# Causal Relationship among Bangladesh RMG export, European GSP and RMG Production: A Vector Error Correction Approach

**Muhammad Mahmudul Hasan [1], Murshida Khanam [2]**

Abstract- GSP facility has become an important topic of the discussion of Readymade garments sector in Bangladesh .The purpose of the study is to analyze the causal relationship among export performances of the readymade garments sector in Bangladesh, GSP facility at European Union and the yearly production behavior of the readymade garments sector in Bangladesh by using fiscal years data from 1990-1991 to 2014-2015 has been collected from Export promotion bureau Bangladesh and BGMEA. Stationary test was carried out by using Augmented Dickey-Fuller, Philips-Perron methods, where we have been found non-stationary at level but stationary at first difference at the same order for all three variables. The Johansen-Juselius co integrated test has been employed showed that one cointegrating long run relationship among three variables. The vector error correction model has been employed in our study, which results also indicated us that short run relationships exist among the three variables. Finally, we have been employed Granger Causality and it has been found unidirectional causality among our three variables. Findings of the study suggest that if GSP facility increase, then the production behavior as well as export performances of the RMG sector also increases. So, in that case our Government should take necessary steps to remain the GSP facility in a good position and as a result the production behavior and the export performances of the readymade garments will be increased as a great extent.

Keywords: GSP, Export performance, European Union, RMG, Co integration, VECM, Bangladesh, Production, Granger Causality



## 1. INTRODUCTION

Jute and tea were the most export-oriented sectors after the birth of Bangladesh. But with the constant threat of flooding, declining jute fibre prices and a gradual decrease in world demand, the contribution of the jute sector to the country's economy has decreased. After that attention has turned to the role of manufacturing sector, especially in garment industry.

1950 was the beginning of RMG in the Western world. But, in Bangladesh it was in 1972. In order to control the level of imported RMG products from developing countries into developed countries, the Multi Fiber Agreement (MFA) was made in 1974. The MFA agreement imposed an export rate 6 percent increase every year from a developing country to a developed country. In the early 1980s Bangladesh started receiving investment in the RMG sector. Some Bangladeshis received free training from the Korean Company Daewoo. After these workers came back to Bangladesh, many of them broke ties with the factory they were working for and started their own [4].

Bangladesh has graduated rapidly from being a predominantly aid-dependent country to an external-trade driven one, and the ready-made garments manufacturing industry has played a pivotal role in this process. During the past decades, various national and international institutions and their policies have been instrumental behind the rapid growth of this premier foreign exchange earner. The relatively favored market access terms the European Union's Generalized System of Preferences (GSP) scheme offers for least-developed countries has provided the apparel sector with its biggest destination of export. The EU's GSP Scheme and Rules of Origin the European Community was the first to extend the privileges of a GSP scheme in 1971 and now 176 developing countries enjoy this scheme with 7200 tariff lines covered for the LDCs. In 1947, when the first talks for GATT had begun, it was recognized that

**Corresponding-Author**: Muhammad Mahmudul Hasan, Department of Statistics, University of Dhaka

Email: baharsh06@yahoo.com

**Co-Author:** Murshida Khanam, Associate Professor, Department of Statistics, University of Dhaka

Email: murshida@statdu.ac.bd

developing and least-developed countries needed preferential market access facilities for them to survive in the world market and close the gap with the developed capitalist countries (DCCs). The EU took this philosophical underpinning into its bilateral relations with LDCs, and the result is the various GSP schemes on offer **[1].** By 1990, RMG exports had overtaken Bangladesh's traditional exports and, by the close of the 1990s, export concentration emerged afresh, with RMG exports reaching a share of 81 percent in 2014 due to GSP. The production of readymade garment was 1717.52 million dollar (U$D) in 1990 but at present it is almost 31198.45 million dollar (U$D) [2**].** This type of increasing nature of the Readymade Garments products and also the production due to the European GSP scheme on our RMG sector motivated us to study the causal relationship among export, European GSP and production.

Our present study is consisting in five parts: 1. Introduction in which brief introduction of topic, history of readymade garments in western world and Bangladesh, current facts and European GSP scheme for the Bangladesh RMG sector. 2. Literature Review in which previous related works are discussed. 3. Modeling framework in which research methodology are explained. 4. Estimation results. 5. Conclusion and some policy implications.

**Research Objectives**

The main objectives of the time series data analysis are to study the post behavior (both short run and long run) of the available data and then fit a suitable model with the help of different suitable techniques. Keeping this in mind, the objectives of our present research are given as follows:

- To examine the long run relationship by using Johansen and Juselius's multivariate co-integrating analysis.
- To examine the short run dynamics adjustment by applying Vector Error Correction Model (VECM).
- To examine the direction of causality by using Granger's Causality.

- To recommend policy implication for the Ready-made garments sector in Bangladesh

**Data & Variables**

**Data Sources:** Time series data from Fiscal year 1990-1991 to 2014-2015 (All the Data are in the million dollars (U. $) has been collected from BGMEA & Export Promotion Bureau Bangladesh [7].

In this study following variables are considered:

- **Export of RMG**- All the exports of readymade garments throughout the world is considered.
- **European GSP**- Though all the garments products are duty free, so the RMG exports at EU are considered as the European GSP variable.
- **Production**- All the production of the ready-made garments in Bangladesh.

**2. LITERATUER REVIEW**

Mostafa (2015) [11] have examined the major changes in the revised EU GSP scheme and their impact on Bangladesh's export by identifying the major competitors, using quantitative tools. The affected items of Bangladesh, as revealed in the study, are mainly knit and woven textile articles. Islam, R.M. And Maruf, N.K. (2014) [9] has identified that the readymade garments export balance is positive with trading countries especially with European Union. They also have showed that there is a strong association between RMG exports under EU GSP. This positive effect also reducing unemployment increases the production behavior and the no of total factory. They have been collected data from export promotion bureau compiled by BGMEA from FY 2008-2009 to 2012-2013.

Ahmed (2014) [1] has analyzed the potential benefits that Bangladesh can enjoy easily the GSP effect because of the LDC listed, which has helped our country to increase our export performances at EU. Using the relevant comparative analysis, export similarity index, Unit price of the readymade garments export and yearly production it has found that Bangladesh is in advantageous against all these indicators among the top RMG export. Trend analysis approach has been used to analyze statistical information for which the data has collected from secondary sources. Finally, it has found that because of the GSP facility Bangladesh export performances of the readymade garments products increases significantly. Ahmed, S.A. (2013) [2] has analyzed the causal relationship between export performances and GSP facility at EU. His analysis showed that the high jump of the export performances increased due to GSP facility, implication for Bangladesh. Akteruzamman, M.S. (2012) [3] has analyzed the export performances of the readymade garments sector. His paper is based on the basis of both primary and secondary data. His results showed that buyers are satisfied towards the readymade garment

products of Bangladesh, the quality of RMG products and the production behavior is also excellent.

Rahman, M. (2011-CPD) [13] has studied the EU GSP and export performances for the Bangladesh. He has showed that the trade of our readymade garments with the GSP facility on EU is statistically significant. He has performed simple linear regression model and test the association between the variables. He has found out that, the correlation is 0.90 that means export of the RMG is strongly correlated with the GSP facility at EU. Taslim, M.A. and Haque, M.S. (2011) [14] have sought out that the RMG sector has captured a larger share of the EU market and then at USA, Canadian markets. Though the RMG export exploring full duty free entry at EU due to the GSP effect, it performances increases quite dramatically. They have also found out that GSP effect has made Bangladesh the second export oriented country in Asia.

## 3. RESEARCH METHODOLOGY

**Theoretical Model:** The identified model is three variables model which hypothesize that Export of RMG as a function of European GSP and production

$$Exp_t = F(Gsp_t, Production_t) \qquad [1]$$

Here, Exp means the export of the ready-made garments in Bangladesh, GSP means the European GSP facility, Production refers all the production in RMG sector where t-sign represent time trend. All the variables are converted in to logarithmic form. Thus, the coefficients can be interpreted with respect to elasticity.

**Stationarity Check:** Stationarity of the time series data is an important phenomenon because it can influence its behavior. Time series stationarity is the statistical Characteristics of a series such as its mean and variance over time. If both are constant over time, then the series is said to be a stationary process, otherwise the series is described as being non-stationary process. Differencing a series using differencing operations produces other sets of observations such as the first-differenced values, the second differenced values and so on. If a series is stationary without any differencing it is designated as I (0), or integrated of order 0. On the other hand, a series that has stationary first differences is designated I (1), or integrated of order 1. Augmented Dickey-Fuller test suggested by [5] and the Phillips-Perron test recommended by [12] have been used to test the stationarity of the variables.

**Johansen and Juselius Cointegration Test:** Johansen and Juselius [10] procedures used to tests to determine the number of cointegration vectors: Maximum Eigen value test and Trace test. The Maximum Eigen value tests the null hypothesis of r cointegrating relations against the alternative of r+1 cointegrating relations for r= 0, 1, 2…….n-1. This test statistics are computed as:

$$\boldsymbol{j_{max} = -T \ln(1 - \hat{\lambda}_i)} \qquad [2]$$

Where, $T$ is the sample size and $\lambda_i$ is the ith largest canonical correlation. **Trace statistics** investigate the null hypothesis of r cointegrating relations against the alternative of n cointegrating relations, where n is the number of variables in the system for r = 0, 1, 2…n-1. Its equation is computed according to the following formula:

$$\boldsymbol{\lambda_{trace} = -T \sum_{i=r+1}^{n} ln(1-\hat{\lambda}_i)} \qquad [3]$$

In some cases Maximum Eigen value and Trace statistics may give the different results and [8] indicates that in this case the results of trace test should be preferred.

**Vector Error Correction Model (VECM):** Presence of cointegration between or among the series indicated us that their exists long-term equilibrium relationship, so we apply VECM in order to find out the short run adjustment relationship of the cointegrated series. In case of absence of cointegration VECM is not valid and we directly deal with the Granger causality tests to assess the causal relationship. The regression equations form for VECM with the series we have used is as follows:

$$\begin{aligned}\Delta LexpRMG_t &= \alpha_1 + \sum_{i=1}^{k} \beta_{1i} \Delta L\ expGSP_{t-i} \\ &+ \sum_{i=1}^{k} \gamma_{1i} \Delta Lproduc_{t-i} \\ &+ \sum_{i=1}^{k} \theta_{1i} \Delta L\, expRMG_{t-i} + \delta_1 \varepsilon_{t-1} \\ &+ e_{1t}\end{aligned}$$

$$\begin{aligned}&\Delta LexpGSP_t \\ &= \alpha_2 + \sum_{i=1}^{k} \beta_{2i} \Delta L\ expGSP_{t-i} + \sum_{i=1}^{k} \gamma_{2i} \Delta Lproduc_{t-i} \\ &+ \sum_{i=1}^{k} \theta_{2i} \Delta L\, expRMG_{t-i} + \delta_2 \varepsilon_{t-1} \\ &+ e_{2t}\end{aligned}$$

$$\Delta \boldsymbol{Lproduc_t} = \boldsymbol{\alpha_3} + \sum_{i=1}^{k} \boldsymbol{\beta_{3i}} \Delta \boldsymbol{L\ expGSP_{t-i}} + \sum_{i=1}^{k} \boldsymbol{\gamma_{3i}} \Delta \boldsymbol{Lproduc_{t-i}} + \sum_{i=1}^{k} \boldsymbol{\theta_{3i}} \Delta \boldsymbol{L\, expRMG_{t-i}} + \boldsymbol{\delta_3 \varepsilon_{t-1}} + \boldsymbol{e_{3t}} \quad [4]$$

In VECM the cointegration rank shows the number of cointegrating vectors. For instance a rank of one indicates that two linearly independent combinations of the non-stationary variables will be stationary. A negative and significant coefficient of the ECM (i.e. $\boldsymbol{\varepsilon_{t-1}}$ in the above three equations) indicates that any short-term fluctuations between the independent variables and the dependent variable will give rise to a stable long run relationship between the variables.

**Granger-Causality:** A general specification of the Granger causality test in a bivariate (X, Y) context can be expressed as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \cdots + \beta_1 X_{t-1} + \cdots + \beta_i X_{t-i} + \mu \quad [5]$$

$$X_t = \alpha_0 + \alpha_1 X_{t-1} + \cdots + \beta_1 Y_{t-1} + \cdots + \beta_i Y_{t-i} + \mu \quad [6]$$

In the model, the subscripts denote time periods and μ is a white noise error. The constant parameter represents the growth rate of Y in the equation 5 and X in the equation 6 and thus the trend in these variables can be interpreted as general movements of cointegration between X and Y that follows the unit process. We can obtain two tests from this analysis: the first test examines the null hypothesis that the X does not Granger cause Y and the second test examines the null hypothesis that the Y does not Granger cause X. If fail to reject the former null hypothesis and reject the latter, then we conclude that X changes are Granger-caused by a change in Y [6]. Unidirectional causality will occur between two variables if either null hypothesis of equation (5) or (6) is rejected. Bidirectional causality exists if both null hypotheses are rejected and no causality exists if neither null hypothesis of equation (5) or (6) is rejected [8].

## 4. RESULTS AND DISCUSSIONS

**Stationarity Test:** It is clear from **Table-1(a) and Table-1(b)** that the null hypothesis of no unit roots for all the time series are rejected at their first differences. Since both the ADF and P-P tests statistic values are less than the critical values at 5% levels of significances by considering constant and constant, linear trend at equations. Thus all the variables are stationary and integrated at same order I (1). In short, all the variables became stationary and do not contain unit root in first differences.

**Determination of Lags:** From the **Table-2,** it has been seen that for lag-1 the AIC and SBIC values are minimum but for lag-2 the HQIC value is minimum. So the lag which satisfies most of the criterions is the optimum lag. We precede further analysis with lag-1.

**Cointegration Test:** Cointegration rank is estimated by using Johansen methodology. Johansen's approach derives two likelihood estimators for the cointegration rank: a trace test and a maximum Eigen value test. The cointegration rank can be formally tested with the trace and the maximum Eigen value statistics.

The results are presented in **Table-3(a) and Table-3(b).** Start by testing $H_0$: r=0, if it rejects repeat for $H_0$: r≤ 1. In the maximum Eigen value test $H_0$: r≤ 1 is not rejected at 5% level of significance (8.2483< 14.2646). So from the **Table-3(a)** for the maximum Eigen value test statistic for the null hypothesis of no cointegration among the variables are rejected. So, it can be concluded that their exists atleast one cointegration among the variables. Now, again start by testing $H_0$: r=0 which is rejected at 5% level of significance (47.2260> 29.7970) for the Trace statistics test but for $H_0$: r=1 test is not rejected at 5% level of significance (8.2577< 15.4947) from **Table-3(b).** In other words, this Trace test result has been indicated us that these three variables are cointegrated. The final number of cointegarted vectors with one lag is equal to one, i.e. rank (π) =1. Since, the rank is equal to one which is more than zero and less than the number of variables; the series are cointegrating among the variables. Nevertheless, we will proceed to estimate the VECM model.

**Vector Error Correction Model:** The presence of cointegration between variables suggests a long term relationship among the variables under consideration. Then, the VEC model can be applied. The long run relationship among European GSP, RMG Export and production for one cointegration vector for the Bangladesh from fiscal years 1990-1991 to 2014-2015 is displayed below:

Log (RMGEXP) = 0.0054 + 0.1021*log (EU GSP) + 0.8434*log (production)

In Table 4, all the coefficients were significant at 5% level of significance. When the variables are in logarithms and one cointegrating vector is estimated,

the coefficients can be interpreted as long run elasticities. Thus, 1 percent increase in export under GSP facility is associated with the 10.21 percent increase in total export performances of the readymade garments sector at EU market and the coefficient is also significant at 5 percent level of significance. For, 1 percent increase in yearly production of the readymade garments is associated with the 84.34% percent increase in total export performances of the readymade garments sector at EU market and the coefficient is also significant at 5 percent level of significance. One of the implications of the cointegration is that, there should be an error correction representation. This error correction is an indication of the long run relationship. When the variables are cointegrated, then in the short run deviation from the long run equilibrium will feed back on the changes in the dependent variable in order to force the movement towards the long run equilibrium [8].

In **Table-5**, it can be said that the values of error correction term coefficient are **-0.1031**, **-0.0921, -0.1177** which have the negative sign implying that the series cannot be drift too far apart and convergence is achieved in the long run. On the other hand, short run export performances of readymade garments are adjusted by 10.31%, 0.09.21%, 11.77% of the past year's deviation from equilibrium. The coefficients on the error correction terms are small; indicating that the yearly production and the effect of GSP in the export performances of the readymade garments sector at EU market adjust quickly to its long run equilibrium. The adjustment coefficients of lagged values of the variables export performances of readymade sector, yearly production and export under GSP facility at EU market are significant at 5 percent level of significance. That means all of the adjustment coefficients of lagged values of all variables has assured the statistical significance of our model and the GSP facilities and the behavior both have significant effects on readymade garments sector export performances. The significance of coefficient values of various lagged endogenous variables (dependent and independent variables, see Table-5) implies that all those variables were actively playing role in bringing long-run equilibrium in the readymade garments through changing their lagged values which is called the short run adjustment mechanism.

**Granger Causality Tests:** Recall that although cointegration between two variables does not specify the direction of a causal relation, if any, between the variables. Economic theory guarantees that there is always Granger Causality in at least one direction [6]. Estimation results for Granger causality between variables are represented in Table-6. The study by [6] used F-test statistics and probability to measure causality between the variables. F-test statistics and probability values constructed under the null hypothesis of non causality show that there is a causal relationship between those variables.

**Table-6** provides the results of pair wise analyses. Significant probability values denote rejection of the null hypothesis. This study reject the null hypothesis if the probability value is less than 5% and accept the null hypothesis if the probability value is greater than 5%. It is found that RMGEXP Granger cause production and GSP Granger cause both production and RMGEXP. There is a unidirectional causality running from RMG Export to production, implying the past values of the readymade garments export have predictive ability in determining the present values of production. Also, unidirectional causality running from GSP to RMG export and production, implying the past values of the European GSP export have predictive ability in determining the present values of production and readymade garments exports.

## 5. CONCLUSION & POLICY IMPLICATION

It can be concluded that, their exist not only short run relationship but also long run equilibrium relationship among RMG export, production and European GSP. We have also found that, if the GSP facilities improve then both of our readymade garments sector production and export performances will be increased. GSP tends to foster Bangladesh exports in the long run as well as short run. So it seems to be a suitable instrument to promote sustainable economic growth and the development of our country, our Government should give the deep concern about the factors behind the GSP facility. For further studies, researchers should attempt to use daily, monthly basis data and some other associated variables.

## 6. REFERENCES

[1] Ahmed, R. (2014), "How does the Revision of EU's GSP Scheme Influence the Exports of Bangladesh?", Journal of textile and management apparel technology and management, volume 8, issue 4,spring 2014.

[2] Ahmed, S.A. (2013), "Impact of trade liberalization looking at the Economics and political weakly 12".

[3] Akteruzzaman, M. *et al*. (2012), "Exploring prospects of the clothing and textile industry: is

Bangladesh in a right growth strategy?", World Journal of social sciences, volume 2(4),pp: 150-161.

[4] Bangladesh - Trade - European Commission from www. europa.eu / trade on 20.10.2013.

[5] Dickey, D. and W. Fuller (1981). "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root," Econometrica, 49, 1057-1072.

[6] Engle, R.F., Granger, C.W.J., 1987. Cointegration and error correction: representation, estimation, and testing. Econometrica 55, 251–276.

[7] EPB, Compiled by: RDTI Cell, BGMEA from BGMEA B2B Web portal http://bgmea.com.bd on 01.08.2015.

[8] Greene, W.H. (2002), Econometric Analysis, fifth edition, prentice Hall, New Jersey.

[9] Islam, R.M. *et al.* (2014), "Impact of EU GSP Facilities on Export Growth of Bangladesh: Especially On Readymade Garments Industry", IJSER, Research volume 3, Issue 9, September-2014: ISSN 2277-8616.

[10] Johansen, S., and K. Juselius (1990) "Maximum Likelihood Estimation and Inference on Cointegration – With Applications to the Demand for Money", Oxford Bulletin of Economics and Statistics, 52, 2, 169—210.

[11] Mostafa *et al.* (2015), "Revised GSP Scheme of European Union: Implications for Bangladesh", Bangladesh Foreign Trade Institute (BFTI), Working Paper, August 1, 2015.

[12] Phillips, P.C. and P. Perron, (1988) "Testing for a unit root in time series regression", Biometrica, 75(2): 335-346

[13] Rahman, M. P. (2011) —Trade Benefits for Least Developed Countries: The Bangladesh Case, Centre for Policy Dialogue (CPD), May, 2011.

[14] Taslim, M. A. *et al.* (2011). "Export Performances of Bangladesh global Recession and after International growth center", working paper 11/0887, November-2011.



# Appendix

**Table 1(a): Results of the Unit Root Test by using ADF Test**

| Series | Considering Constant | | | Considering Constant and Linear Trend | |
|---|---|---|---|---|---|
| | Level/Difference | t-statistic | Critical values (0.05) | t-statistic | Critical values (0.05) |
| Log(export under GSP) | Level | -0.2766 | -4.4983 | -1.9029 | -4.4983 |
| | First Difference | -4.9057 | -4.5326 | -4.7632 | -4.5326 |
| Log(RMG Export) | Level | -0.1556 | -3.6584 | -1.9133 | -3.6584 |
| | First Difference | -4.7198 | -3.6736 | -4.7584 | -3.6736 |
| Log(Production) | Level | -0.1094 | -3.2689 | -1.8345 | -3.2689 |
| | First Difference | -4.7636 | -3.2774 | -4.8220 | -3.2774 |

**Table 1(b): Results of the Unit Root Test by using P-P Test**

| Series | Considering Constant | | | Considering Constant and Linear Trend | |
|---|---|---|---|---|---|
| | Level/Difference | Adjusted t-statistic | Critical values (0.05) | Adjusted t-statistic | Critical values (0.05) |
| Log(export under GSP) | Level | -1.8984 | -4.4983 | -1.9029 | -4.4983 |
| | First Difference | -4.9057 | -4.5326 | -4.7632 | -4.5326 |
| Log(RMG Export) | Level | -0.2286 | -3.6584 | -1.9133 | -3.6584 |
| | First Difference | -4.9077 | -3.6736 | -4.7584 | -3.6736 |
| Log(Production) | Level | -0.1967 | -3.2689 | -1.8345 | -3.2689 |
| | First Difference | -4.7636 | -3.2774 | -4.8220 | -3.2774 |

**Table 2: Results of Lag selection by using different criterions**

| Lag | Akaike information criterion | Schwarz information criterion | Hannan-Quinn information criterion |
|---|---|---|---|
| 0 | -10.3276 | -10.1789 | -10.2926 |
| 1 | -14.1634* | -13.5683* | -13.0233 |
| 2 | -14.0053 | -12.9639 | -14.7600* |
| 3 | -13.7252 | -12.2374 | -13.3747 |

**Table 3(a): Results of Johansen co-integration by using maximum Eigen value test.**

| Null | Alternative | Max-Eigen statistic | Critical value(0.05) | P-value |
|---|---|---|---|---|
| $H_0$: r=0 | $H_0$: r>0 | 38.9743 | 21.1316 | 0.0001 |
| $H_0$: r≤ 1 | $H_0$: r>1 | 8.2483 | 14.2646 | 0.3540 |
| $H_0$: r≤ 2 | $H_0$: r>2 | 0.0033 | 3.8416 | 0.9519 |

**Table 3(b): Results of Johansen co-integration by using Trace test.**

| Null | Alternative | Trace statistic | Critical value(0.05) | P- value |
|---|---|---|---|---|
| $H_0$: r=0 | $H_0$: r=1 | 47.2260 | 29.7970 | 0.0002 |
| $H_0$: r=1 | $H_0$: r=2 | 8.2577 | 15.4947 | 0.4389 |
| $H_0$: r=2 | $H_0$: r=3 | 0.0033 | 3.8414 | 0.9519 |

**Table 4: Outputs of the Normalized Cointegrations**

| Coefficients | Cointegrating Equation(Standard errors) |
|---|---|
| Log(RMG Export) | 1.000 |
| Log(export under GSP) | 0.1021 (0.034) |
| Log(Production) | 0.8434(0.047) |

**Table 5: Outputs of the Vector Error Correction Model**

| Coefficients | $\Delta LexpRMG_t$ | $\Delta LexpGSP_t$ | $\Delta Lproduc_t$ |
|---|---|---|---|
| Error correction term $_{t-1}$ | -0.1031<br>(0.0561)<br>[0.0321] | -0.0921<br>(0.0453)<br>[0.0211] | -0.1177<br>(0.0590)<br>[0.0307] |
| $\Delta Log\ export\ GSP_{t-1}$ | 0.4823<br>(0.0334)<br>[0.0112] | 0.4446<br>(0.0311)<br>[0.0111] | 0.5136<br>(0.0456)<br>[0.0413] |
| $\Delta Log\ production_{t-1}$ | 0.3057<br>(0.0211)<br>[0.0119] | -0.2856<br>(0.0199)<br>[0.0107] | 0.3765<br>(0.0279)<br>[0.0291] |
| $\Delta Log\ export\ RMG_{t-1}$ | 0.1132<br>(0.0451)<br>[0.0342] | -0.0934<br>(0.0367)<br>[0.0311] | 0.1453<br>(0.0581)<br>[0.0456] |
| Constant | 0.0102<br>(0.0231)<br>[0.0016] | 0.0101<br>(0.0202)<br>[0.0010] | 0.0152<br>(0.0237)<br>[0.0021] |
| Notes: standard errors and p- values are given in () and [ ] parentheses respectively | | | |

## Table 6: Results of pair wise Granger Causality Test

| Null Hypothesis | F-test value | p-value | Decision |
|---|---|---|---|
| ΔProduction does not Granger cause ΔRMG | 5.1770 | 0.0955 | Accepted |
| ΔRMG does not Granger cause ΔProduction | 5.6998 | 0.0316* | Rejected |
| ΔGSP does not Granger cause ΔRMG | 5.3619 | 0.0213* | Rejected |
| ΔRMG does not Granger cause ΔGSP | 5.9398 | 0.1743 | Accepted |
| ΔGSP does not Granger cause ΔProduction | 8.0141 | 0.0103* | Rejected |
| ΔProduction does not Granger cause ΔGSP | 6.2326 | 0.1214 | Accepted |