

Domestic Credit, School Enrollment & Hi-Tech Exports in Bangladesh

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Abstract

This paper examines the relationship among hi-tech exports, school enrollment (tertiary) and domestic credit to private sector in Bangladesh through co-integration and vector error correction model (VECM) over the period 1989 to 2014. Given the high sustainability of hi-tech exports we want to examine whether increase in domestic credit to private sector as well as increase in school enrollment (tertiary) affects hi-tech exports in Bangladesh in the long run or not. The Johansen co-integration tests indicate that all the variables are co-integrated with two co-integrating vector. The VECM long run causality model indicates that there is a long run causality running from school enrollment tertiary and domestic credit to private sector to Hi-Tech exports in Bangladesh. However in the short run no causal relationships have been found among the variables. The implication of our findings is that in Bangladesh if we provide a good education to our people and then provide credit facilities to them, it is very likely that our Hi-Tech exports volume will be increased in the long run. This result can also provide important policy suggestion to the policy makers who are working for sustainable development in the area of exporting items in Bangladesh.

Key words: Hi-Tech exports, Credit, school enrollment, Bangladesh, sustainable development, VECM.

JEL Classification: C22, F14, E51, I23.

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This paper was presented by Mr. Sandip Sarker at 2nd International Conference on South Asian Economic Development, organized by Faculty of Economics, South Asian University, New Delhi, India on February 18-19, 2016.

1. Background of the Study:

Bangladesh is gaining prominence as one of the emerging economies in south Asia with a growth rate of 6% over the course of the last six years. One of the key items in total aggregated output is export, with a contribution of almost 19.80% of GDP in the fiscal year 2014-15. From the various commodities such as fish and shrimp, jute goods, leather, raw jute, the readymade garments sector was the highest contributor towards increased exports in Bangladesh. Thus the top exporting item of Bangladesh is readymade garments. Bangladesh takes pride in this sector that has been earning billions of dollars as export earnings and creating jobs for millions of people in the country. However, whether readymade garments exporting will be sustainable or not remains in question. The garments industry has a competitive edge of being a labor intensive industry. Due to its cheap labor, Bangladesh has been an attractive market for both EU and USA. However as the country develops the price of labor will increase alongside. So the question arises as to whether buyers will still be attracted to Bangladesh as labor price increases. It is probable that buyers will move towards other cheaper labor countries. Therefore Bangladesh needs to focus on more sustainable export oriented items. In this regard, hi-technology exports can be more sustainable. Sustainable economic growth means a rate of growth which can be maintained without creating other significant economic problems, especially for future generations. Bangladesh has made rapid progress in the technological sector over the past few years. The value of high technology exports as a percentage of manufacturing exports is also an upward trend. Having high technology sectors and competency in exporting high value added, high technology products are considered as one of these important factors for an economy (Gökmen & Turen, 2013). High technology competency is considered as one of the powerful forces of economic development, particularly in those countries that are involved in export-led growth strategies (Hobday, 2001). The key goals of today's rapidly growing countries that are trying to compete in new and high technology segments of

industries are increasing the share of high technology products and enhancing productivity. (Sara et al., 2012). Statistics show that high-tech manufacturing has been the fastest growing area of world trade and now accounts for over one fifth of total trade (UNDP, 2001). In the future, high technology industries will be the primary source of wealth generation, as opposed to the resource, labor and capital-intensive industries that dominated the twentieth century (Reich, 1991). Many countries have now embarked on technology-based development. New Silicon Valleys have begun to sprout in many parts of the world. A major factor contributing to technological advancement across several nations is investment in R&D and human capital formation (Gani, 2009). Credit also plays a vital role in international trade. Feenstra, Lu, and Yi (2011) showed that credit constraints reduce exports on the extensive margin, a result supported by data on Chinese firms. Firms are more likely to be exporting or importing if they enjoy lower credit constraints. Similarly education plays a crucial role for the development of a nation. According to (Psacharopoulos, 1994), investment in higher education generally provides a higher return in the form of innovation and development. Previous studies on hi-tech exports did not find any relationship among school enrollment & domestic credit to private sector and hi-tech exports. Therefore our study has attempted to identify the relationship among school enrollment tertiary, domestic credit to private sector and hi-tech exports in Bangladesh using Vector Error Correction Model. The rationale behind this study is whether our high-tech exports volume increases as the percentage of domestic credit to private sector and school enrollment tertiary increases. The finding of this study is that it will provide a direction to the policymakers regarding our hi-tech exports issue.

2. Literature Review:

High technology is often used to refer to firms and industries whose products or services embody advanced and innovative technologies. Such firms have in common a dependence on advanced scientific and technological expertise and are often identified by high research and development expenditures (Keeble & Wilkinson, 2000). High technology exports are products with high research and development intensity such as computers, pharmaceuticals, scientific instruments, electrical machinery, consumer electronics, software, transportation electronics and military and civil aerospace products. Information technology (IT) goods such as electronic data processing

equipment, software, electronic components and telecommunications equipment are also part of the high technology products (WDI, 2015). The world trade has increasingly becoming a trade in hi-tech products. Share of developing countries in hi-tech exports have also shown a dramatic progress; 8% in 1983 to near about 23% in 1997 (Mani, 2000). High technology exports volume is known as one of the final products for commercialization of national innovation capability (Furman et al., 2002). Several studies have identified positive relationship between hi-tech exports and other economics performance (Zhang, 2007; Falk, 2009). Most of the previous studies have emphasised R & D expenditure as well as foreign direct investment to increase the share of hi-tech exports. (Gökmen & Turen, 2013). (Sara et al., 2012) studied over the relationship between innovative capability of a country and share of high-technology products in its exports of manufactured goods. They believe that innovative capability is an important factor in a country's ability to design, produce and export high technology products. Belay, (2005) studied over the determinants of levels of high technology exports on a sample of 55 developed and developing countries. He found that inward foreign direct investment has a significant and positive effect on high technology exports. Additionally national technological infrastructure contributes to enhance high technology exports. (Gökmen & Turen, 2013) stressed the importance of technology transfer to have more hi-tech export volume. Therefore more foreign direct investment is necessary. They believe Capability to manufacture and export high technology products in today's competitive global markets basically is an indication of innovation power of a country. Tebaldi (2011) in his panel data study explored that human capital, FDI inflows, and trade openness have a positive and significant impact on high-tech exports. Gani (2009) explored that high technology exports have been a determining factor in per capita economic growth in countries with higher levels of technological achievement. Similarly, Connolly (2003) provides empirical evidence that high technology goods imports from developed countries not only positively affects domestic innovation, but also leads to increased GDP growth as higher quality capital goods are used in domestic production. Salmon and Shaver (2005) have shown that exporting is associated with innovation, as exporters are more likely to access diverse knowledge about competing products and customer preferences through export intermediaries, customer feedback and other foreign agents, thus facilitating innovation. In "The Global Competitiveness Report 2008-2009" the

World Economic Forum concluded that in the long-run a country's competitive standing can only be expanded with technological innovation (Sala-I-Martin et al., 2008). Further Porter (1990) mentioned that in the long run, a nation's higher order competitive advantage can be built only with innovation. A nation's firms must use technical innovation to develop cutting-edge products and processes. In the study of (Levy, 1998; Keeble and Wilkinson, 2000) the role of universities is also mentioned as an important source of knowledge and spillovers to innovative activity of small and medium-sized firms, thus triggering steady growth in the development of high technology.

Most of the previous studies represent important first steps in explaining the factors that affect hi-tech exports. However there is a need for an in-depth examination of important other relevant factors that influence high technology exports to address any policy implications. We add value to the existing literature of exports by adding other variables such as domestic credit to private sector and school enrollment tertiary.

3. Data, Model & Methodology:

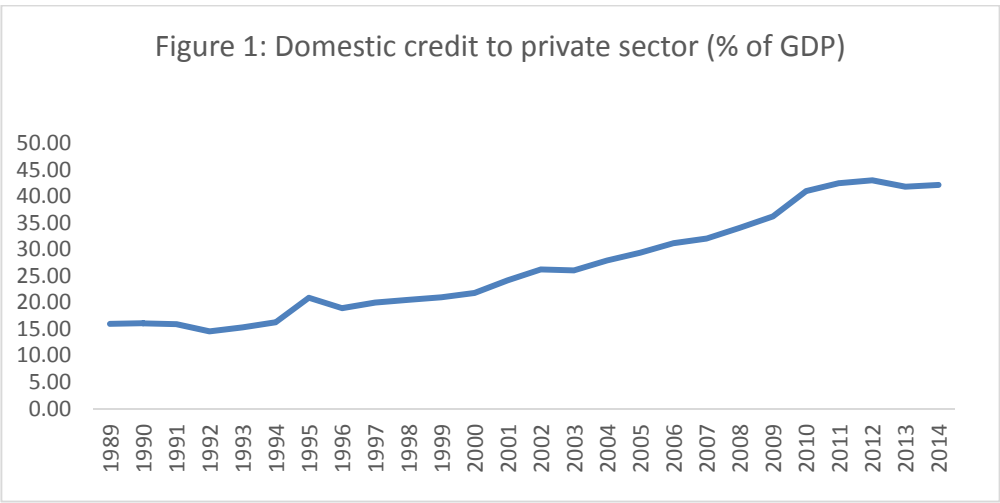
3.1 Data:

'Table 1' presents descriptive statistics for the variables employed in the study. 'Figure 1, 2 & 3' presents the time series of each of the variables in graphical form. In this study our dependent variable is Hi-Tech exports and independent variables are domestic credit in private sector and school enrollment (tertiary). Here a hi-tech export is measured as percentage of total manufacturing exports. High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. On the other hand domestic credit to private sector is measured as percentage of GDP. Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. Finally school enrollment tertiary is measured as percentage of gross. The total enrollment in tertiary education regardless of age, expressed as a percentage of the total population of the five-year age group following on from secondary school leaving. Data has been collected from world development indicators of World Bank data sheet from 1989 to 2014.

Table 1: Descriptive Statistics

Variables	Mean	Median	Skewness	Kurtosis
Hi-Tech Exports	23.05	19.31	2.966662	11.60174
Domestic credit	26.72	25.11	0.474892	-1.14169
School Enrollment	6.72	5.9	0.876538	-0.43939

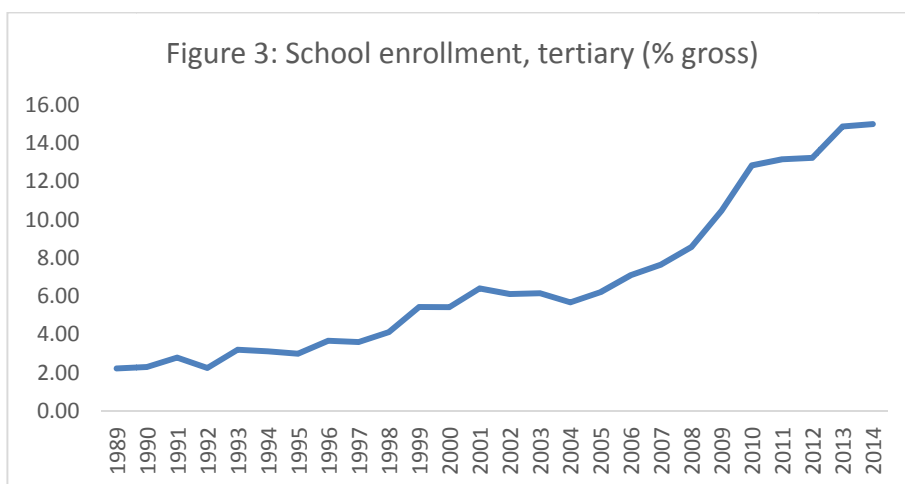
Source: Author’s calculation from World Bank data



Source: World development indicators (World Bank)



Source: World development indicators (World Bank)



Source: World development indicators (World Bank)

3.2 Econometric Modeling Strategy:

The econometric modeling strategy proceeds in several steps, consistent with previous studies. The unit root test is carried out to check the stationarity of the variables as financial and macro variables are well known for their non stationarity. The Augmented Dickey Fuller (ADF) test is then carried out to detect the existence of unit root and as a result of which, some of the variables are found to be non-stationary and thus could not be regressed unless made stationary. The null hypothesis for the ADF unit root test is that the variable has a unit root against the alternative of stationarity. We performed the ADF tests based on the following model:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \dots + \delta_{p-1} \Delta y_{t-p+1} + \epsilon_t,$$

Moreover Phillips-Perron Test has also been employed to verify the unit root test result along with ADF unit root test.

Therefore, the cointegration test is run to find out possible linear combinations of the variables which could be considered stationary. To test for cointegration we use the maximum likelihood test developed by Johansen and Juselius (1990). We use the AIC to determine lag length. Johansen and Juselius multivariate cointegration equation is given below:

$$\Delta X_t = \sum_{i=1}^p \Gamma_i \Delta X_{t-i} + \Pi X_{t-1} + \Omega_t$$

Once the variables are found to be cointegrated, then Vector Error Correction model (VECM) can be employed to identify the long run and short run causality running from our variables. The long-run multivariate models are as follows:

$$Y_t = \alpha + \beta_1 DC_t + \beta_2 SE_t + u_t$$

Where Y_t = hi-tech exports, DC_t = Domestic credit to private sector, SE_t = School enrollment tertiary, u_t = error terms

If there is a long run relationship between the series, shocks will result in disequilibrium in the short-run before the series return to their long-run equilibrium. The short run model corresponding is as follows:

$$\Delta HTE_t = \sum \beta_i \Delta HTE_{t-i} + \sum \alpha_i \Delta DCP_{t-i} + \sum \alpha_i \Delta SE_{t-i} + \epsilon_{it}$$

Where, HTE = High-Tech exports, DCP = Domestic credit to private sector & SE = school enrollment

4. Results:

Initially, we opted for ADF test to check the datasets and we observed that the datasets were non-stationary at level. However, in first difference, we found both the series become stationary ('Table 2'). So it became possible for us to investigate the existence of a long-run relationship within a Johansen cointegration testing framework.

Table 2: Augmented Dickey-Fuller Unit Root Test

Variables	Level	First Difference
	t-statistic	t-statistic
Hi-Tech Exports	-3.495623	-7.384751
Domestic credit	-2.512380	-4.538845
School Enrollment	-1.130041	-4.787454

Phillips-Perron Unit Root Test result (table 3) also suggest that all the variables are non-stationary at their level. However they become stationary in their first difference.

Table 3: Phillips-Perron Unit Root Test

Variables	Level	First Difference
	t-statistic	t-statistic
Hi-Tech Exports	-3.439821	-7.897339
Domestic credit	-2.512380	-4.538845
School Enrollment	-1.130041	-4.787454

In Johansen's method, both the Eigen value statistics and Trace statistics can be used to determine whether variables are cointegrated or not. To trace out the presence of cointegration, we could rely on both Trace statistics and Eigen value. From the Trace statistics (table 4), it was found that all variables have been cointegrated at 5% level where the null hypothesis is rejected indicating long-term association between the variables. Further Maximum Eigenvalue statistics indicates that there is at least one cointegrating equation. As all variables are cointegrated, we can run VECM model.

Table 4: Johansen Cointegration Test Result

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.758464	44.62220	29.79707	0.0005
At most 1 *	0.423199	16.20745	15.49471	0.0890
At most 2 *	0.229036	5.202280	3.841466	0.0225

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.758464	28.41475	21.13162	0.0040
At most 1	0.423199	11.00517	14.26460	0.1540
At most 2 *	0.229036	5.202280	3.841466	0.0225

'Table 5' portrays the method for lag selection model. Here we used VAR lag order selection criteria to determine the number of lag in our model. We used Akaike information criterion (AIC) to select the number of lag. The rule is lower the AIC better the model. Therefore we have selected lag 1.

Table 5: Lag selection model

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-152.3307	NA	2051.405*	16.13307*	16.58115*	16.22054*
2	-150.8674	2.048592	4583.542	16.88674	17.78290	17.06168
3	-138.2856	13.83997	3726.155	16.52856	17.87280	16.79097
4	-133.8435	3.553684	8346.545	16.98435	18.77667	17.33423
5	-119.4087	7.217413	10561.47	16.44087	18.68127	16.87822

„Table 6’ shows the VECM long run causality model. Here C (1) represents the speed of the adjustments towards long run equilibrium. We see that our C (1) is negative and is also significant which indicates that there is long run causality running from domestic credit to private sector and School enrollment tertiary to hi-tech exports. Further we can say that domestic credit to private sector and school enrollment tertiary has influence on our dependent variable hi-tech exports in the long run.

Table 6: VECM Long Run Causality result

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.466807	0.413295	-3.549053	0.0023
C(2)	0.068994	0.244514	0.282166	0.7810
C(3)	3.045325	2.764057	1.101759	0.2851
C(4)	2.147045	6.097582	0.352114	0.7288
C(5)	1.139173	5.767784	0.197506	0.8456
R-squared	0.697024	Mean dependent var		1.091870
Adjusted R-squared	0.629696	S.D. dependent var		45.31532
S.E. of regression	27.57555	Akaike info criterion		9.661396
Sum squared resid	13687.40	Schwarz criterion		9.908243
Log likelihood	-106.1061	Hannan-Quinn criter.		9.723478
F-statistic	10.35267	Durbin-Watson stat		2.131800
Prob(F-statistic)	0.000156			

Now we want to estimate whether there is any short run causality or not among our variables. To do this we use wald statistics test result. ‘Table 7’ shows short run causality result between Domestic Credit to Private sector and Hi-Tech Exports. Result says that there is no short run causality between Domestic Credit to Private sector and Hi-Tech Exports since chi-square value is more than 5%.

Table 7: Short Run Causality between Domestic Credit to Private sector and Hi-Tech Exports

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	1.101759	18	0.2851
F-statistic	1.213873	(1, 18)	0.2851
Chi-square	1.213873	1	0.2706

‘Table 8’ shows short run causality result between School Enrollment (Tertiary) and Hi-Tech Exports. Result says that there is no short run causality between School Enrollment (Tertiary) and Hi-Tech Exports since chi-square value is more than 5%.

Table 8: Short Run Causality between School Enrollment (Tertiary) and Hi-Tech Exports

Wald Test:

Test Statistic	Value	df	Probability
t-statistic	0.352114	18	0.7288
F-statistic	0.123984	(1, 18)	0.7288
Chi-square	0.123984	1	0.7248

Now we want to examine whether our model where Hi-Tech Exports is the dependent variable has any statistical error or not. Here our value of R^2 is

70% which is high. Our F statistics is also significant which a good sign of our model. Breusch-Godfrey's LM Test ('Table 9') indicates that there is no serial-correlation in our model. Further Breusch-Pagan-Godfrey's Heteroskedasticity Test ('Table 10') indicates that this model does not have Heteroskedasticity.

Table 9: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

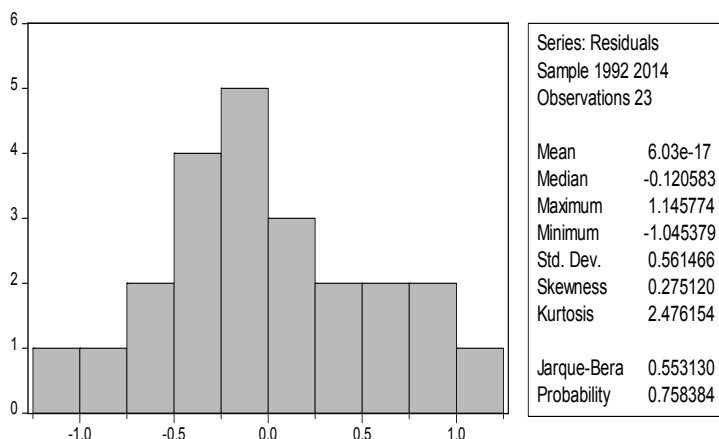
F-statistic	1.145669	Prob. F(1,17)	0.2994
Obs*R-squared	1.452159	Prob. Chi-Square(1)	0.2282

Table 10: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.142082	Prob. F(6,16)	0.9881
Obs*R-squared	1.163468	Prob. Chi-Square(6)	0.9787
Scaled explained SS	3.170262	Prob. Chi-Square(6)	0.7872

Moreover residual of our model is found to be normally distributed ('figure 4'). At the same time stability statistics in 'figure 4' indicates that our model is stable or in other words our dependent variable Hi-Tech exports have stability.



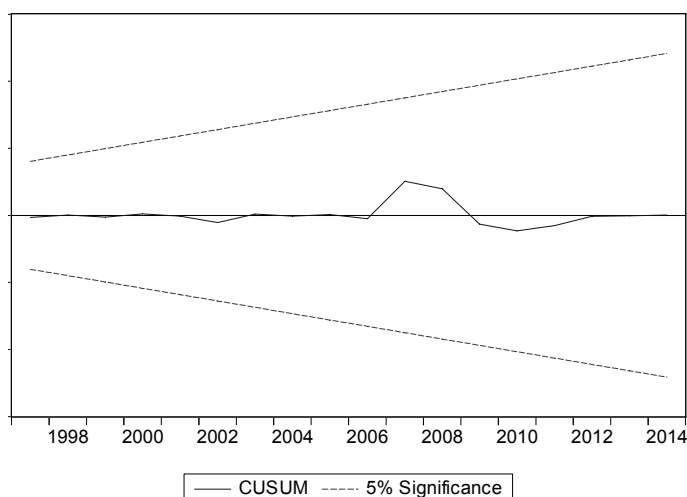


Figure 4: Normality & Stability Test

4.1 Result of Impulse Response:

'Figure 6' displays the impulse response for hi-tech exports to generalize one standard deviation fundamental innovation. It helps to trace out the responsiveness of the dependent variables in the VECM to shocks to each of the variables. The first figure shows that if we give positive shock of one standard deviation to hi-tech exports then hi-tech exports will gradually go down and after one and half year it becomes negative and again positive after third year. Then if we give positive shock of one standard deviation to domestic credit to private sector, then hi-tech will become negative from the very beginning. Then if we give positive shock of one standard deviation to school enrollment (tertiary), then hi-tech exports will also be negative from the beginning to the eighth year.

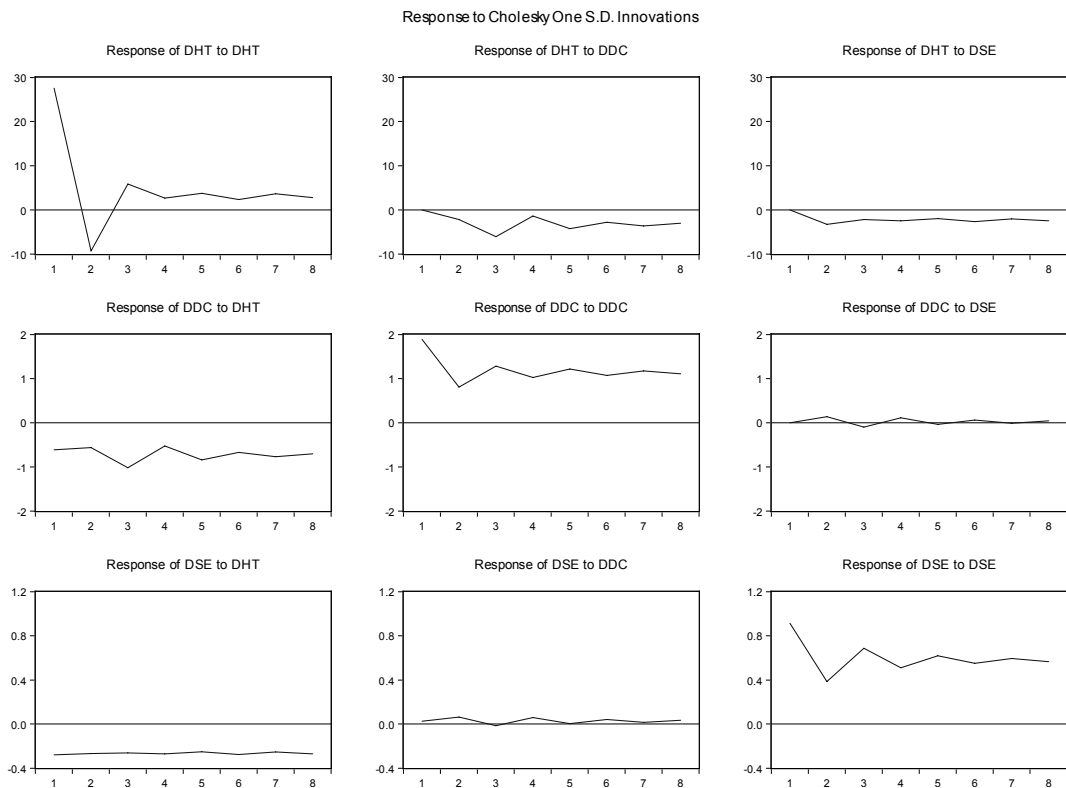


Figure 6: impulse response result

4.2 Result of Variance Decomposition:

As impulse response function does not show the extent of the relationships between variables. Therefore, in order to judge the relative strength of different influences on a given variable, we conducted variance decomposition analysis. ‘Table 11’ shows Variance Decomposition of Hi-tech exports. Here in the short runs (year 3) impulse or innovation or shock to hi-tech exports accounts for 93.93% variation of the fluctuation of hi-tech exports (own shock). At the same time shock to domestic credit to private sector can cause 4.41% variation to the fluctuation of hi-tech exports. Finally shock to school enrollment (tertiary) can cause 1.65% variation to the fluctuation of hi-tech exports. However in the long runs (year 10) shock to hi-tech exports accounts for 84.97% variation of the fluctuation of hi-tech exports (own shock). At the same time shock to domestic credit to private sector can cause 10.22% variation to the fluctuation of hi-tech exports. Finally shock to school enrollment (tertiary) can cause 4.80% variation to the fluctuation of hi-tech

exports in the long run. Therefore among major demographic determinants of hi-tech exports, we can conclude that school enrollment (tertiary) as well as domestic credit to private sector might explain the major variations along with hi-tech exports itself.

Table 11: Variance Decomposition of Hi-Tech Exports

Period	S.E.	DHT	DDC	DSE
1	27.57555	100.0000	0.000000	0.000000
2	29.36266	98.21434	0.543322	1.242338
3	30.62403	93.93260	4.412389	1.655008
4	30.87229	93.17570	4.546132	2.278170
5	31.44948	91.21019	6.199745	2.590066
6	31.77159	89.90650	6.861079	3.232421
7	32.25161	88.52617	7.929691	3.544136
8	32.61063	87.31589	8.635054	4.049060
9	33.03151	86.08956	9.525232	4.385206
10	33.40469	84.97042	10.22505	4.804528

5. Concluding Remarks & Policy Recommendations:

The aim of this study is to determine the relationship among hi-tech exports, school enrollment and domestic credit to private sector in Bangladesh from a time series data. We found long run relationship running from school enrollment tertiary and domestic credit to private sector to hi-tech exports. The study has contributed to the economic literature by identifying those variables that affects hi-tech exports in Bangladesh in the long run. The result of this study has clearly given an indication to the policy makers who are working over how to increase hi-tech exports in Bangladesh. If the government wants to increase its hi-tech exports volume, it needs to focus on its financial sector as well that provides credit to private our sector. In addition to this government should also emphasize on progression of restructuring our tertiary educational system. Bangladesh is doing well in exporting pharmaceuticals items. According

to Export Promotion Bureau (EPB) pharmaceuticals exports were reached \$42.4 million in the FY'14. The target for the FY'15 has been set at \$73.02 million. At the same time Bangladesh is also doing well in IT outsourcing. According to Export Promotion Bureau Bangladesh experienced a 52.43% growth in software exporting in the FY14. Bangladesh earned a record \$109.10 million by exporting computer services, which is 2.95% higher compared to \$106 million in FY 2013-14. The software exports basically include computer data processing as well as hosting services, computer consultancy service, and export of computer software and so on. Therefore a strong initiative by the government can help Bangladesh to further develop hi-tech exports items and therefore achieve sustainability in the long run. However our study has conducted with three variables only. Therefore the study recommends that future research should consider to model with more alternative possible determinants of high technology exports. Moreover cross country analysis may be done and data set may be widened by using other countries' data, in order to enhance the explanatory power of panel data analysis.

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