The Effect of Exchange Rate Volatility on Exports of Selected Industries of India

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Abstract

This study examined the impact of exchange rate volatility on gems & jewellery and textile exports of India from 1993M4 to 2013M3. Using auto-regressive distributive lag (ARDL) co-integration technique, it found that exchange rate volatility did not have any impact on gems and jewellery as well as on textile exports in the long run. The findings of our study suggested that a stable exchange rate may not guarantee the promotion of gems and jewellery and textile exports from India ; other factors are also important, which need to be investigated.

Keywords: **ARDL , exchange rate volatility, exports, gems and jewellery, India, textile**

JEL Classification : C29, F14, F31

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After the collapse of the Brettonwood system, most of the countries adopted floating exchange rate which resulted in variation of both the real and nominal exchange rates. During this period, India adopted a single currency peg, then a basket peg, and at the end, a market determined exchange rate regime (in the nineties). In 1990-91, due to the Balance of Payments (BoP) crisis, a two step (9% and 11%) downward exchange rate adjustment was made to reduce the foreign exchange deficit. Further, to move towards the market determined exchange rate system, the Liberalized Exchange Rate Management System (LERMS) was introduced after the recommendations of Rangarajan Committee in March 1992. The dual exchange rate system was changed to a unified one in March 1993, which marked the beginning of the market determined exchange rate system in the country. This might have caused the exchange rate to be volatile. The volatility in the exchange rate is unavoidable as the country is more integrated with the rest of the world. Volatility in exchange rate often has unfavourable effects on international trade and especially on exports (Arize, 1995).

The aggregate and bilateral trade data may not reveal the true relationship between exchange rate volatility and trade flows. However, the sector or industry specific trade data can reflect the impact of exchange rate volatility on trade flows better. Sectoral trade data would help further to unravel the linkages between exchange rate volatility and trade flows (Caglayan & Di, 2010). It also helps us in examining whether the significant impact of exchange rate volatility on trade is due to data aggregation or not. In a managed float regime, the knowledge of the sensitivity of different sectors is useful for intervention (in order to maximize the gain).

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In this paper, an attempt has been made to examine these aspects. In order to identify the sensitive sectors, it is required to analyze the composition of exports. Gems and jewelery constituted around 13.14% and textile & textile products 10.07% of the total basket of India's merchandise exports for the year 2013-14 (Database on the Indian Economy, RBI). Thus, they together share more than 20% of the values of export. In this study, these two sectors are included.

Review of Literature

A review of the studies relating the effect of exchange rate volatility on exports of some specific industries was

Table 1. Industry Studies on the Effects of Exchange Rate Volatility

Author	Country	Industries	Time period	Methodology	Results
Thorbecke (2008)	East Asia	Intra-industry trade in East Asia	1985 to 2005	Panel dynamic ordinary least squares (DOLS) estimation	Exchange rate volatility decreased the export flow of electronic components within East Asia.
Bahmani-Oskooee & Hegerty (2009)	Mexico	102 industries (Mexican trade with the United States)	1962 to 2004	ARDL bounds-testing approach	Affected majority of the industries in the short-run, though in the long run, it reduced to one-third of the industries.
Bahmani-Oskooee, Ardalani, & Bolhasani (2010)	U.S.	66 American industries	January 1991 to December 2007	Bounds-testing approach to co-integration and error correction modelling	Significantly affected the trade flows of most industries in the short-run, but the short-run effects did not last in the long run in majority of industries.
Bahmani-Oskooee & Harvey (2011)	U.S.	101 U.S. exporting industries and 17 importing industries	1971 to 2006	Bounds testing approach	Exchange rate volatility had significant short-run effects on the trade flows of approximately 2/3rd of the industries, whereas short-run effects turned into the long run in a limited number of small industries (38 U.S. exporting industries and in 10 U.S. importing industries) only.
Bahmani-Oskooee & Satawatananon (2012)	U.S.	118 US exporting industries to Thailand and 41 US importing industries from Thailand	1971-2006	Bounds testing approach to co-integration and error-correction modelling	Exchange rate uncertainty had short-run effects on the trade flows of the majority industries. In the long-run, the major grounds for the trade flows were the level of economic activity in both countries.
Jantarakolica & Chalermsook (2012)	Thailand	9 products in textile and garment sector	first quarter 2000 to first quarter 2011	Panel data models with fixed effects and random effects models.	Exchange rate volatility significantly affected Thai's exports of textile and garment products.
Bahmani-Oskooee, Harvey, & Hegerty (2014)	U.S.	131 U.S. export industries and 88 import industries	1962 to 2009	ARDL bounds-testing approach	Thirty five (35) out of the 74 U.S. export industries were affected (11 positively, 24 negatively). There was some evidence that smaller industries would be more likely to react positively to exchange rate volatility.
Bahmani-Oskooee, Hegerty, & Hosny (2015)	Egypt	Egypt's trade with the European Union for 59 industries' export and import flows	1994:I to 2007:IV	Co-integration analysis	Large industries were more sensitive to risk than the small ones; non-manufacturers were susceptible to increased risk (particularly the Egyptian exports).

attempted for finding the research gap and also to compare the situations of India's export industries with the rest of the world.

A number of studies found significant effect of exchange rate volatility on majority of the industries in the short run but low effect in the long run. These studies took different country's cases and adopted different tools to examine the effect of exchange rate change on export - import of different industries. The details of these studies are given in the Table 1.

The following points are observed from these studies :

(i) These studies examined the effect of uncertainty (arising out of exchange rate volatility, ERV) on a number of industries in different countries using tools like co-integration (ARDL bounds-testing approach), panel data models, etc. They revealed that there was substantial effect in the short run but modest effect in the long run (Bahmani-Oskooee & Hegerty, 2009 ; Bahmani-Oskooee & Harvey, 2011).

(ii) Approximately 30% of the (export and import) industries were adversely affected by ERV. Of these two types, the percentage of export industries was higher than the import substitutes.

(iii) Large industries were more sensitive to risk than the small ones as large volume involved more loss. Some small industries of both types experienced positive impact of ERV (Bahmani - Oskooee et al., 2014).

(iv) The nature of export industry and the composition of export basket had influenced the degree of shock on it.

(v) In the long-run, the trade flows were affected by the level of economic activity of the trading countries (Bahmani - Oskooee & Satawatananon, 2012).

↳ **Studies on India :** A few studies are found in this regard taking the case of India. Using the two-stage least squares estimation method, Ghosh (1990) examined the impact of exchange rate variability on trade balance in India from 1973-74 to 1985-86. It found that the real exchange rate was not a major factor in determining export growth. Rajaraman (1990) tried to examine the effect of change in the real effective exchange rate (REER) of rupee on its export of garment and apparel to countries like Japan, Australia, and non-quota Economic Co-operation and Development (OECD) countries. It found the sensitivity of India's exports to change in the REER. It also compared China's export of the same products to same countries with those of India and tried to explain the difference in terms of relative exchange rates. It concluded that trade competitiveness reflected through change in exchange rate may bring changes in export/trade. However, this study was based on the data of 1974 to 1987 when change in exchange rate was not frequent and sharp. Dholakia and Saradhi (2000) examined the effect of ERV on Indian imports and exports at an aggregate level by using the reduced form of structural regression model. The study used quarterly data from 1980 to 1996. It found that ERV did not affect exports and imports. Bal (2012) also examined the effects of ERV on India's exports by taking both the monthly and quarterly data (1993 to 2008). First, it used autoregressive conditional heteroscadasticity (ARCH) model to measure the ERV of REER. Then it applied simple ordinary least square (OLS) method to study the impact of ERV on India's exports. It also found no significant relationship between the ERV and export.

Srinivasan and Kalaivani (2012) investigated the impact of ERV on the real exports in India using the ARDL bounds testing procedure taking the annual time series data for the period 1970 to 2011.The study found that the ERV did not have any significant negative impact on real exports both in the short-run and long-run. It also found that the foreign economic activity had a significant negative impact on real exports in the short-run and positive impact on real exports in the long-run. However, it used annual data which hides monthly fluctuations. Cheung and Sengupta (2013) tried to overcome the lacuna of Rajaraman (1990) by taking the floating rate regime period (i.e. 2000-2010). It found that a currency appreciation had a strong and significant negative impact on Indian

firms' export shares in the world market. This study differentiated firms on the basis of their market share; firms with smaller export shares tended to have a stronger response to both REER change and volatility. However, the nature of the good was also important in the context of price elasticity and hence, to exchange rate changes. Goel and Goel (2014) examined that removal of quotas on textiles in India that resulted in increased trade in textiles in 2005. Sahu and Heng (2017) found that real exchange rate played an important role in India's exports to its top trading partners. For the economy, examination of the responsiveness of the important (export) sectors to the above is important from the BoP point of view. Taking these two facts into consideration, our study tries to fill up the gap.

Stylized Facts of Gems & Jewellery and Textile Industry

(1) Gems & Jewellery : The gems & jewellery industry is one of the leading export industries of the Indian economy. The items which are included in the gems & jewellery sector are: diamonds, gold, silver, precious and semi-precious stones, and studded and costume jewellery, etc. It is considered to be the significant earner of foreign exchange for India. This sector is mainly export oriented and constitutes approximately 17% of the total exports. Gems & jewellery exports touched US$ 36.2 million during the year 2014-2015. In India, the gems & jewellery industry is predominantly centered in the unorganized sector. Roughly two million workers earn their livelihood from this sector. It is a labour-intensive as well as an import-intensive industry, and hence, extremely vulnerable to external shocks such as ERV, international commodity prices, and external demand.

The growth rate of gems & jewellery exports (volume) in different periods is presented in the Table 2 which shows the growing importance of this sector as the growth rate increased from 0.72 % (during 1993 to 2000) to 1.70 % (during 2000 to 2007).

This sector experienced a deceleration in growth during the post 2007 period (but growth was positive while some industrial countries experienced negative growth rate during the same period). It experienced an overall growth rate of 1.28 % during the whole period.

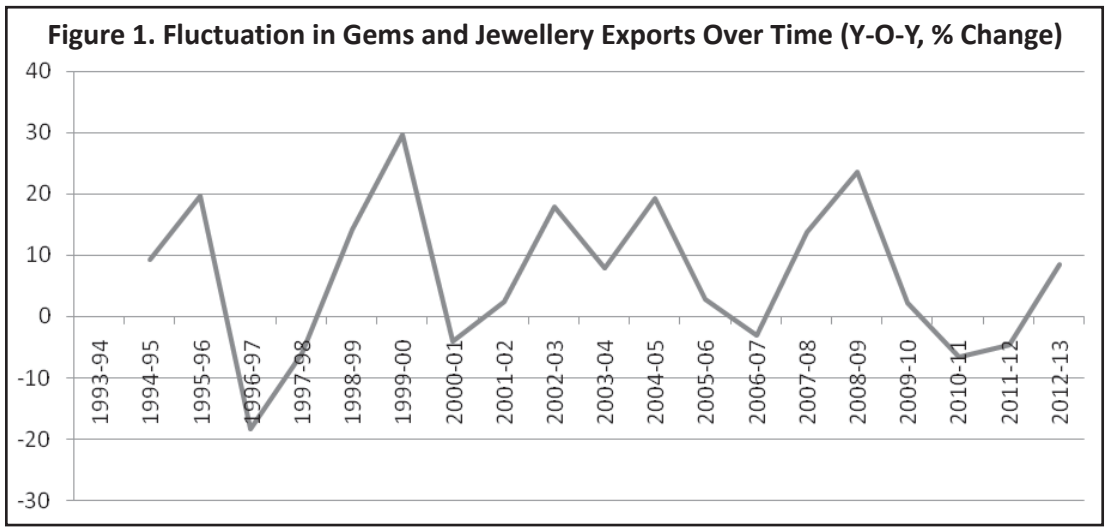
To see the effect of different shocks on the exports in more detail, year-over-year (Y-o-Y) percentage change in exports (volume) of this sector is analyzed and presented in the Figure 1. This shows sharp fluctuations (fall as well as rise) in different years. Sharp decelerations in the Y-o-Y changes are noticed in: 1996-1997, 2000-2001, 2006-2007, 2009-2010, and again in 2011-2012. Similarly, sharp rises are observed in the years 1995-1996, 1999-2000, and 2008-2009. Fall in exports during the year 2000-2001 and 2006-2007 may be attributed to the U.S. market slowdown. There was also a delay in payments from the U.S. and a decrease in the diamond trading activities.

The facility of duty-free treatment under the General Scheme of Preferences (GSP) for precious metals (other than silver) and articles of jewellery enjoyed by Indian exporters was terminated by the USA on July 1, 2007 on the ground that the articles from India were exported in quantities exceeding the applicable competitive need limitation. However, the sector achieved a sharp rise in exports, that is, by 23.60% in 2008-2009 from its earlier

Table 2. Growth Rate of Gems and Jewellery Exports in Different Periods

Year	Growth rate (%)
1993M4-2000M3	0.72
2000M4-2007M3	1.70
2007M4-2013M3	0.24
1993M4-2013M3	1.28

Note : M4 means April (i.e. month four) and M3 means March.



year despite the presence of several odds like high interest rates, appreciating ₹, termination of GSP benefits, and economic slowdown in major export markets. Moreover, fiscal measures such as reduction of import duty on cut and polished diamond (CPD) to 0%, reduction of import duty on unworked (i.e. raw or unpolished) corals and rough synthetic stones from 30% to 10% coupled with various trade facilitation measures undertaken by the Government of India provided a boost to the sector. However, during 2011-2012, change in exports (Y-o-Y) was in negative (- 4.60%), which may be due to the after effects of the Euro-zone crisis.

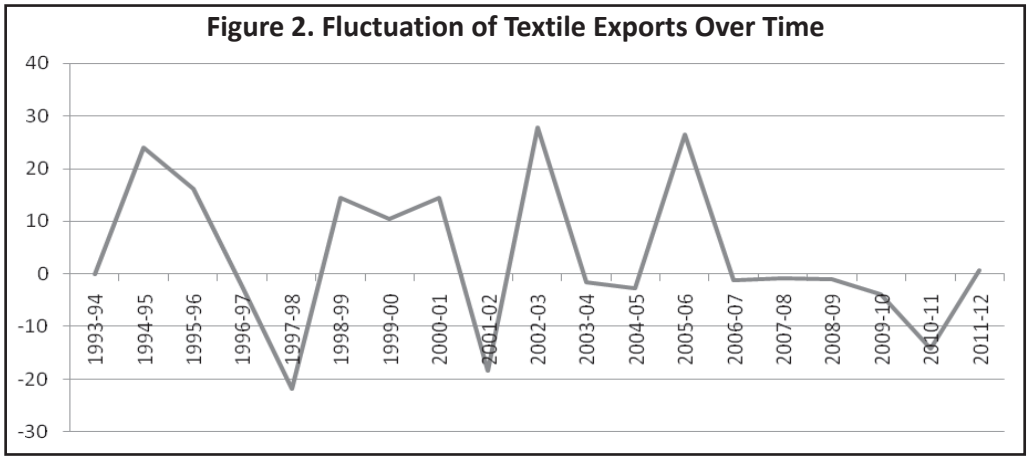
(2) Textile : The textile industry is one of the mainstays of the Indian economy. It has two broad segments. First, the unorganized sector consists of handloom, handicrafts, and sericulture. It is mainly operated through traditional tools and methods. It is small scale in nature. There is also an organized sector in this category comprising of spinning, apparel, and readymade garments. It relates to modern machinery and techniques such as economies of scale. The textile industry contributes around 5% to India's gross domestic product (GDP), and 14% to overall index of industrial production (IIP) which was approximately estimated at US $ 108 billion in the year 2015. It is the biggest employment providing industry and a key foreign exchange earner. This sector is one of the largest contributors to India's exports with 13.6% of total exports for the year 2014-2015. As per the United Nations Commodity Trade Statistics Database (The UN Comtrade, 2013), India was ranked as the 2nd largest textile and clothing exporter in the globe with export value of $40 billion. Textile is one of the promising industries supported by strong domestic as well as export demand. Countries like USA, UAE, China, and UK import textile and apparel from India regularly. A list of its top importers for 2013-2014 is given in the Table A1 (Appendix).

The growth rate of textile exports in different periods of our study is presented in the Table 3 which shows an

Table 3. Growth Rate of Textile Exports in Different Periods

Year	Growth Rate (%)
1993M4-2000M3	0.53
2000M4-2007M3	1.03
2007M4-2012M3	-1.14
1993M4-2012M3	0.55

Note : M4 means April (i.e. month four) and M3 means March.



overall positive growth rate of this sector, although there are variations in the growth rates in the sub-periods. The overall growth rate in the study period is estimated to be 0.55 (refer Table 3). The percentage change (Y-o-Y) of export of this sector from April 1993 to March 2012 is also presented in the Figure 2.

A sharp decline in textile exports (Y-O-Y) is observed in the years 1997-1998, 2001-2002, and 2010-2011. The decline in the year 2001-2002 was mainly due to the (a) slowdown in some of the major importing countries such as U.S., (b) rise in the price of cotton yarn in the domestic market affecting the product prices, (c) the rise of strong competitors like Bangladesh and China who not only improved their efficiency, but also took the advantage of the rise in the prices of Indian textile products. Global meltdown (2006-2007) and Euro zone crisis (2009-2010) further affected the sector through the decline of income of our exporters ; this is shown through the decline in the (y-o-y) percentage change in the export of this sector.

Model Specification

The variability of exports of gems & jewellery and textiles are modeled by taking the exchange rate variability and other related factors. The ₹ - $ exchange rate influences the competitiveness of these sectors through altering the import and export cost. Depreciation helps by raising the export demand for gems & jewellery to some extent, but it also increases the cost of imported raw materials (i.e. precious stones, gold etc.). As raw material cost comprises a considerable part of the production cost of gems and jewellery, the profitability of the sector may depend on the net effect of these two as well as on the income of the foreign buyers of India's products. We have modeled the (long run) export demand function of the gems and jewellery sector which is presented in the following section. In this model, we have not taken the price of imported raw materials because of data constraints.

The standard long-run export demand function of gems and jewellery as specified by Kenen and Rodrik (1986) and Bahmani - Oskooee et al. (2010) is taken as follows :

$$lnexgj_{i,t} = \alpha + \gamma_1 lne_t + \gamma_2 lnev_t + \gamma_3 lny_t + \varepsilon_t \qquad (1)$$

where,
α is the intercept and γ's are coefficients ;
exgj represents gems & jewellery exports from India to the world ;
e represents the exchange rate ;
ev represents the exchange rate volatility ;

y represents foreign income ; and
ε represents the error term.

To incorporate the short - run adjustment process into the estimation procedure, long-run model as shown in equation (1) can be rewritten in an error-correction specification as follows :

$$\Delta ln\ exgi_{j,t} = \alpha_0 + \sum_{i=1}^{p} \delta_i \Delta \ln exgj_{j,t-i} + \sum_{i=1}^{q} \theta_i \Delta ln\ e_{j,t-i} + \sum_{i=1}^{r} \Psi_i \Delta ln\ ev_{j,t-i} + \sum_{i=1}^{s} \phi_i \Delta ln\ y_{j,t-i} + \gamma_1 ln\ exgj_{j,t-1} + \gamma_2 ln\ e_{j,t-1} + \gamma_3 ln\ ev_{j,t-1} + \gamma_4 ln\ y_{j,t-1} + \varepsilon_t \quad (2)$$

where, t is the time dimension, Δ is the first difference operator, α_0 is the intercept, δ_i , θ_i , Ψ_i , ϕ_i , and γ's are coefficients, and ε_t is the white noise error term. The other variables are same as in equation (1).

The specification summarized in equation (2) is due to Pesaran, Shin, and Smith (2001). As in case of gems and jewellery, here in textile sector also we have taken the standard long-run export demand function as specified in Kenen and Rodrik (1986) and Bahmani-Oskooee et al. (2010) as follows :

$$ln\ ext_{i,t} = \alpha + \gamma_1 ln\ e_t + \gamma_2 ln\ ev_t + \gamma_3 ln\ y_t + \varepsilon_t \quad (3)$$

where,
ext represents textile exports from India to the world;
Rest of the terms are same as in equation (1).

We take the natural logarithm of each variable in both models as it retains the elasticities of the variables by their associated coefficients.

The depreciation of the real exchange rate results in an increase in gems & jewellery and textile exports. So, the expected sign of γ_1 is positive (i.e. $\gamma_1 > 0$). The exchange rate volatility may have a positive or negative effect on exports. So, the expected sign of γ_2 is ambiguous ($\gamma_2 > 0$ or $\gamma_2 < 0$). The sign and size of γ_2 is the principal focus in these investigations. The increase in world income is expected to increase exports. So, the expected sign of γ_3 is positive (i.e. $\gamma_3 > 0$).

To incorporate the short-run adjustment process into the estimation procedure, long-run model as stated in equation (3) is rewritten in an error-correction specification of Pesaran et al. (2001) for textiles as follows :

$$\Delta ln\ ext_{j,t} = \alpha_0 + \sum_{i=1}^{p} \delta_i \Delta ln\ ext_{j,t-i} + \sum_{i=1}^{q} \theta_i \Delta ln\ e_{j,t-i} + \sum_{i=1}^{r} \Psi_i \Delta ln\ ev_{j,t-i} + \sum_{i=1}^{s} \phi_i \Delta ln\ y_{j,t-i} + \gamma_1 ln\ ext_{j,t-1} + \gamma_2 ln\ e_{j,t-1} + \gamma_3 ln\ ev_{j,t-1} + \gamma_4 ln\ y_{j,t-1} + \varepsilon_t \quad (4)$$

Data and Methodology

The study uses monthly data for the stated variables from April 1993 to March 2013 for gems & jewellery exports. To know the effect of global financial crisis (if any), the analysis is done not only for the whole period, but also for the period of pre-crisis (1993M4 to 2007M6 ; here, M4 means April and M6 means June). Analysis of the post crisis period is avoided here as it is difficult to know the point of time when the effect of the crisis was felt effectively. The results of the two periods are analyzed for comparison.

The data of gems & jewellery exports *(exgj)* is the volume of gems & jewellery exports at time *t*. It is calculated as the total value of gems & jewellery exports expressed in U.S. Dollar deflated by unit value of exports. The value of gems & jewellery exports at time *t* is available in terms of ₹ value. We have converted it to the U.S. $ by dividing it by the rupee dollar exchange rate. Following Bahmani - Oskooee and Ardalani (2006), we estimated

the prices of gems & jewellery exports by dividing the export values of the same by India's export unit value as the monthly prices of gems & jewellery exports were not available.

Foreign income is calculated as the weighted averages of IIP of the four major trading (exports) partners of India with respect to gems & jewellery. These trading partners are: United States of America, United Arab Emirates (UAE), Belgium, and Japan. For UAE, we have used crude petroleum production instead of IIP as the data of the same is not available. India's gems & jewellery exports to these countries constitute 61.77 % of the total exports of this sector for our study period. REER is used as the exchange rate in the model. The 36-Currency Trade Based Weights (Base: 2004 - 2005 =100) were used in the study. The REER series from April 1993 to May 2004 was available with the base year 1993-1994 (April - March 1993-1994 = 100). And the same series from April 2004 to March 2013 is available with the base year 2004 - 05(April - March) = 100. We converted all the REER series which have the base year 2004-05 by the chaining method. This index is constructed based on bilateral trade weights. The number of countries considered to construct the weights is 36. A number of developing countries were taken into consideration along with most developed countries. ERV was computed using the generalized autoregressive conditional heteroskedasticity (GARCH) method.

For textile exports, the study uses monthly data from April 1993 to March 2012. The data of textile exports *(ext)* is the volume of textile exports at time *t.* It is calculated as the total value of textile exports expressed in U.S. dollar deflated by unit value of exports. The value of textile exports at time *t* is available in terms of ₹ value. We have converted it to the US $ by dividing it by the rupee dollar exchange rate. In the absence of monthly prices of textile exports in this case also, following Bahmani - Oskooee and Ardalani (2006), we deflate textile exports value by India's export unit value. The exchange rate *(e)* and exchange rate volatility *(ev)* are defined as earlier. Foreign income is calculated as the weighted averages of IIP of the 10 major trading (exports) partners of India with respect to textile. These trading partners are as follows: USA, UAE, UK, Bangladesh, Germany, France, Italy, Spain, Turkey, and Netherlands.

The data of gems & jewellery and textile exports were compiled from Indiastat database. The data of foreign income were compiled from the IFS CD-ROM 2014. Exchange rate was compiled from the database of Indian economy, RBI. All series were seasonally adjusted with the X-12 autoregressive integrated moving average (ARIMA) procedure as was adopted by Nishimura and Hirayama (2013). They are then transformed by taking natural logarithms.

Empirical Analysis and Results

The summary statistics of the studied variables of gems and jewellery and textile industry are given in the Table 4.We can see from the Table 4 that the probability of the Jarque-Bera statistics are exceptionally low. It is followed that exports of gems and jewellery and textile industry, exchange rate, exchange rate volatility, and foreign income were distributed normally. The trends in various variables are presented in the Figure 3.

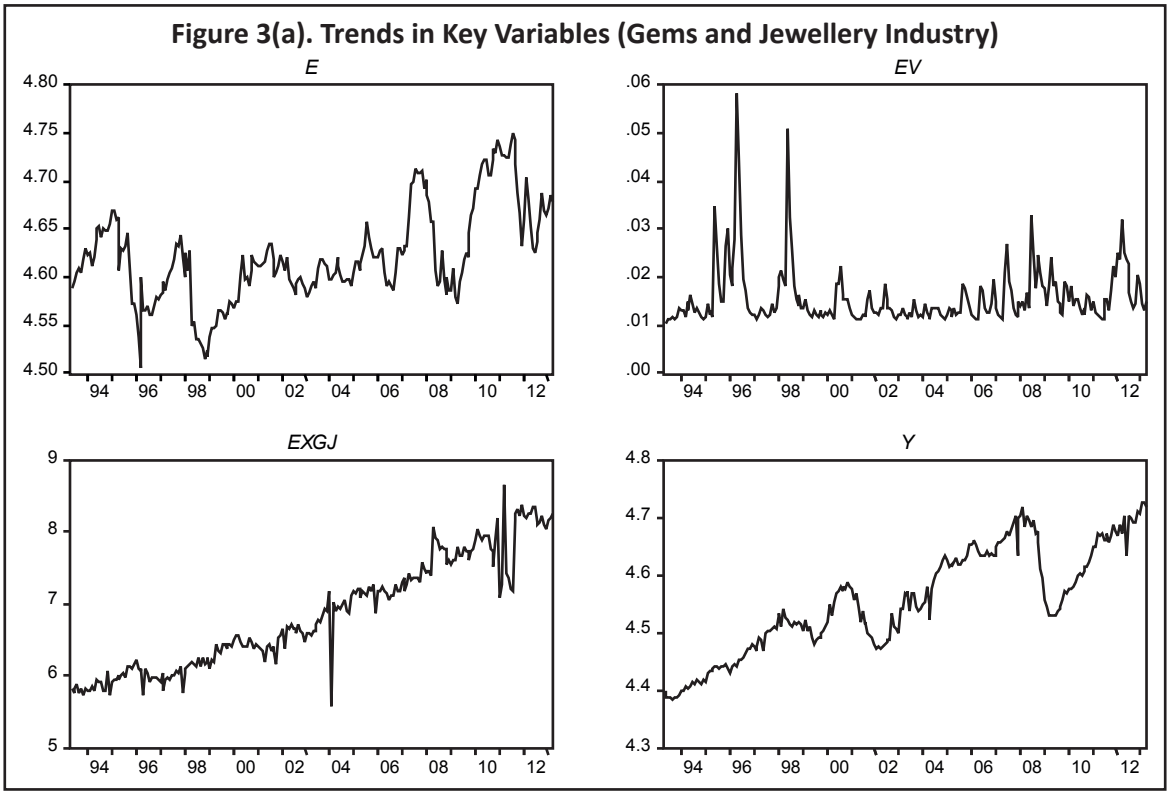
(1) Unit Root Test : We use the Augmented Dickey Fuller (ADF) test to verify the unit root in all variables and to establish the order of integration. The result of the unit root test is given in the Table 5. From the Table 5, it is seen that for gems and jewellery industry, the variables *exgj, ev,* and *y* are stationary at level, and *e* is stationary at first difference. For textile industry, it is seen that the variable *ev* is stationary at level and *ext, e,* and *y* are stationary at first difference. This allows us to proceed with the ARDL model.

(2) Bounds *F* - Test for Co-integration : The result of ARDL Bounds *F*-test for co-integration relationship based on equation (2) and (4) is given in Table 6. The lag length was selected based on the Akaike Information Criterion (AIC).

Table 4. Descriptive Statistics of Key Variables

	Gems and Jewellery Industry				Textile Industry			
	exgj	***E***	***ev***	***y***	***ext***	***e***	***ev***	***y***
Mean	6.846251	4.622171	0.015713	4.557080	5.907514	4.620214	0.015605	4.542230
Median	6.669558	4.615198	0.013631	4.549756	5.805848	4.612101	0.013472	4.555488
Maximum	8.638518	4.749475	0.058361	4.727168	6.756907	4.749475	0.058361	4.698082
Minimum	5.590870	4.505130	0.010240	4.384442	4.809866	4.505130	0.010240	4.321149
Std. Dev.	0.770054	0.049538	0.006055	0.090541	0.494246	0.049869	0.006122	0.095063
Skewness	0.350954	0.507292	3.371505	-0.021942	0.029329	0.602234	3.452209	-0.508078
Kurtosis	1.940891	3.050146	18.95927	1.976605	1.804380	3.169910	19.29752	2.469495
Jarque-Bera	16.07660	10.27594	2989.159	10.44891	13.55330	13.99468	2963.109	12.42834
Probability	0.000323	0.005870	0.000000	0.005383	0.001140	0.000914	0.000000	0.002001
Sum	1636.254	1104.699	3.755293	1089.142	1341.006	1048.789	3.542346	1031.086
Sum Sq. Dev.	141.1298	0.584051	0.008725	1.951066	55.20699	0.562054	0.008470	2.042353
Observations	239	239	239	239	227	227	227	227

Figure 3(a). Trends in Key Variables (Gems and Jewellery Industry)



The computed *F* - statistics of gems and jewellery industry are less than the lower bound critical value of 3.23 at the 5 % level of significance for both the pre-financial crisis period (computed value is 1.31) and the whole period (computed value is 1.61). Thus, the null hypothesis of no co-integration cannot be rejected. This implies that there is no stable long-run co-integration among the variables, that is, *exgj, e, ev,* and *y* for both the periods. This is true for both the whole period as well as the pre-crisis period.

Figure 3(b). Trends in Key Variables (Textile Industry)

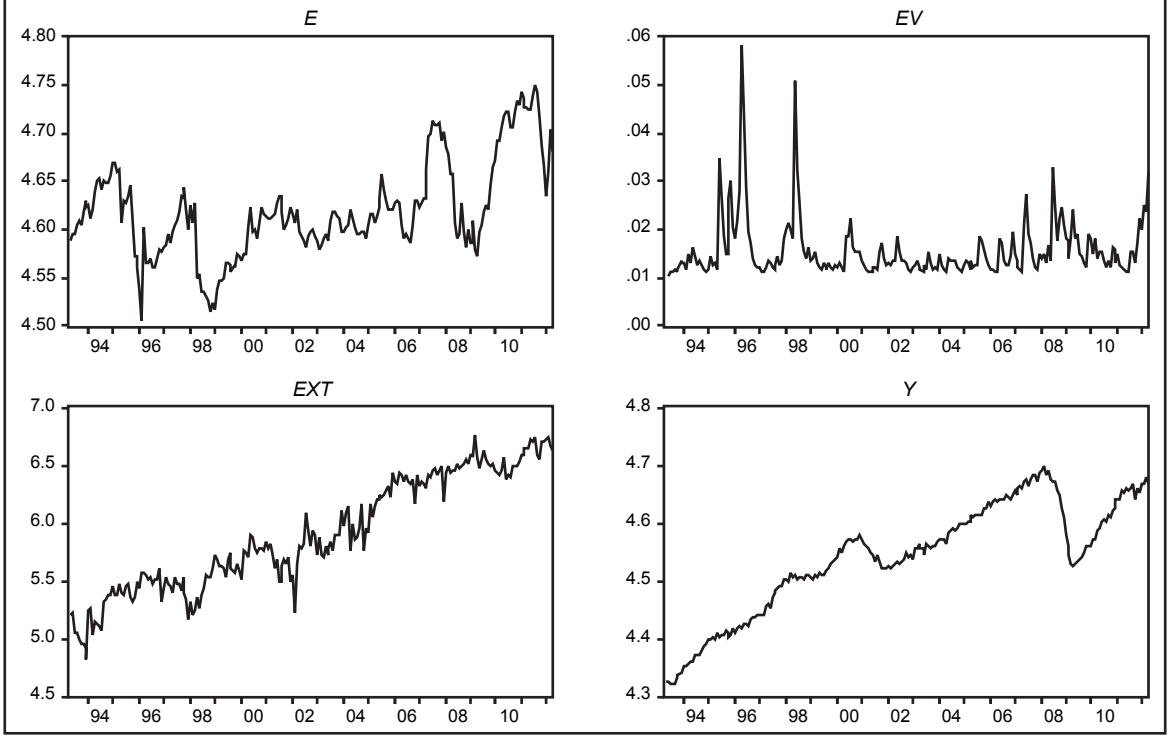


Table 5. Augmented Dickey-Fuller (ADF) Test

Variable	Gems and Jewellery Industry		Textile Industry	
	I(0) Level	*I*(1) First Difference	*I*(0) Level	*I*(1) First Difference
	(Constant with trend)	(Constant without trend)	(Constant with trend)	(Constant without trend)
Exgj/ext	-3.85*	-12.51*	2.978321	-6.024651*
e	-3.21	-6.15*	-3.008089	-5.821797*
ev	-6.91*	-11.45*	-6.478235*	-11.11291*
y	-3.55*	-5.07*	-3.255672	-4.257528*

Note: Lag length is based on AIC, maxlag = 14 (each test at 5% significance level), *Significant at 5% significance level.

Table 6. Results of Bounds Test

	Computed *F* - statistics	
	Gems and jewellery Industry	Textile Industry
Pre-financial crisis period	1.31	2.77
The whole period	1.61	1.74

Notes: The bounds critical values are 3.23-4.35 (lower bound-upper bound) at 5% significance level which are obtained from Pesaran et al. (2001), p. 300, Table: CI (iii) Case III: Unrestricted intercept and no trend (*k* =3).

In the case of textile industry also, similar results are obtained: the computed *F*-statistics are less than the lower bound critical value of 3.23 at the 5% significant level for the pre-crisis period (computed value is 2.77) and for

Figure 4. CUSUM and CUSUM of Squares Test

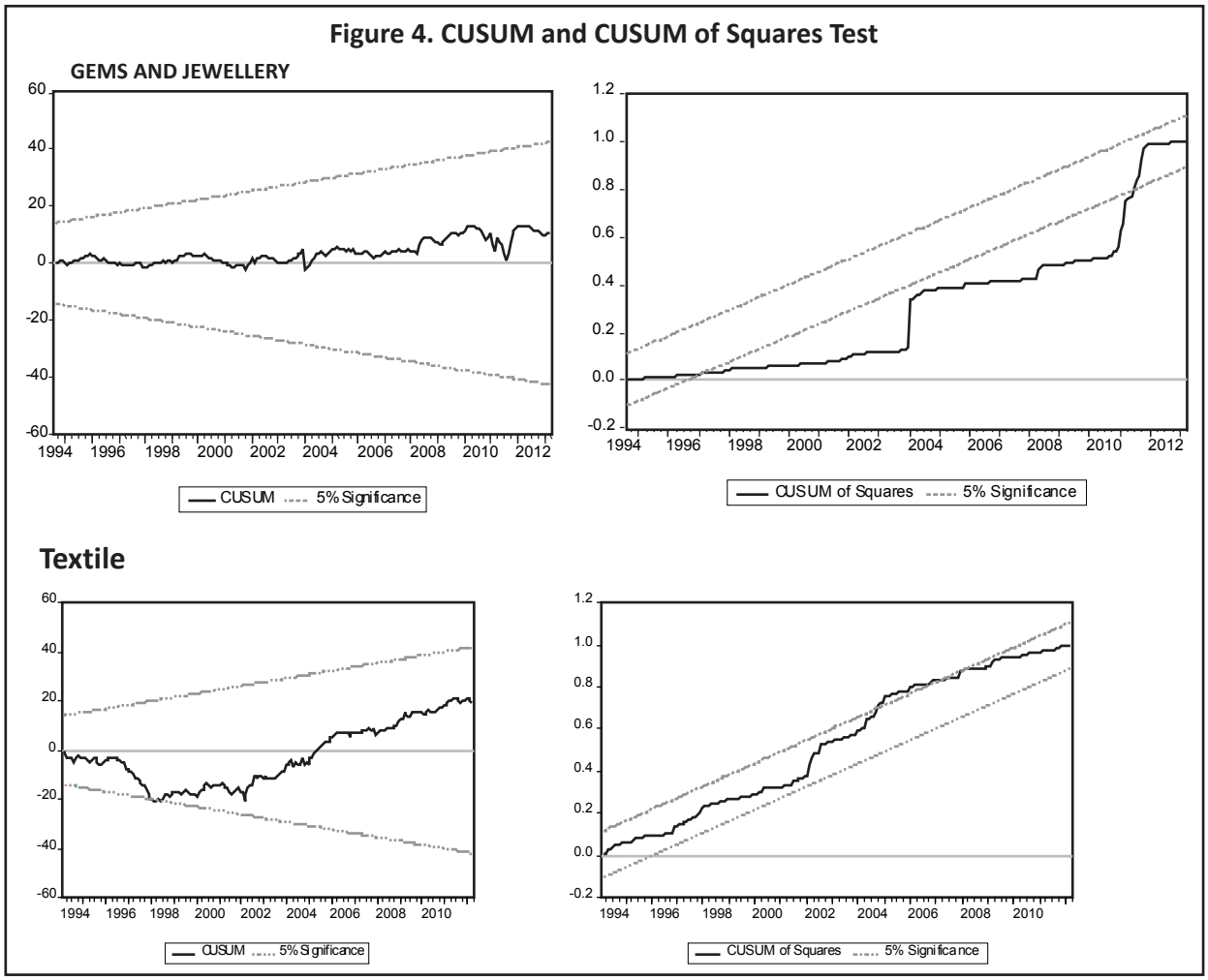


Table 7. Breusch - Godfrey Serial Correlation LM Test

	Gems and Jewellery Industry	Textile Industry
F-statistic	0.318125	0.475169
Prob. *F*(2,222)	0.7278	Prob.*F* (2,216) 0.6224
Obs**R*-squared	0.671582	0.985599
Prob. Chi-Square(2)	0.7148	0.6109

the whole period (computed value 1.74) . Thus, here also the null hypothesis of no co-integration cannot be rejected. Hence, similar conclusions are derived (refer Table 6 for details).

(3) Diagnostic and Stability of the ARDL Process

(i) Serial Correlation LM Test : We try to test whether there exists any serial correlation or not by employing Breusch-Godfrey Serial Correlation LM Test. It is given in the Table 7. Serial correlation does not exist in any of the two cases as the probability chi-square is 0.7148 in case of gems and jewellery industry, and 0.6109 in case of textile industry.

Table 8. Heteroskedasticity Test : Breusch-Pagan-Godfrey

	Gems and jewellery Industry		Textile Industry
F-statistic	1.658528		1.755611
Prob. *F* (10,224)	0.918	Prob. *F* (10,218)	0.1095
Observed R-squared	16.20025		10.37079
Prob. Chi-Square(10)	0.0940	Prob. Chi-Square(6)	0.1099

Table 9. Short Run Dynamics : Pre Financial Crisis (April 1993 - June 2007)

Gems and Jewellery Industry			Textile Industry		
Variable	**Co-efficient**	**Probability**	**Variable**	**Co-efficient**	**Probability**
d(exgj(-1))	-0.767196	0.0000	*d(ext(-1))*	-0.289894	0.0001
d(exgj(-2))	-0.432770	0.0000			
d(exgj(-3))	-0.185573	0.0211			
d(e)	0.804830	0.2778	*d(e)*	-0.098160	0.8517
d(ev)	-5.420973	0.0187	*d(ev)*	-0.902326	0.5729
d(y)	0.208073	0.8337	*d(y)*	3.194052	0.0136
Coint Eq(-1)	-0.080963	0.0107	CointEq(-1)	0.192473	0.0004

(ii) Heteroskedasticity Test : We also test the heteroskedasticity of Breusch-Pagan-Godfrey. The results are given in the Table 8. Here, for gems and jewellery industry, the Prob. of Chi-Square (10) value is 9.40% which is desirable. For the textile industry, the Prob. Chi-Square (6) value is 10.99%. So, we accept the null hypothesis that the models are homoskedastic (refer Table 8 for details).

Finally, we examine the stability of the models by using the cumulative sum (CUSUM) plots (see Figure 4). The CUSUM test (Brown, Durbin & Evans, 1975) is established on the cumulative sum of the recursive residuals. Here, the export demand functions are stable during the study period as the CUSUM does not lie outside the area between the two critical lines in both gems & jewellery and textile cases, that is, all the estimated coefficients are placed within the bands (at the 5% level of significance). However, CUSUM of squares reveals that it is unstable.

(iii) Short - Run Dynamics : As we have seen that there is no long-run relationship among the variables, we studied the short run behaviours through the error correction model (ECM). For this, we have taken both the pre-crisis and the whole period.

[i] Pre Financial Crisis Period (April 1993 - June 2007) : The error correction representation of ARDL selected for gems and jewellery is (4, 0, 1, 0) model and for textile it is (2, 0, 0, 1) model. The results are presented in the Table 9 which shows that error correction term (ECT) in both cases are negative and significant as the corresponding probability values in both cases are less than 5% (i.e. 1.07% in case of gems & jewellery and 0.04% in case of textile). It is also found that 8% of the disequilibrium in real exports of gems & jewellery from the previous period's shock are converged back to the long-run equilibrium in the current period. The same is 19% in case of textile.

Among the factors that significantly affect export demand functions in the short run are as follows :

- Exchange rate neither affects export of gems & jewellery nor of textile ;
- Exchange rate volatility significantly affects exports of gems &jewellery but not the textile exports ;
- Foreign income significantly affects the textile exports but not the gems & jewellery sector ; and

Table 10. Short Run Dynamics (The Whole Period)

Variable	Gems and Jewellery Industry		Textile Industry		
	Co-efficient	Probability	Variable	Co-efficient	Probability
d(exgj(-1))	-0.661519	0.0000	*d(ext(-1))*	-0.446156	0.0000
d(exgj(-2))	-0.553617	0.0000	*d(ext(-2))*	-0.226846	0.0005
d(exgj(-3))	-0.326388	0.0000			
d(exgj(-4)	-0.205822	0.0015			
d(e)	-1.098647	0.1648		-0.339872	0.04145
d(e(-1))	-1.651583	0.0370			
d(ev)	-4.058637	0.1216		-0.245177	0.8561
d(y)	1.269803	0.1283		1.037113	0.2228
CointEq(-1)	-0.055025	0.0053		-0.062455	0.0073

Note: Gems and Jewellery: April 1993 - March, 2013; Textiles: April 1993 - March, 2012)

↳ Lagged values of exports of gems & jewellery (three) and textile (one) are also found to significantly affect export demands.

[ii] The Whole Period : The error correction representation of ARDL selected for gems & jewellery is (5, 2, 0, 0) model and for textile it is (3, 0, 0, 0) model. The results are presented in the Table 10 which shows that error correction term (ECT) is - 0.055025 for gems & jewellery and -0.062455 for textile. The corresponding probabilities of both are less than 5%. This implies that models are significant and variables have significant short-run relationships among them. Among the factors that significantly affect export demand functions in the short run are as follows :

↳ In the short run, exports of gems & jewellery are significantly affected by the (a) lagged values of exports and (b) lagged values of exchange rate only. Other variables like foreign income, exchange rate, and exchange rate volatility are not found as significant determinants.

↳ In case export of textiles, factors significantly affecting the exports are the (a) lagged values of exports and (b) exchange rate. Other variables like foreign income, and exchange rate volatility are not affecting significantly the export of textiles in the short run.

Conclusion and Policy Implications

Our results indicate that demands for our two important export items (gems & jewellery and textile) have no long run relationship with the most expected variables like exchange rate, exchange rate volatility, and foreign income. This implies that some other variables such as taste & preferences of consumer, government policy providing incentives, etc.) may be important determinants. So, further studies are required to confirm this.

The short run analyses of two periods indicate that in both cases, the lagged values of the exports are found as one of the significant determinants ; other variables are foreign income, exchange rate, lagged value of exchange rate, and exchange rate volatility. However, each of these other variables is a significant determinant for only one case. Lagged values of the exports as the determinant in all cases of our short run analysis indicate the continued export of these items irrespective of the shocks/changes experienced in their expected variables; this may be due to producers' decision of not losing the market or foreigners' strong preference for our products or both. However,

whatever be the case, it has a positive implication for policy makers, that is, incentive to the exporters of both these products is likely to promote export and bring more export earnings to the country, which will help the growth of the sectors. The findings of our study thus, suggest that only a stable exchange rate could not be an effective policy instrument for promoting gems & jewellery and textile exports from India. Other factors are also important, which need to be investigated. Similar conclusions were also drawn by Sarkar (1995), Ghosh (1990), Dholakia and Saradhi (2000), Bal (2012), though they differ in (a) period of study and (b) methodology. However, Srinivasan and Kalaivani's (2012) findings differ from our study. They found a significant negative effect of ERV on exports.

Limitations of the Study and Scope for Further Research

The study used India's export unit value as the proxy for the prices of gems & jewellery and textile exports for the estimation of volume of exports of these items. However, a number of studies have also used the same owing to data constraints. This study may stimulate researchers to examine the firm-specific impacts of exchange rate volatility of these two industries where firm's asymmetric risk taking response can be modelled with non-linear equations. This will throw more light on the issue. Thus, nonlinear causality test of the export functions provide scope for future research in this field.

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Table A1. India's Top 10 Export Markets of Textile and Apparel Products for 2013-14

S. No.	Countries	Exports (US $ Million)	% share
1	USA	6704	29
2	China	4071	18
3	United Arab Emirates	2676	12
4	United Kingdom	2268	10
5	Bangladesh	1926	8
6	Germany	1821	8
7	France	974	4
8	Spain	828	4
9	Italy	871	4
10	Turkey	869	4
	Subtotal	23008	56
	Total	**41359**	**100**

Source: DGCI&S

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