possibility of applying a number of numerical algorithms in order to determine a suitable band width or smoothing parameter. The current study uses the least-squares cross-proof method developed in Li-Racine's (2004) studies. The least-squares cross-proof method chooses the parameters $h_1, h_2, \ldots h_q$, $\lambda_1^u, \lambda_2^u, \ldots \lambda_r^u$ in order to minimize the cross-proof function given in equation 11.

$$CV = \sum_{i=1}^{n} \left(y_i - \hat{m}_{-i}(x_i)\right)^2 M(x_i) \tag{11}$$

$$\hat{m}_{-i} = \sum_{l \neq i}^{n} y_l K_\gamma(.) / \sum_{l \neq i}^{n} K_\gamma(.)$$

$0 \leq M(.) \leq 1$ is a weight function. The purpose of the *M(.)* function is to eliminate the difficulties which may arise as a result of dividing by zero (or the slow convergence speed caused by boundary action).

2.3. Calculating Institutional Quality Index

Institutional quality index is a hidden variable which cannot be calculated easily and directly. Let us assume that Y is a hidden variable and that it is linearly determined by external variables such as $X_1, X_2, \ldots X_k$. This linear relationship is given in equation 12.

$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_k X_k + u_k \tag{12}$$

$X_1, X_2, \ldots X_k$ is the set of variables which enable us to capture Y. If the variation of the error term ε is smaller than the total variation of hidden variable Y, we may assume that the total change in Y can be explained, to a large extent, by the change in the aforementioned variables. We may therefore see which combination of X_1, $X_2, \ldots X_k$ can explain the total change in Y via $X_2, \ldots X_k$.

In a study by Nagar and Basu (2002), it is recommended to use a set of variables equal to the number of the main constituents. In this way, it becomes possible to explain a 100% change in variables by their main constituents.

$$X_k = \left[X_k - \frac{minimum\,(X_k)}{maksimum\,(X_k) - minimum\,(X_k)} \right] \quad (13)$$

First, the variables were transformed using equation 13. Next, the Institutional Quality Index was calculated as a weighted sum of the transformed version of the chosen variables. Here the relevant weights were obtained from the analysis of main constituents. As a result, the highest weight was assigned to the first main constituent, wherefore the first main constituent came to possess the highest share of the total change present in all indicator variables. In a similar way, the second main constituent was given the second highest weight and therefore, came to possess the second highest share. In this manner, all the variables were assigned to their respective weights.

In order to calculate the Institutional Quality Index, three separate variables of the index were created, i.e. Economic, Social, and Political Institutional Quality Indices. These three variables were combined later. In addition, the high values of the Institutional Quality Index demonstrate a high level of institutional quality.

3. The Data Set and The Empirical Model

3.1. The Data Set

The present study makes use of data drawn between the years of 1995 and 2010 and from the last 11 countries of the G-20 group in terms of foreign trade volume–namely from Turkey, Italy, India, Mexico, Indonesia, Canada, Australia, Argentina, Brazil, Southern Korea, and Russia. The data was compiled from sources associated with the databases of UNCTAD and the University of Pennsylvania.[1]

The foreign trade goods categorized according to their technological intensity in the paper were classified in accordance with the United Nations Comtrade Harmonized System (4-digit). The values used were calculated in US dollars. In this classification, the foreign trade goods were divided into six groups according to their technological intensity: (A) raw materials, (B) source-intensive goods, (C) goods that demand a low level of technology and skill, (D) goods that demand a middle level of technology and skill, (E) goods that demand a high level of technology and skill, (F) solid mineral fuel. The study focuses on the share of the goods that fall under the categories of C-D-E in the export volumes of the countries in question. The shares of other categories were excluded from the study.

[1] *Sources associated with the data used in the study are shown in Table 4.*

3.2. Dependent and Independent Variables

In order to determine the economic performance levels of the countries in question, GDP per capita (2005, in constant dollars) was used as a dependent variable. According to foreign trade literature, an increase in the level of technology and skill that is used for foreign trade goods should ameliorates the economic performance of those countries. For this reason, three separate independent variables were employed in order to study the effects of the technology and skill level (used in these goods) upon real GDP per capita. The variables are as follows: goods that demand a low level of technology and skill (CNEXP), goods that demand a middle level of technology and skill (DNEXP), and goods that demand a high level of technology and skill (CNEXCP). When these variables take high values, this means that the relevant countries get higher shares from the pie of foreign trade goods.

Another factor to effect the economic performance of a country in terms of foreign trade is the Institutional Quality Index (IQI). Institutional Quality Index calculated by authors for all of the countries in question. In order to calculate the IQI, three components of the index were created. These three components are the economic, social, and political institutional quality indices. In the calculation of the economic quality index, indices such as property rights, bureaucratic quality, corruption, democratic accountability, government stability, legal order, the independence of the judiciary, and supervision were taken into account. In the calculation of the social institutional quality index, indices such as the independence of the press, civil rights, physical integrity rights, empowerment rights, and the political-economic-social rights of women were taken into account. In the calculation of the political institutional quality index, indices such as restriction by the current authority, democracy, political rights and regime, lower and higher legislations were taken into account. The three components were combined afterwards. High values in the Institutional Quality Index demonstrate a high level of institutional quality (Basu, 2008).

A factor no less important than the level of technology used in the manufacture of foreign trade goods is the human capital used. Increasing the qualification of the human capital upgrades workforce efficiency and, by extension, economic performance. The presence of a skilled workforce increases the production of goods which demand a higher level of skill and makes it possible to conduct foreign trade with higher added value. The current study made use of the gross enrolment ratio (CGER) as a representative of the human capital variable.

3.3. The Empirical Model

The principal purpose of this study is to analyze the relationship between real GDP per capita and the exportation of foreign trade goods which require low, middle, and high levels of technology and skill (CNEXP, DNEXP, and ENEXP). The analysis is done with reference to variables such as human capital (CGER) and institutional quality (IQI). The parametric form which demonstrates this relationship is given in equation 14.

$$lnGDP_{it} = \beta_0 + \beta_1 \ln(C\backslash D\backslash E) NEXP_{it} + \beta_2 lnIQI_{it} + \beta_3 lnCGER_{it} + \varepsilon_{it} \quad (14)$$

The non-parametric form of the relationship in question is given in equation 15.

$$lnGDP_{it} = m(\alpha_i, lnCNEXP_{it}, lnIQI_{it}, lnCGER_{it})$$
$$lnGDP_{it} = m(\alpha_i, lnDNEXP_{it}, lnIQI_{it}, lnCGER_{it})$$
$$lnGDP_{it} = m(\alpha_i, lnENEXP_{it}, lnIQI_{it}, lnCGER_{it}) \quad (15)$$

The *m(.)* value found in equation 15 expresses the unknown smoothing regression function of the variables. As for α_i, it is constant and denotes the unobservable characteristics of the countries. When the real functional form is unknown, the parametric specifications are considered invalid. When compared to parametric methods, non-parametric methods are more effective in capturing the non-linear relationship of the system emphasized. Thus, the problem of false modeling is eliminated as well.

4. Model Results

In this chapter, model results are evaluated. The model results obtained from the data drawn from the last 11 countries (in terms of foreign trade volume) of the G-20 between years 1995-2010. For this, three independent variables were employed. The first independent variable is the share of skill-and-technology intensive manufacture industry exports (low, mid, high level) in total export (LnCnsexp, LnDndexp, LnEnsexp), the second is total gross enrolment ratio (LnCger), and the third is the institutional quality index (LnIQI). All variables have been incorporated into the model logarithmically. Estimations of all non-parametric variables were therefore interpreted as flexibility measurements (as is the norm in parametric variable estimations) in Table 1-2-3.

The first columns of Table 1a, Table 1b, and Table 1c demonstrate the extent to which any change in the level of skill and technology used for the exports has an impact on GDP. To put it in simpler terms, they reveal how much impact a 1% change in the level of skill and technology used for exports would have on GDP per capita in terms of percentage (exportation flexibility).

For exports that demand low technology and skill, the parameter value was found to be 0.139 in the first quadrant and for 1% statistical significance. On the median and for 1% significance the value was 0.121. In the third quadrant and for 1% significance, it was -0.096. The fact that the parameter values were positive on the first two levels indicates that for more than 50% of the countries in question, the exportation flexibility of goods that demand low technology and skill is positive. For goods that demand middle levels of technology and skill, the parameter value was -0.462 in the 1st quadrant, 0.273 on the median, and 0.242 in the 3rd quadrant (for 1% statistical significance in all cases). The fact that the parameter values were positive on the median and in the 3rd quadrant indicates that for more than 75% of the countries in question, the exportation flexibility of goods that demand a middle level of technology and skill is positive. For goods that demand high levels of technology and skill, the parameter value was 0.216 in the 1st quadrant and for 1% significance, 0.287 on the median and for 1% significance, -0.062 in the 3rd quadrant and for 5% significance. The fact that the parameter values were positive on the median and in the 1st quadrant indicates that for more than 50% of the countries in question, the exportation flexibility of goods that demand a high level of technology and skill is positive.

When we inspect the slope parameter estimation values on the median, we see that the lowest value of the parameter is 0.121 for low-level technology and skill exports, whereas its highest value is 0.287 for high-level technology and skill exports. The fact that the exportation flexibility of goods that demand high levels of technology and skill is higher than the exportation flexibility of those that demand middle and low levels indicates that high-level technology and skill exports have a greater impact on GDP per capita. When we increase the share of the exports that demand high levels of technology and skill in total export volume by 1%, GDP per capita increases by 0.28%.

The percentage of change that will occur in GDP per capita as the result of a 1% change in Institutional Quality Index (institutional quality flexibility) is given on the second columns on Table 1a, 1b, 1c. On every level of technology and skill, the parameter values have come up positive on the median and in the 3rd quadrant. This indicates that in more than 75% of the countries in question, quality flexibility is positive. The highest quality index is 1.1 on every level of technology and skill (Table 1a). Raising the Institutional Quality Index by 1% causes a 1.1% change in GDP per capita, which is quite significant.

The percentage of change that will occur in GDP per capita as the result of a 1% change in Gross Enrolment Ratio (educational flexibility) is given on the third columns on Table 1a, 1b, 1c. On every level of technology and skill, the parameter values came up positive on the median and in the 3rd quadrant. This indicates that in more than 75% of the countries in question, educational flexibility is positive. The highest quality index is 3.668 on every level of technology and skill (Table 1c). Raising the Educational Quality Index by 1% causes a 3.7% change in GDP per capita, which is quite significant.

In the model obtained via non-parametric estimation techniques, the standard errors of the educational parameters were calculated via the bootstrap method. They can be found on Table 1a, 1b, 1c in parentheses. The results obtained via parametric estimation techniques were also shown on the last rows of Table 1a, 1b, 1c. The results of the parametric and non-parametric models were similar on the median. They reveal that high skill-level and technology-intensive manufacture industry exportation has the greatest impact on economic growth.

Flexibility values (exportation, institutional quality, educational) calculated on the median and sorted by country for each level of technology and skill (low, middle, high) are to be found on Table 2a, 2b, 2c. While South Korea has the highest exportation flexibility (0.291) for exports that demand low technology and skill, Russia has the lowest value (-0.869). 6 countries have positive and 5 countries have negative values. The exportation flexibility of Turkey is 0.186. Canada has the highest institutional quality flexibility (6.166), whereas India has the lowest (-3.433). 7 countries have positive and 4 countries have negative values. The institutional quality flexibility of Turkey is -1.204. Indonesia has the highest educational flexibility (2.517), whereas Brazil has the lowest (-3.059). 8 countries have positive and 3 countries have negative values. The educational quality flexibility of Turkey is 0.862.

While Russia has the highest exportation flexibility (1.031) for exports that demand a middle level of technology and skill, Mexico has the lowest value (-0.121). 9 countries have negative and 2 countries have positive values. The exportation flexibility of Turkey is 0.045. Australia has the highest institutional quality flexibility (6.796), whereas Turkey has the lowest (-3.462). 7 countries have positive and 4 countries have negative values. Indonesia has the highest educational flexibility (2.656), whereas Brazil has the lowest (-4.301). 10 countries have positive values whereas 1 country has a negative value. The educational quality flexibility of Turkey is 1.415.

While Russia has the highest exportation flexibility (0.905) for exports that demand high technology and skill, Turkey has the lowest value (-0.177). 7 countries have negative and 4 countries have positive values. Canada has the highest institutional quality flexibility (8.001), whereas Southern Korea has the lowest (-0.271). 9 countries have positive and 2 countries have negative values. The institutional quality flexibility of Turkey is 1.939. Southern Korea has the highest educational flexibility (3.305), whereas Mexico has the lowest (0.785). All countries have positive values. The educational quality flexibility of Turkey is 1.060.

Flexibility values (exportation, institutional quality, educational) calculated on the median and sorted by year for each level of technology and skill (low, middle, high) are to be found on Table 3a, 3b, 3c. Exportation flexibility for goods that demand low technology and skill generally took positive values and followed an unstable path. The highest value was 0.328 in 2004 and the lowest value was -0.613 in 1997. Institutional quality and educational flexibility values generally took positive values and followed an unstable path, as with exportation flexibility values.

Exportation flexibility for goods that demand middle levels of technology and skill took positive values. The highest value was 0.416 in 1996 and the lowest value was 0.015 in 2010. The exportation flexibility of goods that demand middle levels of technology and skill on the median was found to be higher than the exportation flexibility of goods that demand low technology and skill. Institutional quality values generally took positive values and followed an unstable path. Educational flexibility values, on the other hand, were consistently and increasingly positive. Exportation flexibility for goods that demand middle levels of technology and skill took positive values. The highest value was 0.494 in 1997 and the lowest value was 0.056 in 2010. The exportation flexibility of goods that demand high levels of technology and skill was found to be higher on the median than the exportation flexibility of goods that demand low and middle levels of technology and skill. The fact that the exportation flexibility values of goods which demand high technology and skill have been higher on an annual basis demonstrates that they have a greater impact on economic growth than low and middle levels. Institutional quality values generally took positive values and followed an unstable path. Educational flexibility values, on the other hand, took positive values and were on the rise until 2009. They suffered a decline in 2010.

5. Conclusion

The analysis carried out in this study focused on the last 11 countries (in terms of foreign trade volume) of the G-20 and covered the time period 1995-2010. These countries were: Turkey, Italy, India, Mexico, Indonesia, Canada, Australia, Argentina, Brazil, Southern Korea, and Russia. The study determined that goods which demand high level technology, and skill have a greater impact on economic growth than mid-level and low-level goods. To calculate this, the Li-Racine (2004) Generalized Kernel Estimation Method was used. The results herein may be strong indicators to policy-makers who wish to achieve economic growth.

Based on the analysis results, it is possible to categorize the countries in question according to their export structures. This has been presented in Table 5. According to table 5, India, Indonesia, Turkey, and Argentina are the countries wherein low-and-middle skill and technology exports have a positive impact on economic growth, whereas high level exports have negative flexibility. Italy, Russia, Canada, and Australia are the countries wherein exports that demand middle and high levels of skill and technology have positive values in terms of exportation flexibility. South Korea has positive exportation flexibility on all three levels. For Mexico, low and middle level exports have a positive impact on economic growth, whereas for Brazil the exportation flexibility of high level exports is positive.

Table 5: Categorizing the Countries According to Their Export Structures

Countries	Export Structure		
	Low	Medium	High
Italy		✓	✓
Russia		✓	✓
Canada		✓	✓
India	✓	✓	
Australia		✓	✓
South Korea	✓	✓	✓
Indonesia	✓	✓	
Turkey	✓	✓	
Argentina	✓	✓	
Mexico	✓		✓
Brazil			✓

✓ shows positive impact of skill and technology content manufactures on development

In this context, it is necessary to reduce the dependency of export on a few number of markets and sectors, and to direct export to the markets with high purchasing power. In addition to diversification of product and market, production of high value added goods, keep up with the technological innovations, supporting and informing exporters with government aid, monitoring input cost reduction policies in exporter sectors are some suggestions that can be offered for the growth of export. Moreover, increasing the share of high-tech products among the exported goods, in order to rise the value added derived from export; regulations that increase public and private sector R & D spending can be made, can be facilitated technology import, can be encouraged co-production agreements with foreign companies, can be provided additional incentives for the foreign investors which will make technology intensive production.

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List of Tables

Table 1: Nonparametric First, Second and Third Quartile Estimates

Table 1.a: Low Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP		
	LnCnsexp	**LnIQI**	**LnCger**
1st quartile	0.139	-0.780	-3.80
Std. Error	(0.020)	(0.101)	(0.050)
t-value	6.80*	-7.72*	-71.56*
Median	0.121	1.100	3.622
Std. Error	(0.015)	(0.176)	(0.075)
t-value	8.13*	6.26*	48.21*
3rd quartile	-0.096	1.680	2.706
Std. Error	(0.010)	(0.249)	(0.136)
t-value	-10.02*	6.75*	19.85*
Parametric	0.095	1.349	3.406
Std. Error	(0.055)	(0.289)	(0.209)
t-value	1.72***	4.66*	16.28*

Table 1.b: Medium Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP		
	LnDnsexp	**LnIQI**	**LnCger**
1st quartile	-0.462	-1.134	-3.122
Std. Error	(0.023)	(0.302)	(0.135)
t-value	-20.26*	-3.76*	-23.12*
Median	0.273	0.397	3.596
Std. Error	(0.015)	(0.120)	(0.053)
t-value	17.83*	3.31*	67.73*
3rd quartile	0.242	0.211	4.124
Std. Error	(0.017)	(0.167)	(0.162)
t-value	14.12*	1.27	25.38*
Parametric	0.251	0.617	3.457
Std. Error	(0.490)	(0.308)	(0.195)
t-value	5.10*	2.00**	17.64*

Table 1.c: High Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP		
	LnEnsexp	**LnIQI**	**LnCger**
1st quartile	0.216	-0.748	-3.877
Std. Error	(0.024)	(0.179)	(0.085)
t-value	9.13*	-4.17*	-45.81*
Median	0.287	0.603	3.668
Std. Error	(0.008)	(0.049)	(0.022)
t-value	11.36*	12.33*	169.6*
3rd quartile	-0.063	1.967	2.419
Std. Error	(0.029)	(0.131)	(0.135)
t-value	-2.21**	14.97*	17.92*
Parametric	0.256	1.233	3.385
Std. Error	(0.665)	(0.303)	(0.208)
t-value	1.45	4.07*	16.22*

Notes: Standard errors are in parentheses.
Standard errors of nonparametric estimates are obtained from bootstrapping (seed 10101 and reps 200)
* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level.

Table 2: Nonparametric Median Estimates by Country
Table 2.a: Low Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP					
	LnCnsexp	**SE**	**LnIQI**	**SE**	**LnCger**	**SE**
Italy	-0.169*	0.004	1.541*	0.005	0.678*	0.001
Russia	-0.869*	0.009	2.675*	0.046	0.450*	0.031
Canada	-0.333*	0.062	6.166*	0.531	1.999**	0.935
India	0.122*	0.001	-3.433*	0.094	2.512*	0.009
Australia	-0.178*	0.001	2.685*	0.086	0.136*	0.030
South Korea	0.291*	0.008	-1.319*	0.032	2.198*	0.050
Indonesia	0.234*	0.069	-0.387*	0.046	2.517*	0.163
Turkey	0.186*	0.011	-1.204*	0.036	0.862*	0.013
Argentina	0.168*	0.028	1.785*	0.057	2.251*	0.080
Mexico	0.212*	0.052	0.511*	0.118	1.296*	0.147
Brazil	-0.139*	0.009	4.160*	0.408	-3.059*	0.662

Table 2.b: Medium Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP					
	LnDnsexp	**SE**	**LnIQI**	**SE**	**LnCger**	**SE**
Italy	0.234***	0.011	0.661*	0.247	0.729*	0.015
Russia	1.031*	0.002	0.431*	0.026	1.351*	0.021
Canada	0.371*	0.006	2.629*	0.225	2.078*	0.001
India	0.747*	0.067	-2.941*	0.022	2.656*	0.108
Australia	0.121*	0.021	6.796*	0.429	1.101*	0.223
South Korea	0.642*	0.001	-1.740*	0.019	2.306*	0.002
Indonesia	0.152*	0.003	-0.521*	0.010	2.038*	0.003
Turkey	0.045*	0.030	-3.362*	0.225	1.415*	0.073
Argentina	0.480*	0.010	1.009*	0.193	1.861*	0.035
Mexico	-0.120	0.202	0.880*	0.148	0.679*	0.016
Brazil	-0.095*	0.035	5.285*	0.586	-4.301**	1.739

Table 2.c: High Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP					
	LnEnsexp	**SE**	**LnIQI**	**SE**	**LnCger**	**SE**
Italy	0.203***	0.041	0.698*	0.120	0.744*	0.024
Russia	0.905*	0.032	0.938*	0.099	3.222*	0.098
Canada	0.601*	0.169	8.001*	0.908	1.799*	0.054
India	-0.176*	0.047	1.146**	0.493	1.674*	0.014
Australia	0.188*	0.001	5.160*	0.059	0.881	0.021
South Korea	0.118***	0.067	-0.271	0.208	3.305*	0.066
Indonesia	-0.059*	0.023	-0.116**	0.048	1.755	0.088
Turkey	-0.177*	0.001	1.939*	0.027	1.060*	0.008
Argentina	-0.170*	0.007	2.216*	0.059	2.814*	0.034
Mexico	0.090*	0.034	0.582*	0.100	0.785*	0.008
Brazil	0.016*	0.023	5.664*	0.336	2.045**	0.948

Notes: Standard errors of nonparametric estimates are obtained from bootstrapping (seed 10101 and reps 200)

* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level.

Table 3: Nonparametric Median Estimates by Year

Table 3.a: Low Skill- and Technology-Intensive Manufactures

Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP						
	LnCnsexp	**Rank**	**LnIQI**	**Rank**	**LnCger**	**Rank**
1995	-0.081*	15	2.236*	7	1.346*	13
	(0.013)		(0.045)		(0.044)	
1996	0.067	12	1.820*	8	1.695*	12
	(0.068)		(0.233)		(0.224)	
1997	-0.163*	16	2.681*	6	0.803*	16
	(0.054)		(0.205)		(0.177)	
1998	0.006**	14	3.106*	4	0.929*	14
	(0.003)		(0.098)		(0.100)	
1999	0.499*	1	3.072*	5	2.024*	10
	(0.034)		(0.178)		(0.127)	
2000	0.445*	2	4.022*	2	1.841*	11
	(0.018)		(0.151)		(0.080)	
2001	0.229*	7	5.628*	1	0.897	15
	(0.014)		(1.593)		(0.979)	
2002	0.228*	8	3.848*	3	2.032*	9
	(0.015)		(0.884)		(0.468)	
2003	0.249*	6	1.727*	9	3.281*	8
	(0.044)		(0.257)		(0.154)	
2004	0.328*	4	1.246*	10	4.173*	7
	(0.068)		(0.403)		(0.166)	
2005	0.132***	11	0.025	13	5.308*	5
	(0.070)		(0.361)		(0.123)	
2006	0.266*	5	0.255**	11	5.724*	3
	(0.010)		(0.103)		(0.004)	
2007	0.147*	10	-0.271	14	5.560*	4
	(0.037)		(0.378)		(0.020)	
2008	0.197*	9	-0.359***	15	6.206*	2
	(0.020)		(0.200)		(0.016)	
2009	0.329*	3	0.191*	12	6.304*	1
	(0.030)		(0.057)		(0.096)	
2010	0.022	13	-0.740*	16	5.126*	6
	(0.026)		(0.253)		(0.015)	

Notes: Standard errors are in parentheses.
Standard errors of nonparametric estimates are obtained from bootstrapping (seed 10101 and reps 200)
* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level.
Higher rank indicates higher absolute value of the estimates

Table 3.b: Medium Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP					
	LnDnsexp	**Rank**	**LnIQI**	**Rank**	**LnCger**	**Rank**
1995	0.317*	10	0.317	10	2.733*	16
	(0.056)		(0.444)		(0.429)	
1996	0.416*	1	-0.487*	13	3.477*	11
	(0.017)		(0.140)		(0.120)	
1997	0.405*	3	-0.439*	12	3.656*	9
	(0.004)		(0.021)		(0.014	
1998	0.407*	2	0.168*	11	3.592*	10
	(0.003)		(0.014)		(0.010)	
1999	0.395*	5	0.873*	9	3.317*	13
	(0.001)		(0.002)		(0.001)	
2000	0.397*	4	1.097*	5	3.246*	15
	(0.001)		(0.001)		(0.001)	
2001	0.357*	7	1.276*	4	3.322*	12
	(0.005)		(0.005)		(0.001)	
2002	0.345*	8	1.527*	3	3.249*	14
	(0.007)		(0.003)		(0.001)	
2003	0.344*	9	0.893*	8	3.729*	8
	(0.012)		(0.006)		(0.002)	
2004	0.374*	6	0.960*	7	4.140*	7
	(0.016)		(0.224)		(0.052)	
2005	0.308*	13	0.994**	6	4.804*	5
	(0.038)		(0.560)		(0.128)	
2006	0.312*	12	1.570**	2	4.789*	6
	(0.053)		(0.743)		(0.154)	
2007	0.313*	11	1.603***	1	4.854*	4
	(0.089)		(0.962)		(0.180)	
2008	0.122*	14	-0.986**	16	5.804*	1
	(0.042)		(0.495)		(0.090)	
2009	0.107**	15	-0.633	14	5.494*	2
	(0.047)		(0.642)		(0.115)	
2010	0.015*	16	-0.806*	15	5.091*	3
	(0.001)		(0.001)		(0.001)	

Notes: Standard errors are in parentheses.
Standard errors of nonparametric estimates are obtained from bootstrapping (seed 10101 and reps 200)
* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level.
Higher rank indicates higher absolute value of the estimates

Table 3.c: High Skill- and Technology-Intensive Manufactures

	Dependent variable: GDP per capita (international $, 2005 Constant Prices) lnGDP					
	LnEnsexp	**Rank**	**LnIQI**	**Rank**	**LnCger**	**Rank**
1995	0.186* (0.002)	7	2.170* (0.019)	5	1.325* (0.011)	13
1996	0.199* (0.075)	4	2.336* (0.217)	4	1.158* (0.266)	14
1997	0.494* (0.131)	1	1.251* (0.356)	8	2.312* (0.427)	11
1998	0.422* (0.046)	9	3.211* (0.031)	3	0.832* (0.028)	15
1999	0.449* (0.025)	8	1.381* (0.347)	7	3.343* (0.078)	9
2000	0.423* (0.053)	3	1.857* (0.716)	6	3.197* (0.491)	10
2001	0.195* (0.067)	5	4.435* (1.471)	2	1.702** (0.844)	12
2002	0.308* (0.050)	2	6.974* (0.540)	1	0.770* (0.271)	16
2003	0.187* (0.053)	6	1.229* (0.453)	9	3.726* (0.125)	8
2004	0.462* (0.001)	10	-0.336* (0.001)	14	4.427* (0.001)	7
2005	0.104* (0.001)	12	-0.079* (0.001)	10	4.842* (0.001)	5
2006	0.134* (0.001)	14	-0.138* (0.001)	11	4.828* (0.001)	6
2007	0.156* (0.001)	15	-0.206* (0.001)	13	4.920* (0.001)	4
2008	0.166* (0.024)	16	-0.428* (0.036)	15	5.207* (0.048)	1
2009	0.122** (0.062)	13	-0.202*** (0.114)	12	5.010* (0.129)	2
2010	0.058 (0.043)	11	-0.667* (0.073)	16	4.921* (0.096)	3

Notes: Standard errors are in parentheses.
Standard errors of nonparametric estimates are obtained from bootstrapping (seed 10101 and reps 200)
* Significant at 1% level, ** Significant at 5% level, *** Significant at 10% level.
Higher rank indicates higher absolute value of the estimates

Table 4: Sources of Variables

Variable	Description	Source
GDP	GDP per capita (international $, 2005 Constant Prices, Chain series)	PWT 7.1, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania
Cnexp	Export goods that demand a low level of technology and skill	UNCTAD
Dnexp	Export goods that demand a medium level of technology and skill	UNCTAD
Enexp	Export goods that demand a high level of technology and skill	UNCTAD
IQI	Institutional Quality Index	
Political IQI	Executive constraint	Polity IV Project
	Political rights	Economic Freedom Index dataset
	Polity score	Polity IV Project
	Index of democracy	PRIO Dataset
Social IQI	Press freedom	Economic Freedom Index dataset
	Civil liberties	Economic Freedom Index dataset
	Physical integrity index	CIRI Human Rights Data Project
	Empowerment rights index	CIRI Human Rights Data Project
	Freedom of association	CIRI Human Rights Data Project
Economic IQI	Legal and property rights	Economic Freedom Index dataset
	Control of Corruption	The Worldwide Governance Indicators (WGI) project
	Bureaucratic quality	The QOG Institute
	Government Effectiveness	The Worldwide Governance Indicators (WGI) project
	Independent judiciary	POLCON Henisz Dataset
	Regulatory Quality	The Worldwide Governance Indicators (WGI) project
	Rule of Law	The Worldwide Governance Indicators (WGI) project
Cger	Combined gross enrolment ratio	UNESCO Education Database

Note: All variables are converted in logs, denoted by "ln"