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Factors Transforming High-Tech Exports from OICs

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Abstract

This paper intends to empirically examine how R&D expenditures, import of intermediate inputs and scale-economies influence high-tech exports from Organization of Islamic Countries (OICs). In this context, the study assesses the predictions of the theories of international trade on comparative advantage, processing trade as well as new economic geography. The paper focuses on selected OICs that are aspiring to become technologically advanced by diversifying their production and export base from low-end products to high-tech products. To achieve this objective, these countries are investing on domestic R&D activities, and making efforts to attract foreign technologies and knowledge through imported inputs and foreign direct investment. Besides, they are restructuring their industries to benefit from scale-economies. Within this perspective, using the Empirical Bayesian technique, the paper concludes that R&D expenditures positively influence high-tech exports as predicted by traditional theories; while economies-of-scale are relatively less effective in the promotion of high-tech exports. The variable import of electronic parts and components strongly support the presence of a phenomenon of processing trade. Based on these findings, the paper draws some implications for policy making to leverage high-tech exports from OICs.

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1. Introduction

With harmonization of trade policies and revolution in ICT technology, the world is experiencing freer movement of goods and services as well as of factors of production across countries. These movements are increasingly influencing the location of factors of production, which in turn is changing the dynamics of comparative advantage. In this context, investment made in research and development (R&D) and human capital are helping countries to transform their economies to become attractive locations to produce and export high-tech products rather than low-end products.

Conventional trade theories predict that with the evolution of factor proportion, through the increase of knowledge changes the comparative advantage over period. Countries can graduate from producing low-end products to high-tech products. Recent literature on product cycle and dynamic increasing returns appears to confirm the predictions of the conventional trade theories (Vernon, 1966; Krugman, 1979; Redding, 1999).

Heckscher- Ohlin (HO) theory of international trade is based onthe assumption of relative differences in capital-labor ratios across countries and predicts that a country will export that product which intensively employs the abundantly available factor of production.

New trade theories focus on the "size" (scale) of the market as an important determinant of production and hence trade. In larger markets, consumers benefit from a wider range of choices and lower prices, while workers are also rewarded with higher real wages (Krugman, 1980). As production of knowledge and technology (patents) are usually characterized by scale-economies, it may be expected that the production which is more concentrated with R&D establishes its place in bigger markets. Nonetheless, international experience shows that small countries with well-built exhaustive R&D production, due to acquisition of knowledge historically or accidently, can also specialize in high-tech products and gain sufficient scale-economies to penetrate in global markets (McCann and Mudambi, 2004). It needs to be underscored here that at times when diffusion of knowledge is effective in a small economy then it becomes more important transforming factor than even scale-economies to gain comparative advantage (Fagerberg, *et al*., 2009).

North-South models developed by Krugman (1979) and Lu (2007) allow for technological differences across countries, which explain the historical as well as modern trade patterns. The model allows North either to enhance R&D investment ("*moving-in*" phenomenon) to create new technology or transfer its existing technology to countries in the South ("*moving-out*" phenomenon), thus giving an advantage to the South to benefit from advanced technology of the North. These theoretical contributions provide the foundation for understanding the specialization patterns prevalent in the developing South. Transfer of modern technology thus allows Southern countries to gain comparative advantage in the production of high-tech goods (Redding, 1999).Thus, technological innovation that takes place in the North and later transfer of technology to the South both play an important role in determining the trade pattern and evolution of trade pattern over time. In this context, Srholec (2007) showed that high-tech specialization in developing countries is not due largely to indigenous technological capabilities but due mainly to intra-product import of parts and components (embodied technology transfer).

The production and the exports of high-tech goods would possibly be slightly affected or there would be no run-over of R&D expenditures if a country has weak support institutions, which eventually do not facilitate export firms to realize opportunities originating from knowledge- related activities. Conventional trade theories whereas do consider intuitional setup in their model formulations by considering perfect competition in both goods and factor markets but refrain from modeling international differences in intuitional set-ups. Lack of competition, barriers to entry, and state regulations are important for the growth of output and international trade.To capture the role of institutions on economic growth and comparative advantage, the ratio of government expenditure to GDP is used as a proxy.

Within the above perspective, this paper empirically examines whether Organization of Islamic Countries (OICs), who aims at increasing production and export of high-tech products through increased R&D expenditures, are able to impact their high-tech exports, or whether market size effect is a prominent determinant of their specialization in high-tech products and comparative advantage in high-tech products. The paper also attempts to assess whether imports of intermediate inputs (electronics parts and components) have helped OICs to move into high-tech goods production and exports. Besides, the effect of relevant control variables is examined, such as intuitional quality, education and FDI, on high-tech exports.

Remaining of the paper has 4 sections divisions. Section 2 set downs theoretical framework. Empirical model is given in section 3. Section 4analyzes the empirical findings. Finally, section 5 concludes the paper and draws some implications for policy.

2. Theoretical Framework

The models of 'dynamic comparative advantage' designate an input function to investments in knowledge attracting activities (primarily innovation through research and development) in shifting a country's comparative advantage since a long period of time. Such an evolution in comparative advantage could either be explained through conventional theories of international trade, enlightened by Ricardian model (differentials across countries related to productivity) or HO model (differential factor endowments across countries). Alternatively, evolution in comparative advantage can follow what predicted by new economic geography model, stating that high-tech goods manufacturing is subjected to increasing return to scale and is therefore more likely to be situated in larger countries in presence of positive and high trade costs.[1]

In order to model the impact of an increase in knowledge capital (i.e., R&D-expenditures), the HO model is model. R&D is considered as an input into the production of high-technology goods either directly or indirectly in terms of skilled workers. The model (via Rybczynski theorem) predicts that increased endowment of skilled workers will increase the supply of goods and hence exports (or decrease in imports).

Alternatively, using the Ricardian model of comparative advantage in terms of a cross section of countries with differences in technological knowledge, it can be predicted that past technological change (it depends on earlier expenditures on R&D, or production knowledge gathered with time) determines the existing comparative advantage, which then structures the pace of learning by doing and technological growth in each sector and each economy.

The models predict that increased expenditure on R&D results in a stronger comparative advantage in technology which then results improved production of the industry. Therefore, both HO and the Ricardian approach imitate the positive impact of R&D on the high-technology exports.

The new economic geography models weights the importance of market size. The economies-of-scale and market size determine the specialization patterns of trade within industries and everybody gains from trade as long as this share is large, thus results the specialization in intermediate products with the presence of closer and expanded linkages. Larger market size also allows the chance of capturing externalities going that above of smaller countries. Thus a focused spatial allocation of production may be encouraged. In literature pecuniary linkages (consisting of backward linkages showing supplies of intermediate goods and forward linkages illustrating to larger demands i.e. size) are separated very precisely from the non-pecuniary

[1] Theoretical and empirical frameworks presented here are based on Braunerhjelm and Thulin (2008).

linkages related to knowledge overflows (here related as R&D). These knowledge overflows increases in the larger domestic markets as the markets are closer to each other. In order to get benefit of these expanded positive externalities it is assumed that such knowledge overflows are confined to home and increasing in market size and geographical closeness is compulsory. Thus in the presence of trade cost and size differences across countries if R&D is linked with increasing return to scale in production, the production of the increasing scale good say here the high-tech good will mainly occur in more sizable countries (who are too the net exporters of the high-tech good).

The differences across countries that are related to the institutional setting and with which the firms deal within their operations are ignored by the trade and economic geography justifications of production and export specialization specified above. Also different institutional designs are likely to dominate or encourage the employment and transmission of a given technology, so institutions can be viewed as a transfer factor. It has been revealed by the prior research that how differences in the regulatory structures, taxes, property rights, royalties, patents and incentives are directly linked to the innovative process (Coughlin*et al*., 1991; Hill and Munday, 1992). Hence, for that reason proxies for such variables are included to scrutinize the determinants of the dynamics of comparative advantage into the empirical study.

3. Empirical Model

3.1 Empirical Condition

In this study the variable "share of high-tech exports" is taken as an endogenous variable and is termed as the ratio of high-tech exports to the total exports expressed as HTX. Instead of production variable the export variable is selected as it points out that the products have reached sufficient level of complexity or exclusivity, which generates their demand from foreign countries. Besides, the selected countries have mixed trends of increase and decrease in their exports of high-tech products for the duration of the study time, and the paper intends to analyze these trends. It may be noted for the period of study that this share of exports of high-tech products varies from 0.01 percent for Kuwait during 2000-2003 period to 40.47 percent for Malaysia in 2000-2003. This difference has remained fairly stable. The impression achieved since 1996 from the countries with large share of high-tech exports, two visible points come into sight. Primarily, in expressions of ranking, Pakistan's ranking increased from 10^{th} to 6^{th}place during 1996-2012, although the increase is steady but good thing is that it is consistently moving up. Secondarily, considering the highest positions it can be seen that Malaysia remained at the top with the highest share of 39.9 percent of the total exports, followed by Indonesia who stands at the high-tech export share of 8.03 percent. Thus, Malaysia, Indonesia, Morocco, Tunisia and Kazakhstan are holding five highest positions for the share of high-tech exports among all OICs even for the entire study period too. It is also observed that HTX for OICs does not increase over time. The average increase in the share of high-tech exports between 1996 and 2012 for OICs is slightly above 2.38 percentage points in year 2008 with the maximum of 4.54 percentage point increase in the year 2000. Malaysia who has the highest share of HTX is experiencing a fall in it since 2000. It is noted that during 2000-2003 Malaysia had HTX of 40 percent while during this period its imports of electronics parts and components was 24 percent of total imports and the R&D expenditure was 0.6 percentage share of the GDP.

The theoretical study furnishes a comprehension that the HO model strongly supports the indigenous innovation capabilities through investment in R&D, which enhances the high-tech exports. In contrast, the model of new economic geography emphasizes that large economies support the production of high-tech goods and their exports. On the basis of these models, the purpose is to examine whether or not the HO model offers good explanation of high-tech exports from OICs? Does the new economic geography theory propose well enough justification of high-tech exports from OICs? Whether the processing trade phenomenon is more efficient in exporting high-tech goods from OICs? To find the relevance of hypothesized questions an empirical method is adopted.

A pooled data of OICs is taken over the time to give a balanced panel of data in the analysis. In a sequence, to estimate the impact on the dependent variable, panel regressions with random effects are applied because individual differences of countries are not observable. Moreover, the set of parameters for all countries is the same, which is problematic, and thus the Empirical Bayesian methodology is used to get estimates for each individual country. The error term is expected to exhibit standard properties; that is $\varepsilon_{j,t}$ is supposed to be autonomously and identically distributed with a zero mean and variance σ^2 for all j and t. Hence, the equation estimated is as follows:

$$HTX = \beta_0 + \beta_1 R\&D_{j,t} + \beta_2 SIZE_{j,t} + \beta 3INS_{j,t} + \beta_4 ImP\&C_{jt} + \beta_5 Z_{j,t} + \varepsilon_{j,t}$$

where, HTX represent the share of high-tech exports in total exports, the explanatory variables are *R&D* as the relative level of expenditure or disbursements on R&D as a percentage of GDP, market size (*SIZE*) represent the size of a country's GDP, *INS* relates to the impact of institutional settings on the endogenous variable, imports of electronics parts and components as a share of total imports (denoted by $ImP\&C_{jt}$) and *Z* reflects the remaining control variables in country *j* at time *t*. Hence, the general form of equation including details of control variables is:

$$HTX = \beta_0 + \beta_1 R\&D_{j,t} + \beta_2 SIZE_{j,t} + \beta_3 GEXP_{jt} + \beta_4 IMP\&C + \beta_5 EXPHK + \beta_6 FDI + \beta_7\, TBP + \beta_8\, RGDPCH + \varepsilon_{j,t}$$

The coefficient β_1 include the effect of expenditure on R&D as a percentage of GDP and is expected to have a positive sign. The coefficient β_2 captures the effect of market size used as a proxy for GDP as a percentage of OIC GDP with the PPP adjusted current dollars on the dependent variable. The large size of market is likely to have a positive influence on the dependent variable. The coefficient β_3 captures the effect of total government expenditures on the share of high-tech export products, it is used as a proxy for the institutional settings and is expected to have a positive sign of the coefficient. The coefficient β_4 relates the relative share of imports of electronics parts and components in total imports and is expected to positively affect the dependent variable. The coefficient β_5 shows the effect of public sector expenditure on education and is expected to positively influence the export of high-tech goods. The coefficient β_6 *represents* the inflow of foreign direct investment to OICs and is expected to positively influence the high-tech exports. The coefficient β_7 shows the impact of exported technology. The coefficient β_8 measures the impact of real GDP per capita, employed as an alternative for capital per worker, and is anticipated to have a negative impact.

Summary of the variables used in the analysis is described in Table 1 along with the data sources and the anticipated theoretical signs for each variable.

Table 1
Variables Construction, Expected Theoretical Signs and Data Sources

Variable	Description	Expected Sign	Data Source
HTX	High-tech exports/total exports	Dependent Variable	WDI, World Bank
R&D	Expenditure on R&D as % of GDP(GERD)	+/-	World Bank and UNESCO
Imports of IC&E	Logarithm of Import of integrated circuits and electronic components	+	WTO
SIZE	GDP as a % of OIC, PPP adjusted current dollars	+	SESRIC Statistics and Data base
FDI	Inward stock of foreign direct investment	+	UNESCO
EXPEDU	Public spending on education as % of GDP	+	UNESCO/ World Bank Data
RGDPCH	Real GDP per capita (constant price)	-	Heston, et al. (2002)
TBP	Patents, royalties and license fees, receipts divided by payments, expressed in logarithm	?	WDI, World Bank

Source: Adopted from Thulin (2006)

3.2 Data and Data Sources

To empirically analyze the above model for OICs, a complete data set was required. In particular great difficulty was faced in collecting data on the variable measuring knowledge and technology (patents and royalties).The data used in the estimation of empirical model is for the period 1996 to 2012.

The data are obtained from World Development Indicators (WDI) by the World Bank, SESRIC Statistics and Database by UNESCO, UN Statistical Yearbook, specific Country's case studies, UNIDO, WIPO, and U.S patent and trade mark office website for patents (Table 1). In order to maintain the consistency in data, missing data empirical techniques is used to fill the values.

3.3 Hypotheses on Exogenous Variable

On the basis of the stylized facts of OICs and theoretical underpinnings the following three hypotheses are formulated:

H1: Investment on knowledge positively influences high-tech exports.

H2: Scale economies positively impact high-tech exports.

H3: Import of intermediate inputs (transfer of embodied technology) positively impact high-tech exports.

3.4 Methodology and the Estimation Procedure

Classical econometrics is applicable to stationary progression. As the panel data comprise of both time-series and cross-section, to obtain consistent results the time-series measurement makes it compulsory to apply the Unit Root test for the certainty of outcomes. The study applies various Unit Root tests to all the variables involved in the analysis following the Nelson and Plosser (1982). To get reliable estimates, stationarity is crucial for standard econometric theory. To obtain the stationary series, the order of integration is identified giving us the minimum number of difference through the modern technique of panel unit root developed by Im, Pesaran, Shin (2003) [hereafter IPS technique]. IPS technique is carried forward by the famous method of Dickey-Fuller approach and is powerful for the fewer time observations by merging both the time-series dimension with the cross-section dimension. It identifies a disintegrated ADF regression for each cross-section with individual outcomes and no time trend. Furthermore, Kao (1999) panel co-integration test of Engel-Granger (1987) is employed for more than one variable, which is found non-stationary so as to check the presence of co-integration among the series and it is a second step of estimation. Long run relationship between the chosen variables is measured by a two-step residual based test.

3.5 Empirical Bayesian Estimator

Most of the econometrics techniques rotate around the classical background. A new popular approach adopted in addition to classical technique is empirical Bayesian approach. Bayesian estimation technique has an important feature as it uses prior distribution by assuming previous experience or guesses and makes the model more powerful and flexible. With this character, this approach is particularly useful when some data values are missing from the available data series. The approach by creating missing values thus allows an improvement in the significance level of the parameter estimates. It produces natural results of the model thus contradicting the complexities of the classical approach in which the prior parameters values are assumed randomly. In Bayesian technique prior parameter values are estimated from the data. Considering the advantages of Bayesian approach, this is used method to estimate the model of high-tech exports share. The Empirical Bayesian method does not make the estimates worse if missing values exist unlike the traditional methods. In case of insufficient data with the sample size quite smaller the Bayesian Approach establishes the necessary accuracy of the model. Given the model

$$HTX_i = Y_i\beta_i + \epsilon_i$$

where, HTX_i denotes the vector of high-tech exports share for the i^{th} country, Y_i is a matrix of autonomous exogenous variables, $\beta_i$is the vector of coefficients and ϵ_i is the vector of residuals for each i^{th} country.

In the Bayesian methodology, βi is assumed as random with several prior density, i.e., $\beta i \sim N(\mu, \Omega)$ somewhere μ is mean of prior density and the Ω is variance of the prior density. The prior density incorporates our belief about the parameters and the knowledge from the past experience.

The estimates of coefficients of regression, which are identified as posterior, are gained by the following expression.

$$\hat{\beta}_{i,BAYES} = \left[\frac{1}{\sigma^2}(Y'_i \quad Y_i) + \Omega^{-1}\right]^{-1} \quad \left[\frac{1}{\sigma^2}(Y'_i \quad Y_i)\hat{\beta}_i + \Omega^{-1}\mu\right]$$

Variance of these estimates is given by

$$Var(\hat{\beta}_{BAYES}) = \left[\frac{1}{\sigma^2}(Y' \quad Y) + \Omega^{-1}\right]^{-1}$$

Thus, the Bayesian estimate is a weighted average of the prior and the data density. The accuracy of the Bayesian methodology is sum of the precision of prior and data. Thus, the Bayes estimates are constantly precise than the data and the prior. The prior can be used from the previous beliefs on the subject of the parameters. Additionally, it is possible to approximately estimate the prior from the data and this methodology is called the Empirical Bayes method as recommended by Carrington and Zaman (1994).The mean of the prior density is estimated using the subsequent method:

Let, X_i be the vector of dependent variable for the i^{th} cross-sectional unit and Y_i be the vector of independent variables then

$$\hat{\beta}_i = (Y'_i \quad Y_i)^{-1}(Y'_i \quad A)$$

with, $var(\hat{\beta}_i) = \hat{\sigma}_i^2(Y'_i \quad Y_i)^{-1} = \Sigma_i^{-1}$

then, $\mu = (\Sigma_1^{-1} + \Sigma_2^{-1} + \cdots + \Sigma_n^{-1})^{-1}[\Sigma_1^{-1}\hat{\beta}_1 + \Sigma_2^{-1}\hat{\beta}_2 + \cdots + \Sigma_n^{-1}\hat{\beta}_n]$

where, "*n*" is total number of cross-sectional units.

It can be seen that mean of the prior density is precision weighted average of OLS estimates for all the cross sections. The variance of the prior is given by

$$\Omega = (\Sigma_1^{-1} + \Sigma_2^{-1} + \cdots + \Sigma_n^{-1})^{-1}$$

These prior mean and variance will be used to determine the coefficients of the posterior density.

$$\hat{\beta}_{iEB} = [\Sigma_i^{-1} + \Omega^{-1}]^{-1}[\Sigma_i^{-1}\hat{\beta}_i + \Omega^{-1}\mu]$$

4. Empirical Results

Main purpose of the study is to determine the major factors influencing high-tech export goods in OICs. This study thus provides meaningful empirical support, which could be helpful in promoting high-tech goods' exports from OICs.

4.1 Results of Panel Unit Root and Residual Based Co-Integration Tests

In order to assess the impact of different variables on the high-tech exports, different classifications of variables is made. Thus, before reaching at the final estimation, unit root test on each variable is checked as per change in classification and it is also checked how differently it behaved on the dependent variable. Finally, the variable is selected for which meaningful results are obtained. Im, Pesaran and Shin (2003) unit root test is employed. The results of unit root test on the selected variables are shown in Table 2.

Table 2
Panel Unit Root Test

Variable	Statistics	P Value	Unit Root If:
GEXP	-1.90919	0.0281	Not unit root (stationary)
EE	-1.19126	0.1168	Unit root
FDI	-1.46256	0.0718	Unit root
HTX	-3.42111	0.0003	Not unit root (stationary)
IMP&C	-2.95155	0.0016	Not unit root (stationary)
PATENTS	4.59720	1.0000	Unit root
R&D	-2.29896	0.0108	Not unit root (stationary)
RGDP	4.96125	1.0000	Unit root
SIZE	0.21232	0.5841	Unit root

The variables are tested at level form. The series that are not stationary shows the existence of unit root. Also the series which are unit root reflect the null hypothesis; on the other hand the series which are stationary at the level reflect the alternative hypothesis of unit root absence. Table 2 shows that five variables including *GEXP, HTX, IMP&C and R&D* are stationary at the level and do not show unit root in the Im, Pesaran and Shin test when integrated at order I(0), depicted by t-value and the corresponding P-values in Table 2. The remaining variables are not stationary and show unit root, which forces us to employ co-integration test over them.

Now co-integration test is applied for the variables that are non-stationary in order to find long run relationship between the high-tech exports and its determinants. This would help in deriving better results. An Im, Pesaran and Shin Panel co-integration test based on residual is employed to see the long run relationship between the variables. The output of the estimation is given in Table 3. The regression of the variables at the first difference shows that there is long-run relationship between them and it allows us to move to further estimation procedure.

Table 3
Results of Residual Based Co-Integration test

	At Level Form		At First Difference	
Method	Statistic	PROB.** (IF P<0.05,YES: IF P>0.05 NO)	Statistic	PROB.** (IF P<0.05,YES: IF P>0.05 NO)
Im, Pesaran and Shin W-Stat	-0.29633	0.3835 (No)	-6.38925	0.0000 (Yes)

4.2 Empirical Bayesian Results

Empirical Bayesian (EB) technique is used as the final estimation step; the estimates of the empirical Bayes on the high-tech exports and its determinant variables are reported in Table 4. The results obtained for selected comparative advantage variables are consistent with the findings of Braunerhjelm & Thulin (2008), especially when technology-related variables are included in the regression.

In Table 4, the R&D is statistically significant and is positively linked with high-tech exports. In particular, R&D turned out to be highly significant for Azerbaijan and Morocco. Calvo (1996), Grossman (1990), and Jochem and Schleich (2011) also found a positive association between R&D and high-tech exports.

Another key variable, the market-size, which has a positive relationship with the high-tech exports turned out to be statistically insignificant. This indicates that OICs do not have sufficient scale-economies due to small-scale and fragmentation of high-tech producing industries.

The variable import of electronic P&C is also introduced. It turned out to be highly significant and is positively influencing the high-tech exports from OICs. The coefficient shows that a one percent increase in IMP&C magnifies the share of high-tech exports by about five percent. This finding is consistent with the results found by Alves (2010), Srholec (2007) and Lemoine and Kesenci(2002).

Table 4
Empirical Bayesian Results for High-Tech Exports

Country	Variable	R&D	SIZE	IMP&C	FDI	E E	GEXP	PATENTS	RGDP
AZERBAIJAN	POSTERIOR MEAN	0.74	3.67	0.61	-7.7E-04	-0.01	3.0E-03	1.23E-06	-2.4E-05
	T STATISTIC	2.62***	1.11	5.71***	-0.57	-0.92	0.71	0.52	-2.33***
BURKENA FASO	POSTERIOR MEAN	0.40	3.55	0.57	-8.1E-04	-0.01	4.1E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.35	1.08	5.53***	-0.45	-0.70	0.92	0.52	-2.33***
EGYPT	POSTERIOR MEAN	0.45	2.15	0.57	-1.3E-03	-0.01	4.0E-03	1.2E-06	-2.4E-05
	T STATISTIC	1.58	0.76	5.64***	-0.76	-0.75	0.93	0.52	-2.29***
Indonesia	POSTERIOR MEAN	0.44	2.71	0.60	-8.9E-04	-0.01	3.9E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.49	0.82	5.64***	-0.50	-0.75	0.88	0.52	-2.33***
KAZAKISTAN	POSTERIOR MEAN	0.43	3.62	0.61	-4.5E-04	-9.8E-03	4.0E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.44	1.10	5.72***	-0.25	-0.65	0.89	0.50	-2.33***
KUWAIT	POSTERIOR MEAN	0.33	4.81	0.59	-8.2E-04	-0.02	6.8E-03	1.2E-06	-1.3E-05
	T STATISTIC	1.13	1.48	5.57***	-0.47	-1.30	1.73*	0.52	-1.69*
KRYGISTAN	POSTERIOR MEAN	0.44	3.55	0.62	-7.5E-04	-0.01	4.1E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.47	1.08	5.84***	-0.42	-0.71	0.91	0.52	-2.33***
MALAYSIA	POSTERIOR MEAN	0.48	3.59	0.57	-7.0E-04	-0.01	4.1E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.63	1.09	5.87***	-0.39	-0.74	0.91	0.52	-2.33***
MORROCO	POSTERIOR MEAN	0.57	3.55	0.79	-7.8E-04	-0.01	3.6E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.94*	1.07	8.88***	-0.43	-0.69	0.81	0.53	-2.33***
PAKISTAN	POSTERIOR MEAN	3.4E-01	3.24	0.63	-8.0E-04	-0.01	4.79E-03	1.4E-06	-2.5E-05
	T STATISTIC	1.23	1.00	5.89***	-0.45	-0.52	1.08	0.62	-2.33***
SAUDI ARABIA	POSTERIOR MEAN	0.26	2.93	0.59	-2.1E-04	-0.01	2.5E-03	1.2E-06	-2.3E-05
	T STATISTIC	1.05	1.05	5.57***	-0.13	-0.54	0.69	0.51	-2.25***
TUNISIA	POSTERIOR MEAN	0.47	3.55	0.58	-7.0E-04	-0.01	3.98E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.61	1.08	5.50***	-0.39	-0.72	0.89	0.52	-2.33***
TURKEY	POSTERIOR MEAN	0.49	5.72	0.59	-7.3E-04	-0.01	3.92E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.68*	1.85*	5.68***	-0.41	-0.73	0.88	0.70	-2.33***
UGANDA	POSTERIOR MEAN	0.45	3.55	0.61	-7.2E-04	-0.01	4.0E-03	1.2E-06	-2.5E-05
	T STATISTIC	1.51	1.07	5.71***	-0.40	-0.71	0.90	0.52	-2.33***

The variable stock of inflow of FDI is negatively influencing the high-tech exports. It is well known that FDI in OICs is largely used in non-export activities and is meant for domestic markets of these countries. As such this finding is not contrary to general expectations.

Institutional setting in OICs is represented by the proxy total government expenditures (GEXP). The results show that it has a positive relationship with high-tech exports. It can be inferred that lack of institutions or their capability adversely affect the high-tech exports and indeed act as a trade barrier.

The expenditure on education (EE) has unexpected adverse impact on high-tech exports and is weakly significant for all OICs. This may be due to a greater proportion of education expenditure spent in OICs on non-technical education and lower levels of general education. In this context, Seyom (2005) argued that it is strong technological institutional infrastructure and tertiary education that is positively associated with high-tech exports.

Patents and royalties, which represent use of technology, have a positive relation with high-tech exports. Weak relationship however indicates that OIC countries still need to benefit from the potential of foreign technology available to them.

The variable RGDP which is used as proxy for labor cost has a negative and insignificant impact on high-tech goods exports. It thus indicates that cheap labor could be helpful in the promotion of high-tech exports from OICs , as these countries are currently mostly engaged in assembling the parts and components for high-tech finished products for exports, which is basically a labor intensive process. This result is consistent with the findings of Grossman (1990), Alves (2010), Baldone*et al*. (2001) and Macroni and Rolli (2007).

5. Conclusion and Policy Implications

The empirical findings discussed in the preceding section conclude that the phenomenon of processing trade is present as imports of intermediate inputs are helping OICs to produce finished high-tech products for exports markets. Significant impact of R&D on high-tech exports is found. This confirms the role of indigenous capabilities in promoting high-tech exports from OICs. We, however, could not find the presence of scale-economies in OIC countries, which may benefit high-tech exports; of course, with the exception of Turkey. As such we reject the incidence of home market effect.

The analysis also conclude that vertical specialization through the processing trade phenomenon is creating skill competencies in OICs who generally have low skills and in turn is promoting exports of high-tech finished goods. Improvement in institutional settings and quality is positively affecting the export of high-tech goods from OICs. Empirical findings further indicate that OICs are exporting high-tech products but with less input from FDI and human capital. These countries have small indigenous innovation capabilities.

All in all, the empirical analysis led us to conclude that the product cycle theory enlightens OICs more than the traditional trade theories or new economic geography theory (*a la*economies-of-scale). The globalization of world trade and trade liberalization allows countries to get benefit of knowledge and skills of high tech goods components through import, thus ultimately getting a grip on production technique of high-tech goods through learning-by-doing process. The study finds that in this regard Malaysia and Indonesia are the dominant OICs, who are focusing on the high-tech industries. Remaining OICs though are in line but are quite far away from both of these countries.

Above conclusion lead us to draw some implications for policymaking in OICs. The deficiency in innovation capabilities needs to be overcome through enhancing quality R&D resources. There is no coordination between research institutions and private industries to produce high-end and quality products. Therefore, OICs need to create this coordination not only within each country but across the region as well.

Since import of electronics parts and components is positively and significantly contributing towards promotion and expansion of high-tech exports, it is therefore desirable that OICs remove most if not all the trade restrictions faced by the high-tech industries. Governments in each OICs need to allocate more and more resources for the education sector in general and for higher education in particular to boost the innovation process in their countries. OICs should attract FDI in export industries rather than FDI exclusively meant for non-traded industries. This would benefit high-tech industries in terms of receiving high quality foreign knowledge, technology and foreign market access.

References

Alves, G.F.S. (2015). *Determinants of High-tech Exports.* Portugal: University of Aveiro. Available at:http://hdl.handle.net/10773/1829.

Baesu, V., Albulescu, C.T., Farkas Z., and Drăghici, A. (2015). Determinants of the High-tech Sector Innovation Performance in the European Union: A Review. *Science Direct, 19,* 371-378.

Baldone, S., F., Sdogati, and Tajoli, L. (2001).Patterns and Determinants of International Fragmentation of Production: Evidence from Outward Processing Trade between the EU and Central Eastern European Countries. *WeltwirtschaftlichesArchiv, 137*(1), 80-104.

Braunerhjelm, P., and Thulin, P. (2008).Can Countries Create Comparative Advantages? R&D-Expenditures, High-tech Exports and Country Size in 19 OECD-countries: 1981–1999. *International Economic Journal*, *22*(1), 95-111.

Carrington, W. J., and Zaman, A. (1994).Inter-industry Variation in the Costs of Job Displacement. *Journal of Labor Economics, 12*(2), 243-75.

Calvo, J.L. (1996). *Export Behaviour of Spanish SME Manufacturing Firms: The Role of Innovation.* Available at: http://www2.uned.es/dpto-analisis-economico1/fichprof/jcalvo/articulos/ExportPME.pdf.

Coughlin, C.C., Terza, J.V., and Vachira, A. (1991). State Characteristics and the Location of Foreign Direct Investment in the United States. *Review of Economics and Statistics, 73,* 675–683.

Fagerberg, J., Srholec, M., and Verspagen, B. (2009). Innovation and Economic Development. In Hall, B., and Rosenberg, N. (eds.) *Handbook of the Economics of Innovation*. North Holland.

Grossman, G.M. (1990). Explaining Japan's Innovation and Trade: A Model of Quality Competition and Dynamic Comparative Advantage. *Monetary and Economic Studies, 8*(2), 75-100.

Heston, A., Summers, R., and Aten, B. (2002). *Penn World Table Version 6.1.* PA, USA: Center for International Comparisons at the University of Pennsylvania(CICUP).

Hill, S., and Munday, M. (1992). The U.K. Regional Distribution of Foreign Direct Investment in the United States: Analysis and Determinants. *Regional Studies*, *26,* 535–544.

Jochem, P., and Schleich, J. (2011). *Exploring the Drivers Behind Automotive Exports in OECD Countries - An Empirical Analysis*. (Working Paper Sustainability and Innovation No. S 3/2012). Karlsruhe, Germany: Fraunhofer Institut für System- und Innovationsforschung ISI.

Krugman, P. (1980). Scale Economies, Product Differentiation, and the Pattern of Trade. *The American Economic Review*, *70*(5), 950-959.

Krugman, P. (1979). Increasing Returns, Monopolistic Competition, and International Trade. *Journal of International Economics, 9,* 469-479.

Lemoine, F., and Kesenci, D. (2003). International Trade and Technology Transfer: The Cases of Turkey, India and China Compared (Working Paper, No. 2003 – 16). The Centre d'Études Prospectives et d'Informations Internationales (CEPII).

Lu, C. (2007). Moving up or moving out? A Unified Theory of R&D, FDI, and Trade. *Journal of International Economics*, *71*, 324 – 343.

McCann, P., and Mudambi, R. (2004).The Locational Behaviour of Multinational Enterprises: Some Analytical Issues. *Growth and Change*, *35*(4), 491-524.

Marconi, D. and Rolli, V. (2007). *Comparative Advantage Patterns and*

Domestic Determinants in Emerging Countries: An Analysis with a focus on Technology. Rome, Italy: Banca d'Italia.

Redding, S. (1999). Dynamic Comparative Advantage and the Welfare Effects of Trade. *Oxford Economic Papers*, *51,* 15–39.

Seyoum,B. (2005). *Advances in Competitiveness Research*. PA, USA: American Society for Competitiveness.

Srholec, M. (2007).High-tech Exports from Developing Countries: A Symptom of Technology Spurts or Statistical Illusion? *WeltwirtschaftlichesArchiv*, *143,* 227-25.

Vernon, R. (1966). International Investment and International Trade in the Product Cycle. *Quarterly Journal of Economics*, *80,* 190–207.