Master Thesis

Effects of major exports and imports on the balance of foreign trade in Pakistan.

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Abstract

This thesis focuses on the econometric evaluation of the effects of major exports and imports on the balance of foreign trade in Pakistan. Various statistical techniques at our disposal have been used such as principal component analysis, stepwise regression and multiple linear regression. Attempt has been made to look out for the stationarity in the data for the balance of trade in Pakistan. Augmented Dickey Fuller test has been used for this purpose. The techniques have been applied to the balance of trade, more specifically exports and imports from 1972 till 2005. The gap between imports and exports is continuously increasing, which leads us to conclude that we do not see any stationarity in the balance of trade in the long run.

Keywords: Principal Component Analysis, Regressions, Unit Root Test

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1. Introduction

Aim

The main intension in this paper is to find which export and import commodities have a significant effect on the balance of trade in Pakistan. The export and import commodities are divided into four major groups, food industry, textile industry, manufacturing industry and miscellaneous to see their effect on balance of trade. We tried to investigate the following issues:

1) We try to investigate principal components of the aforementioned groups from the given set of export and import variables. We further check the effects of these principal components on the balance of trade.
2) We check for the stationarity in the series for the balance of trade in Pakistan. Further to it, we try to do statistical forecasting on the aforementioned series.

Balance of trade

The balance of trade is the difference of exports and imports of a country. A favourable balance of trade is positive when exports are more than imports, whereas negative balance of trade is known as trade deficit for a country. The balance of trade can be divided into goods and services.

In this study the balance of trade is for the goods only.

Background of the foreign trade in Pakistan

Pakistan is a developing country in the South East of 172.8 million inhabitants where the economy is mainly based on agriculture. From 1947 to date, Pakistan has for most of the years been experiencing a trade deficit. Globalization and competition with other developing countries of the region pose a future challenge for the economy of Pakistan and the gap has consistently increased between imports and exports. Though, Pakistan has made good progress in both exports and imports but the imports has grown relatively more as compared to the exports. As a result, Pakistan is now facing trade deficit, which has become more severe with the passage of time. Generally, the balance of foreign trade has been negative throughout the history of Pakistan.

However, there has been diversification in the foreign trade policy under different regimes and Pakistan has successfully diversified export portfolio. In 1947, 99% of the exports were primarily commodities such as cotton, fish, tobacco, leather etc, whereas in 1996, basic exports made up less than 20%, which is a great achievement in exports (See Husain, 1998, p 277-281).

The export contribution mainly comes from the manufacturing industries and raw material such as food, fish and fish preparations, fruits, vegetables and spices, textile, cotton, clothing and agricultural commodities. Other exports of Pakistan are floor coverings and tape stripes, sports goods, jewellery, surgical instruments, cutlery, tobacco, furniture, chemicals and pharmaceutical products. *"Pakistani government gave financial incentives to encourage the exports especially for textiles"* (See Looney, 1997, p 86). In addition, export duties on agricultural commodities were reduced. After 1977, the exports of the Pakistan increased sharply due to an increasing trend in the world trade. Pakistan has made significant progress from primary commodities to manufactured goods in the export sector; there is especially a good progress in non-traditional exports in the period 1990 to 2000. On the import side, the consumer goods decreased from 40% to 15% in between 1947 to 1996. (See Husain, 1998, p 296-300). On the other hand, the import bills have increased rapidly which has had a negative effect on the economy of the Pakistan. *´´Sharp increases in crude oil prices, such as those of 1979-81 and 1990, raised the nation's import bill significantly*``. In addition, government tightened the import licenses and reversed the policy for import liberalization in 1979. It affected foreign trade in a negative manner and the imports continued to exceed the exports. The narrow base exports of the country remain unchanged. Most of the decline of export commodities was in the beginning of the period 1988 due to the decrease of the prices of traditional commodities like rice, cotton and fish etc. (See Husain, 1998, p 282-298).

Pakistan is a big importer of the commodities such as minerals, fuels and lubricants, food and live animals, crude materials, animals and vegetables oils, machinery and transport, chemicals and manufactured goods. Other imports which are growing fastest nowadays are computer accessories, telecommunication equipments, military equipments and civilian aircrafts etc.

These have a significant effect on the balance of trade and the import bills are growing faster than export bills. As a result, the trade deficit of Pakistan is growing with the passage of time due to increasing gap between imports and exports of the country.

In sum, although the exports of the country have increased but the imports also grew relatively more, especially in last two decades. The trade deficit is growing every year. This is an alarming rate for an emerging market.

2. Data, Methodology and Techniques

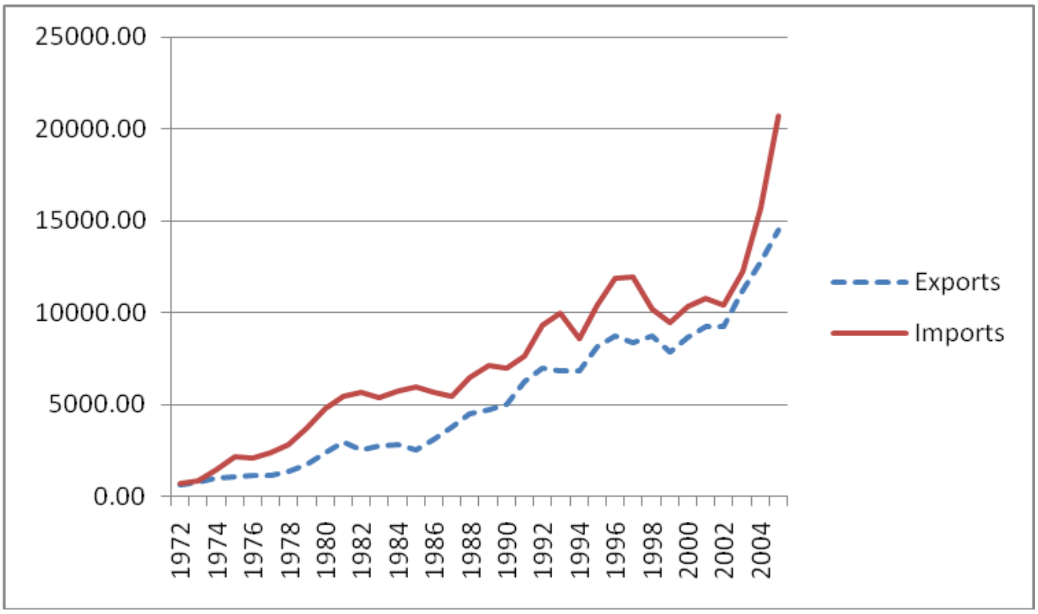
2.1 Data

The source of the data is from the official website of the State Bank of Pakistan. The data comprises of import and export commodities, along with the value of balance of trade. The data extends from 1972 to 2005. The reason we have taken the data from 1972 is that Pakistan was partitioned into two countries (Pakistan & Bangladesh) in December 1971.

Some changes in the original data have done for the study. Initially in original data, there were more variables. Some of them have missing observations for several years. This creates a problem for the possible strategy of analysis, which is overcome by including these variables in the miscellaneous (exports) and miscellaneous (imports). This strategy works well because the value of import and export commodities remains the same. Further, it doesn't change the principal variable of balance of trade.

The following figure 2.1 shows the imports and exports for period 1972-2005

Million $



Years

Fig 2.1

In Fig 2.1 it can be seen clearly that the import commodities increases relatively more as compare to the export commodities. Especially in 2005 the imports grew up sharply due to which the balance of trade becomes more negative.

2.2 Methodology

We have a dual purpose of first checking out the principal components of the export and import commodities in Pakistan and then checking out for the stationarity of the data for the balance of trade in Pakistan. Thus, we'll talk about the techniques we used for both these issues.

For the first issue, we'll talk about the techniques of principal component analysis. Usually in economic data, correlation exists among the variables. First of all, we have divided the data into four possible groups. They are food commodities, textile goods, manufacturing and miscellaneous which seems to be more correlated. In addition, by applying the different statistical techniques, we try to find the import and export commodities which have significant effect on the balance of trade.

For the second issue, we'll talk about the techniques used for the checking the stationarity and forecasting.

The different statistical techniques for the analysis of data and the balance of trade in Pakistan are given below.

Techniques

Principal Component Analysis

Principal component analysis is a statistical technique which transforms correlated variables into a smaller number of uncorrelated variables which are known as principal components. We haven't applied the principal component analysis on our data as a whole because in this way we will lose our information. Actually, had we used the principal component analysis on all the variables without grouping them, we wouldn't have been able to identify the proper groups which have a direct bearing on the balance of trade.

Firstly, Principal component analysis is applied for the different groups of the data. The first group consists of the agricultural and animals products. The variables are highly correlated and give us one principal component. The second, third and fourth groups consist of textile goods, manufactured products and miscellaneous respectively for import and export commodities. Each group gives us one principal component. In this way we get four major variables instead of the 16 variables for the further analysis.

Further, we apply the regression technique to check the effect of these four different variables on the balance of trade, where these four variables are the first principal components of each of the four groups of commodities as mentioned above.

Stepwise Regression

In the stepwise regression, there is one dependent variable and ‘p’ potential independent variables. Stepwise regression uses t-statistics to determine the significance of the independent variables in various regression models. The t-statistic indicates that the independent variable is significant at α-level if and only if the related p-value is less than α.

The stepwise procedure continues by adding independent variables one at a time of the model. After each step one independent variable is added to the model if it has the larger t-statistic of the independent variables not in the model and if its t-statistic indicates that it is significant at the α-level.

It removes an independent variable if it has the small as t-statistic of independent variables already included in the model. This removal procedure is sequentially continued, and only after the necessary removals are made, does the stepwise procedure attempt to add another independent variable to the model. The stepwise procedure terminates when all the independent variables not in the model are insignificant at α level.

Multiple linear regressions

Secondly, multiple linear regressions are applied to find the effect of exports and imports on balance of trade. After applying the regression on exports and imports variables, the insignificant variables are excluded from the data and again checked the effect of balance of trade on all significant variables of exports and imports. The lag variables of explanatory variables are also included in the model.

Time series model for balance of trade

For the model building of balance of trade and forecasting by using this fitted model we follow the strategy.

- First of all test the series for stationarity by the Augmented Dickey Fuller (ADF) test.
- Identify the model after making the series stationary if it is not already so.
- By removing the last five years values and forecast by using the fitted model.

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Augmented Dickey Fuller test (unit root test)

Augmented dickey fuller test provides a formal test for non-stationarity in the time series data. This test is used to test for the presence of unit root in the coefficient of lagged variables. If the coefficient of a lagged variable shows a value of one, then the equation show that there exists unit root in the series.

To test for the presence of a unit root in the balance of trade, ADF of the form given below is carried out, where *Y* represent the series for the balance of trade.

$$\Delta Y_t = a_0 + \gamma Y_{t-1} + \beta_2 \Delta Y_{t-1} + \beta_3 \Delta Y_{t-2} + \ldots. + \varepsilon_t$$

The null hypothesis for the test is given below

$H_0 : \gamma = 0$, there exists a unit root problem.

Decision rule

- If t-statistic > ADF critical value. We don't reject the null hypothesis. Unit root exists in this case.
- If t-statistic < ADF critical value. We reject the null hypothesis. Unit root doesn't exist in this case.
- The test statistic is the statistic used in the ADF test.
- If the null hypothesis is accepted, we assume that there is a unit root in the series and before applying the model we should to take the first difference of the series.
- If the null hypothesis is rejected, the data of the series is stationary and can be used for modelling without taking any difference of the series.

3. Analysis of the data and results

3.1 Principal Component Analysis

Finding Principal Components

1st group's principal component

The first group of commodities consists of four different food commodities (fish and fish preparations, rice, food and live animals, animal and vegetable oils). These variables are highly correlated due to the increase over the years in these commodities. The first principal component of the variation in these food commodities is given below, where X_1, X_2, X_3 and X_4 represent fish, rice, live animals and oils respectively.

$$\mathbf{Z_1 = .926\ X_1 + .736\ X_2 + .856\ X_3 + .936\ X_4}$$

This component accounts for 75% variation in this group. We can clearly see in Fig 3.1, the magnitude of slope (tangent) between component 1 and 2 is the highest and a lot higher in comparison to the others. Thus, we have only one principal component.

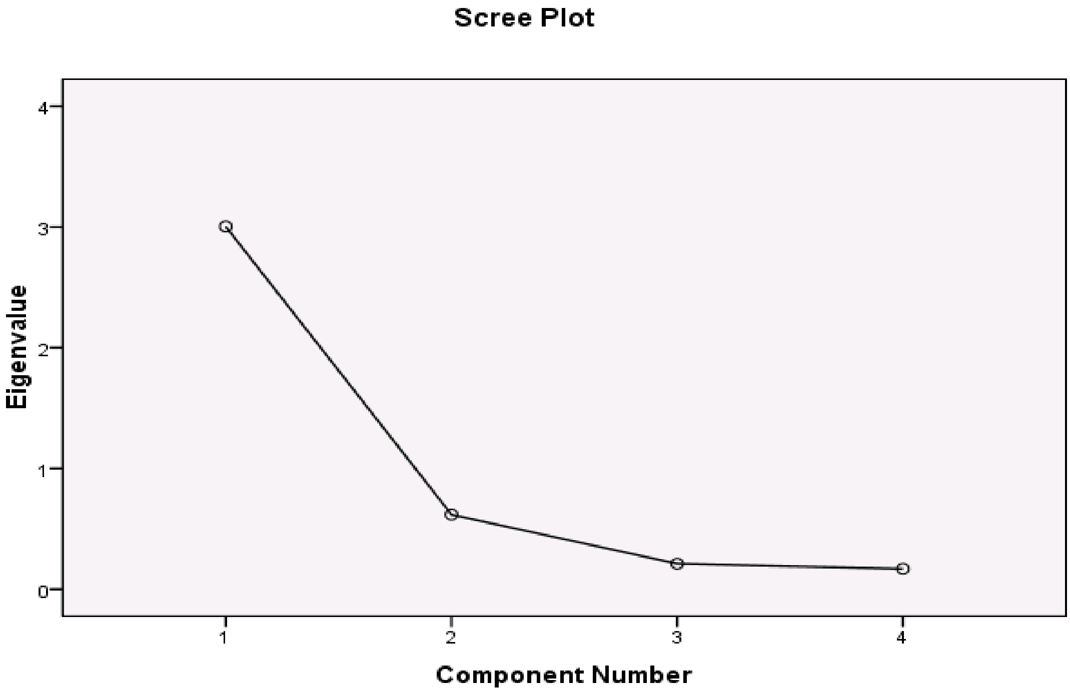


Fig 3.1

2^{nd} group's principal component

The second group of commodities consists of four different textile commodities (textiles-yarn, cotton fabric, floor covering and cotton manufacturers). These variables are highly correlated due to the increase over the years in these commodities. The first principal component of the variation in these textile commodities is given below, where X_5, X_6, X_7 and X_8 represent textiles-yarn, cotton fabric, floor covering and cotton manufacturers respectively.

$$\mathbf{Z_2 = .875\ X_5 + .933\ X_6 + .848\ X_7 + .926\ X_8}$$

This component accounts for 80.32% variation in this group. We can clearly see in Fig 3.2, the magnitude of slope (tangent) between component 1 and 2 is the highest and a lot higher in comparison to the others. Thus, we have only one principal component.

Fig 3.2

3rd group's principal component

The third group of products consists of four different manufacturing products (leather, sports goods, minerals, machinery). These variables are highly correlated due to the increase over the years in these products. The first principal component of the variation in these manufacturing products is given below, where X_9, X_{10}, X_{11} and X_{13} represent leather, sports goods, minerals and machinery respectively.

$$\mathbf{Z_3 = .896\ X_9 + .858\ X_{10} + .813\ X_{11} + .925\ X_{12}}$$

This component accounts for 76.45% variation in this group. We can clearly see in Fig 3.3, the magnitude of slope (tangent) between component 1 and 2 is the highest and a lot higher in comparison to the others. Thus, we have only one principal component.

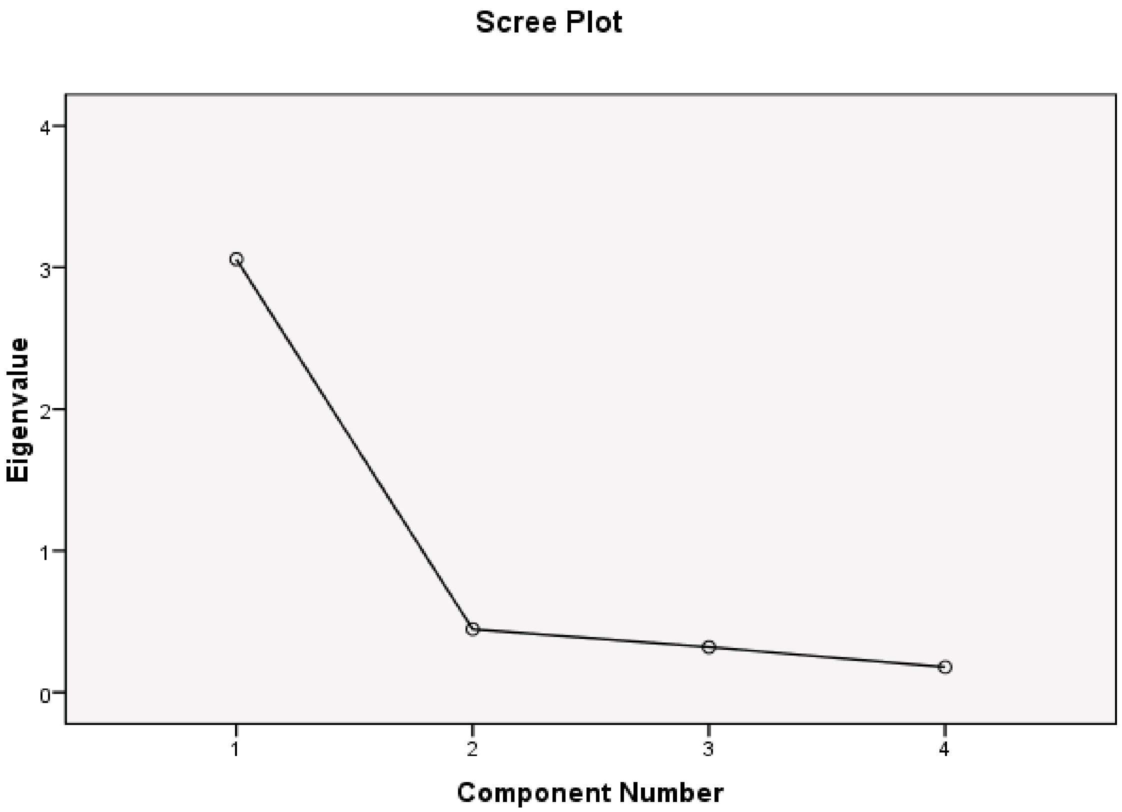


Fig 3.3

4th group's principal component

The fourth group of products consists of four different miscellaneous products (miscellaneous exports, miscellaneous imports, crude material and chemicals). These variables are highly correlated due to the increase over the years in these products. The first principal component of the variation in these miscellaneous products is given below, where X_{13}, X_{14}, X_{15} and X_{16} represent miscellaneous (exports), miscellaneous (imports), chemicals and crude material.

$$\mathbf{Z_4 = .985\ X_{13} + .966\ X_{14} + .963\ X_{15} + .955\ X_{16}}$$

This component accounts for 93.59% variation in this group. We can clearly see in Fig 3.4, the magnitude of slope (tangent) between component 1 and 2 is the highest and a lot higher in comparison to the others. Thus, we have only one principal component.

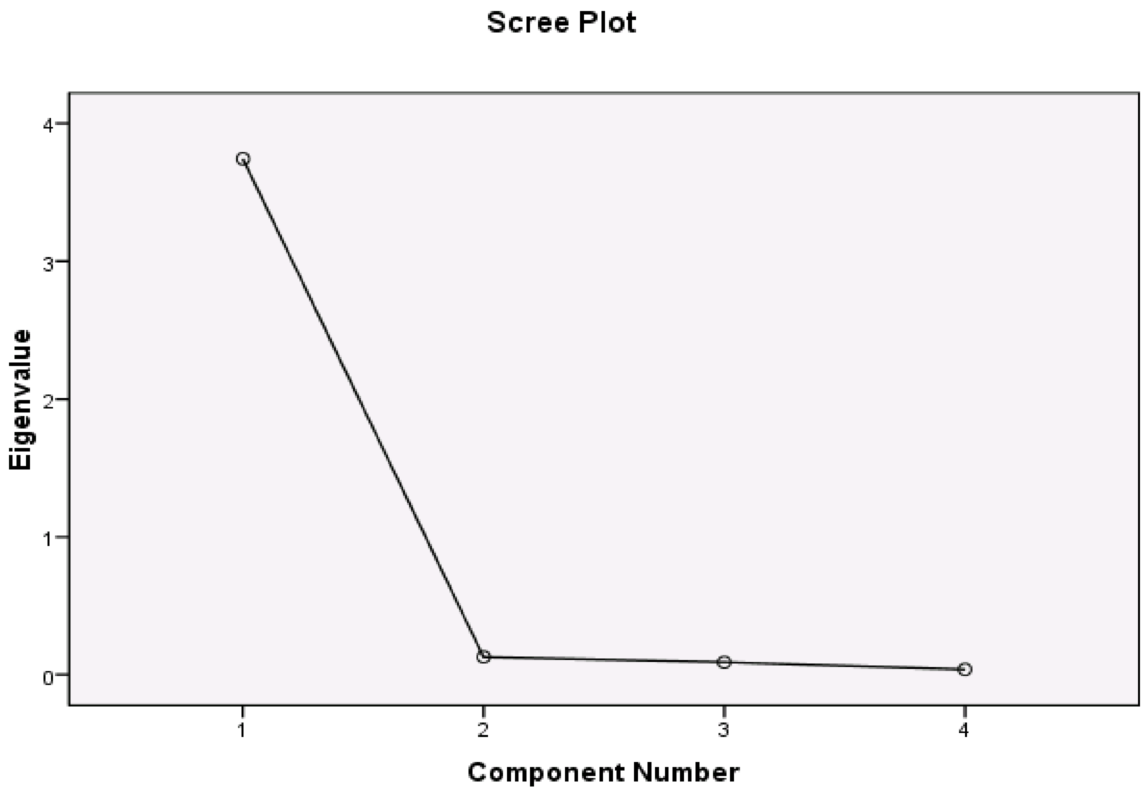


Fig 3.4

Effect of principal components on balance of trade

We apply the regression technique to check the effect of four different variables on the balance of trade, where these four variables are the first principal components of each of the four groups of commodities. We regress balance of trade on Z_1, Z_2, Z_3 and Z_4.

$$\mathbf{Y= -1.32Z_1+2.07Z_2-1.45Z_3-0.05Z_4}$$

The regression coefficients of three components, food commodities, textile commodities and miscellaneous have negative signs, whereas for the principal component corresponding to textile commodities has positive sign. The principal components corresponding to food commodities, textile commodities and manufacturing are significant. The principal component corresponding to miscellaneous products is insignificant (marked in table 3.1).

Dependent Variable: BOT
Method: Least Squares
Date: 05/31/09 Time: 03:51
Sample: 1 34
Included observations: 34

	Coefficient	Std. Error	t-Statistic	Prob.
Z1	-1.317752	0.473677	-2.781965	0.0093
Z2	2.068377	0.510756	4.049636	0.0003
Z3	-1.451923	0.219086	-6.627188	0.0000
Z4	-0.046544	0.068067	-0.683803	0.4993

R-squared	0.725849	Mean dependent var	-2020.838
Adjusted R-squared	0.698434	S.D. dependent var	1169.374
S.E. of regression	642.1618	Akaike info criterion	15.87769
Sum squared resid	12371154	Schwarz criterion	16.05726
Log likelihood	-265.9207	Hannan-Quinn criter.	15.93893
Durbin-Watson stat	1.035869		

Table 3.1

The AdjR^2=0.70 is obtained by applying the model. $\mathbf{R^2}$ indicate that 70% balance of trade is explained by these principal components.

In the groups, food commodities, manufacturing and miscellaneous, where there is dominance of imports over exports. We can clearly see from the magnitudes in the regression equation above that food commodities and the manufacturing have relatively high propensity towards imports.

3.2 Stepwise Regression

The procedure of the stepwise regression terminates when all the independent variables not in the model become insignificant at the α-level. We apply the stepwise regression in two different ways of analysis.

Firstly, the balance of trade is taken as dependent variable, while all the sixteen variables of the imports and exports are taken as independent variables. Further, one lag behind for the independent variables are also included in the model. The significant variables obtained by this method are manufactured goods (import), sports goods (export), cotton fabrics (export), food and live animals (imports), and minerals (import).

Commodities	Manufactured goods (i)	Sports goods	Cotton Fabrics(Lag)	Leather(Lag)	Food and live animals	Minerals and Lubricants
Coefficients	-4.40	10.35	-1.70	8.10	-1.77	-.374

The Adjusted $\mathbf{R^2=0.91}$ which tells us that 91% of the variation in the balance of trade is explained by these variates in stepwise regression. All other variables are insignificant in this model. The negative coefficients of (manufactured goods, cotton fabrics (lag1), food and live animals, minerals & lubricants) show inverse relationship between the balance of trade, where as the positive coefficients of the variables (sports goods and leather) shows direct relationship with balance of trade.

Secondly, the balance of trade is taken as dependent variable, while again all the other variates of the imports and exports are taken as independent variables. Further, two lag behind for the independent variables are also included in the model. The significant variables obtained by this method are manufactured goods (import), sports goods (export), cotton (export), floor coverings (export), animal &vegetables oils (import).

Commodities	Manufactured goods(i)	Sports goods	Cotton	Animals and vegetables oil	Floor covering and stripes	Cotton (Lag 2)
Coefficients	-5.63	9.72	.918	-2.69	6.42	.74

The Adjusted $\mathbf{R^2=0.91}$ which tells us that the 91% variation is explained by these variates. All other variables become insignificant in this model. The negative coefficients of (manufactured goods, animal and vegetables oil) shows negative relationship between the balance of trade whereas the positive coefficients of the variables (sports goods, cotton, floor covering) tells us the direct relationship with balance of trade.

3.3 Multiple linear Regressions

Step 1 We find the significant variates by regressing balance of trade on export variables only. Fish, cotton fabrics, sports goods and miscellaneous (exports) have significant effect on balance of trade. The value of the adjusted R square is 0.69.

Step2 By regressing balance of trade on import variables only we have found that crude materials, chemicals, manufactured goods and miscellaneous of the imports have significant effect on balance of trade. The value of the Adjusted R square is 0.77.

Step3 In the third step we regress balance of trade on the significant variates chosen in first and second step. We find that fish, cotton fabrics, miscellaneous (exports), manufactured goods and miscellaneous (imports) have significant effect on the balance of trade. The value of the adjusted R square is 0.85.

Imports variables crude materials, chemicals, manufactured goods have relatively stronger effect on the balance of trade as compared to the export variables like fish, cotton fabrics and sports goods.

In exports, sports goods and cotton fabric contribute more than other export variates in the foreign trade, whereas in imports manufactured goods have strong effect on balance of trade.

3.4 Time series model for balance of trade

The graph below shows the balance of trade (in million $) from 1972 to 2005 in Pakistan. There has been continuous negative balance of trade, right from 1974 till 2005.

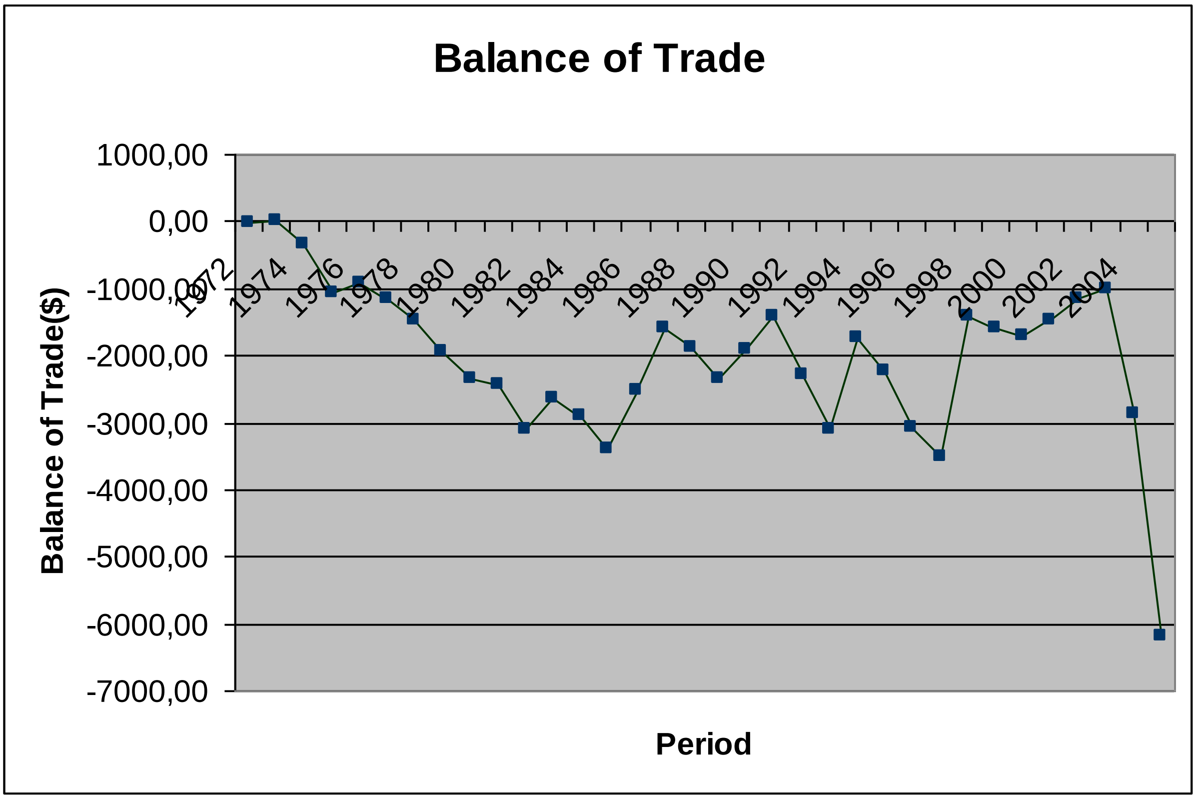


Fig 3.5

We have to check for the stationarity of the data for the balance of trade in Pakistan. For this we would look for is the presence of unit root in the data. If we find the unit root, it means that the time series is not stationary. We use Augmented Dickey Fuller test for the testing of the unit root in the data.

ADF Test

The following model is used to check for the stationarity in the data for the balance of trade.

Null Hypothesis: BALANCE_OF_TRADE has a unit root
Exogenous: None
Lag Length: 0 (Automatic based on SIC, MAXLAG=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.451704	0.8064
Test critical values:	1% level	-2.636901	
	5% level	-1.951332	
	10% level	-1.610747	

*MacKinnon (1996) one-sided p-values.

We don't reject the said null hypothesis that the series has a unit root. It's because our test statistic (t=0.4517) doesn't lie in the critical region. There exists a unit root which tells us that the series is not stationary at the level.

The series may become stationary after taking the first difference of the data for the balance of trade. We take the first difference and test by ADF test whether the series becomes stationary or not.

ADF Test after taking the first difference

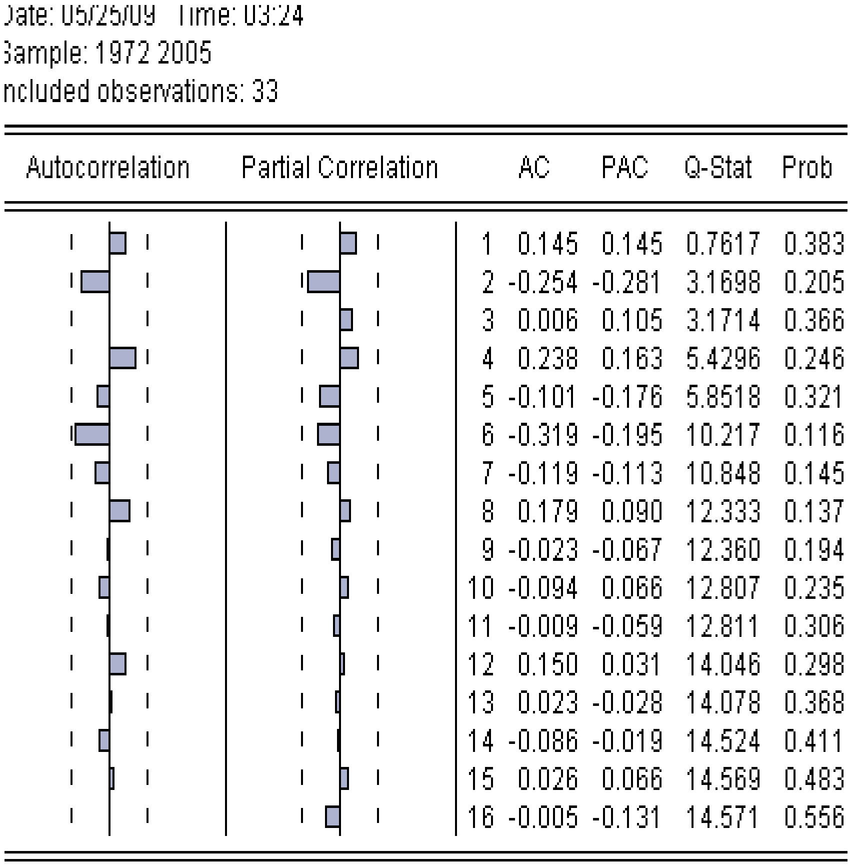
The following model is used to check for the stationarity in the data for the balance of trade after taking the first difference. We reject the null hypothesis that the series has a unit root because the t-statistic lies in the critical region.

Null Hypothesis: DIFBOT has a unit root
Exogenous: None
Lag Length: 1 (Automatic based on SIC, MAXLAG=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.559136	0.0009
Test critical values:	1% level	-2.641672	
	5% level	-1.952066	
	10% level	-1.610400	

*MacKinnon (1996) one-sided p-values.

The following is the correlogram after taking the first difference of the data for the balance of trade. The second spike of the autocorrelation function and partial autocorrelation function is higher than the first spike.



Date: 05/25/09 Time: 03:24
Sample: 1972 2005
Included observations: 33

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.145	0.145	0.7617	0.383
		2	-0.254	-0.281	3.1698	0.205
		3	0.006	0.105	3.1714	0.366
		4	0.238	0.163	5.4296	0.246
		5	-0.101	-0.176	5.8518	0.321
		6	-0.319	-0.195	10.217	0.116
		7	-0.119	-0.113	10.848	0.145
		8	0.179	0.090	12.333	0.137
		9	-0.023	-0.067	12.360	0.194
		10	-0.094	0.066	12.807	0.235
		11	-0.009	-0.059	12.811	0.306
		12	0.150	0.031	14.046	0.298
		13	0.023	-0.028	14.078	0.368
		14	-0.086	-0.019	14.524	0.411
		15	0.026	0.066	14.569	0.483
		16	-0.005	-0.131	14.571	0.556

We applied various models like MA(1), AR(1), AR(2) ARMA(1,1) and ARMA(1,2) on the first difference of the data for the balance of trade. These aforementioned models were motivated by the fact that MA(1) and AR(2) models are significant for the first difference of the data for the balance of trade. The final selected model for this series would be the one which performs the best among this assortment of possible models. The summary of the above mentioned models for different statistics is given in the table 3.1. We checked these models for the stationary time series, obtained by taking the first difference of the data for the balance of trade, with different statistics.

Models Summary for the difference of balance of Trade

Model	**MA(1)**	**MA(2)**	**AR(2)**	**ARMA(1,1)**	**ARMA(1,2)**
AIC	16.465	16.475	16.492	16.556	16.533
SBC	16.510	16.520	16.537	16.647	16.624
DW	1.80	1.32	1.29	1.75	1.646
Adj R2	0.044	0.035	0.079	0.014	0.037
S.E	896.67	901.06	907.79	924.14	913.66
Significance 10%	Significant	insignificant	Significant	insignificant	insignificant
Autocorrelation	No	No	No	No	No

Table 3.1

From the above table AR(2) model is suitable for the series on the different statistics.

- The two models AR(2) and MA(1) are significant.
- The **AdjR^2** is higher for the model AR(2).
- The value of AIC and SBC are approximately same in all models.
- The S.E of regression in MA(1) is least among the models.
- The residual correlogram of the AR(2) and M.A(1) doesn't have any spike outside the bound. It means that the autocorrelation doesn't exist in the models.

AR(2)

We fit the model AR(2) for the first difference of the data for balance of trade. This model is significant for the series of difference of balance of trade.

Dependent Variable: Y
Method: Least Squares
Date: 06/06/09 Time: 03:59
Sample (adjusted): 1975 2005
Included observations: 31 after adjustments
Convergence achieved after 3 iterations

	Coefficient	Std. Error	t-Statistic	Prob.
AR(2)	-0.486451	0.245557	-1.981008	0.0568

R-squared	0.079223	Mean dependent var	-188.9645
Adjusted R-squared	0.079223	S.D. dependent var	946.0426
S.E. of regression	907.7954	Akaike info criterion	16.49164
Sum squared resid	24722773	Schwarz criterion	16.53790
Log likelihood	-254.6204	Hannan-Quinn criter.	16.50672
Durbin-Watson stat	1.290860		

In AR(2) model it is clear that there isn't any autocorrelation. As can be seen in the figure below, for both autocorrelation and partial autocorrelation, there is no spike outside the upper and lower limit.

Date: 06/06/09 Time: 04:05
Sample: 1975 2005
Included observations: 31
Q-statistic probabilities adjusted for 1 ARMA term(s)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.116	0.116	0.4593	
		2	0.073	0.061	0.6484	0.421
		3	-0.067	-0.083	0.8106	0.667
		4	0.054	0.068	0.9211	0.820
		5	-0.179	-0.187	2.1749	0.704
		6	-0.168	-0.146	3.3321	0.649
		7	-0.181	-0.121	4.7212	0.580
		8	0.067	0.093	4.9186	0.670
		9	0.006	0.011	4.9203	0.766
		10	0.003	-0.040	4.9208	0.841
		11	-0.040	-0.063	5.0013	0.891
		12	0.113	0.046	5.6865	0.893
		13	0.102	0.079	6.2779	0.901
		14	-0.088	-0.128	6.7433	0.915
		15	0.023	0.080	6.7771	0.943
		16	-0.089	-0.127	7.3168	0.948

MA(1)

We fit the model MA(1) for the first difference of the data for the balance of trade. This is significant, but has lower coefficient of determination as compared to the model AR(2).

Dependent Variable: D(BALANCE_OF_TRADE)
Method: Least Squares
Date: 06/02/09 Time: 14:44
Sample (adjusted): 1973 2005
Included observations: 33 after adjustments
Convergence achieved after 6 iterations
MA Backcast: 1972

	Coefficient	Std. Error	t-Statistic	Prob.
MA(1)	0.395049	0.174534	2.263447	0.0305

R-squared	0.044604	Mean dependent var	-186.7364
Adjusted R-squared	0.044604	S.D. dependent var	917.3641
S.E. of regression	896.6715	Akaike info criterion	16.46509
Sum squared resid	25728632	Schwarz criterion	16.51044
Log likelihood	-270.6740	Hannan-Quinn criter.	16.48035
Durbin-Watson stat	1.805156		

Inverted MA Roots	-.40

In MA(1) model it is clear that there isn't any autocorrelation. As can be seen in the figure below, for both autocorrelation and partial autocorrelation, there is no spike outside the upper and lower limit.

Date: 06/02/09 Time: 03:05
Sample: 1973 2005
Included observations: 33
Q-statistic probabilities adjusted for 1 ARMA term(s)

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.049	-0.049	0.0883	
		2	-0.145	-0.148	0.8738	0.350
		3	-0.040	-0.057	0.9357	0.626
		4	0.262	0.242	3.6761	0.299
		5	-0.113	-0.108	4.2070	0.379
		6	-0.234	-0.197	6.5435	0.257
		7	-0.072	-0.105	6.7718	0.342
		8	0.130	0.009	7.5572	0.373
		9	-0.037	-0.014	7.6217	0.471
		10	-0.051	0.043	7.7548	0.559
		11	-0.003	-0.013	7.7552	0.653
		12	0.074	-0.030	8.0594	0.708
		13	0.048	0.043	8.1941	0.770
		14	-0.092	-0.077	8.7142	0.794
		15	0.052	0.068	8.8906	0.838
		16	-0.056	-0.092	9.1029	0.872

Forecasting

We re-estimate the models by excluding last five years values of first difference of the data for balance of trade for forecasting. The model AR(2) for the difference of balance of trade by removing the last five years values is shown below.

AR(2)

Dependent Variable: DBAL_OF_TRADE
Method: Least Squares
Date: 06/07/09 Time: 00:38
Sample (adjusted): 1975 2000
Included observations: 26 after adjustments
Convergence achieved after 3 iterations

	Coefficient	Std. Error	t-Statistic	Prob.
AR(2)	-0.413319	0.181439	-2.278008	0.0315

R-squared	0.167438	Mean dependent var	-52.45769
Adjusted R-squared	0.167438	S.D. dependent var	729.3592
S.E. of regression	665.5027	Akaike info criterion	15.87666
Sum squared resid	11072347	Schwarz criterion	15.92505
Log likelihood	-205.3966	Hannan-Quinn criter.	15.89060
Durbin-Watson stat	2.263068		

The model is significant for AR(2) after excluding the last five years values.

Forecasted graph for the series.

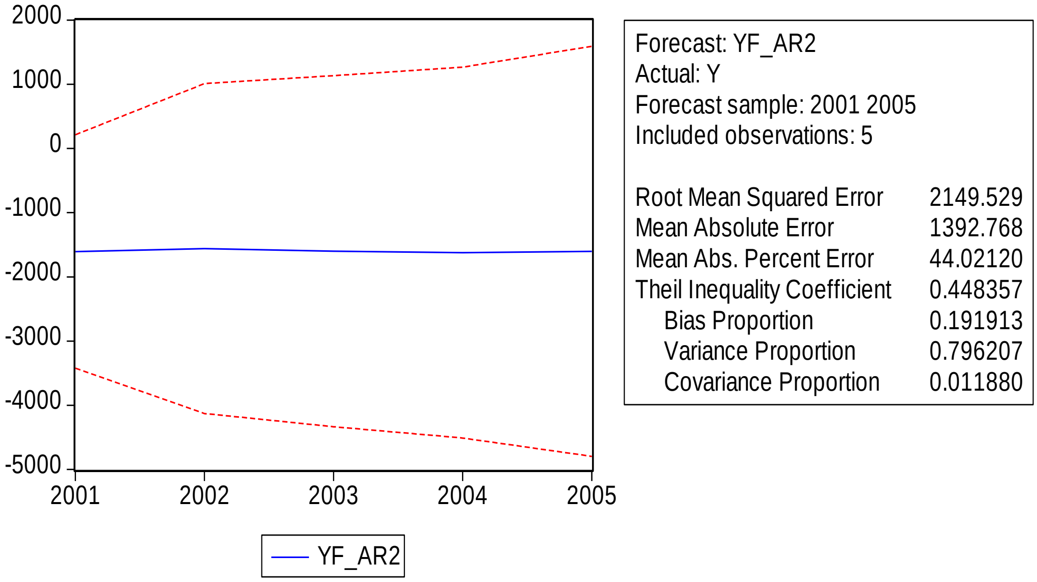


Fig 3.6

MA (1)

The model MA(1) obtained by taking the first difference of the data for the balance of trade by removing the last five years values is shown below.

Dependent Variable: DBAL_OF_TRADE
Method: Least Squares
Date: 06/07/09 Time: 01:15
Sample (adjusted): 1973 2000
Included observations: 28 after adjustments
Convergence achieved after 7 iterations
MA Backcast: 1972

	Coefficient	Std. Error	t-Statistic	Prob.
MA(1)	-0.310898	0.183399	-1.695203	0.1015

R-squared	0.036906	Mean dependent var	-59.58214
Adjusted R-squared	0.036906	S.D. dependent var	704.3510
S.E. of regression	691.2315	Akaike info criterion	15.94989
Sum squared resid	12900628	Schwarz criterion	15.99747
Log likelihood	-222.2984	Hannan-Quinn criter.	15.96443
Durbin-Watson stat	1.837164		

The model is insignificant for MA(1) after excluding the last five years values.

Forecasted graph for the series.

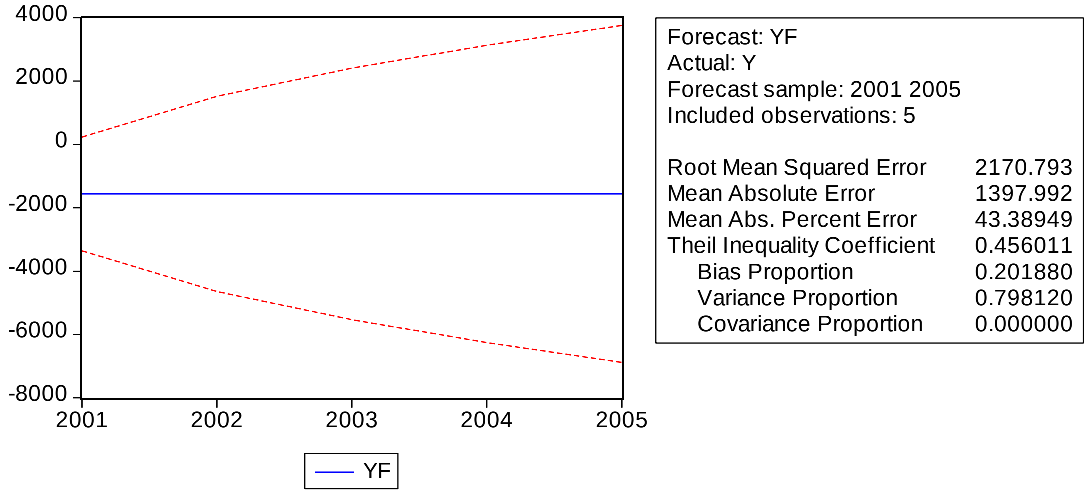


Fig 3.7

The model MA(1) until year 2000 is insignificant. In addition MSE of AR(2) is small compared to MA (1) model. The Coefficient of determination of AR(2) is greater than MA(1). We prefer the forecasting on the basis of model AR(2).

The model AR(2) for the first difference of data for balance of trade is significant when we exclude the last five year values. We forecast the values for the model AR(2) for the last five years.

Years	$\mathbf{Y_i}$	$\mathbf{Y_i}$ **estimated**	**Ei=**$\mathbf{Y_i}$**–**$\mathbf{Y_i}$ **estimated**	$\mathbf{Ei^2}$
2001	215.8	73.57	142.23	20229.3729
2002	330.1	39.39	290.71	84512.3041
2003	130.4	-30.39	160.79	25853.4241
2004	-1861.4	-16.28	-1845.12	3404467.814
2005	-3308.9	12.56	-3321.46	11032096.53
Totals	**-**	**-**	-4572.85	14567159.45

Table 3.2

MSE = 14567159.45/5

MSE = 2913431.89

The mean square error (MSE) which is used as a monitor for a forecasting system, is high in this case. It shows that the forecasts cannot be expected to be accurate in this case. From the forecasted value of year 2005, it is clear that the gap in export and import commodities have increased significantly. We have forecasted for the series of first difference of data for balance of trade. The economy of Pakistan is highly susceptible to geo-political changes that are why we see a lot of noise in the data.

4. Summary and results

We used principal component analysis for the deduction of important variables which contribute towards the balance of trade in Pakistan. The principal components of the first three groups have significant effect on balance of trade; where as the principal component of fourth group is insignificant. Those three components are food, textiles and manufacturing. Both stepwise and multiple regression further analyse the components of the said three principal components. In the food category, food products and live animals (import variables) have significant effect on the balance of trade. In the textiles category, cotton fabrics, and floor covering and stripes have a significant effect on the balance of trade. In the manufacturing category, manufactured goods (imports), sports goods (export), leather (export), and fuel and lubricants (import) have significant effect on the balance of trade.

In the time series for the balance of trade from 1972-2005, the gap between imports and exports is continuously increasing, which leads us to conclude that we do not see any stationarity in the balance of trade in the long run.

Results

Food industry Fish, rice, vegetable and animal oils and live animals constitute the said industry. Improvement should be done in the quality and quantity of fish and rice so that we can increase its production manifold, thereby helping the export market. Also, effort needs to be put in improving the live stock, which would give us primarily two benefits. Firstly, Pakistan shall be able to meet the need of animal oils and live animals for meat, given its rising population and secondly, it shall benefit the export sector tremendously. Since, Pakistan is an agriculture based economy, it can give a boost to small enterprises, thus benefiting the economy of the country.

Textile industry Cotton/Textile industry should be promoted extensively because this industry is considered reliable for exports in Pakistan. This industry has generated a lot of revenue in the past and has a potential in creating a balance of trade in the future.

Manufacturing industry Leather and sports goods are helping the exports, whereas mineral, lubricants and machinery are dependent on imports. Mineral, lubricants and machinery are a vital industry for any nation and can play a pivotal role in the development of a nation like in the case of China. These industries must be promoted, even if that requires offering some incentives, so as to encourage the enterprise. For the balance of trade this sector, well sports and leather industry are a driving factor here. At the minimum, an attempt should be made to increase its exports, so as to decrease the unfavourable balance between exports and imports.

Limitations of the study

- The forecasting is for the difference of the balance of trade rather than the actual series of balance of trade.
- In this paper we have only 34 observations for the time series modelling which are not sufficient to draw reliable results for forecasting.
- The factor of population, which increased very fast, is not considered in the study which might have a significant effect on balance of trade.
- Currency exchange rate, foreign debt, foreign aid and trade of foreign services are not considered in the study.

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Appendices

Appendix 1 Principal component analysis

1.1 1st principal component of first group.

Table 1.1(a) Correlation matrix

	Fish & Fish Preparations	Rice	Food and Live Animals	Animals and Vegetable Oils
Fish & Fish Preparations	1,000	,584	,761	,828
Rice	,584	1,000	,405	,630
Food and Live Animals	,761	,405	1,000	,756
Animals and Vegetable Oils	,828	,630	,756	1,000

Table 1.1 (b) Component Matrix

	Component
	1
Fish & Fish Preparations	,926
Rice	,736
Food and Live Animals	,854
Animals and Vegetable Oils	,936

Table 1.1(c) Communalities

	Initial	Extraction
Fish & Fish Preparations	1,000	,857
Rice	1,000	,542
Food and Live Animals	1,000	,729
Animals and Vegetable Oils	1,000	,876

Table 1.1(d) Total variation

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,004	75,089	75,089	3,004	75,089	75,089
2	,617	15,432	90,521			
3	,211	5,270	95,792			
4	,168	4,208	100,000			

1.2 1st principal component of second group.

Table 1.2(a) Correlation matrix

	E_textileyarn	E_cottonf	E_floor	I_ manufacture
E_textileyarn	1,000	,841	,608	,686
E_cottonf	,841	1,000	,657	,834
E_floor	,608	,657	1,000	,791
I_manufacture	,686	,834	,791	1,000

Table 1.2 (b) Component Matrix

	Component
	1
E_textileyarn	,875
E_cottonf	,933
E_floor	,848
I_manufacture	,926

Table 1.2(c) Communalities

	Initial	Extraction
E_textileyarn	1,000	,766
E_cottonf	1,000	,871
E_floor	1,000	,719
I_manufacture	1,000	,858

Table 1.2(d) Total variation

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,213	80,327	80,327	3,213	80,327	80,327
2	,464	11,595	91,922			
3	,230	5,753	97,675			
4	,093	2,325	100,000			

1.3 1st principal component of third group.

Table1.3 (a) Correlation matrix

	E_Leather	E_sports	I_mineral	I_machinairy
E_Leather	1,000	,672	,644	,804
E_sports	,672	1,000	,570	,756
I_mineral	,644	,570	1,000	,656
I_machinairy	,804	,756	,656	1,000

Table1.3 (b) Component Matrix

	Component
	1
E_miscellaneous	,985
I_miscellaneous	,966
I_chemicals	,963
I_crude	,955

Table1.3 (c) Communalities

	Initial	Extraction
E_Leather	1,000	,804
E_sports	1,000	,737
I_mineral	1,000	,662
I_machinairy	1,000	,856

Table 1.3(d) Total variation

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,058	76,450	76,450	3,058	76,450	76,450
2	,446	11,142	87,592			
3	,319	7,972	95,563			
4	,177	4,437	100,000			

1.4 1st principal component of fourth group.

Table1.4 (a) Correlation matrix

	E_miscellaneous	I_miscellaneous	I_chemicals	I_crude
E_miscellaneous	1,000	,938	,946	,929
I_miscellaneous	,938	1,000	,908	,892
I_chemicals	,946	,908	1,000	,874
I_crude	,929	,892	,874	1,000

Table 1.4 (b) Component Matrix

	Component
	1
E_miscellaneous	,985
I_miscellaneous	,966
I_chemicals	,963
I_crude	,955

Table1.4 (c) Communalities

	Initial	Extraction
E_miscellaneous	1,000	,971
I_miscellaneous	1,000	,933
I_chemicals	1,000	,928
I_crude	1,000	,911

Table1.4 (d) Total variation

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,744	93,592	93,592	3,744	93,592	93,592
2	,129	3,215	96,808			
3	,090	2,246	99,053			
4	,038	,947	100,000			

Appendix 2 Stepwise Regression

2.1 One lag

Table 2.1(a)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,783[a]	,613	,600	715,6515
2	,885[b]	,782	,768	545,4053
3	,908[c]	,824	,806	498,4930
4	,923[d]	,853	,832	464,3658
5	,953[e]	,909	,892	372,4568
6	,962[f]	,926	,909	341,8812

Table 2.1 (b)

6	(Constant)	901,997	223,377		4,038	,000
	Manufactured Goods_i	-4,405	,465	-1,159	-9,472	,000
	Sports Goods_e	10,355	2,083	1,133	4,971	,000
	CottonFabric1	-1,695	,646	-,697	-2,625	,014
	Leather1	8,104	1,496	,598	5,417	,000
	Food and Live Animals_i	-1,768	,407	-,359	-4,344	,000
	Minerals1	-,374	,152	-,187	-2,459	,021

Table 2.1(c)

Residuals Statistics[a]	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	-6039,135	173,383	-2081,364	1089,3828	33
Residual	-900,7029	491,9792	,0000	308,1675	33
Std. Predicted Value	-3,633	2,070	,000	1,000	33
Std. Residual	-2,635	1,439	,000	,901	33

2.2 Two lags

Table 2.2(a)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,753[a]	,567	,552	725,6245
2	,869[b]	,755	,738	554,7085
3	,893[c]	,798	,776	513,1245
4	,940[d]	,884	,867	396,1875
5	,957[e]	,915	,899	345,3059
6	,965[f]	,932	,915	315,3553

Table 2.2(b)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	134,651	386,174		,349	,730
	Manufactured Goods_i	-2,907	,464	-,753	-6,264	,000
2	(Constant)	568,460	309,154		1,839	,076
	Manufactured Goods_i	-4,390	,474	-1,137	-9,269	,000
	Sports Goods_e	5,081	1,075	,580	4,726	,000
3	(Constant)	482,602	288,158		1,675	,105
	Manufactured Goods_i	-4,972	,499	-1,287	-9,956	,000
	Sports Goods_e	6,769	1,213	,772	5,578	,000
	Cotton_e	1,179	,486	,253	2,427	,022
4	(Constant)	840,871	236,494		3,556	,001
	Manufactured Goods_i	-5,193	,389	-1,345	-13,359	,000
	Sports Goods_e	10,567	1,265	1,205	8,353	,000
	Cotton_e	1,848	,404	,396	4,575	,000
	Animalsoil2	-2,129	,477	-,466	-4,469	,000
5	(Constant)	530,637	229,284		2,314	,029
	Manufactured Goods_i	-5,651	,370	-1,463	-15,280	,000
	Sports Goods_e	9,945	1,121	1,135	8,872	,000
	Cotton_e	1,400	,381	,300	3,677	,001
	Animalsoil2	-2,519	,434	-,552	-5,803	,000
	Floor Coverings & Tapestries_e	5,477	1,773	,306	3,089	,005
6	(Constant)	370,574	219,083		1,691	,103
	Manufactured Goods_i	-5,631	,338	-1,458	-16,665	,000
	Sports Goods_e	9,719	1,028	1,109	9,457	,000
	Cotton_e	,918	,398	,197	2,305	,030
	Animalsoil2	-2,688	,402	-,589	-6,684	,000
	Floor Coverings & Tapestries_e	6,423	1,663	,359	3,862	,001
	Cotton2	,740	,298	,157	2,485	,020

Appendix 3 Multiple Regressions

3.1 Balance of Trade on Exports

Table 3.1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,883a	,780	,697	643,4584

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	352,167	406,405		,867	,395
Fish & Fish Preparations_e	-13,460	6,559	-,564	-2,052	,051
Rice_e	-2,702	2,342	-,393	-1,154	,260
Cotton_e	,645	,827	,125	,779	,443
Leather_e	-,664	4,502	-,048	-,148	,884
Textile Yarn and Thread_e	1,105	,785	,466	1,408	,172
Cotton Fabrics_e	-6,851	2,026	-3,019	-3,382	,002
Floor Coverings & Tapestries_e	-2,261	5,249	-,137	-,431	,670
Sports Goods_e	16,990	3,742	1,802	4,541	,000
Miscellaneous(e)	,664	,269	1,414	2,473	,021

3.2 Balance of Trade on Imports

Table 3.2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	,908a	,825	,768	562,6643

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	622,157	390,206		1,594	,123
Food and Live Animals_i	,093	,797	,019	,116	,908
Crude Materials_i	1,302	,776	,577	1,677	,106
Minerals, Fuels, Lubricants_i	-,329	,313	-,159	-1,052	,303
Animals and Vegetable Oils_i	1,452	,956	,296	1,520	,141
chemicals_i	1,387	,415	1,008	3,343	,003
Manufactured Goods_i	-5,630	1,062	-1,504	-5,302	,000
Machinery and Transport equipments_i	-,239	,286	-,255	-,833	,412
Miscellaneous(i)	-,788	,338	-,680	-2,330	,028

3.3 Balance of Trade on Exports and Imports

Table 3.3

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	,945[a]	,893	,859	438,6910

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	714,606	257,140		2,779	,010
Fish & Fish Preparations_e	-10,098	4,735	-,423	-2,133	,043
Cotton_e	1,410	,592	,273	2,383	,025
Sports Goods_e	5,768	3,395	,612	1,699	,102
Miscellaneous(e)	,608	,270	1,295	2,252	,033
Crude Materials_i	-,516	,706	-,229	-,731	,471
chemicals_i	-,013	,442	-,009	-,029	,977
Manufactured Goods_i	-4,940	,698	-1,319	-7,077	,000
Miscellaneous(i)	-,743	,299	-,642	-2,482	,020