Factors Transforming High-Tech Exports from OICs

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Abstract

This paper intends to empirically examine how R&D expenditures, imports of intermediate inputs and scale-economies influence the 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 electronics parts and components strongly support the presence of the phenomenon of processing trade. Based on these findings, the paper draws some implications for policy making to leverage high-tech exports from OICs.

Key Words: High-Tech Exports, Empirical Bayesian Method, OIC Countries.

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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 factors proportions, say through the accumulation of knowledge, comparative advantage changes over time. As a result 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 on the 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 R&D-intensive production is located in larger markets. Nonetheless, international experience shows that small countries with strong position in R&D-intensive 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 take 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).

R&D expenditures may have little or no impact on production and export of high-tech products if a country has weak support institutions, which 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 factors 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, we use the ratio of government expenditure to GDP 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, we examine the effect of relevant control variables, such as intuitional quality, education and FDI, on high-tech exports.

Rest of the paper is divided into 4 sections. Section 2 set downs theoretical framework. Empirical model is given in section 3. Section 4 analyzes 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 a key function to investments in knowledge attracting activities (primarily innovation through research and development) in shifting a country's comparative advantage since long period of time. Such an evolution in comparative advantage could either be explained through conventional theories of international trade, i.e., Ricardian model (productivity differentials across countries) or HO model (differential factor endowments across countries). Alternatively, evolution in comparative advantage can follow the predictions of new economic geography models, which state that high-tech production is subjected to increasing return to scale and is therefore more likely to be located in larger countries in presence of positive and high trade costs.

In order to model the impact of an increase in knowledge capital (i.e., R&D-expenditures), we follow the HO 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 across countries differences in technological knowledge, it can be predicted that past technological change (depends on previous expenditures on R&D, or accumulated production knowledge) determines the current comparative advantage, which then shapes the rate of learning by doing and technological progress in each sector and each economy.

The models predict that increased expenditure on R&D can be expected to reflect an improved production technology and enhanced productivity. Thus, an increased expenditure on R&D results in a stronger comparative advantage in production of the industry. Consequently, both in the HO and the Ricardian world, R&D should have a positive impact on high-technology exports.

The new economic geography models stress the importance of market size. More sizable markets allow specialization in the production of intermediate goods, closer and more diversified linkages and the possibility of capturing externalities exceeding that of small countries. This may in turn foster a concentrated spatial distribution of production. The literature is separated between pecuniary linkages, which are defined as either backward linkages (suppliers of intermediate goods) or forward linkages (sizeable demand), and non-pecuniary linkages. The latter refer to knowledge spillovers. Such spillovers are assumed to be local and increasing in market size and geographical proximity is necessary in order to profit from these positive externalities. If R&D is associated with increasing returns to scale in production then, in the presence of trade costs and size differences across countries, production of the increasing return to scale good will predominantly take place in more sizable countries, who are also net exporters of high-tech goods.

The trade and economic geography explanations of production and export specialization given above has disregarded differences across countries related to the institutional setting, which firms are confronted with in their operations. Institutions can be viewed as a shift factor where different institutional designs tend to oppress or promote the utilization and diffusion of a given technology. Previous research has shown how differences in the regulatory frameworks, property rights, taxes and incentives are closely linked to the innovative process (Coughlin *et al*., 1991; Hill and Munday, 1992). We, therefore, incorporate proxies for such variables into the empirical analysis to examine the determinants of the dynamics of comparative advantage.

3. Empirical model

3.1. Empirical specification

The endogenous variable employed in the empirical specification is defined as a ratio of a country's exports of high-tech products to total exports (XHT). We prefer to use exports over production variables since exports indicate that the products have attained sufficient degree of complexity or exclusivity, which creates foreign demand for them. Besides, selected have mixed trends of increase and decrease in their exports of high-tech goods during the study period, and the paper intends to analyze these trends. It may be noted for the period of study that the share of exports of high-tech products ranges 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. Looking at the countries with large shares of high-tech exports since 1996, two visible points emerge. First, in terms 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. Also, 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. Malaysia, Indonesia, Morocco, Tunisia and Kazakhstan hold the five highest positions for the entire period. The other point is that XHT 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 maximum of 4.54 percentage point increase in 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 XHT 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 the comprehension that the HO model strongly supports the indigenous innovation capabilities through investment in R&D, which enhance the high-tech exports. On the other hand, the new economic geography models emphasize that large economies support the production of high-tech goods and their exports. On the basis of these models, we want 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 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 in the following.

We pool the data of OICs over the time, thus giving us a balanced panel of data. Panel regressions with random effects will be used to estimate the impact on the dependent variable because individual differences of countries are not observable. Moreover, set of parameters for all countries is same, which is problematic, and thus we are using the Empirical Bayesian methodology to get estimates for each individual country. The error term is expected to exhibit standard properties; that is $\varepsilon_{j,t}$ is assumed to be independently and identically distributed with a zero mean and variance σ^2 for all *j* and *t*. Hence, we estimate the following equation:

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

where, HTX represents the share of high-tech exports in total exports, the explanatory variables are *R&D* as the relative level of expenditures on R&D as a percentage of GDP, market size (*SIZE*) represents the size of country's GDP, *INS* relates to see the impact of institutional settings on the endogenous variable, imports of electronics parts and components as a share of total imports ($ImP\&C_{jt}$) 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 includes the effect of expenditure on R&D as a percentage of GDP and is expected to have positive sign. The coefficient β_2 captures the effect of market size used as 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 exports 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 exports 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, used as a proxy for capital per worker, and is expected 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, we needed a complete data set. We particularly faced great difficulty in collecting data on the variable 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, we used missing data empirical techniques to fill the values.

3.3. Hypotheses on exogenous variable

On the basis of the stylized facts of OICs and theoretical underpinnings we formulate the following three hypotheses:

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, we have identified the order of integration 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 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. This approach is quite useful due to its ability to deal with the missing data and gives significant values and better estimates of the missing values and different values of data parameters. Bayesian analysis gives prior distribution by assuming previous experience or guesses and makes the model more powerful and flexible. 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, we use this 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,

where, HTX_i denotes the vector of high-tech exports share for the i^{th} country, Y_i is a matrix of independent exogenous variables, $_i$ 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 some prior density, i.e., $\beta i \sim N(\mu, \Omega)$ where 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 we had from the past experience.

The estimates of coefficients of regression, which are called posterior, are obtained by the following expression.

Variance of these estimates is given by

Thus, the Bayesian estimate is a weighted average of the prior and the data density. The precision of the Bayesian methodology is sum of the precision of prior and data. Therefore, the Bayes estimates are always precise than the data and the prior. The prior can be used from the previous beliefs about the parameters. It is also possible to estimate the prior from the data and this methodology is called the Empirical Bayes method as suggested by Carrington and Zaman (1994). The mean of the prior density is estimated using the following 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

with,

then,
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

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

4. Empirical results

Main purpose of the study is to determine the major factors influencing high-tech exports 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 tests and Residual Based Co-Integration test

In order to assess the impact of different variables on the high-tech exports, we have made different classifications of variables. Thus, before reaching at the final estimation, we have checked unit root test on each variable as per change in classification and checked how differently it behaved on the dependent variable. Finally, we have selected the variable for which we got meaningful results. We have employed Im, Pesaran and Shin (2003) unit root test. 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: P<0.05,Yes P>0.05,No**
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 reflects the null hypothesis; on the other hand the series which are stationary at the level reflects 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 we need to proceed towards co-integration test 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.**	Statistic	PROB.**
		(IF P<0.05,YES: IF P>0.05 NO)		(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)

5.2 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 positive association between R&D and high-tech exports.

Table 4: Empirical Bayesian Results for High-Tech Exports

Country	Variable	R&D	SIZE	IMP&C	FDI	EE	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***

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.

We have also introduced the variable imports of electronic P&C, 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).

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 in OICs is spent 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 OICs still need to benefit from the potential of foreign technology available to them.

Management Department, Politehnica University Timisoara, P-ta. Victoriei, No.2, Timişoara, 300006, RomaAvailable online 3 April 2015The 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).

6. Conclusion and Policy Implications

From the empirically findings discussed in the preceding section led us to 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. We find significant impact of R&D on high-tech exports, thus confirm the role of indigenous capabilities in promoting high-tech exports from OICs. We, however, could not find the presence of scale-economies in OICs, 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 lead us to 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 exports 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 imports 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 OIC need to allocate more and more resources for 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 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.

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