ISSN : 2347-503X

Research Chronicler

International Multidisciplinary Research Journal

Vol II Issue I : January 2014

Editor-In-Chief

Prof. K. N. Shelke

www.research-chronicler.com

Research Chronicler

A Peer-Reviewed Refereed and Indexed International Multidisciplinary Research Journal

Volume II Issue I: January – 2014

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Empirical Study of Indian Export and Exchange Rate elasticity

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Abstract

This paper examines the income and exchange rate elasticity of Indian export. The export elasticities have major macro-economic policy implications for any country. If export's income elasticity is high then export of nation will grow with growth world economy. If exchange rate elasticity is high then depreciation of currency will have positive and significant effect on export performance of country. These changes could be tracked and predicted by a robust model for the export demand function. . We will use annual times series data from 1994-95 to 2011-12. We will use multiple regression model (double log) to estimate the elasticities. The export's exchange rate elasticity is found near unity and export's income elasticity is found near 2. High income elasticity indicates the nature of Indian export's composition.

Key Words: income, exchange, elasticity

Export elasticity has major macro-economic policy implications for any country especially in a developing country like India It has great importance in the macroeconomic policy framework of country. Major factor influencing export of country is World GDP, real exchange rate of the country. If export's income elasticity is high then export of nation will grow with growth of country. If exchange rate elasticity is high then depreciation of currency will have positive and significant effect on export performance of country. These changes could be tracked and predicted by a robust model for the export demand function. India's exports have grown much faster than GDP over the past few decades. For example, its exports have grown over 11% per annum while growth in GDP was about 5% during the1970-98 periods. Exports have grown faster since 1947. Several factors appear to have contributed to this phenomenon. We used multiple regression model. Many authors pointed out that application of multiple regression may result spurious regression but we tested data for spurious regression, which we found doesn't exist in our case. The application of cointegration may be considered as improvement but results from my studies are comparable with studies (Garg D and Ramesh S) which uses error correction model.

Literature Review

A number of studies have attempted to analyze the various dimensions of Indian export sector and some clues about such factors may be drawn from the existing literature. The effect of exchange rate on export performance is found significant for Indian export to US (Marjit S, Dasgupta B and Mitra S (2000)). Banik N (2001) identifies a set of factors that appear to be responsible for a significant decline in India's export growth during the post-reform era, and he also examines the possible impediments for high export growth in a sustained manner. The decline in Indian exports during 1996-97 was mainly due to a fall in the growth rate of export volumes. Rath Dilip and Saho A (1990) analyze the determinants of capital goods exports using econometrics techniques. Export demand is found to be inelastic, but supply is elastic with respect to prices. The econometric model is also used to assess the impact of recent government policies on capital goods exports. Using the annual data from 1960 to 1986, Koshal et al. (1992) estimated the export elasticity for India using simultaneous equations. They found the price elasticity of export equals unity and income elasticity to be greater than one. Sinha D (2001) estimated trade demand functions for 5 Asian countries including India. He used annual time series data from 1950-1996 for import and 1960 -1996 for exports.

Methodology

Economic theory tells us that world real income and real exchange are the two major economic variables in the demand for a country's export. Assuming a multiplicative model holds, which is then linearised in parameters through a natural logarithmic transformation like the following: ln Xt= a0 +a1ln (world GDP) + a2 ln (real exchange rate) +a3 t + u. Following tests are also used in this paper.

- T test- t test is used to determine the significance level of individual coefficient. If p-value is less than level of significance then coefficient is significant (i.e. different from zero).
- F test- F test is used to determine the overall significance of the model. We test that all slope coefficient are equal to zero against alternative hypothesis that at least one of them is non-zero. If we accept null hypothesis it indicates that we are using wrong model and independent variables does not have any explanatory power.
- The Breusch-Godfrey Lagrange Multiplier Test: The Breusch-Godfrey test is a general test of autocorrelation. It can be used to test for first-order autocorrelation or higher-order autocorrelation. This test is a specific type of Lagrange multiplier test. We will illustrate this test with reference to a second order autoregressive scheme. Suppose that we have a model: $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \varepsilon_t$ .... (1) and we suspect a second order autoregressive scheme: $\varepsilon_t = \rho_1 \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + \mu_t$ .... (2). Then the model could be written as: $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \rho_1 \varepsilon_{t-1} + \rho_2 \varepsilon_{t-2} + \mu_t$ .... (3)

This we could term the *unrestricted* form of the model. It is unrestricted because we do not restrict the form the error term may take, if it is an independent random error the ρ value will be zero, if the error is autocorrelated up to a second order then one or both of the ρ will be non-zero. If we estimated the equation as $Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + \mu_t$ .... (4)

This would be a *restricted* form of the equation, since implicit in this form is the restriction that $\rho_1 = \rho_2 = 0$. We can define a χ^2 variable with h degrees of freedom as;

$$\frac{(SSR_R - SSR_U)}{\hat{\sigma}^2_R} \sim \chi2(h) \quad .... (5)$$

Where h is degree of freedom, which is the number of restrictions (in this 2nd order example h=2), SSR the sum of squares residuals for the restricted and unrestricted equations and $\hat{\sigma}^2_R$ the estimated variance of the restricted equation.We can further show that,

$$\frac{(SSR_R - SSR_U)}{\hat{\sigma}^2_R} = \frac{SST - SSR}{SST/n} = nR^2$$

Where R^2 comes from auxiliary regression.

Breusch-Pagan test for heteroskedasticity-

The Breusch-Pagan test assumes the error variance is a linear function of one or more variables. Suppose that the regression model is given by

$Y_t = \beta_1 + \beta_2 X_t + \mu_t$ for $t = 1, 2, \ldots, n$

We postulate that all of the assumptions of classical linear regression model are satisfied, except for the assumption of constant error variance. Instead we assume the error variance is non-constant. We can write this assumption as follows:

$Var(\mu_t) = E(\mu_t^2) = \sigma_t^2$ for $t = 1, 2, \ldots, n$

Suppose that we assume that the error variance is related to the explanatory variable X_t. The Breusch-Pagan test assumes that the error variance is a linear function of X_t. We can write this as follows:

$\sigma_t^2 = \alpha_1 + \alpha_2 X_t$ for $t = 1, 2, \ldots, n$

The null-hypothesis of constant error variance (no heteroscedasticity) can be expressed as the following restriction on the parameters of the heteroscedasticity equation

$H_o: \alpha_2 = 0$

$H_1: \alpha_2 \neq 0$

To test the null-hypothesis of constant error variance (no heteroscedasticity), we can use a Lagrange multiplier test. This follows a chi-square distribution with degrees of freedom equal to the number of restrictions you are testing.

RESET Test- The Ramsey Regression Equation Specification Error Test (RESET) test (Ramsey, 1969) is a general specification test for the linear regression model. More specifically, it tests whether non-linear combinations of the fitted values help explain the response variable. The intuition behind the test is that if non-linear combinations of the explanatory variables have any power in explaining the response variable, the model is mis-specified.

DEBETA-Outliers can sometimes cause problems with regression results. Outliers are defined by Gujarati (2004) as an observation with a large residual – a larger vertical distance between the observation and the predicted line than is generally true for the rest of the data. Such observations may have high "leverage" if they are disproportionately far away from the rest of the data points. There are multiple methods for detecting outliers. Probably the most popular tools are DFBETA. DFBETA is a measure found for each observation in a dataset. The DFBETA for a particular observation is the difference between the regression coefficient for an included variable calculated for all of the data and the regression coefficient calculated with the observation deleted, scaled by the standard error calculated with the observation deleted. The cut-off value for DFBETAs is 2/sqrt(n), where n is the number of observations. However, another cut-off is to look for observations with a value greater than 1.00. Here cutoff means, "this observation could be overly influential on the estimated coefficient."

Result

The output from regression model is shown in table 2.1

Table 2.1 Model Estimation		
	Model 1	Model 2
	lnexport	lnexport
lnexhrate	0.396	0.983
	(0.91)	(4.12)**
Ln world gdp	2.489	1.741
	(36.94)**	(14.71)**
t		0.042
		(6.61)**
Constant	-34.224	-24.248
	(21.83)**	(14.20)**
Observations	18	18
Adj R-squared	0.992	0.999
Absolute value of t statistics in parentheses		
* significant at 5%; ** significant at 1%		

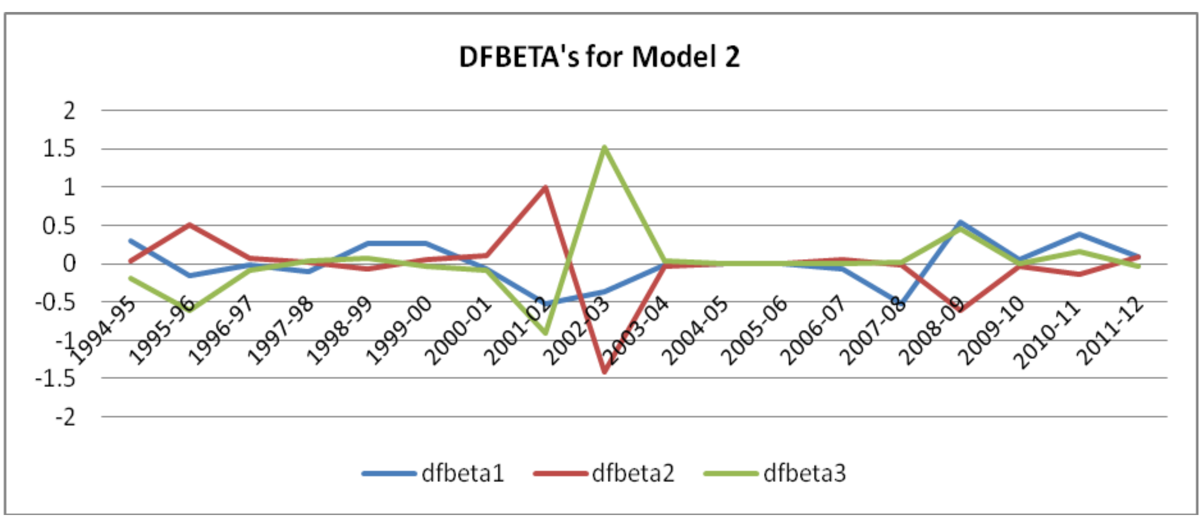
In above table model, time variable (t) is not included whereas in model 2, time variable is included as independent variable. In the model 1, the sign of parameter of real exchange rate is positive but it is not significant. World GDP have significant impact on export. Adjusted R2 is very good, it is 0.992. so independent variables are explaining about 99.2% variation in export. From the economic theories, the real exchange rate is important variable which affects the export of country. When we run some diagonistic test on model (table 2.2), we found that there is autocorrelation in model. In the presence of autocorrelation the estimator is no longer BLUE, as the estimator is not the best. In this case the t-statistics and other tests are no longer valid.

When we include the time variable as independent variable, Adjusted R2 improves and coefficient of real exchange rate becomes significant and autocorrelation does not exist in model 2. So model 2 is supporting the economic theories about importance of real exchange rate for export. World GDP and time (t) both have significant impact on dependent variable (export).

Table 2.2 Diagnostics table				
	model 1		model 2	
	Test statistic	P-value	Test statistic	P-value
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	0.16	0.693	0.54	0.4619
Breusch-Godfrey LM test for autocorrelation	5.197	0.0226	0.005	0.945
RESET test	2.06	0.1594	0.96	0.4473
SK test	3.29	0.1932	1.94	0.3784

From table 2.2, the p-value of PG test is 0.945, so we can not reject null hypothesis of zero autocorrelation at any level of significance. The Ramsey RESET test indicates that there are no omitted variable. The SK test indicates that the residuals from our model 2 are normally distributed. And BP test indicates that there is no heteroskedasticity. So our model is satisfying our all classical assumptions of OLS model.

Outliers can sometimes cause problems with regression results. We can use DFBETA to check outlier in our data set. In following chart dfbeta1 is dfbeta for (lnexhrate), dfbeta2 is dfbeta for lnworldgdp and dfbeta3: dfbeta for t (time variable). We will use 1 as threshold limit to identify outlier. From fig, data of 2002-03 is outlier.



Now we will analyze our previous models (model 1 and model 2) with data set excluding the data of 2002-03 i.e. by excluding one observation.

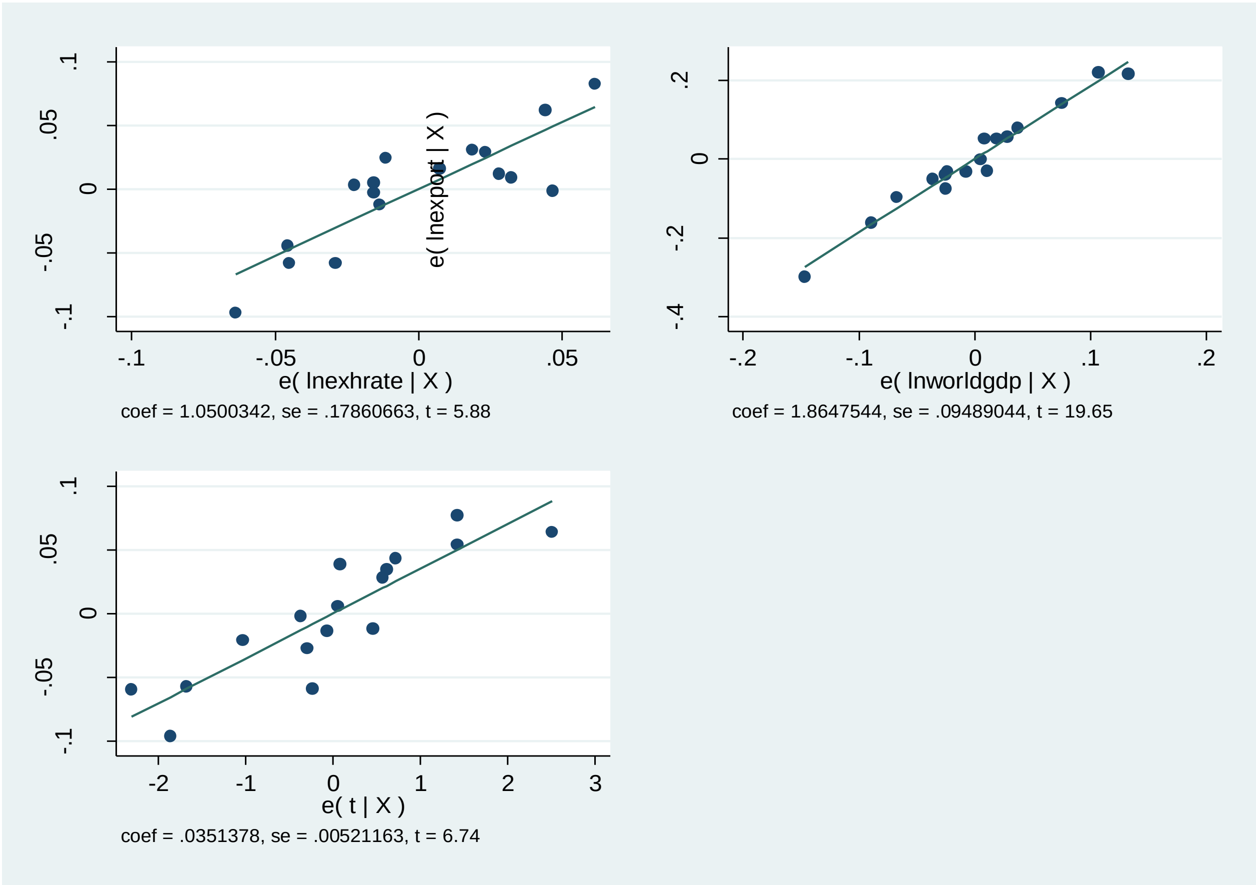
The estimate Model is shown in table 2.3.

Table 2.3 Estimated Model (outlier excluded)		
	Model 1B	Model 2B
	lnexport	lnexport
lnexhrate	0.693	1.05
	(1.99)	(5.88)**
lnworldgdp	2.481	1.865
	(47.42)**	(19.65)**
t		0.035
		(6.74)**
Constant	-35.468	-26.667
	(27.87)**	(18.44)**
Observations	17	17
Adj R-squared	.995	0.999
Absolute value of t statistics in parentheses		
* significant at 5%; ** significant at 1%		

Again in model 1B, the real exchange rate is not significant at 5% level of significance, but value of t ratio improved. In model 2B, all variable's coefficient have expected sign and significant. Adjusted R2 also improved due to exclusion of outlier. The diagnostics tests for model 1B and model 2B are given in table 2.4.

Table 2.4 Diagnostics table				
	model 3		model 4	
	Test statistic	P-value	Test statistic	P-value
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	0.11	0.739	0.93	0.335
Breusch-Godfrey LM test for autocorrelation	4.262	0.039	0.526	0.4683
RESET test	3.06	0.0733	1.96	0.1833
SK test	0.96	0.6174	1.39	0.4986

Model 1B suffers from the problem of autocorrelation as indicated by BG test at 5% level of significance. But there is no autocorrelation if we take level of significance as 1%. The model 2B satisfies all classical assumptions of OLS model i.e. no autocorrelation, no hetroskedasticity, normality of residual, right functional form etc. We can also use added variable plot to get clue of correct functional form of the regressor.



So we choose model 2B as final model to estimate the elasticity with respect to real exchange rate and world GDP (income elasticity)

Table 2.5 Export Elasticity	
real exchange rate elasticity	1.05
Income elasticity	1.86

The export elasticity with respect of real exchange rate is more than one. So depreciation of Indian currency will have positive and significant effect on export performance by India. India's export income elasticity is 1.86, so India's export is income elastic. This can be seen by looking India's composition of export. India's main exports are engineering goods (19 percent of total exports), gems and jewellery (15 percent), chemicals (13 percent), agricultural products (9 percent) and textiles (9 percent). India is also one of Asia's largest refined product exporters with petroleum accounting for around 18 percent of total exports.

Conclusion

In this paper we estimated income and exchange elasticity of Indian export. The export elasticity with respect of real exchange rate is more than one. So depreciation of Indian currency will have positive and significant effect on export performance by India. India's export income elasticity is 1.86, so India's export is income elastic. This indicates the nature of India's composition of export. The export elasticity with respect of real exchange rate is more than one. So depreciation of Indian currency will have positive and significant effect on export performance by India. India's export income elasticity is 1.86, so India's export are income elastic. This can be seen by looking India's composition of export.

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