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Export and Economic Growth in the Case of the Manufacturing Industry: Panel Data Analysis of Developing Countries*

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ABSTRACT: The correlation between growth in export and economic growth, which is called "Export-led Growth Hypothesis" in the literature, is still a current issue in both the theoretical and empirical literature. In the present study, the effect of different classifications of export and import on economic growth in 22 developing countries in the 1998–2006 period was tested based on two models, via panel data analysis. According to the results of the first model, the analysis of which included variables such as high and low-tech manufacturing industry exports, investment and population, it was found that only two variables, high-tech manufacturing industry export and investment, have a positive and significant effect on growth. In addition to the first model which included the analysis of all variables, the second model investigated the effect of high and low-tech manufacturing industry imports on growth. The findings revealed that only high-tech manufacturing industry export, investment and low-tech manufacturing industry import have a positive and significant effect on growth.

Keywords: High and Low-tech Manufacturing Industry Imports and Exports; Economic Growth; Export-led Growth Hypothesis; Developing Countries; Panel Data Analysis
JEL Classifications: F14; F43

1. Introduction

Whether an economy can benefit from an increase in export depends on the supply and demand elasticity of export goods. The higher the supply and demand elasticity of export goods, the more export stimulates economic growth. The supply and demand elasticity of export goods in developed countries is higher than that of developing countries. Therefore, the effect of export on economic growth is more in developed countries compared to developing countries.

Higher growth rate in the manufacturing sector results in higher growth rate in Gross Domestic Products. Kaldor (1968) explains why the manufacturing industry is growth's engine and how it creates positive externalities in the economy. Kaldor (1968) states that increasing returns to scale existing in the industry sector increase investment returns. Due to such features, the industry sector provides positive externalities in the economy in general and accelerates economic growth via these externalities. The growth of the industry sector increases productivity not only in itself, but also in other sectors with a large range of facilities for division of labour. That is why Kaldor considers the industry sector as "growth's engine". Kaldor maintains that growth in industrial manufacturing can be possible only through external demand with a high growth rate; that is, through export. The higher the growth rate in the manufacturing industry that export determines, the faster the transfer of the labour will be from sectors in which economic productivity is low to the industrial sector, which leads to a faster productivity increase.

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In the present study, the effect of high and low-tech manufacturing industry exports and imports on economic growth was tested for 22 developing countries in the 1998–2006 period via panel data analysis. Therefore, this study is significant in that it discusses to what extent different classifications of export are effective on growth; in other words, the degree to which export affects growth and whether growth genuinely results from export or other factors.

Relying on the results of the study, we aimed to determine the foreign trade policies that need to be implemented in order to achieve long-term sustainable economic growth in developing countries and to provide policy-makers with suggestions related to the issue.

The study consists of two main parts, in the first part, the correlation between export and economic growth in the theoretical and empirical literature is discussed. The second part includes econometric models and findings. In the conclusion section, the findings of the study are presented.

2. The Correlation between Export and Economic Growth in the Literature

In this part of the study, the correlation between export and economic growth is examined in terms of the theoretical and empirical literature.

2.1. Theoretical Literature

The correlation between foreign trade and economic growth dates back to Smith and Ricardo. According to classical foreign trade theory, trade presents each country with a comparative advantage by providing specialization in production. However, the "Classical Foreign Trade Theory" has been criticized by many economists. According to these economists, the theory is not appropriate for real, dynamic conditions, especially in terms of poor countries that want to develop. These countries are export dealers of primitive substance (Serin, 1981: 29). This means that the hypothesis of foreign trade as growth's engine is not relevant to developing countries. As Nurkse (1959) asserts, foreign trade undertook the role of growth's engine in such countries as Canada, the United States and Australia in the 19th century. According to Kravis (1970), the real reason for growth through foreign trade in these countries was their rich natural resources. Cairncross (1961) states that developing countries use their natural resources only to meet their domestic demands, and they can allot only an insignificant portion for export.

Internal Growth Theories, the basis of which dates back to Adam Smith, also emphasize the growth-increasing effect of foreign trade. Among the supporters of Internal Growth Models, Grossman and Helpman (1990a) discuss the internal growth of countries that are engaged in foreign trade along with international information overflow. In their study, it is assumed that information overflows occur automatically, and the growth performance of a small country which can obtain scientific and technological information flow from foreign countries, gauged by its foreign trade, is analyzed. In addition, it is asserted that some policies that are incentives for foreign trade accelerate growth by decreasing the harmful effects caused by innovation externality and promote national prosperity. Moreover, the study reveals that without external technological improvement and constant returns in manufacturing, information overflows can promote long-term economic growth.

In another study in which the correlation between foreign trade and growth is investigated, Grossman and Helpman (1990b) claim that the R&D (research and development) sector, which benefits from the opportunities foreign trade provides, is the driving force of growth by providing the domestic economy with a comparative advantage. According to the authors, by liberalizing their foreign trade, developing countries will be able to have access to world information stock by means of technology transfer, and eventually they will get the maximum benefit from liberalization.

Rivera-Batiz and Romer (1991) examine the effect of economic integration on growth in countries that have similar technology and factor endowment, such as Europe and North America. The results indicate that if economic integration leads to increasing returns to scale in two different economies that have similar development levels, this integration undertakes the task of the growth's engine. Therefore, integration increases the long-term growth rate as it clearly leads to market expansion. In conclusion, if increasing returns expand the sector, growth occurs. Economic integration increases long-term growth rate by pruducing the scale effect. Policies that influence long-term growth rate have a great effect on economic prosperity.

According to Young (1991), when two countries are engaged in trade, as in the Comparative Advantage Model, developed countries specialize in high-tech goods, and developing countries in low-tech goods. As it is assumed in the model that high-tech manufacturing leads to learning by

practising faster, the effect of free trade increases growth in developed countries and decreases growth in developing countries. That is why, in the case of autharchy, while free trade increases the growth rate in developed countries, it reduces it in developing countries.

Chuang (1998) presents a model that shows how foreign trade and externalities created by learning by doing increase their contribution to economic growth in developing countries, as stated also by Young (1991). The model emphasizes two critical points. The first is that both export and import are important for economic growth. As for the second, expansion in foreign trade is essential, but not sufficient, for growth to accelerate. The author asserts that countries specialize depending on their existing resource supplies (comparative advantages) along with expansion in foreign trade, and that is why the manufacturing structure has become labour-intensive. However, to ensure the technological development of countries, their exported goods should be technology-intensive.

According to Chuang (1998), learning makes a country produce new goods, and thus export authentic goods. The export of authentic goods eventually leads to the assimilation of new skills and experiences, and thus creates demand for new technologies that are beneficial for increasing the quality of national technology. This effect, in turn, increases international competitiveness and accelerates the need for the import of technically developed goods, which makes national manufacturing efficient and convenient. According to the results of cross section analysis, in which Chuang (2002) investigated the effect of trade-led learning on growth in 78 countries from 1960 to 1985, the realization of this process depends on the quality of the goods and the differences between the technological development of the countries and their trade partners. The reason is that technology-intensive goods are more instructive. Moreover, the higher the technological capacities of partners, the faster the effect of learning will be.

Lucas (1988) assumes that there are two types of countries; countries that produce high-tech goods and those that produce low-tech goods. He emphasizes that in the case of high-tech goods, the ratio between the human capital rate and substitutability rate of goods is higher compared to low-tech goods. Therefore, according to the author, as countries specialize in high-tech goods, the effect of the export of these goods on growth will be more than that of low-tech goods.

The effect of export on growth is also included in Export-led Growth Models. These models are suggested by Lamfalussy (1963), Beckerman (1962), Kaldor (1970) and Thirlwall (1975) (Gandolfo, 1998:212). Lamfalussy is one of the first economists who suggests Export-led Growth Theory in the account of the differences in the growth performance of Western European countries. In the Lamfalussy Model, export-led growth is significant for three reasons. Firstly, being one of the determinants of demand, export's growth rate is a significant determinant of investment. Secondly, growth entails import; if export does not increase as much as the need for import, growth will be constrained by balance of payments. Thirdly, the smaller the national market is, the more important foreign demand is in order for the entrepreneur to reach the economies of scale. Beckerman expresses similar views to Lamfalussy regarding export-led growth. According to Beckerman, demand determines investment and growth. Export is an important component of demand. A high level of investment and demand has positive effects on growth by contributing to more export demand and greater competitiveness (McCombie and Thirlwall, 1994: 425).

According to Kaldor, there are four growth laws. First, faster growth rate in the manufacturing industry sector leads to faster growth rate in Gross Domestic Products. Second, a faster growth rate in manufacturing industry production leads to a faster growth rate in labour productivity in the manufacturing industry due to increasing returns to scale. This is called the Verdoorn Law. Third, growth rate in manufacturing industry production is not constrained by labour supply, but determined by the demand in the agricultural sector in the early stage of development and by export in the later stages. Fourth, faster growth in export leads to long-term economic growth (Blecker, 2009: 4-5).

Thirlwall's Export-led Growth Model is known as "Thirlwall's Law" in the literature. Thirwall (1979) explains varieties of factor supply and productivity among different countries. He asserts that these varieties, and thus varieties in growth rate, result from varieties of demand among countries. According to Thirlwall's Law, the economic growth of outward economies is constrained by the income elasticity of import and export. For this reason, Thirlwall's Law is also called "balance of payments constrained growth". Therefore, according to Thirlwall, growth in domestic demand results in a constraint on the balance of payments of the country depending on increasing import. Consequently, balance of payments will have a restrictive effect on growth. As for the financing of the

balance of payments, it is only possible via export in the long run. The financing of the balance of payments through capital movement is short-term.

According to Thirlwall and Hussain (1982), in Thirlwall's Law, economic growth is determined by the income elasticity of import and export demand. In other words, the bigger the income elasticity of export in a country, the faster the economy grows as a whole. On the other hand, parallel with the economic growth in the country, the size of the income elasticity of import constrains the growth performance of the country.

2.2. Empirical Literature

In the empirical literature, there are several studies that investigated the effect of export on growth, called the Export-led Growth Hypothesis, in the case of individual countries and groups of countries. However, conflicting results due to variations in the era studied, country or groups of countries focused on, or the methods used still make this topic current and a focus of attention.

The correlation between export and economic growth is displayed in terms of the author(s), country(ies), method, variables and results in Table 1 in the case of groups of countries and in Table 2 in the case of individual countries.

In the case of groups of countries, the studies carried out on this topic and cited most are those by Feder (1982), Ram (1985, 1987) and Tyler (1980). As seen in Table 1, there are a few studies in the literature that assessed the Export-led Growth Hypothesis in terms of total manufacturing industry export in the case of the manufacturing industry; these are the studies by Parida and Sahoo (2007) and Abu-Qarn (2001).

As Table 1 indicates, there are few studies that investigated Export-led Growth Hypothesis both in terms of total manufacturing industry export and the export of the sub-sectors of the manufacturing industry. For example, Alam (2003) tested the Export-led Growth Hypothesis in the case of the manufacturing industry for two Latin American countries (Mexico and Brazil), using the FMOLS (Fully Modified OLS) Model developed by Phillips and Hansen (1990). In that study, the author divided manufacturing industry export into sub-sectors depending on SITC Rev. 3 classification. Therefore, manufacturing industry export is composed of the combination of products numbered as SITC 5+6-67-68+7+8. As for real capital goods import, it is composed of SITC 7. The results of the study reveal that capital goods import has a significant effect on growth in both countries.

Another study that divided the manufacturing industry into sub-sectors and investigated the correlation between manufacturing industry export and growth was carried out by Cuaresma and Wörz (2005). The authors tested the hypothesis of qualitative differences between high and low-tech manufacturing industry export with respect to output growth through panel data analysis for 45 developed and developing countries between 1981-1997. According to the results of the study, high-tech manufacturing industry export has a significant and positive effect on Gross Domestic Products, while low-tech manufacturing industry export has a meaningless effect. In other words, the hypothesis of qualitative differences between high and low-tech manufacturing industry export is confirmed.

The review of the literature reveals that, as shown in Table 2, studies that focus on total manufacturing industry export for individual countries are very few. Studies in which the Export-led Growth Hypothesis was tested in the case of the manufacturing industry were conducted by Kurt and Terzi (2007) and Herzer, Lehmann and Siliverstovs (2005).

Table 1. The Correlation Between Export and Economic Growth: The Case of Groups of Countries

Authors	Countries	Period	Method	Variables	Results
Parida and Sahoo (2007)	4 South Asian Countries India, Pakistan, Bangladesh, Sri Lanka	1980-2002 (Annual Data)	Panel Data Analysis	*Dependent Variables (Real)* • GDP, Non-Export GDP *Independent Variables (Real)* • Gross Fixed Capital Formation, Public Health and Educational Expenses, Manufacturing Industry Import, Manufacturing Industry Export, Total Export	Confirmation of Export and Manufacturing Industry Export-led Growth Hypothesis
Cuaresma and Wörz (2005)	45 Developed and Developing Countries	1981-1997 (Annual Data)	Panel Data Analysis	*Dependent Variable (Real)* GDP Growth Rate *Independent Variables (Real)* • The Share of Investment in GDP, The Growth Rate of Population, The Share of High-Tech and Low-Tech Manufacturing Industry Export in GDP, The Share of Non-Manufacturing Industry Export in GDP	Confirmation of Manufacturing Industry Export-led Growth Hypothesis
Alam (2003)	2 Latin American Countries Mexico, Brazil	Mexico (1959-1990) Brazil (1955-1990) (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Capital Stock, Employed Labour, Manufacturing Industry Export, Capital Goods Import	Rejection of Manufacturing Industry Export-led Growth Hypothesis
Abu-Qarn and Suleiman (2001)	The Middle Eastern and North African Countries Algeria, Egypt, Iran, Israel, Jordan, Morocco, Sudan, Tunisia, Turkey	Algeria, Sudan (1968-1996) Egypt, Morocco, Tunisia, Turkey (1966-1996) Iran (1974-1995) Israel (1976-1996) (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Export, Import, Manufacturing Industry Export	Confirmation of Export and Manufacturing Industry Export-led Growth Hypothesis for Algeria and Sudan, Rejection of the Hypothesis for the other Countries
Ram (1985)	73 Medium and Low-Income Less Developed Countries	1960-1970 and 1970-1977 (Annual Data)	Cross Section Analysis	*Dependent Variable (Real)* • GDP Growth Rate *Independent Variables (Real)* • The Growth Rate of Labour, The Share of Investment in GDP, The Growth Rate of Export	Confirmation of Export-led Growth Hypothesis
Ram (1987)	88 Medium and Low-Income Less Developed Countries	1960-1972 and 1973-1982 (Annual Data)	Cross Section and Time Series Analysis	*Dependent Variable (Real)* • GDP Growth Rate *Independent Variables (Real)* • The Growth Rate of Population, The Share of Investment in GDP, The Growth Rate of Export	Confirmation of Export-led Growth Hypothesis in General in the Countries Discussed
Feder (1982)	55 Developed and Developing Countries	1964-1973 (Annual Data)	Cross Section Analysis	*Dependent Variable (Real)* • GDP Growth Rate *Independent Variables (Real)* • The Share of Investment in GDP, The Growth Rate of Population, The Growth Rate of Export, The Share of Export in GDP	Confirmation of Export-led Growth Hypothesis
Tyler (1980)	55 Middle-Income Developing Countries	1960-1977 (Annual Data)	Cross Section Analysis	*Dependent Variable (Real)* • GDP Growth Rate *Independent Variables (Real)* • Manufacturing Industry Growth Rate, Gross Domestic Investment Growth Rate, The Growth Rate of Export, The Growth Rate of Manufacturing Industry Export, The Growth Rate of Direct Private Foreign Capital Investment, The Change of Net Terms of Foreign Trade	Confirmation of Export-led Growth Hypothesis

Table 2. The Correlation Between Export and Economic Growth: The Case of Individual Countries

Authors	Country	Period	Method	Variables	Results
Boltho (1996)	Japan	1913-1937 1952-1973 1973-1990 (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variable (Real)* • Export	Confirmation of Export-led Growth Hypothesis for 1952-1973 Period Rejection of Export-led Growth Hypothesis for 1913-1937 and 1973-1990 Period
Medina-Smith (2001)	Costa Rica	1950-1997 (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Export of Goods and Services • Gross Domestic Investment • Population	Confirmation of Export-led Growth Hypothesis
Kaushik, Arbenser and Klein (2008)	India	1971-2005 (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Export • Export Variability • Investment	Confirmation of Export-led Growth Hypothesis
Kurt and Terzi (2007)	Turkey	1989-2003 (Quarterly Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP Growth Rate *Independent Variables (Real)* • Manufacturing Industry Export • Manufacturing Industry Import • Productivity Index for Each Working Hour in the Manufacturing Industry Production	Confirmation of Manufacturing Industry Export-led Growth Hypothesis
Tuncer (2002)	Turkey	1980-2000 (Quarterly Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Export • Import • Investment	Rejection of Export-led Growth Hypothesis
Keong, Yusop and Sen (2005)	Malaysia	1960-2001 (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Export • Import • Exchange Rate • Labour	Confirmation of Export-led Growth Hypothesis
Karagöl and Serel (2005)	Turkey	1955-2002 (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GNP *Independent Variables (Real)* • Export	Rejection of Export-led Growth Hypothesis
Akbar and Fatima (2003)	Pakistan	1975-1998 (Quarterly Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Export • Import • Investment • Energy Consumption	Rejection of Export-led Growth Hypothesis
Herzer, Lehmann and Siliverstovs (2005)	Chile	1960-2000 (Annual Data)	Time Series Analysis	*Dependent Variable (Real)* • GDP *Independent Variables (Real)* • Capital Stock • Labour • Capital Goods Import • Manufactured Export • Primary Export	Confirmation of Export-led Growth Hypothesis in Terms of Manufactured Export

3. Econometric Model and Findings

In this part of the study, initially, information regarding the data set used is provided. Then, panel unit root tests that determine whether the series are stagnant or not are carried out, and findings gathered from panel data analysis are evaluated.

3.1. Data Set

In the study, initially, the effect of high and low-tech manufacturing industry on economic growth was tested with regard to the sub-sectors (digits) of the manufacturing industries in 22 developing countries for the 1998–2006 period. The rationale behind choosing manufacturing industry export was that in the limited number of studies conducted in the case of the manufacturing industry sector, manufacturing industry export led to dynamic externalities in the economy. In these studies, the dynamic technological diffusion effect was correlated with manufacturing industry export rather than total export, and it was assumed that exports of agricultural products and service did not lead to dynamic externality. In the present study, high and low-tech manufacturing industry imports were added to the model later, and the effect of high and low-tech manufacturing industry exports and imports on growth was tested for the stated period and countries. The rationale behind the inclusion of high and low-tech manufacturing industry imports was to determine whether economic growth resulted from manufacturing industry export or import, or whether manufacturing industry export or import had a greater effect on growth.

The variables in the study are Gross Domestic Products (GDP), investment, population, high and low-tech manufacturing industry exports and high and low-tech manufacturing industry imports. The data regarding GDP (GDP with Current Prices and the year 2000 Fixed Prices) and investment (the year 2000 Gross Fixed Capital Formation at Constant Prices) were gathered in US dollars from the 2010 webpage of World Development Indicators-WDI- of the World Bank. The population data, in which each number indicates a million people, were retrieved from the 2009 CD-ROM of International Financial Statistics-IFS, IMF. High and low-tech manufacturing industry export and import data were in US dollars and were retrieved from the 2009 CD-ROM of the Industrial Demand-Supply Balance Database-IDSB, and the United Nations Industrial Development Organization-UNIDO. Manufacturing industry data were grouped according to ISIC Rev.2, based on the OECD's manufacturing industry classification according to levels of technology. Sectors in the study are presented in Table 3 according to their levels of technology in the manufacturing industry.

Manufacturing industry data were grouped according to intensity of technology based on the industry classification depending on OECD's technology intensity, as stated by Hatzichronoglou (1997). As seen in Table 3, industries are divided into four groups according to intensity of technology: high-tech industries, medium-to-high-tech industries, medium-to-low-tech industries and low-tech industries. In the study, high-tech and medium-to-high-tech industries were classified as high-tech industries, and medium-to-low-tech and low-tech industries were classified as low-tech industries. For each country discussed in the study, manufacturing industry export and import data included in the high and low-tech group were formed based on the stated classification.

All the data used in the study, except for those of manufacturing industry, are real. However, manufacturing industry data were nominal, and were made real via GDP deflator calculated by the researchers. The dependent variable in the study is real GDP growth rate. The independent variables are as follows: the share of real investment in real GDP (INV), the growth of the population (POP), the share of high-tech real manufacturing industry export in real GDP (HTX), low-tech real manufacturing industry export in real GDP (LTX), the share of high-tech real manufacturing industry import in real GDP (HTI), and the share of low-tech real manufacturing industry import in real GDP (LTI).

The countries focused on in this study were chosen from among middle-income developing countries (lower middle-income and upper middle-income countries), depending on the obtainability of manufacturing industry data, by taking into consideration the classification of the countries according to the income groups of the World Bank. The 22 countries analyzed are shown in Table 4.

Table 3. Sectors in Manufacturing Industry According to Intensity of Technology (ISIC Rev.2)

Industries According to Intensity of Technology	ISIC Rev.2 Code	UNIDO ISIC Rev.2
A. High-Tech Industries		
1. Aerospace	3845	3845
2. Computers, Office Machinery	3825	3825
3. Electronics-Communications	3522	3522
4. Pharmaceuticals	3832	3832
B. Medium-High-Tech Industries		
5. Scientific Instruments	385	3851+3852+3853
6. Motor Vehicles	3843	3843
7. Electrical Machinery	383-3832	(3831+3832+3833+3839)-3832
8. Chemicals	351+352-3522	(3511+3512+3513+3521+3522+ 3523+3529)-3522
9. Other Transport Equipment	3842+3844+3849	3842+3844+3849
10.Non-Electrical Machinery	382-3825	(3821+3822+3823+3824+3825+ 3829)-3825
C. Medium-Low-Tech Industries		
11. Rubber and Plastic Products	355+356	3551+3559+3560
12. Shipbuilding	3841	3841
13. Other Manufacturing	39	3901+3902+3903+3909
14. Non-Ferrous Metals	372	3720
15. Non-Metallic Mineral Products	36	3610+3620+3691+3692+3699
16. Fabricated Metal Products	381	3811+3812+3813+3819
17. Petroleum Refining	353+354	3530+3540
18. Ferrous Metals	371	3710
D. Low-Tech Industries		
19. Paper Printing	34	3411+3412+3419+3420
20. Textile and Clothing	32	3211+3212+3213+3214+3215+ 3219+3220+3231+3232+3233+ 3240
21. Food, Beverages and Tobacco	31	3111+3112+3113+3114+3115+ 3116+3117+3118+3119+3121+ 3122+3131+3132+3133+3134+ 3140
22. Wood and Furniture	33	3311+3312+3319+3320

Source: Hatzichronoglou, 1997, 6; UNIDO, 2009.

* For the content of the products in the ISIC Rev.2 classification, see UNIDO, 2009.

Table 4. Countries Involved in the Analysis

Developing Countries	
Upper Middle-Income Countries	**Lower Middle-Income Countries**
Argentina	Bolivia
Algeria	Equador
South Africa	Indonesia
Gabon	Côte D'lvoire
Mexico	Philippines
Malaysia	Honduras
Peru	India
Romania	Egypt
Chile	Thailand
Turkey	Pakistan
Uruguay	
Venezuela	

3.2. Panel Unit Root Tests

In order to obtain significant correlations between the variables used in the analysis, the series need to be stagnant or homogeneous at the same degree. In order to observe whether the data were stagnant, panel unit root tests were carried out. Panel is generally heterogeneous and panel unit root tests should take this heterogeneity into account. If unit root is detected in the data, the problem of spurious regression occurs in the panel data analysis as well. Table 5 reveals the unit root analysis results of the variables used in the analysis.

Table 5. Panel Unit Root Analysis (Constant Term Only)

Method	Variables						
	GDP	**INV**	**POP**	**HTX**	**LTX**	**HTI**	**LTI**
Ho: Unit Root Exists							
Levin, Lin & Chu t	-24.7065 (0.0000)	-18.6734 (0.0000)	-6.69718 (0.0000)	-4.04496 (0.0000)	-8.67047 (0.0000)	-6.08295 (0.0000)	-5.45519 (0.0000)
Ho: Unit Root Exists							
Im, Pesaran and Shin W-stat	-6.12319 (0.0000)	-8.03238 (0.0000)	-2.63378 (0.0042)	-0.04378 (0.4825)	-2.51518 (0.0059)	-2.40880 (0.0080)	-0.26725 (0.3946)
ADF - Fisher Chi-square	101.279 (0.0000)	129.045 (0.0000)	39.1893 (0.0003)	44.2685 (0.4603)	78.0002 (0.0012)	81.4097 (0.0005)	49.4593 (0.2644)
PP - Fisher Chi-square	121.961 (0.0000)	140.706 (0.0000)	26.2987 (0.0237)	72.3010 (0.0046)	83.2473 (0.0003)	77.2072 (0.0015)	59.2294 (0.0623)
The numbers of delay were chosen via ***Schwarz Information Criterion***. The values in parentheses indicate the possibility values.							

As indicated in Table 5, according to Levin, Lin and Chu t-test results, all variables were found to be stagnant in their own levels. Additionally, Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square, PP - Fisher Chi-square test results are also presented in the table.

3.3. Model and Panel Analysis Results

In the study, estimations for two different models were made. First, the estimation of the first model, which tested the effect of high and low-tech manufacturing industry exports on growth, was made. After that, the high and low-tech manufacturing industry imports were also included in the first model, and the effect of high and low-tech manufacturing industry imports on growth were examined in the second model. The Ordinary Least Squares (OLS), Random Effects (RE), Fixed Effects (FE) and Panel Corrected Standard Errors (PCSE) methods were used for estimations of the models. Next, the most appropriate method for the data set used in the study was identified, and finally, the results were evaluated statistically.

3.3.1. Panel Analysis Results for the First Model

The first model to be estimated was as follows:

$GDP_{it} = \alpha + b_1 INV_{it} + b_2 POP_{it} + b_3 HTX_{it} + b_4 LTX_{it} + e_{it}$

For the first model, OLS and PCSE Model results achieved through panel data analysis carried out with all independent variables are presented in Table 6.

As Table 6 shows, only the INV and HTX variables are statistically significant at the 5% and 10% level respectively. The INV variable affects growth to a greater extent compared to the HTX variable. On the other hand, the LTX and POP variables are statistically meaningless. Therefore, it could be stated that the LTX and POP variables have no effect on economic growth in terms of the period and countries discussed.

In order to check the reliability of the results of the model, determination of whether there is heteroscedasticity or autocorrelation problems is essential. According to the results of the Wooldridge test carried out for the determination of autocorrelation, the test coefficient (4.222) is statistically significant at the 10% level, and the null hypothesis, which states that there is no autocorrelation in the model, is rejected. The results of the Likelihood-Ratio Test (LR Test), carried out to determine heteroscedasticity, reveal that the test coefficient (68.82) is statistically significant at the 5% level, and the null hypothesis, stating that there is no heteroscedasticity in the model, is rejected. Therefore, as

asserted in Beck and Katz's (1995) study, the best estimation method with no such problems is the PCSE Model.

Table 6. OLS and PCSE Models Estimation Results for the First Model

Variables	OLS	PCSE
Constant	1.700611* (0.634330)	1.700611* (0.640615)
HTX	0.013820** (0.008216)	0.013820** (0.008174)
LTX	0.035408 (0.041554)	0.035408 (0.042395)
POP	0.387619 (0.279375)	0.387619 (0.282281)
INV	1.041895* (0.056441)	1.041895* (0.061814)
R^2	0.640747	0.633301
F Statistics	86.05643*	86.05643*
Wooldridge Test	4.222**	
Likelihood-Ratio Test	68.82*	
The Number of Observations	198	
The Number Of Countries	22	
* Statistically significant at the 5% level. ** Statistically significant at the 10% level. The numbers in parentheses indicate standard errors.		

As seen in Table 6, according to the results of the PCSE Model, while only the INV and HTX variables are statistically significant at the 5% and 10% level respectively, the LTX and POP variables are statistically meaningless. As in OLS results, the positive effect of the INV variable on GDP is more than the effect of the HTX variable.

In addition, another analysis was carried out by excluding the POP and LTX variables, which are statistically meaningless for the first model. Table 7 presents the estimation results according to OLS, RE, FE and PCSE Models. As indicated in Table 7, according to OLS test results, the HTX and INV variables are statistically significant at the 5% level and have a positive effect on GDP. According to Breusch-Pagan LM test results carried out in order to make a choice between the OLS and RE Models, the test statistics (1.12) are found to be statistically meaningless at the 5% level, and the null hypothesis is confirmed. Hence, for the data set, it was more appropriate to apply the OLS Regression Model rather than the RE Model.

Moreover, the Hausman Test was applied so as to make a choice between the FE and RE Models. According to the test results, the test statistics (4.620496) are statistically meaningless at the 5% level, the null hypothesis is confirmed, and the RE Model was found to be appropriate. According to the results of the RE Model, while the HTX variable is statistically significant at the 10% level and has a positive effect on GDP, the INV variable is statistically significant at the 5% level and has a positive effect on GDP. Furthermore, the results of the analysis carried out based on FE Model reveal that the only variable that is significant is INV.

The Wooldridge test results indicate that there is no autocorrelation problem in the model; however, there is a problem of heteroscedasticity, as revealed by the LR test results. In order to overcome this problem and obtain more reliable results, in other words more efficient and consistent estimators, the estimation results of the PCSE Model are presented in the last column of the table. It is observed that both the INV and HTX variables have a positive and statistically significant effect at the 5% level on the growth numbers of the 22 developing countries discussed. However, the effect of INV on growth is stronger than that of the HTX variable. It should be noted that the results of the OLS Model and the PCSE Model are very similar. Therefore, it could be maintained that the most appropriate model for our data set was the PCSE Model freed from the heteroscedasticity problem.

Table 7. OLS, RE, FE and PCSE Models Estimation Results for the First Model

Variables	OLS	RE	FE	PCSE
Constant	2.570313* (0.204667)	2.580658* (0.243316)	3.951987* (0.864321)	2.570313* (0.204362)
HTX	0.017559* (0.006514)	0.016954** (0.007739)	-0.089675 (0.065967)	0.017559* (0.006358)
INV	1.029959* (0.055802)	1.023351* (0.054399)	1.046904* (0.059766)	1.029959* (0.061472)
R^2	0.632936	0.638766	0.656900	0.632936
F Statistics	170.8459*	175.1762*	17.39895*	170.8459*
Wooldridge Test	2.650			
Likelihood-Ratio Test	68.04*			
Hausman Test		4.620496		
Breusch-Pagan LM Test		1.12		
The Number of Observations	198			
The Number Of Countries	22			

* Statistically significant at the 5% level.
** Statistically significant at the 10% level.
The numbers in parentheses indicate standard errors.

3.3.2. Panel Analysis Results for the Second Model

The second model to be estimated in the study is as follows:

$GDP_{it} = \alpha + b_1 INV_{it} + b_2 POP_{it} + b_3 HTX_{it} + b_4 LTX_{it} + b_5 HTI_{it} + b_6 LTI_{it}\ e_{it}$

The OLS and PCSE results, obtained through panel data analysis carried out for the second model with all independent variables, are presented in Table 8.

Table 8. OLS and PCSE Models Estimation Results for the Second Model

Variables	OLS	PCSE
Constant	1.867117* (0.754020)	1.867117* (0.821383)
HTX	0.075083** (0.039755)	0.075083** (0.043895)
LTX	0.003273 (0.044063)	0.003273 (0.049588)
HTI	-0.070924 (0.043253)	-0.070924 (0.047886)
LTI	0.124270** (0.068641)	0.124270** (0.074772)
POP	0.376201 (0.281674)	0.376201 (0.303041)
INV	1.045265* (0.056529)	1.045265* (0.070846)
R^2	0.638192	0.638192
F Statistics	58.91452*	58.91452*
Wooldridge Test	3.472**	
Likelihood-Ratio Test	67.86*	
The Number of Observations	198	
The Number Of Countries	22	

* Statistically significant at the 5% level.
** Statistically significant at the 10% level.
The numbers in parentheses indicate standard errors.

According to OLS results, the INV variable has a positive and statistically significant effect on GDP at the 5% level; the HTX and LTI variables also have a positive and statistically significant effect on GDP at the 10% level. However, it is observed that the INV variable affects growth to a larger extent than the HTX and LTI variables. Moreover, it could be maintained that the LTI variable is more effective on growth than the HTX variable for the countries and the period discussed. On the other hand, the HTI, LTX and POP variables are statistically meaningless at the 5% level. As a result, it could be asserted, according to OLS results, that the HTI, LTX and POP variables have no effect on economic growth for these countries and period.

According to the results of Wooldridge and LR tests conducted to evaluate the reliability of the results of the model, the model has both autocorrelation and heteroscedasticity problems.

The estimation results derived through the PCSE Model from which autocorrelation and heteroscedasticity problems were excluded are presented in the last column of Table 8. As seen in Table 8, while the INV variable has a positive and statistically significant effect on GDP at the 5% level, and the HTX and LTI variables at the 10% level, the HTI, LTX and POP variables have a statistically significant effect at the 5% level. As in the OLS results, the positive effect of the INV variable on GDP is more than those of the HTX and LTI variables. It could also be stated that the LTI variable is more effective on growth than the HTX variable in the countries and period discussed.

In addition, data were analyzed again for the second model by excluding the POP and LTX variables that were statistically meaningless. Table 9 displays the estimation results for the OLS, RE, FE and PCSE Models. As shown in Table 9, according to the OLS test results, the HTX variable is statistically significant at the 5% level and has a positive effect on GDP. The LTI and HTI variables are both statistically significant at the 10% level; however, the LTI variable has a positive effect on GDP whereas the HTI variable has a negative effect. The INV variable is statistically significant at the 5% level and and has a positive effect on GDP. Based on the results of the Breusch-Pagan LM test carried out in order to choose between the OLS and RE Models, the OLS Regression Model was preferred. In addition, based on the results of the Hausman test conducted to choose between the FE or RE Model, the RE Model was preferred.

As seen in Table 9, the results of the Wooldridge and LR tests indicate respectively that there is no autocorrelation problem, but there is a heteroscedasticity problem in the model.

Table 9. OLS, RE, FE and PCSE Models Estimation Results for the Second Model

Variables	OLS	RE	FE	PCSE
Constant	2.557528* (0.410683)	2.504570* (0.482990)	2.193320 (1.371452)	2.557528* (0.576548)
HTX	0.080358* (0.037710)	0.077491* (0.034916)	-0.072500 (0.099332)	0.080358* (0.034489)
HTI	-0.076283** (0.042173)	-0.074301** (0.038909)	-0.055127 (0.081575)	-0.076283* (0.032772)
LTI	0.111630** (0.063856)	0.121998* (0.040598)	0.471272** (0.224857)	0.111630** (0.062097)
INV	1.039832* (0.055980)	1.032334* (0.135793)	1.037906* (0.061199)	1.039832* (0.070975)
R^2	0.638496	0.642206	0.661828	0.638496
F Statistics	87.98631*	89.39892*	16.42176*	87.98631*
Wooldridge Test	2.266			
Likelihood-Ratio Test	68.86*			
Hausman Test		4.00		
Breusch-Pagan LM Test		0.78		
The Number of Observations	198			
The Number Of Countries	22			

* Statistically significant at the 5% level.
** Statistically significant at the 10% level.
The numbers in parentheses indicate standard errors.

The estimation results of the PCSE Model, made in order to overcome this problem and obtain more reliable results, in other words to obtain more efficient and consistent estimators, are presented in the last column of the table. All the coefficients that yielded similar results to the OLS Model and were analyzed in the PCSE Model were found to be statistically significant. Based on the results of the PCSE Model, it could be maintained that the most effective variable on economic growth is INV, and the positive effect of the LTI variable on growth is greater than that of the HTX variable.

4. Conclusion

In this study, the effect of high and low-tech manufacturing industry exports and imports on growth was investigated for 22 developing countries for the 1998–2006 period within the framework of two models. In the first model, the effect of high and low-tech manufacturing industry exports on growth was examined. In the second model, high and low-tech manufacturing industry imports were also included in the analysis along with the exports.

In the first model in which all variables were included in the analysis, the OLS and PCSE estimation results were as follows: Investment and high-tech manufacturing industry export variables have a positive and significant effect on growth. As for the population and low-tech manufacturing industry export variables, their effect is positive and meaningless. These results obtained via the OLS and PCSE methods are consistent with Internal Growth Models and the studies of Cuaresma and Wörz (2005), who investigated the effect of export classifications on growth in the empirical literature.

In the second model in which all the variables were included in the analysis, the OLS and PCSE estimation results were the same as the results of the first model in terms of investment, high-tech manufacturing industry export, low-tech manufacturing industry export and population. The effect of high-tech manufacturing industry import on growth was negative and meaningless. Population and low-tech export variables, which were meaningless, were excluded, and the data were analyzed again. The same results were obtained in terms of investment, high-tech manufacturing industry export and low-tech manufacturing industry import. However, the effect of high-tech manufacturing industry import on growth was found to be negative and significant.

As stated by Chuang (1998), the negative effect of high-tech manufacturing industry import on growth could be explained by developing countries' not being able to achieve a certain development level; in other words, by inadequacy of growth due to the fact that high-tech manufacturing industry export does not reach the desired level in these countries. Countries can increase their prosperity by exporting high-tech and importing low-tech goods in the early stages of development until they reach a certain development level. Once they reach that development level, the demand for high-tech goods import increases. Therefore, the import of high-tech goods by countries which have not reached a certain development level affects growth performance negatively. All the analysis results for the second model are also consistent with Internal Growth Models and Chuang's (1998 and 2002) statements.

All the results obtained from the study revealed that for developing countries, due to the positive and dynamic externalities, high-tech, rather than low-tech, export has a significant effect on the economic growth performance of those countries. From this perspective, the results suggest ideas regarding the foreign trade policy to be applied. In developing countries, a foreign trade policy that encourages high-tech manufacturing industry export and imports low-tech goods for production, and thus for export, is essential for sustained growth. In this regard, the amount of imports should be set accurately in order to overcome the current account deficit, which has become a crucial problem in developing countries.

In further studies, results could be evaluated again by using the Generalised Method of Moments (GMM) Model, which also takes into account the dynamic effects of the series in panel data analyses. In addition, based on the country classification system of some international organizations, the analysis results could be compared in terms of the other group of countries involved in the classification.

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