RELATIONSHIP BETWEEN R&D INVESTMENT AND HIGH-TECH EXPORTS: EMPIRICAL STUDY FROM PAKISTAN

Relação entre investimento em P&D e exportações de alta tecnologia:
Estudo empírico do Paquistão

Muhammad Usman
School of Financ Zhongnan University of Economics and LawWuhan P.R, China
E-mail:usmanzuel@yahoo.com

Abstract: The aim of this study is to explore the impact of R&D investment on high tech exports in Pakistan - a developing and emerging economy. To testify such relationship, data are collected from firms' financial statements, World Bank data base and State Bank of Pakistan data source. Time span of study is consisting of 20 years from 1995 to 2014. By using ordinary least square with robust standard error, along with several macroeconomic control variables, we found significantly positive relationship between R&D investment and high the exports. According to the product life cycle theory of international trade, innovative activities help to create competitive advantage which is essential for competing in worldwide markets. The empirical results show that R&D investment creates new products, which can attract foreign customers and creating export opportunities.
Key words: R&D Investment, High Tech Exports, Pakistan

RELATIONSHIP BETWEEN R&D INVESTMENT AND HIGH-TECH EXPORTS: EMPIRICAL STUDY FROM PAKISTAN

Relação entre investimento em P&D e exportações de alta tecnologia:
Estudo empírico do Paquistão

Muhammad Usman
School of Financ Zhongnan University of Economics and LawWuhan P.R, China
E-mail:usmanzuel@yahoo.comcom

Resumo: O objetivo deste estudo é explorar o impacto do investimento em P&D nas exportações de alta tecnologia no Paquistão - uma economia em desenvolvimento e emergente. Para testemunhar essa relação, os dados são coletados das demonstrações financeiras das empresas, da base de dados do Banco Mundial e da fonte de dados do Banco do Estado do Paquistão. O período de tempo do estudo é de 20 anos, de 1995 a 2014. Utilizando mínimos quadrados comuns com erros-padrão robustos, juntamente com várias variáveis de controle macroeconômico, encontramos uma relação significativamente positiva entre investimento em P&D e aumento nas exportações. De acordo com a teoria do ciclo de vida do produto no comércio internacional, as atividades inovadoras ajudam a criar uma vantagem competitiva que é essencial para competir nos mercados mundiais. Os resultados empíricos mostram que o investimento em P&D cria novos produtos, que podem atrair clientes estrangeiros e criar oportunidades de exportação.
Palavras-Chave: Investimento em P&D, Exportações de Alta Tecnologia, Paquistão

INTRODUCTION

High technological products largely depend upon innovation that leads to product development and growth. High tech products involve skillful labor, sophisticated technology and high cost. Three approaches are used in high tech production; sector approach, product approach and patent approach. Sector approach is based upon intensity of technology. While product approach linked with trading of high tech products. Lastly patent approach associated with patent registration. Intellectual property rights (IPR) is a platform through with firms can contribute innovations (Ismail, 2013). According to the Russian Classification of Economic Activities, high tech industries consist of Arms and ammunition production, Production of engines and turbine other than aircraft, Automobile and motorcycle engines, Production of centrifuges, calendars, and vending machines, Manufacturing of nuclear reactors and its components, Manufacturing of helipad, aircraft, and other flying machines, Manufacturing of spacecraft including boosters, and Manufacturing of automobile (Frolov & Lebedev, 2007).

In technology industrial segmentation, enhancing share of high tech products and productivity are two most important objectives for every growing country (Sara et al., 2012). In twenty first century high tech manufacturing is the fastest growing sector round the globe. There is a step wise process which starts from production sector, R&D led to the invention of new/high tech products, which farther leads to high technology exports. These high tech products exportation have a significant effect on economy of exporting country (Liu* & Lin, 2005). According to manufacturing, high tech industry can be divided into three categories: Mass manufacture (e.g. automobiles), Mainstream manufacture (e.g. in the first place, civil aircraft), and Individual manufacture (e.g. nuclear reactors, boosters, spacecraft) (Frolov & Lebedev, 2007).

High tech product idea development, its manufacturing and consumption are firstly take place in advanced countries afterwards in less developed countries (Stokey, 1991). Export diversification also may be different for more and less developed countries. More developed economies diversify their exports through innovation and new technological investment (Hummels & Klenow, 2005). But less developed economies usually depend upon natural resources, agriculture and low cost labor (Hesse, 2006).

In these days, high tech manufacturing are extremely important because every country put its efforts to get sustainable economic growth. EU countries witness that at the time of crises high tech sector perfume with high rate of growth as compare to medium and low tech sectors. There is direct link between R&D/innovative intensity and firm capability to identify and develop high tech knowledge. These firm capabilities help to produce competitive products for export. These capabilities are also beneficial to discover domestic and foreign demand (Sandu & Ciocanel, 2014). Enrichment of exports in developing countries is based upon capability to establish and maintain competitive advantage through speedy response to change in market environment (Li, 2011).

In these days, country's competitive advantage in intercontinental trade cannot only attain through resources but it can be creating through prudence, perseverance and relation with world economies (Beise, 2005). Asian region is also heading towards innovation. In 2002 R&D in Asia was 1.2 % of GDP, but at the end of 2009 it reached to 2.3% of GDP, which were close to OECD countries (Ismail, 2013). Pakistan also has contribution in Asian high tech exports. Last ten years witness the consistent growth of Pakistan's industrial R&D investment, high technology exports and economic growth. (Chapter 5 Table 1)

The purpose of this study is to identify the effect of R&D investment on high tech exports in Pakistan. Being a developing country whose major exports depend upon agrarian product, Pakistan's economy struggling hard to increase its high tech exports. Yet technology in Pakistan has enormous potential for future growth. To empirically test above said relationship we used firm level R&D investment along with country level high tech exports. Results suggested that R&D investment in manufacturing sector is an important element to increase high tech exports in Pakistan.

The remaining portion of study is ordered as follow. In the subsequent section (chapter 2) we discuss literature review. In section 3 hypotheses and theoretical framework are developed. In section 4 detail methodology, variable definition, models developments. Section 5 consists of empirical analysis of data and results explanation. In last section we conclude this study by summarize, limitations and future research directions.

LITERATURE REVIEW:

In recent years, high tech exports especially ICT (information and communication technology) are significantly increased. Vogiatzoglou (2009), investigated the determinants of ICT in 28 countries from 2000 to 2007. He used several variables like research and development, human capital stock, competitive cost, ICT home market size, agglomeration economies, access to international markets, infrastructure, multinational firm activity etc. to find their impact on export of ICT. He found R&D and human capital are the most significant determinants of ICT exports. Hausmann et al. (2007), Rodrik (2006), Fagerberg (2000) and Greenaway et al. (1999) also found that ICT performance and specialized exports leads to higher economic growth and productivity. Increase in exports of high technology products does not mean increase in technological capabilities. The main reason for that is value chain process of ICT production through outsourcing and international production fragmentation which involves low value addition and less technological intensive activities. China is good example for the above said case (Amighini, 2005; Gaulier et al., 2007; Lemoine, Françoise & Unal-Kesenci, 2002; Lemoine, Francoise & Ünal-Kesenci, 2004).

R&D intensity has an impact on high tech exportation through; technological production capacity of firms, country level technological capital, patent application etc. Sandu and Ciocanel (2014), conducted a research on 26 European countries from 2006 to 2010. The purpose of the study was to find the impact of R&D and innovation on high tech exports. By using multi linear regression model, results confirmed the positive correlation between R&D and high tech exports but outcome varied country to country. They farther explained that the private R&D had stronger impact on high tech export as compare to public R&D. In the times of crisis, high tech industry exhibits high growth rate as compare to medium tech and low tech sector among EU.

Past studies of Romer (1990) and Grossman and Helpman (1991) recommended that R&D intensive manufacturing should be associated to large markets. Braunerhjelm and Thulin (2008), empirically examined the effect of R&D and market size on the share of high technology products in exports. They used panel of OECD countries over the period from 1981 to 1999. Results indicated that R&D had positive and significant effect on share of high technology exports in country's trade. They not found any effect of country size on high tech exports. These results were consistent with Fagerberg (1995), who explained positive effect of R&D and ambiguous effect of size on high tech production and exports. Long run competitive advantage of country can be attained through technology and innovation (Martin et al., 2008). According to Cesen (2010) product and service innovation foster competitive advantage, growth and employment. In a cutting-edge study, Sara et al. (2012), explained the relationship between country's innovative capability and share of high tech products. They used large sample of 120 countries and found that country's innovative capabilities significantly determine the share of high tech products among export of manufactured goods.

High tech exports from developing countries dramatically change global exports. Some economists consider it as statistical illusion (Srholec, 2007) and some consider it as a good sign that developing countries competing with developed countries in term of high tech exportation (The Economist, April 17th, 2010, p.9). Fu et al. (2012), examined the effect of innovation on decision of high tech exports in Chinese industry. More specifically they investigated the effect of firm level innovation on exports of Chinese high tech sector. They analyzed these effects from 2005 to 2007 between different industries and different provinces. Results showed that innovation had minor effect on Chinese high tech exports. However the effect of innovation on export propensity was very significant across industries and provinces. Results are similar with past study of Zhao and Li (1997) that R&D had positive and significant impact on growth and export propensity in china.

Past literature also explained different factors that can influence high technology exports. Basarac Sertić et al. (2015), elaborated the determinants of total and high tech exports in 27 European countries within the time period from 2000 to 2011. Using GMM technique they found industrial production and domestic demand had positive and statistically significant impact on total as well as high tech exports. In another study Gökmen and Turen (2013), investigated the impact of economic freedom, human development level and foreign direct investment on high tech exports. They used panel data analysis of 15 European countries from 1995 to 2011. The results indicated that foreign direct investment, human development level and economic freedom had significant and positive impact on

high tech exports. In a study on Asian countries Srholec (2007), evaluated the indicators of high tech exports and hypothesis of "statistical illusion" in developing countries. He used large sample size of 111 countries and econometrically found that domestic technologies had some influence on high tech exports (electronics). He also explained that even developing countries export some high tech products but they are still specialized in low tech industry and low skill characteristics of the specific value chain because of limited technological capabilities.

HYPOTHESIS DEVELOPMENT:

According to the product life cycle theory of international trade, innovative activities help to create competitive advantage which is essential for competing in worldwide markets (Dollar, 1986; Krugman, 1979; Vernon, 1966). According to the competitive advantage setting, there is positive relationship between innovative activities and high tech exportation (Vogiatzoglou, 2009). Generally, results of R&D activities will be innovation in term of product or process. R&D creates new products, which can attract foreign customers and creating export opportunities. On the other hand, R&D activities innovates new processes, because of which marginal cost of product will be decreased and/ or production capacity will be increased. So that products became price competitive in international markets which farther increase exports (Czarnitzki & Wastyn, 2010).

According to Ricardian view, increase in high tech input (R&D investment) will result in enlargement of technological production (Vogiatzoglou, 2009). Technological products which depend upon S&T innovation (science and technology), leads to new/improved product and services. These high tech products help firms to get competitive advantage in international markets (Ismail, 2013). In previous literature there are lots of studies conducts to investigate the effect of R&D/innovation on high tech exports. Most of the studies reported the positive and significant effect of R&D/innovation on high tech exports (Barrios et al., 2003; Braunerhjelm & Thulin, 2008; Fagerberg, 1995; Hirsch & Bijaoui, 1985; Ito & Pucik, 1993; Kirbach & Schmiedeberg, 2008; Seyoum, 2005; Srholec, 2007; Tebaldi, 2011).

By bearing in mind above said discussion and literature review we can draw following hypothesis;
H1: There is positive and significant impact of R&D investment on high tech exports.

METHODOLOGY:
Data and Empirical Models

In this study secondary data related to firm level as well as country level variables are used. Firm level data are collected from Firm financial statements and country level data are collected from World Bank database. The data related to variables are gathered from 1995 to 2014. Different statistical techniques are used to analyze data. For testing hypothesis illustrate in section 3, we develop following model that contain dependent, independent and control variables.

High Tech Exports = β0 + β1 R&D Investment + β2 Exchange Rate + β3 Foreign Direct Investment + β4 Investment Freedom Index + β5 Trade Openness + β6 Taxes on Foreign Trade + β7 Globalization Index + ε   (1)

Measuring Variables:

Following table exhibit the detail of variables along with their notations and measurement. These variables are largely used in past studies to evaluate the effect of research and development expenditure on high tech exports.

Sr.#	Variable Name	Notation	Measurement
1	High Tech Exports	THE	Log of high tech exports
2	R&D Investment	RD	Log Firm Level R&D
3	Exchange Rate	EXR	PKR/US$
4	FDI	FDI	Log FDI % of GDP
5	Investment Freedom Index	IFI	Investment Freedom Index
6	Trade Openness	TO	Imports + Exports (% of GDP)
7	Taxes on Foreign Trade	TFT	Tax rate on foreign trade
8	Globalization Index	GI	Globalization Index

• In above said model we use high tech exports as dependent variable. We use log value of high tech exports.

• Key independent variable is R&D Investment. As mentioned in chapter 2 R&D/innovation is the key driver for increase in high tech export. We use log value of total annual R&D Investment of manufacturing firms.

• We use abundant control variables according to past literatures.

o Exchange rate: As literature explained increase in exchange rate will make the home product cheap in international markets that leads to increase in high tech exports. We use exchange rate of Pakistan rupee in term of US dollar. (Basarac Sertić et al., 2015)

o Foreign direct investment: According to past studies, by increase in foreign direct investment new investor from developed countries or foreign investor from high tech industry will invest in home country. In result of that home industry will boost up that farther lead to high tech exports. We use log value of foreign direct investment % of GDP to find its impact on high technology exports. (Braunerhjelm & Thulin, 2008; Gökmen & Turen, 2013; Tebaldi, 2011)

o Investment freedom: Freedom of investment provides an opportunity to investor, to invest in any sector/industry. In this situation mostly investors choose sector/industry which increase their wealth. High technology industry is the first choice of investor due to fast growing and highly ROI oriented industry. We use investment freedom index developed by Heritage Foundation USA. It contains value range from 0 to 100 depend upon investment freedom in country. (Ferragina & Pastore, 2007)

o Trade openness: Trade openness is policy in which there is no restriction on investor (local and foreign) for trading (import and export) of goods and services. A key characteristic of trade openness is that it leads not only imports but also increase exports. We use sum of exports and imports as percentage of GDP in above said model. (Tebaldi, 2011)

o Taxes on Foreign Trade: No doubt taxes are the key element for government income. But taxes on production and exports will increase the price of product. So it's become difficult to compete in international market with high prices. In results of high taxes usually exports are significantly harmed and reduced. We use rate of tax on foreign trade in Pakistan from 1995 to 2014 in our model. (Ferragina & Pastore, 2007)

o Globalization Index: Globalization means cross boarder movement of local, national and regional economy's products and services. So the country with higher globalization will features higher exports (technological exports). We use Globalization Index developed by Swiss Institute of Technology in Zurich as a proxy of Pakistan's globalization. This index use average value of economic, political and social index values. (Hatzichronoglou, 1997)5. Empirical Results and Analysis:

In table 1 summary of variables are presented. It contains number of observation, average value, standard deviation, minimum and maximum value of all variables used in the study. Data from 1995 to 2014 (20 years) are used for analysis. High technology exports of Pakistan are representing average value of 14725.68 million PKR. Minimum value is 1433.68 million PKR and maximum value is 35443.46 million PKR. Annual firm level R&D Investment presented lower value of 3.487 million PKR and higher value of 3610 million PKR.

Table1: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
High Tech Exports (M PKR)	20	14725.68	10771.86	1433.68	35443.46
R&D Investment (M PKR)	20	666	903	3.487	3610
Exchange Rate	20	72.774	17.0111	53.65	101.63
Foreign Direct Investment (% of GDP)	20	1.38	1.1003	0.38	3.67
Investment Freedom	20	44	10.3854	30	70
Trade Openness	20	32.4486	2.1294	28.13	35.68
Taxes on Foreign Trade	20	9.6671	2.1464	6.73	13.58
Globalization Index	20	48.992	3.2799	41.38	52.54

High Tech Exports: annual high technology exports, R&D Investment: annual manufacturing firm's R&D Investment, Exchange Rate: annual average PKR/US$, Foreign Direct Investment: foreign direct investment inflow % of GDP, Investment Freedom: Heritage Foundation index, Trade Openness: imports + exports (% of GDP), Taxes on Foreign Exports: tax rate on foreign trade, Globalization: Swiss Institute of Technology index

Exchange rate of PKR is represented in term of US$. As shown in table the average exchange rate from 1995 to 2014 is 72.774 rupee ranging from minimum 53.65 and maximum 101.63 rupee. It exhibits the high volatility of Pakistani rupee overtime from 1995 to 2014. Foreign investors are keen to invest in Pakistan due to developing and emerging markets. Average foreign direct investment in Pakistan from 1995 to 2014 is 1.38 % of GDP which represent attractiveness of Pakistani markets. To understand investment freedom in Pakistan we use index developed by Heritage Foundation USA having value from 0 (low) to 100 (high). As per average value of index, Pakistani economy has intermediate level of investment freedom. Trade openness (imports + exports) shows average value 32.44% of GDP with lower 28.13% and higher 35.68%. General taxes on foreign trade show low rate as 6.73% and high rate as 13.58%. We use index of Globalization developed by Swiss Institute of Technology as a proxy of globalization. This index has value range from 0 to 100. Pakistan's economy has average 48.992 score.

In this section impact of R&D Investment on high tech exports is evaluated. For this, we use time series data, in which some time non-stationary problem exist. This problem leads to biased estimates. A large number of unit root tests are suggested in past studies, but among them ADF test is widely used. Table 2 show values of Augmented Dickey Fuller (ADF) test for unit root for all variables. This test indicates that all the variables used in regression model are stationary at level point.

Table 2: Augmented Dickey Fuller Test for Unit Root

Variables	Intercept/Trend	ADF- Stat	Critical Value 5% & 10%	Stationary
LHTE	Intercept & Trend	-6.7507	-3.9333	Level
			-3.4200	
LRD	Intercept & Trend	-4.7062	-3.8753	Level
			-3.3883	
EXR	Intercept & Trend	-3.9924	-3.9333	Level
			-3.4200	
IFI	Intercept & Trend	-4.7830	-3.7911	Level
			-3.3422	
TO	Intercept	-3.2202	-3.0988	Level
			-2.6904	
GI	Intercept	-3.2883	-3.0988	Level
			-2.6904	
LFDI	Intercept	-4.3741	-3.1753	Level
			-2.7289	
TFT	Intercept & Trend	-3.5956	-3.9333	Level
			-3.4200	

Table 3 presented Pearson correlation coefficients with their significance level. Coefficient values in Pearson matrix table intimate the relationship between variables. High correlation between independent variables or control variables causes multi-collinearity issue which produce unreliable and biased results. So before step ahead to regression analysis it is important to know that is there any problem of multi-collinearity exist between variables or not.

Table 3: Pearson Correlation Matrix

	LHTE	LRD	EXR	IFI	TO	GI	LFDI	TIT
LHTE	1.000							
LRD	0.8176***	1.000						
EXR	0.7739***	0.6158**	1.000					
IFI	-0.7691***	-0.7176***	-0.6438***	1.000				
TO	0.6741***	0.4011	0.1271	-0.6065**	1.000			
GI	0.9487***	0.7837***	0.6888***	-0.8838***	0.6757***	1.000		
LFDI	0.2002	-0.568	-0.3463	-0.1257	0.6121**	0.2460	1.000	
TFT	-0.3333	-0.3057	-0.6299**	0.2255	0.2657	-0.2036	0.4304	1.000

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

As reported in table 3, we not find any multi-collinearity issue between variables. Independent variable and control variables are highly correlated with dependent variable. It shows that these variables are good explanatory variables. Among all coefficient values of explanatory variables, research and development expenditure (LRD) is highly correlated (0.8176) with high tech export (LHTE) at 1% significance level. This value informs us that increase in R&D Investment will foster high tech exports. Exchange rate (EXR), foreign direct investment (LFDI), trade openness (TO) and globalization (GI) presented positive and significant relationship with high tech exports. Investment freedom (IFI) has significantly negative relation and taxes on foreign trade (TFT) have negatively insignificant relationship with high tech exports.

Regression analysis is the best statistical technique for more in-depth analysis of dependent, independent and control variables. For this purpose we use ordinary least square (OLS) technique with robust standard error. According to many econometricians OLS techniques is the best regression technique because of BLUE (Best Linear Unbiased Estimator). According to ADF test results, all the variables in regression equation are at level point so we can use OLS technique to analysis our stucy model.

Table 4: Regression Analysis

Variable	Expected Sign	Coefficient	Robust Std. Error	T-Stat
LRD	+	0.1330	0.0508	2.62**
EXR	+	0.0090	0.0035	2.57**
IFI	+	0.0160	0.0042	3.78***
TO	+	0.0518	0.0158	3.27**
GI	+	0.0812	0.0185	4.38***
LFDI	+	0.1395	0.1105	1.26
TFT	-	-0.0258	0.0121	-2.13*
Constant		-3.8612	0.8788	-4.39***
F-value				68.60***
R^2				0.9458

LRD: log of annual manufacturing firm's R&D Investment, EXR: annual average amount of PKR/US$, LFDI: log of annual foreign direct investment inflow (% of GDP), IFI: Heritage Foundation investment freedom index, TO: annual imports + exports (% of GDP), TFT: annual average tax rate on foreign trade), GI: Swiss Institute of Technology economic globalization index

*Significant at 10% level

**Significant at 5% level

***Significant at 1% level

In table 4 regression results of variables are reported with their expectation sign as per past literature. Coefficients (β) of variables and their t-stat value with significance level are also narrated. Results indicate that after controlling different variables (EXR, FDI, IFI, TO, TFT, GI), there is positive and statistically significant relationship between R&D investment and high technology exports in Pakistan. According to regression analysis 1% increase in firm level R&D investment will increase high tech exports by 0.133%. This relationship is significant at 5% level and consistent with literature (Barrios et al., 2003; Braunerhjelm & Thulin, 2008; Fagerberg, 1995; Hirsch & Bijaoui, 1985; Ito & Pucik, 1993; Kirbach & Schmiedeberg, 2008; Seyoum, 2005; Srholec, 2007; Tebaldi, 2011). Exchange rate is an important element in foreign trade. According to the theory of international trade, devaluation of currency increase exports due to decrease in product price. As per statistics results presented in table 4, 1 rupee depreciation (PKR/US$) in Pakistani currency will increase high tech exports by 0.9%. Foreign direct investment inflow % of GDP is a tool used by foreign investor to invest in overseas country. Usually FDI boost home industry due to capital and knowledge transfer. These two elements will farther increase high tech production as well as exports. Regression result also show positive effect of FDI on high tech exports. 1% increase in FDI will increase 0.13% high tech exports.

According to past studies freedom of investment enhances exports/high tech exports. Table 4 explains positive and significant relationship between investment freedom and high tech exports i-e 1 point score increase in Heritage Foundation index will increase Pakistani high tech exports by 1.6%.

Theory based review indicates that trade openness make home market accessible for both importers and exporters. In result of that country's imports and exports both are increased. In the situation of Pakistani market 1% increase in trade openness boost 5.18% high tech exports. High taxes are good for government but bad for industry. Because taxes increase product cost and with the costly products it become difficult survive in international competition. This will results in significantly reduction in exports more especially high tech exports. Results are also leads us to same direction i-e. 1% increase in the revenue related to taxes on foreign trade will reduce high tech exports by 2.58%. Current era witnesses that globalize economies are well performing in local and foreign markets. Through regression statistics we came to know that 1 point increase in globalization index will increase high tech exports of Pakistan by 8.12%. Overall our model passes f-statistics at 1% significance level and R-square is 94%. Results extracted from regression analysis are parallel with our hypothesis. So we accept that, there is positive relationship between R&D investment and High tech Exports in Pakistan.

CONCLUSION:

The purpose of this study is to investigate the effect of industrial research and development on high tech exports. For this we use annual firm level R&D investment and country level high tech exports and economic growth. For data collection we use World Bank database, Financial Statements, State Bank of Pakistan data resources etc. Period of study consist of 20 years ranging from 1995 to 2014.

For statistical analysis we use Augmented Dickey Fuller, Pearson correlation matrix and ordinary least square with robust standard error technique. We utilize regression model to evaluate impact of R&D on high tech exports. By using different control variables (Exchange Rate, Foreign Direct Investment, Investment Freedom, Trade Openness, Taxes on Foreign Exports, Globalization) we find positive and significant impact of R&D on high tech exports. Key findings of study indicate that low level of high tech exports of Pakistani is due to nominal investment in corporate research and development. Industrial R&D is an important driver to enhance high tech exports by product and process innovation. There is massive competition in foreign markets for developing countries like Pakistan, but R&D innovative activities can be helpful to release competition up to some extent. For the survival in high tech international markets, Pakistani industries have to invest substantially in R&D and innovation activities.

REFERENCE:

Amighini, A. (2005). China in the international fragmentation of production: Evidence from the ICT industry. The European Journal of Comparative Economics, 2(2), 203.

Barrios, S., Görg, H., & Strobl, E. (2003). Explaining Firms' Export Behaviour: R&D, Spillovers and the Destination Market*. Oxford Bulletin of Economics and Statistics, 65(4), 475-496.

Basarac Sertić, M., Vučković, V., & Škrabić Perić, B. (2015). Determinants of manufacturing industry exports in European Union member states: a panel data analysis. Economic Research-Ekonomska Istraživanja, 28(1), 384-397.

Beise, M. (2005). Lead markets, innovation differentials and growth. International Economics and Economic Policy, 1(4), 305-328.

Braunerhjelm, P., & 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.

Cesen, T. (2010). Intellectual capital in waiting. Paper presented at the 31st general conference of The.

Czarnitzki, D., & Wastyn, A. (2010). Competing internationally: on the importance of R&D for export activity. ZEW-Centre for European Economic Research Discussion Paper(10-071).

Dollar, D. (1986). Technological innovation, capital mobility, and the product cycle in North-South trade. The American Economic Review, 76(1), 177-190.

Fagerberg, J. (1995). Is there a large-country advantage in high-tech? : NUPI Oslo.

Fagerberg, J. (2000). Technological progress, structural change and productivity growth: a comparative study. Structural change and economic dynamics, 11(4), 393-411.

Ferragina, A. M., & Pastore, F. (2007). High tech export performance: which role for diversification? Paper presented at the Ninth annual ETSG conference.

Frolov, I., & Lebedev, K. (2007). Assessing the impact of high-technology exports on the growth rate and structure of the Russian economy. Studies on Russian Economic Development, 18(5), 490-500.

Fu, D., Wu, Y., & Tang, Y. (2012). Does innovation matter for Chinese high-tech exports? A firm-level analysis. Frontiers of Economics in China, 7(2), 218-245.

Gaulier, G., Lemoine, F., & Deniz, Ü.-K. (2007). China's emergence and the reorganisation of trade flows in Asia. China Economic Review, 18(3), 209-243.

Gökmen, Y., & Turen, U. (2013). The Determinants of High Technology Exports Volume: A Panel Data Analysis of EU-15 Countries. International Journal of Management, Economics and Social Sciences, 2(3), 217-232.

Greenaway, D., Morgan, W., & Wright, P. (1999). Exports, export composition and growth. Journal of International Trade & Economic Development, 8(1), 41-51.

Grossman, G., & Helpman, E. (1991). Innovation and growth in the world economy: Cambridge, ma: mit Press.

Hatzichronoglou, T. (1997). Revision of the high-technology sector and product classification.

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What you export matters. Journal of economic growth, 12(1), 1-25.

Hesse, H. (2006). Export diversification and economic growth. World Bank, Washington, DC.

Hirsch, S., & Bijaoui, I. (1985). R&D intensity and export performance: a micro view. Weltwirtschaftliches archiv, 121(2), 238-251.

Hummels, D., & Klenow, P. J. (2005). The variety and quality of a nation's exports. American Economic Review, 704-723.

Ismail, N. W. (2013). Innovation and High Tech Trade in Asian Countries. Paper presented at the International Conference on Recent Developments in Asian Trade Policy and Integration.

Ito, K., & Pucik, V. (1993). R&D spending, domestic competition, and export performance of Japanese manufacturing firms. Strategic management journal, 14(1), 61-75.

Kirbach, M., & Schmiedeberg, C. (2008). Innovation and export performance: adjustment and remaining differences in East and West German manufacturing. Econ. Innov. New Techn., 17(5), 435-457.

Krugman, P. (1979). A model of innovation, technology transfer, and the world distribution of income. the Journal of political economy, 253-266.

Lemoine, F., & Unal-Kesenci, D. (2002). China in the international segmentation of production processes: Citeseer.

Lemoine, F., & Ünal-Kesenci, D. (2004). Assembly trade and technology transfer: the case of China. World Development, 32(5), 829-850.

Li, X. (2011). Sources of external technology, absorptive capacity, and innovation capability in Chinese state-owned high-tech enterprises. World Development, 39(7), 1240-1248.

Liu*, W.-H., & Lin, Y.-C. (2005). Foreign patent rights and high-tech exports: Evidence from Taiwan. Applied Economics, 37(13), 1543-1555.

Martin, X., Blanke, J., Drzeniek-Hanouz, M., Geiger, T., Mia, I., & Paua, F. (2008). The global competitiveness index: Prioritizing the economic policy agenda. The global competitiveness report, 3-42.

Rodrik, D. (2006). What's so special about China's exports? China & World Economy, 14(5), 1-19.

Romer, P. (1990). Endogenous technological change. Journal of Political Economy(98(5)), 71-102.

Sandu, S., & Ciocanel, B. (2014). Impact of R&D and Innovation on High-tech Export. Procedia Economics and Finance, 15, 80-90.

Sara, T. S., Jackson, F. H., & Upchurch, L. T. (2012). Role of Innovation in Hi-Tech-Exports of a Nation. International Journal of Business and Management, 7(7), 85.

Seyoum, B. (2005). Determinants of levels of high technology exports an empirical investigation. Journal of Competitiveness Studies, 13(1), 64.

Srholec, M. (2007). High-tech exports from developing countries: A symptom of technology spurts or statistical illusion? Review of World Economics, 143(2), 227-255.

Stokey, N. L. (1991). The volume and composition of trade between rich and poor countries. The Review of Economic Studies, 58(1), 63-80.

Tebaldi, E. (2011). The determinants of high-technology exports: A panel data analysis. Atlantic Economic Journal, 39(4), 343-353.

Vernon, R. (1966). International investment and international trade in the product cycle. The quarterly journal of economics, 190-207.

Vogiatzoglou, K. (2009). Determinants of export specialization in ICT products: a cross-country analysis.

Zhao, H., & Li, H. (1997). R&D and export: An empirical analysis of Chinese manufacturing firms. The Journal of High Technology Management Research, 8(1), 89-105.