MODELING THE IMPACT OF EXPORTS ON THE ECONOMIC GROWTH OF PAKISTAN: A SUPER EXOGENEITY ANALYSIS

BY

AMBREEN FATEMAH

Registration No: PIDE2015FMPHILETS06

MPhil Econometrics

A Dissertation Submitted to the Pakistan Institute of Development Economics, Islamabad, in partial fulfillment of the requirements of the Degree of Master of Philosophy in Econometrics

Supervised By

Dr. ABDUL QAYYUM
Joint Director
PIDE

Department of Econometrics and Statistics

Pakistan Institute of Development Economics
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CERTIFICATE

This is to certify that this thesis entitled: **"Modeling the Impact of Exports on the Economic Growth of Pakistan: A Super Exogeneity Analysis"** submitted by Ms. Ambreen Fatemah is accepted in its present form by the Department of Econometrics and Statistics, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in **Master of Philosophy in Econometrics**.

Supervisor:

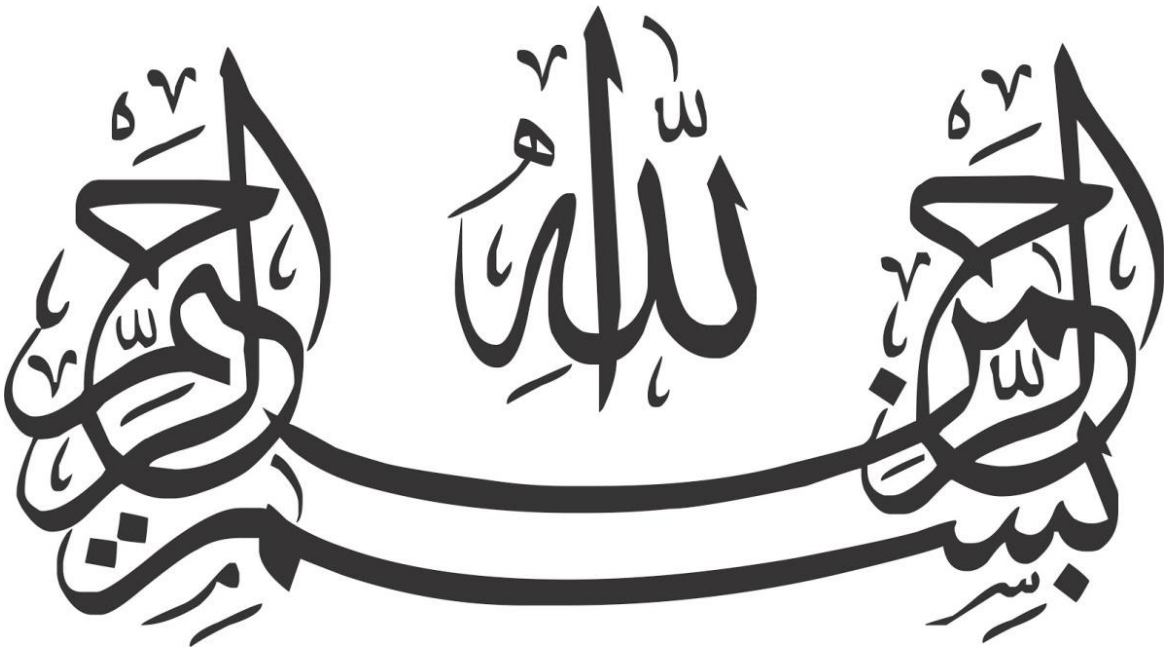
Dr. Abdul Qayyum
Joint Director
PIDE, Islamabad

External Examiner:

Dr. Zahid Asghar
Associate Professor
Quaid-e-Azam University,
Islamabad

Head,
Department of Econometrics and Statistics

Dr. Amena Urooj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This document represents part of the author's MPhil study program at Pakistan Institute of Development Economics. The views stated therein are those of the author herself and the work has been completed in a scheduled time.

Dedicated to my beloved Father WAZIR AHMED and Mother
My Support, My Inspiration & My World.

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AMBREEN FATEMAH

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Acronyms

AD Aggregate Demand

ADF Augmented Dickey- Fuller Test

AIC Akaike Information Criterion

ARCH Auto Regressive Conditional Hetroscedasticity

BLUE Best Linear Unbiased Estimates

BOP Balance of Payments

C_D Conditional Density Function

CI Cointegration

CPFTA China-Pakistan Free trade Agreement

CUSUM Cumulative Sum

DCPS Domestic Credit to Private Sector ratio

DGP Data Generating Process

ECI Economic Complexity Index

ECM Error Correction Model

ELGH Export led Growth Hypothesis

LM test Lagrange Multiplier Test

M_D Marginal Density Function

MLE Maximum Likelihood Method

OLS Ordinary Least Squares

PSFTA Pakistan-Sri lanka Free Trade Agreement

RGDP Real Gross Domestic Product

RX Real Exports

SAFTA South Asian Free Trade Agreement

SIC Schwartz Information Criterion

TFP Total Factor Productivity

VAR Vector Auto Regressive

VECM Vector Error Correction Model

Abstract

This study is an empirical investigation to Export led Growth hypothesis in case of Pakistan by applying maximum likelihood methodology and error correction model along with Super exogeneity. Whenever an econometric model is used for policy analysis, it's important to consider that the model is congruent and encompassing so that it conveys reliable inferences about policy responses in the DGP .Therefore, cointegration, invariance and exogeneity are focused The study proved that the exports are important and significant determinant of economic growth in Pakistan. The analysis also reveals that the exports along with labor force, investment and financial credit are important for the long-run as well as short run economic growth of Pakistan. The parameters of dynamic model are found to be super-exogenous for the relevant class of interventions which indicates that the dynamic error correction model can be used for policy analysis.

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Key Words

[Exports led Growth, Maximum Likelihood Estimation, Dynamic Error Correction Model ,Super Exogeneity]

Chapter 1

Introduction

The thought that export activity leads to economic growth has been liable to impressive level headed discussion in the advancement and development writing for a long time, [Keesing ,1967 and Krueger ,1978]. Export growth is considered the "engine" of economic development and growth, and contemporaneous relationship exists between them, [Nurkse (1961) & Tahir et al. (2015)]. This literature relates that export activity/outward orientation and development was known back since nineteenth century. Outward orientation is measured by some function of the trade flow of exports for the export-led growth (ELG) studies.

The ELG hypothesis suggests that the growth generation in the economy cannot be the result of enhanced labor and investments only but also by expanding the export sector. We restrain our consideration regarding this assortment of work. The promotion of exports and achieving the potential level are constructive for both industrialized and developing economies for many reasons as according to the neo-classical export led growth (ELG) hypothesis premise that export promotes economies of scale, labour productivity, progress through technological improvements, production of quality enhanced goods and services, reduce current account pressures, lessen the unemployment and other production factors and reduce economic inefficiencies and hence promote economic growth [Helpman and Krugman (1985), Kruger (1985), and Akbar et al (2005)].

In both long run and short run, the ELG hypothesis is supported in the Pakistan economy where sometimes accompanied by fluctuations too. Siddique et al. (2008). Pakistan real exports averaged around 3422.419 (Pak Million Rs) from 1971 until 2016, attaining the highest of 8315 million in 2013, accordingly real GDP fluctuations were also observed showing their relevance and impact.

Previously in Pakistan many studies have been conducted on the ELG model, the Short run and Long run relationships between Exports and economic Growth were estimated by the use of different estimation techniques like Cointegration, Granger causality , 3SLS etc and were applied on cross sectional, time series and Panel data sets across the World. Among all, for developing Economies (like Pakistan) the ELGH (Export led Growth Hypothesis) mostly proved valid. [,Shirazi and Manap (Pak 2005), Quddus *et al*. (2005), , Siddique *et al*. (2008) and Shahbaz *et al*. (2011) etc].

In any case, to test the appropriateness of their evaluated models that are being utilized for the forecasting and policy implications. The significant answer to these critical questions is given by the exogeneity theory, especially testing of interested parameter of super exogeneity.Ericson (1992).

Cointegration theory takes care of non-stationarity of data. The question arises accrding to exogeneity theory if the model that is estimated is really suitable for statistical inference, for forecasting, policy implications or not, Engle, *et al.* (1983) .It is worth using long data sets covering the period of reforms and to obtain current estimates of the Exports and Growth that can be used in the policy analysis by policy makers. It is worth claimed that the exogeneity analysis of parameters of interest is the requirement for policy analysis by utilizing the CI approach. The exogeneity of concerned variables depends upon the parameters of interest and the perspective of the model. Weak exogeneity is analyzed when

statistical inference or analysis is the requirement. Strong exogeneity becomes the concern . when ,the data needs to be forecasted for the future years and hence finally the significance of super-exogeneity lies in if study objective is that the(like Export led Growth) model can be used for policy analysis. [Ericson(1991), Ericson,Hendry and Mizon(1998) , David Hendry (1995), Ericson, Hendry and Ricardo (1991), Qayyum(2005)].

Subsequently, the purpose of the study is examination and testing the ELGH, (Export led Growth Hypothesis) considering the data of Pakistan. Following are the three distinct features of this study, in comparison to the bundles of empirical studies published on growth. First, the data gap uptil 2016 will be covered by using new econometric techniques. The exports as a factor of production provides a substitute procedure for capturing TFP growth. Next, focus of this study is on DC Pakistan for estimating the empirical link between the export extension and economic or output growth. Thirdly, this study leaves behind the outdated shortrun effects, and employs modern time series methods for examining the empirical long run relationships, and follow several procedures for testing super exogeneity. Finally , the objective of study is quantifying the significance of exports in the Pakistan's economy.

1.1 Objectives of the study

The main objective of the study is

- To model the impact of exports on the economic/output growth of Pakistan and Super Exogeneity analysis.

The specific objectives are as following,

1- To determine long run relationship among the variables using cointegration techniques by Johnson(1988).
2- To estimate the dynamic Error Correction Mechanism on Export-led Growth model.
3- Testing the super-exogeneity of concerning parameters of preferred model following Hendry and Ericson (1991) and Qayyum (2005)so that for policy analysis the concerned model can be used.

1.2 Hypotheses:

The hypotheses for this study are as under,

$\boldsymbol{H_{01}}$: There exists no long run association between the variables i.e. Rank $(\boldsymbol{\pi = \alpha\beta'}) = \boldsymbol{r = 0}$, r is the rank of the matrix

$\boldsymbol{H_{02}}$ **:** The estimated dynamic Error Correction Model is super exogenous for the GDP growth of Pakistan.

$\boldsymbol{H_{03}}$ **:** The exports policies (good/bad) are exogenous to Real GDP growth of Pakistan

$\boldsymbol{H_{04}}$ **:** Exports significantly impact the GDP growth of Pakistan

1.3 Significance of the study

The parameters of the reduced form model sometimes doesn't remain constant because of structural breaks like oil price shock, any financial change in economy, disaster etc. Hence the model that loses constancy of parameters in such situations cannot be fit for policy analysis, Lucas (1976). This creates the situation where idea of super-exogeneity becomes important, because it states empirical concerns for Lucas's critique, the instability of Export led Growth function and the invariance in the parameter of interest.

1.4 Methodology:

We will use different econometric techniques in this study organized as, firstly, for stationarity and the nature of data generating process of the series Dickey-Fuller test (1979) is used in this regard. Secondly, following Johansen (1988), variables having similar integration order can be analyzed for long run association i.e. whether there exists any longrun relationship among the variables or not. For this purpose, based on trace and maximum Eigen value statistics, Johansen Maximum Likelihood Ratio (LR) test is applied. Thirdly, we estimate the dynamic Error Correction Model (ECM) following Sargan, (1964). Finally, we test the exogeneity of parsimonious model following Engle at el. (1983), Ericson (1991, 1992) and David Hendry(1995).

1.5 Data source

Pakistan's annual time series data is used from the period 1971 to 2016 and gathered from national data sources i-e Government of Pakistan (Economic Survey of Pakistan, Various issues) and State Bank of Pakistan.

Variables used in this study are; Real exports (Million Rs) , real Gross Domestic Product (Million Rs), inflation , Labor force participation rate ,Real Gross fixed capital formation(Million Rs) , DCPS (Domestic credit to private sector ratio as %age to GDP).

1.6 Organization of the Study

After the illustration of comprehensive introduction in Chapter 1, the remaining part of the study will follow as: Apart from a detailed Review of Literature the Chapter 2 discusses the main research question and allied working hypothesis of the study. Chapter 3 explains the salient features of Pakistan exports and economic growth , Chapter 4 is about theoretical and empirical methodology. A chapter 5 details about results, findings and discussions, and Chapter 6 finally concludes the overall work and policy implications related to the study.

Chapter 2

Literature Review

2.1 International review:

Although trade and economic growth remained part of discussion on the theoretical grounds for over last centuries, but debates regarding the real effects are still at rise. The discussions regarding trade leads back to the classical school of economic thought that begun in nineteenth century with Adam Smith as pioneer and which were subsequently enriched by the studies of Mill. J (1817,1869), Ricardo (1891), Mill J.S (1969), and later by Bhagwati (1978) etc. there are different studies that have been conducted for investigating the impact of exports in the process of economic growth ,since the late 1960s,. Though the empirical literature is considered to be vast but its results are clearly conflicting for both developing and industrialized economies.

For the past thirty years, policies relevant to exports are playing a vital role in the growth of Developing countries (DC),Export-led growth is a development strategy aimed at growing productive capacity by focusing on foreign markets, promoting product development; and exposing firms to competition , a feature that could explain why economies (South Korea, Hong Kong, Singapore, and Taiwan), the so-called Four Tigers, have been successful in achieving high and sustained rates of economic growth , Palley (2011).

Moreover, in the last decade there has been an astonishing and impressive recommencement of activity in the economic growth literature triggered by the endogenous growth theory, by using different econometric techniques the ELGH was observed like cointegration, granger causality,3SLS etc. Some studies used rank and simple cross-correlation techniques under bi-variate model and applied ordinary least square (OLS) estimation method. The correlation coefficient explained high correlation between exports and GDP growth. The authors assumed this positive correlation as adequate evidence for ELG hypothesis. Nevertheless, this argument was criticized because of inappropriate econometric technique that results in spurious correlation and misleading outcomes . Moosa (1999), Keong *et al.*, 2005, Ghatak and Price (1997).

Boltho (1996) investigated ELG in case of Japan and results after estimation depicted that domestic forces rather than foreign demand propelled longer-run growth and export showed continuous cyclical fluctuations and Henriques and Sadorsky (1996), investigated the export-led growth hypothesis for Canada and founded one-way Granger causal relationship , whereby changes in GDP preceded changes in exports. Ahmed and Harnhirun (1996), worked on five ASEAN countries and found no statistical evidence of long-term relationship among exports to economic growth. Sinha (1999) estimated the relationship between export instability, investment and economic growth in Asian countries. and found positive relationship in case of Pakistan, Korea (South), Myanmar and Thailand whereas negative relation between export instability and GDP growth for Sri Lanka, Japan, Malaysia and Philippines while for India the results were inconclusive.

In different analysis,. Among many others, the causal relationship between exports and economic/output growth was found by Kravis (1970), Michaely (1977) Heller and Porter

(1978), Bhagwati (1978) and Marin(1992). Balassa (1978) and Krueger (1980) pinpointed that due to exports the echancement in production shows the great effect on economies of scale and other related externalities.

Ray (2011) performed timeseries analysis on exports and GDP of India and applied cointegration and Granger causality techniques. The results indicated the existence of short and long run cointegration between exports and GDP growth. The presence of bi-directional causality was also observed.

Kwan and Kwok (1995) ponder exports a major FOP in case of China and applied the Exogeneity techniques. Bahmani-Oskooee and Alse (1993) re-investigated the relationship in case of ELGH for nine Developing countries and found strong support for the export-led growth hypothesis for all the countries. Dutt and Ghosh (1996) and Xu (1996) found supportive results among 17 out of 32 economies under study. The analysis were checked for different data sets like time series, cross sectional and panel. Although in many models the trade and growth nexus has been emphasized, they highlighted that one of the major variables enter the growth function is trade. But, the supporters of the ELGH have stressed that the main engine of South East Asian growth is because of exports.

On the contrary Researches that do not support ELGH contain, Kormendi and Meguire (1985), , Gonçlaves and Richtering (1987), Helleiner (1986), De Gregorio (1992), Yaghmaian and Ghorashi (1995), and Burney (1996). As it is problematic to isolate why these studies did not supported ELG hypothesis while other studies do but the only reasons we found are different country data sets, time periods variability,socio-political behviours and variable definitions.

All of above mentioned studies worked upon the ELGH by the consideration of variety of econometric techniques but no one employed super exogeneity while modelling (except in case of China by Kwan and Kwok(1995)).To check the model stability and for policy implications as proposed by Engle, *et al.* (1983), Johansen (1991) Ericsson (1992,1998),and Hendry(1998)

2.2 Review in Context of Pakistan:

Sherazi & Manap, (2005) investigated ELGH for Pakistan. They have used CI and multivariate Granger Causality [developed by Toda and Yamamoto (1995)] to investigate the long-run and short- run relations between the growth of exports and output over the timespan of 1960 to 2003. Some recent studies on Pakistan posit that with modern technologies the economic growth can be accelerated by exporting manufactured goods produced [Saeed et al. (2005)].

The long-run relationship among export and output growth has been supported by the empirical results .The study found one directional relationship from export to output growth. [Siddique et al, (2008)]. Quddus and Saeed (2005) also found in the long run there exist a unidirectional causality going from exports to economic growth and results also shows the positive effect the growth rate of exports, total investment, and labor employed have on GDP growth rate.

Exports are highly observed to be causative in many studies. In developing economies such as Pakistan, who has adequate domestic resources, export expansion still depends on the import of certain goods that help in the production of export driven goods

hence play a key role in the indirect channel towards development. Hence, Pakistan still needs to access the necessary required technology in order to hold a competitive position. The theoretical argument is that, export growth enhances the openness of the economy and, by the exposition to foreign technology and foreign competition, incites a rapid technological progress.Overall, these authors recommended that countries with a higher export growth rate over a longterm period tend to grow faster than others.

Considering some other studies conducted recently in Pakistan also include Khan and Saqib (1993), who employed simultaneous equation model and came across a positive relationship b/w exports and economic growth of Pakistan. For the case of Pakistan two directional causality among export growth and economic growth is validated by Khan, *et al.* (1995) . Rana (1985) estimated a production function with increase export effect for Pakistan and almost other 14 developing Asian economies. Their evidence concluded in the contribution of economic growth ,exports have major and positive effect. Similarly Anwar and Sampath (2000) examine the ELGH for 97 countries together with Pakistan covering 1960–1992 time period and end up with finding a unidirectional causality in case of Pakistan.

Apart from finding positive relationship while employing ELGH ,there are researches which concluded rejection. Mutairi(1993).ELGH including foreign dept was investigated for Bangladesh, Srilanka India, Pakistan, and four South East Asian states using a trivariate causality framework but ELGH was rejected(except Bangladesh) [Ahmed, *et al.*(2000)].
Kemal, *et al.* (2002) investigated ELGH for five South Asian Nations including Pakistan and The study found no evidence of causation in the short run for Pakistan However, they reported strong support for long-run causality. [see also Afzal and Hussain (2010)].

By studying the previous literature its inferred that uptil now super exogeneity on the case of Export led Growth is rarely applied[1] so, by the application of advance econometric techniques of exogeneity , the Export led Growth hypothesis can be checked as a contribution to Pakistan's econometric literature desk .

2.3 Concluding Remarks

By considering the above literature ,both theoretical and empirical sides are keenly analyzed The literature is divided into two sections i-e International and national review. This study is purely based on Pakistan so by the application of Super Exogeneity technique ,this study covers the literature gap mentioned above.

[1] Qayyum(2005),Jawad(2014),Haider(2014) have employed Exogeneity in case of Pakistan in their studies but by considering different economic theories and models.

Chapter 3

Salient Features of Pakistan Exports and Economic Growth

3.1 Introduction

Pakistan according to OEC reports is among the 66th largest export economy in the world and the 87th most complex economy according to the Economic Complexity Index (ECI). (The Observatory of Economic Complexity ,2015[2]). Exports play as a role of engine in driving the level of economic growth, employment and the balance of payments (BOP) in any economy. Exports in Pakistan averaged 38619.28 PKR Million from 1950's until 2016, reaching at all time high of 2366478 PKR Million in 2013 and a record low of 51 PKR Million in 1958.

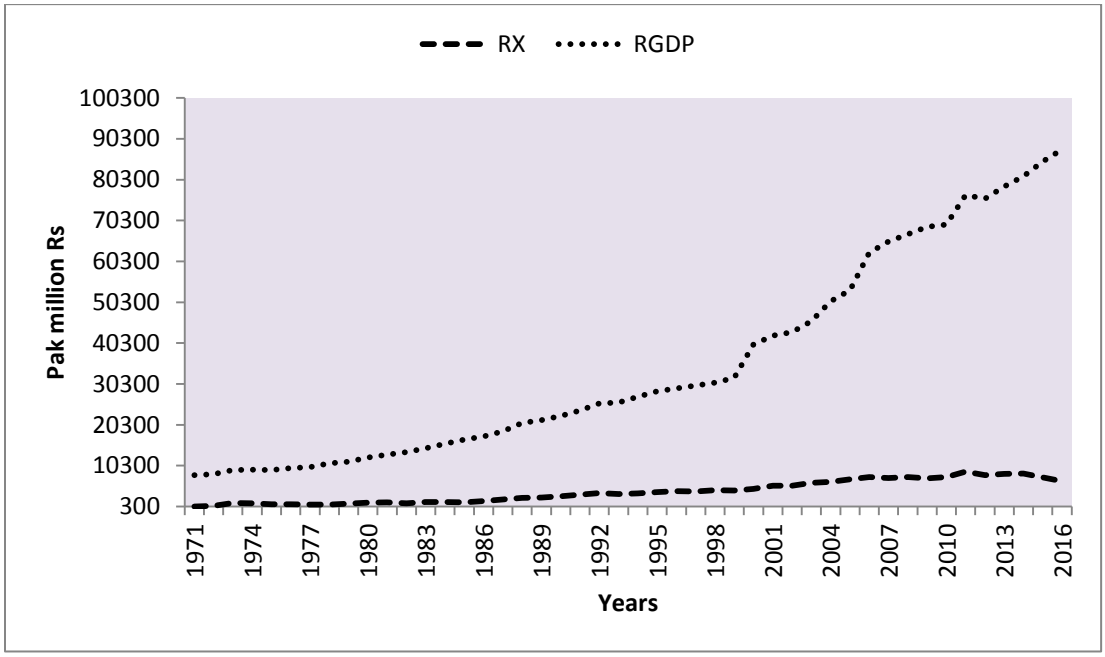
3.2 Pakistan's Export and GDP growth :

On comparative analysis from 1971 to 2016 we came across that Pakistan is an illustrative example towards Export led Growth .Although Pakistan is naturally enriched with the most diverse agro climatic zones and plenty of resources but fluctuating and trembling political hold, over decades didn't let the industries to fully bloom and to show upto their full potential ,that is why Pakistan export's share in the GDP growth is far behind the industrialized economies .Analyzing the figure 3.1 , the contribution of Export sector in

[2] Pakistan exports almost 229 products with revealed comparative advantage (i-e its share of global exports is larger than what would be expected from the size of its export economy and from the size of a product's global market).

growth can be easily judged ,only in the last decade the graph shows a little supportive towards ELGH

Figure 3.1: Real Exports and Real GDP of Pakistan , Comparative Analysis (Pak million Rs) from 1971-2016



3.3 Pakistan Exports and Trading Partners

Pakistan exports include mainly agricultural products like rice, oranges , mangoes, furniture, cotton fiber , beverage and tobacco (13 %). livestock, and sea food etc. Because of her agro climatic zones and fertile lands , agriculture is often considered the back bone of Pakistan's economy. Pakistan also exports mineral fuels (19 % of the total shipments), manufactured/industrial goods (19 %) Others include: food and live animals (11 %), crude materials (11 %), chemicals (11 %), machinery (8 %) and miscellaneous articles (8 %).

According to the recent survey by OEC the billion share of the main products include Rice ($1.91B), House linens ($2.99B) , Rice ($1.91B), Non-Retail Pure Cotton Yarn ($1.75B), Non-Knit Men's Suits ($1.49B) and Heavy Pure Woven Cotton ($1.01B)(Revising 1992, HSC). Defence equipment (submarines, tanks, radars), salt, onyx, engineering goods, and many other items are also currently manufacturing and in the export lists

Main export partners are United States (13.6%), China (11 %of the total export), Germany (9%), United Arab Emirates (8.5 %) , Afghanistan (10%) and Saudi Arabia (8.5%). Pakistan also produces and exports cement to Asia and the Middle East. In August 2007, Pakistan started exporting cement to India to fill in the shortage there caused by the building boom. Russia is a growing market for Pakistani exporters.

3.4 Reviewing highest Exports (2013) of Pakistan:

The highest exports were observed in 2013 in Pakistan's history. After a very long time of independance ,Pakistan somehow better established the trade linkages in relation to her past but still at this point when the data of Pakistan's imports were compared ,the results showed the imports of 31.5 million which were very high as compared to 17.3 billion of exports (2013 Figure 3.1). One of the reason of Pakistan's dependency in case of imports is excessive China's cheapest products takeover. For automobile, textile, machinery , and even food etc we are making ourselves dependant by closing down the small industries. Here an attention from government is required.

By reviewing the competitiveness, quality addition in the products, exchange rate depreciation ,analyzing longrun data behaviours and economic growth of different countries the problems of in export industry can easily be tackled.

3.5 Economic Policies and Export Promotion

In relevancy to international situations and issues ,Government of Pakistan has taken certain initiatives to promote economic growth through re-establishment of trade with other economies. This study will only focus on export relevant policies .

The package named 'Export led Growth' has started this year 2016 , and is showing great progress.Number of policy measures in the Strategic Trade Policy Framework has been announced for technological developments , to overcome the financial constraints Govt. established the Exim Bank which will later take its part.International connections with EU is also in a process of negotiations .E commerce and IT sectors are also taken into consideration for Export promotion.Different agreements are also in progress like Malaysis-Pakistan FTA , CPFTA, PSFTA, SAFTA etc.Pakistan is hoping for a contributory significant export role in the economic growth of Pakistan.

3.6 Conclusion

This chapter throws light to export and growth sector of Pakistan and how they are linked, basically it covers the the salient feature of Pakistan export industry The main products that Pakistan exports , to which countries we are trading partners and which policies are affecting this partnership is all summarized.

Chapter 4

Methodology

4.1 Introduction

The suitable technique and to design right methodology are thought to be as main focus of any research study. In case, if the decision of suitable methodology is not proper, than the effect of study is not any more productive. The primary target of this chapter is to clarify the different econometric tools and technique that are used in this study alongside data collection, interpretation and analysis of data .The description of data, respective source and methodology employed for their analyses are also explained in this chapter. Earlier it was considered that the time series data was stationary but as the time went on, the expansions in time series econometrics exposed that most of the time series data was non-stationary ,Thomas (1997). and if the data is non-stationary then the use of Ordinary least square (OLS) method to analyze such data wasn't appropriate at all, Granger and Newbold (1974).

Firstly after data description ,Augmented Dickey-Fuller test (1979) is used to test the stationarity of the data. Secondly, if the variables have same integration order then these variables can be tested for cointegration analysis i.e. the long run relationship. For this purpose, Maximum Likelihood Ratio (LR) test based on trace statistics and maximum Eigen value statistics following Johansen (1988) is applied. Thirdly, based on Granger representation theorem (Granger, (1986)) which tells us that a dynamic model can be expressed as Error Correction Model if there is a long run relationship between two non-

stationary variables. We estimate the frugal dynamic Error Correction Model (ECM) following Sargen (1964). Finally, we will test the Super exogeneity of frugal model following Hendry and Ericson (1991), Ericson, (1992) and Qayyum (2005)

4.2 Theoretical Model

Export-led growth hypothesis in Pakistan is the growth model based on aggregate production function and it started with neoclassicals like Solow and Swan (1956) .Exports and other variables may be added to capture their contribution to economic Growth as independent variables.

Following Krueger(1977), Feder (1982), Fosu(1982), Smith (2001), Balassa(1985),Siddique et al, (2008) ,and Lucus(1988), the model appears as

$$RY_t = f(K_t , L_t , RX_t , \pi_t , DCPS_t , u_t) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.1)$$

Real GDP (RY_t) is used instead of its growth rate as the dependent variable.The study goes beyond the traditional neoclassical theory of production by adding capital (K), Labour force participation rate (L_t),real exports (RX_t), inflation (π_t) as a measure of macroeconomic volatility, domestic credit to private sector (DCPS) as a ratio to GDP(i-e an indicator of financial development), as inputs of production using a linear equation.

This provides an alternative procedure to capture total factor productivity (TFP) growth. We model the relationship between real GDP and real exports not in a bivariate framework but in a multivariate one by including the other variables.

The equation captures the long run effects only.

$$LRY_t = \beta_o + \beta_1 LK_t + \beta_2 LL_t + \beta_3 LRX_t + \beta_4 \pi + \beta_5 LDCRPS_t + \varepsilon_t \quad \ldots \quad \ldots \quad (4.2)$$

Where

LRY_t = Log of real GDP

LK_t = Log of real gross fixed capital formation

LL_t = Log of Labour Force Participation rate of Pakistan

LRX_t = Log of Total or aggregate exports (real)

π_t = Inflation (annual % change in CPI)

$LDCRPS_t$= Log of Domestic credit to private sector (% to GDP)

ε_t ~ IID $(0,\sigma^2)$.

The dynamic error correction model(ECM) is as under,

$$\Delta \boldsymbol{LRY_t} = \boldsymbol{\beta}_o + \sum_{i=1}^{n} \boldsymbol{\beta_{1i}} \Delta \boldsymbol{LRY_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\beta_{2i}} \Delta \boldsymbol{LK_{t-i}} + \sum_{i=1}^{n} \boldsymbol{\beta_{3i}} \Delta \boldsymbol{LL_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\beta_{4i}} \Delta \boldsymbol{LRX_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\beta_{5i}} \Delta \boldsymbol{\pi_{t-i}} + \sum_{i=0}^{n} \boldsymbol{\beta_{6i}} \Delta \boldsymbol{LDCRPS_{t-i}} + \boldsymbol{\lambda ECM_{t-1}} + \boldsymbol{\varepsilon_{t-i}} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.3)$$

4.3 Empirical Methodology

Following four steps are followed in performing econometric estimations.

I. We will use ADF test of unit roots by Dickey and Fuller (1979, 1981),to check the stationarity of the data and to determine the order of integration for each variable.

II. The VAR model proposed by Johansen (1988) , is specified before the co-integration test. If all variables that are used in this study found to have same integration order i.e. I (1), therefore, a test based on Maximum Likelihood method is used to test the presence of co-integration among them as proposed by Johansen (1988).

III. The variables ,if are I(1), then the long run relationship is estimated using OLS method. The dynamic Error Correction Mechanism is used to estimate the short run adjustment of the variables.

IV. Engle et al. (1983), explains different concepts on weak, strong and supper exogeneity. Finally, we test the suitability of the estimated model i.e. whether it is used for forecasting or for policy analysis. Therefore, we test the super-exogeneity of concerning parameters of preferred model following Hendry and Ericsson (1991) and Qayyum (2005).

4.3.1 ADF Unit Root Test

Because of difficulty in determining the order of integration of DGP at level or at its differenced form by simple graphical analysis, autocorrelation or PACF functions, and by spectral density estimates, different tests on unit root have been developed. For this study the Augmented Dickey Fuller (ADF) test is applied to check the presence of unit root on the log data of all variables, using constant and trend. If the series follow the same order, like *I(1)* and the linear combination of these variables have order of integration less than the order of variables, then we conclude that there exists a long-run relationship between the variables. The optimum length of lags is decided upon minimum AIC and other lag length criterions. ADF test considers set of three equations which differ on the presence of deterministic components i.e. the constant and trend term. The general ADF equation is as following,

$$\Delta \log(x_t) = \alpha + \beta t + \rho \log(x_{t-1}) + \gamma \sum_{i=1}^{k} \Delta \log(x_{t-i}) + \varepsilon_t \quad \dots \quad \dots \quad \dots \quad (4.4)$$

Where x_t denotes the variable to be tested, t representing the trend, γ shows the coefficient of autocorrelation, $\alpha \; and \; \beta$ are taken as parameters, ε_t is the error term, and t in subscript is showing the time period. Thus to test the stationarity of the series one of these three auto-regressive processes can be used with no intercept or trend, including intercept but no trend, and having both intercept and trend terms in it. Lag length is determined by serial correlation LM-test. The one-tailed null hypothesis is:

H_0: $\rho = 0$

H_a: $\rho < 0$

If H_0 is rejected, that means all the roots lie within the unit circle therefore stationary. If H_0 is not rejected, we will say there is a unit root and series is not stationary.

Initially, we apply the test on data series at levels, and if non-stationary at level, then we go for first difference of the series beforethe application of ADF test. If the first difference of the series is non-stationary then take second difference and process continues until the series become stationary. To achieve the stationarity of the series by differencing is concerned with the number of unit roots present in that series. Furthermore the ADF test statistic is based on t-statistic [(Fuller, (1976), Dickey and Fuller (1979)] which does not follow the asymptotic standard normal distribution but it follows non-standard limiting distribution while the critical values using simulation were obtained and are available in Fuller (1976), Davidson and MacKinnon (1993). If the value of ADF test–statistic is less than critical value (at 5% level of significance) then null hypothesis will be rejected and we can say that series is stationary

4.3.2 VAR Model

As per reviewing different literature its observed that Sims (1980) had introduced the concept of VAR model for multivariate analyses. The AIC ,SBC, and HQ criteria were the basis through which the decision about the adjusted LR test statistics and optimal lag length

of the variables is made. Dynamics of VAR is usually difficult to interpret ,however there are some authors who interpreted the VAR coefficients as the long run elasticities e.g. Hallam and Zanoli, (1993) and is followed by many researchers as Ahmed (2011); Smith (2001). Moreover , Johansen (1988) suggested that Error Correction Mechanism (ECM) can be achieved through different methods. Obtaining VECM through the application of VAR process is one of them. We applied conventional time series techniques for attaining the stationarity of the data series and for checking the interdependence of the variables, VAR ECM is estimated.

Hence, k-dimensional VAR process is opted, as mentioned

$$X_t = u_t + a_t \sum_{i=1}^{k} X_{t-i} + u_t + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.5)$$

Where X_t is vector of variables that are used in this study i.e $LRY_t, LK_t, LL_t, LRX_t, \pi_t and\ DCPS_t.$, u_t is a constant term and ε_t is white noise error term i-e IN(0, Ω).

The VAR model proposed by Johansen (1988), is specified before the co-integration test. If all variables that are used in this study found to have same integration order i.e. I (1), therefore, a test based on Maximum Likelihood method is used to test the presence of cointegration among them as proposed by Johansen (1988).

The likelihood function is

$$\mathrm{L}(\alpha, \beta, \Lambda) = |\Lambda|^{-\mathrm{T}/2}\mathrm{EXP}[-\frac{1}{2\sum_{t=1}^{\mathrm{T}}(\mathrm{R_{0t}}+\alpha\beta'\mathrm{R_{kt}})}{}'\Omega_t^{-1}(\mathrm{R_{0t}} + \alpha\beta'\mathrm{R_{kt}})] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.6)$$

4.3.3 Test of Cointegration

Cointegration (CI) as an econometric technique estimates the long run(LR) relationship among variables in the relevance to the application of particular statistical models. The presence of CI for statistical inferences is provided by the statistical theory on specific unit root processes and with the help of CI the dynamic ECM is effectively obtained, Neil R. Ericson (1991).

Following Granger (1981,1986), Granger representation theorem asserts if two variables are non stationary i-e I(1) and have cointegrationg relationship it means longrun relationship exists among them. Engle and Granger (1987) gives an argument that Cointegrated variables must have a representation of ECM, or otherwise the regressions will be based on spurious correlations. The core concept behind cointegration is to explain the stable relations of the economy through linear combinations which are more stationary than the variables under consideration

Engle and Granger (1987) proposed the two step CI test also known as Residual based test but as limitation this test cannot estimate when variables appear more than two. Another test of cointegration is called autoregressive distributive lag model (ARDL) or unstructured vector error correction model (UVECM) by Pesaran et al (2001) which can be used only when I(1)/I(0) both types exist and that can be mutually cointegrated. So,not fulfilling the assumptions of ARDL ,maximum likelihood method (MLE) is followed. Johansen (1988) presented the Maximum Likelihood Method for the estimation of more than one cointegrating vector and all variables should have same integration order I (d) i.e. I (1). In Johansen cointegration test all variables are taken as endogenous so the problem is avoided. Another advantage of this approach is that we can estimate the cointegrating vectors

empirically. If deterministic trend is present in I(1) variables, this leads us to the two types of cointegration: *Stochastic cointegration* and *Deterministic cointegration* (see Campbell and Perron (1991)).

- A vector $\boldsymbol{X_t}$ of I(1) variables with cointegrating rank *r is* called *stochastically cointegrated,* if there exist *r* linearly independent combinations of $\boldsymbol{X_t}$which are I(0).
- A vector $\boldsymbol{X_t}$ of I(1) variables with cointegrating rank *r is* called *deterministically cointegrated* if there exists *r* linearly independent combinations of $\boldsymbol{X_t}$ which are I(0) stationary with no deterministic trend (Madalla and Kim, 1998)

Let assume that the vector of variables $\boldsymbol{X_t}$, has the following representation;

$$X_t = u_t + \sum_{i=1}^{k} \pi_i \, X_{t-i} + \varepsilon_t \qquad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \qquad (4.7)$$

Here, X_t represents a vector of given variables of the model, u_t shows a constant term, $\boldsymbol{\pi_i}$ is rank of the matrix and ε_t is IN(0, Ω) disturbance term.

The Johansen's Maximum Likelihood approach is emphasized on the relationship between characteristic root and rank of the matrix. The rank of a matrix equals number of characteristic roots that are not equal to zero (i.e $.\lambda_{i,s} \neq 1$ represents total number of cointegrating vectors).

There are three cases that can be analyzed:

1. If Rank (π) = 0: There are no cointegrating relations among the study variables that are used. In other words , all rows of the matrix are linearly dependent, so the system is non-stationary.

2. If Rank (π) = k (No. of variables), if this happens then it means that the rank is full, therefore π is nonsingular matrix which shows that all rows or columns are linearly independent and all roots lie in interior of unit circle with the condition $|\lambda_{i,s}|<1$, implies that the system is stationary and variables have consistent means atlevels. In this case, estimation with unrestricted OLS, the VAR at level and ECM will provide same results. The concept $\pi = \alpha\beta'$ Where α is a (k x r) loading matrix, estimates the average speed of convergence towards long run equilibrium and β is a (k x r) matrix consisting upon parameters which determine the number of cointegrating vectors.
3. If Rank (π) = r < k. The system is non-stationary but there exists r, CI relationships among the variables i.e. there are r linearly independent rows, thus there exist r linearly independent combinations that are stationary.

There are two LR test-statistics used to test the number of CI relationships between RGDP (Growth) and its determinants based on characteristic roots named as, Trace Statistic and Maximum-Eigen Value Test Statistic as used .

Trace test:

It can be inferred that the trace test is a joint test for significance as compared to the Maximum-Eigen Value test. The Trace Test Statistic is as follow

$$\lambda_{tra}(r) = -T\sum_{i=r+1}^{k} log_e(1-\lambda_i) \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (4.8)$$

Where λ_i are eigen values corresponding to eigen vectors v_i of the π matrix and can be arranged in a descending order as $\lambda_1 > \lambda_2 > \lambda_3 \ldots\ldots > \lambda_k$. Following hypothesis will be tested;

H_o: rank k (π) ≠ r where 0 < r > k

Ha: rank k (π) > r

Maximum-Eigen Value Test

It tests that how many numbers of Eigenvalue are not equals to zero. It can be verified through following hypothesis

H_o: rank (Π) = r

Ha: rank (Π) = r + 1

The test statistic can be seen as follows

$$\lambda_{max}(r, r+1) = -Tlog_e(1-\lambda_i) = \lambda_{tra}(r) - \lambda_{tra}(r+1) \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.9)$$

Note that these test stats are distributed as $\chi^2 \sim r(k-r)$ when t→ ∞ . Note that if these two tests reports different number of cointegrating vectors then choose trace test as it is more powerful than maximum-eigen value test because it contains all k-r values of the least eigen vector and in case of non-normality Chuengand Lai (1993) preferred trace test over maximum-eigen value test.

4.3.4 Dynamic Error Correction Model

Having established that a cointegrating relationship exists among the variables, a Vector Error-Correction Model (VECM) is estimated to determine the dynamic behaviour of the growth equation[e.g Johnson and Juselius(1989)]. The Error Correction Mechanism was first used by Sargen, (1964) The error correction model captures the short run dynamics of the system.With manipulation in equation 4.7 , The general modeling based on the ith adjustment to equilibrium period is,

$$X_t = \pi_i X_{t-i} + u_t + \sum_{i=1}^{k} \Gamma_i X_{t-i} + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.10)$$

Here, X_t in the model is vector of included variables, μ_t represents constant term , noise term(ε_t is IN(0, Ω)) and here error correction term whose coefficient is expected to be negative and significant and shows the speed of adjustment in the model and remaining

coefficients in the model are short run dynamic coefficients which shows the adjustment of the long run equilibrium.

4.3.5 Testing Super Exogeneity

Engle, *et al.* (1983) explains the different concepts of weak, strong and super exogeneity. There are three main purposes of the model which are whether it can be used for the statistical analysis, for multi-step ahead prediction or it can be used for policy purposes. The answer lies in weak exogeneity, strong exogeneity and in super exogeneity respectively. A valid exogeneity assumption could encompass any or all of inference, forecasting, and policy. But if these assumptions are invalid, then estimation of the conditional model alone can lead to a wasteful or unreliable inferences, and then the result obtained will be misleading.

Sometime because of a structural break in the economy like an earthquake disaster, oil price shocks or ER fluctuations etc ,the model parameters of reduced form model, like Equation (4.10), loses constancy. Hence ,that model which holds non-constant parameters could not be used for policy analysis by policy makers [Lucas (1976)]. In this specific case the concept of super-exogeneity is important, because it has empirical concerns for Lucas's critique, instability of growth function, and invariance in the parameters of interest.

By following Ericsson and Hendry (1991), Hendry at el.(1993) and Qayyum (2005) ,the conditional and marginal models will be made and interrelated to check exogeneity conditions.

For this, joint density function can be factorized into the conditional density function of y_t $(real\ GDP)$ given z_t $\left(i.e., F_{\frac{y}{z_t}}\left(\frac{y}{z_t}; \lambda_1\right)\right)$ and the marginal density function of z_t $(i.e., F_{z_t}(z_t;\ \lambda_2))$.

The dynamic conditional density function C_D for real GDP can be written as

$$\Delta y_t = \omega \Delta z_t + \sum_{i=1}^{k} \Gamma\Delta\, y_{t-i} + \prod x_{t-i} + u_t + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.11a)$$

And the marginal density function M_D of z_t is written as;

$$\Delta z_t = \alpha_z \beta' x_{t-i} + \sum_{i=1}^{k} \Gamma\Delta\, x_{t-i} + u_t + \varepsilon_t \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (4.11b)$$

Here, $\boldsymbol{z_t}$ is basically vector of all independent variables used in the model .The conditional model (Equation 4.11a) considers the immediate effect that change in $\boldsymbol{z_t}$ has on the change in $\boldsymbol{y_t}$,the term $\prod \boldsymbol{x_{t-i}}$ (with the condition $\Pi < 0$ i-e requirement for the dynamic stability of concerned model) which shows the effect on change in $\boldsymbol{y_t}$ of having $\boldsymbol{y_{t-i}}$ out of equilibrium with $\boldsymbol{\beta z_{t-1}}$. The solution for ECM to be static in the long-run requires $\boldsymbol{y_t}$= $\beta \boldsymbol{z_t}$. Inspecting the model closely indicates that the CI vector (β) enters into both conditional(C_D) and marginal function (M_D). In such specific situations the parameters of C_D and M_D are organized and consistent , which indicates that complete model analysis is required for getting inference about the parameters proficiently. On the other hand, if $\boldsymbol{z_t}$ is weakly exogenous for the parameters α and β , then the facts about the CI relations and the adjustment coefficients of C_D model are equal to the information collected from the complete system analysis [Engle, *et al*. (1983)].

One of the main objective of the concern study is testing the exogeneity of preferred GDP growth function. Basically we are trying to examine whether the estimated dynamic model can be perfectly used for forecasting and policy implications or not ? . The solution to this question lies in the exogeneity analysis of the concerned parameters of conditional model. Engle, *et al.* (1983) presented three different and interrelated concepts of exogeneity i-e weak , strong and super Exogeneity. Econometric theory indicates the significant conditions for the presence of weak exogeneity .The conditions are as under

(i) The parameters of interest be a function of C_D function parameters only, and

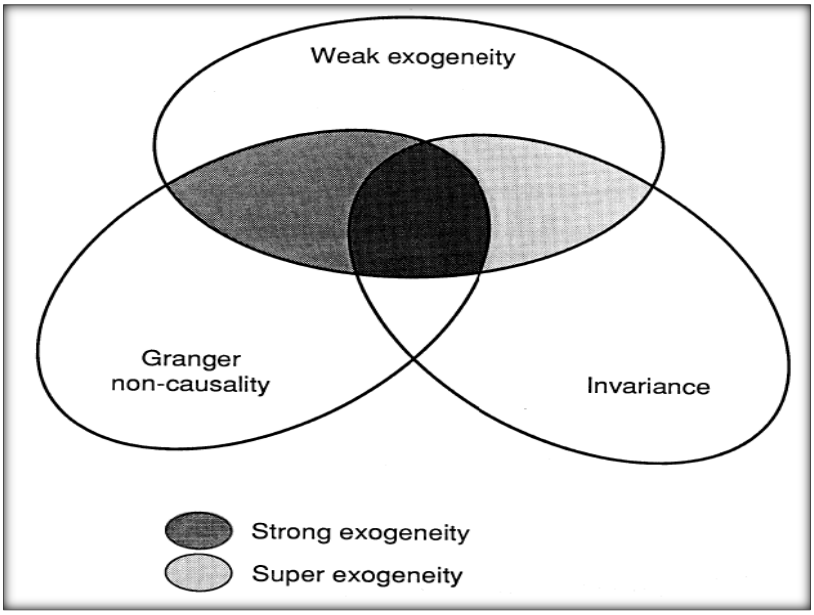
(ii) Their should be no variation in the parameters of conditional and marginal models.[Ericsson (1992)].

Moreover, If the parameters of CI vector (β) are the parameters of interest, then the restriction that $\alpha_z = 0$ on the marginal density function (Equation 4.11b) confirms the weak exogeneity of z_t However, in such conditions other loading parameters enter the conditional model. This results in concluding that the parameters of C_D and M_D models are free of variation as explained by Johansen (1991).

Considering the dynamic model as related to this study, the concept of strong exogeneity appears most relevant. The strong exogeneity is the blend of two significant features i-e weak exogeneity and the Granger non causality [see Ericsson (1992)]. The presence of strong exogeneity allows multi-step-ahead predictivity of output or GDP growth from the model, conditional on predicting z_t generated from M_D model with conditions that $\alpha_z = 0$, when prediction of z_t depends on the lags of their own.

Super-exogeneity comes in relevancy when we talk about policy analysis. Super-exogeneity is also a mix of two significant conditions i-e weak exogeneity and invariance [Ericsson (1992)]. This whole scenario is explained through Venn diagram as,

Figure 4.1 Venn Diagram for Exogeneity



Existence of super exogeneity is basically to ensure the validity of policy implications. For policy analysis we need to introduce changes in the M_D processes. The conditional model is only valid when the parameters of C_D model remain invariant to the changes in the M_D models. The reply to the significant question for the validity of estimated dynamic model for policy analysis or not? lies in the super exogeneity analysis of a variable w.r.t specified class of interventions. The non-constancy in the reduced form equation can be due to some exterior shocks such as any disaster, crises, policy changes or financial innovation. In such case the factorization of the general joint density function into conditional function and marginal model helps in the isolation of these shocks. This implies that the shocks only affect the marginal process parameters whereas the constancy of conditional model parameters retains. This infers that the parameters of conditional model

are invariant to the interventions to the marginal model. In other words, the conditional model parameters do not depend on the marginal process parameters.

4.4 Diagnostic Tests :

During the procedure of model selection, different tests will be applied to identify the problem of autocorrelation, non-normality and Heteroscedasticity. To detect these problems Breusch-Godfrey Serial Correlation LM test (1978), Jarque-Berra test (1980) (χ^2) of normality and White Hetroscedastisity (ARCH) LM test (F-stat.) respectively are applied. Finally the stability of the parameters of estimated dynamic error correction model is checked by CUSUM and CUSUMSQ suggested by Brown, Durbin and Evans (1975).

4.5 Concluding Remarks

In this chapter we have discussed some econometric techniques and methodologies such as Augmented Dickey Fuller test (1979) for stationarity, Johansen (1988) test of cointegration, the dynamic Error Correction Model following Sargen (1964) and finally different concepts of super-exogeneity and its validation following Hendry and Ericson (1991) and Qayyum (2005) are used for the autopsies of our results and findings. In the next chapter we will use the above mentioned techniques to cope up with our results.

Chapter 5

Results and Discussion

5.1 Introduction

This chapter discusses the results and discussions about the econometric analysis. These results are being estimated on the basis of methodology that is given in preceding chapter.

In this chapter section wise ,initial discussion is based on the results of unit root test using Augmented Dickey Fuller test ,after detailed graphical analysis . After that the outcome of Maximum likelihood method of cointegration is examined and finally super exogeneity analysis is explained.

5.2 Graphical Analysis

Firstly , all data series are graphically analyzed (figure 5.1 t 5.6) for examining the pattern, like presence of trend and intercept which have been introduced in the ADF equation. Real GDP and real Exports are the main variables of this study.

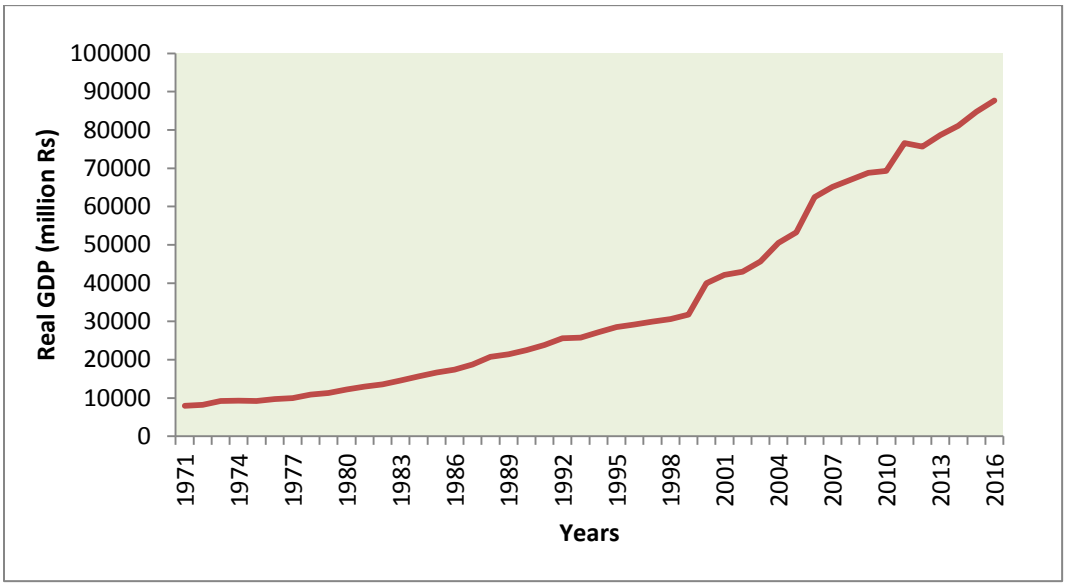
From the graphs of the all series it can be seen that except inflation all data show some visible pattern. For checking the stationarity we have to apply ADF test. Intercept and trend will be accordingly justified.

Now for smoothing and reducing the inconsistency in the variance of the data at the phase of model specification, we transform the data into logarithmic form.

The description of the variables used in the study under investigation can be seen as follow:

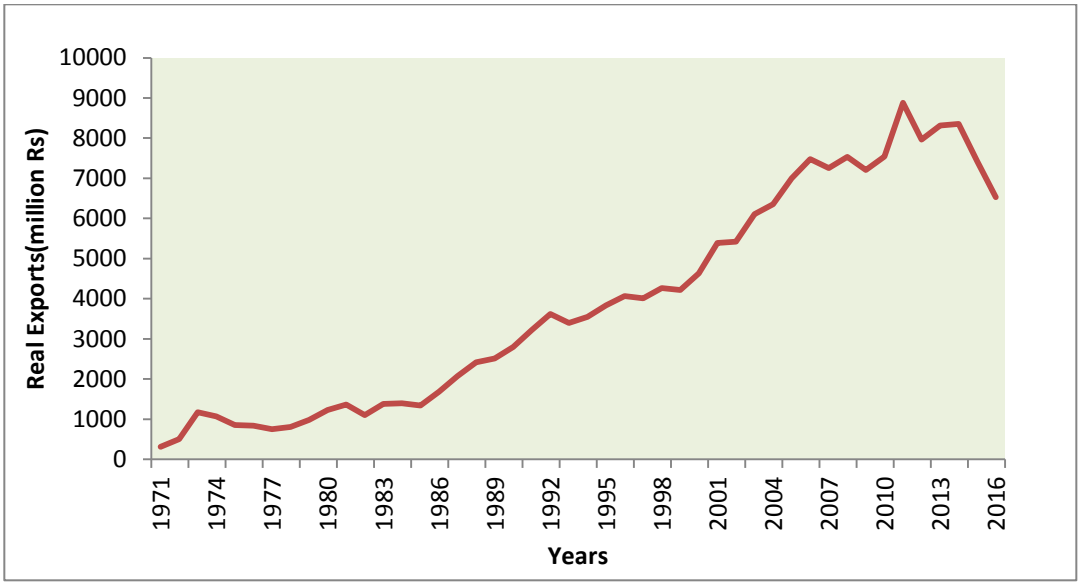
The data taken for all series is from 1971 to 2016. The graph of Real GDP of Pakistan is presented in figure 5.1 below. The time span in years is along x-axis and Real GDP (Pak million Rs) is shown along y-axis. The graph shows an upward trend.

Figure 5.1 : Real GDP of Pakistan



The graph of Real Exports (X) of Pakistan is shown in Figure 5.2 . The graph of exports is also showing an upward trend.

Figure 5.2 : Real Exports of Pakistan



Similarly all series are plotted below. The pattern of series is quite visible.

Figure 5.3 : Labor force Participation Rate of Pakistan

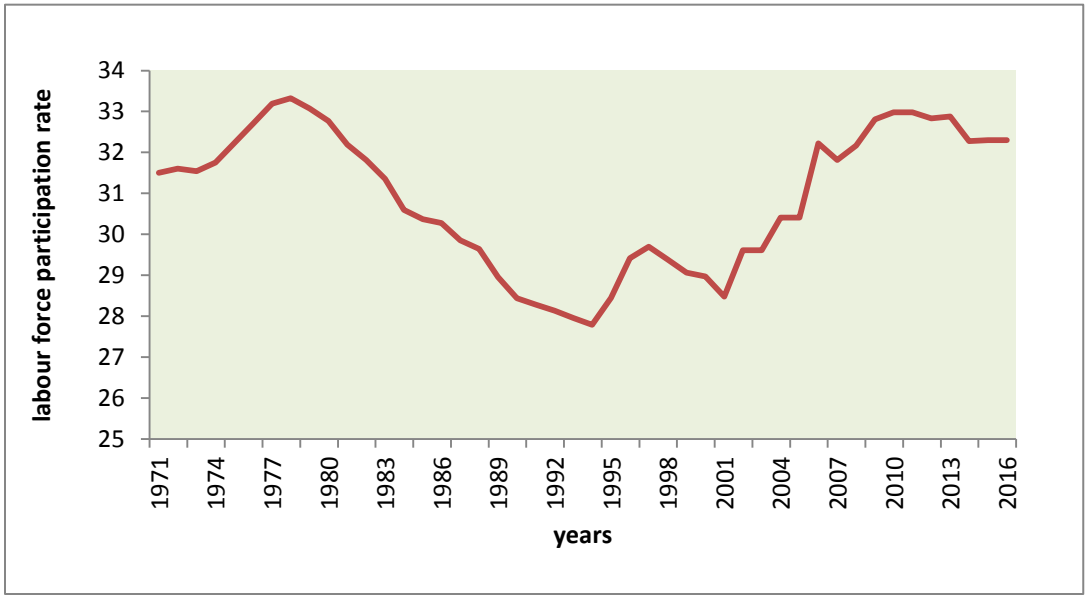


Figure 5.4 : Domestic Credit to Private Sector ratio of Pakistan

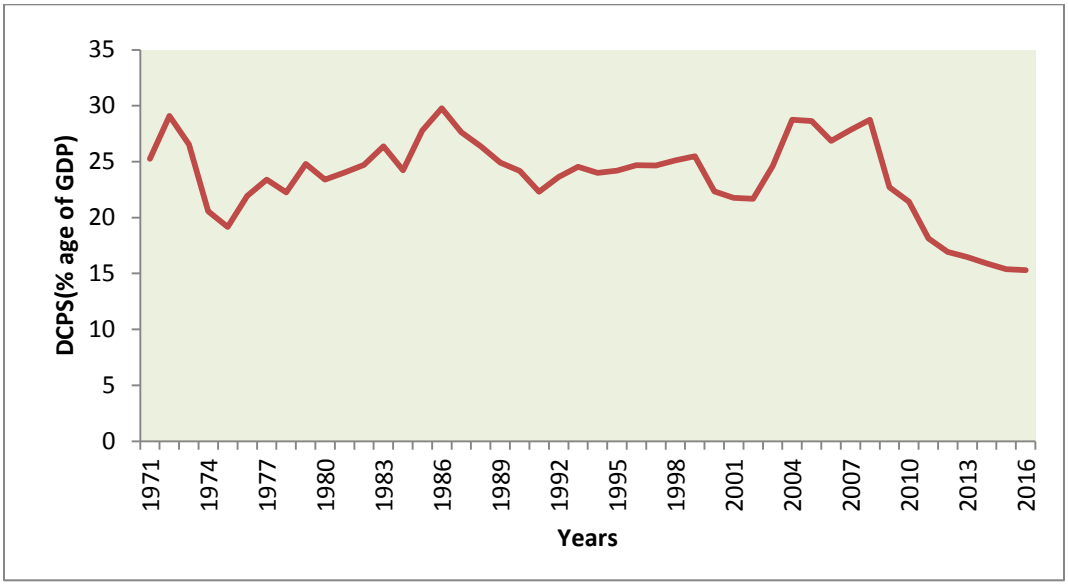


Figure 5.5 : Inflation Rate of Pakistan

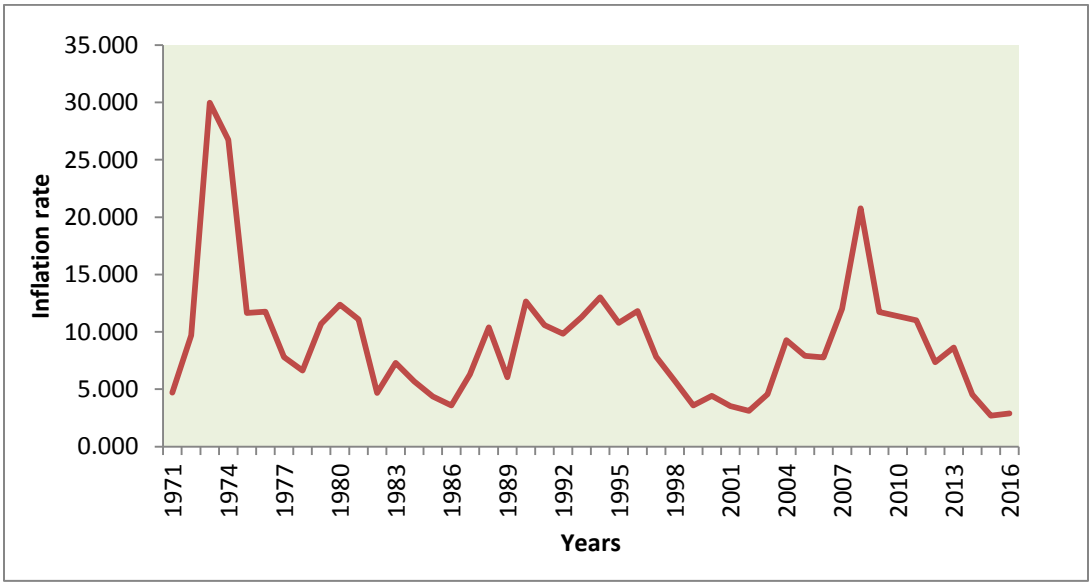
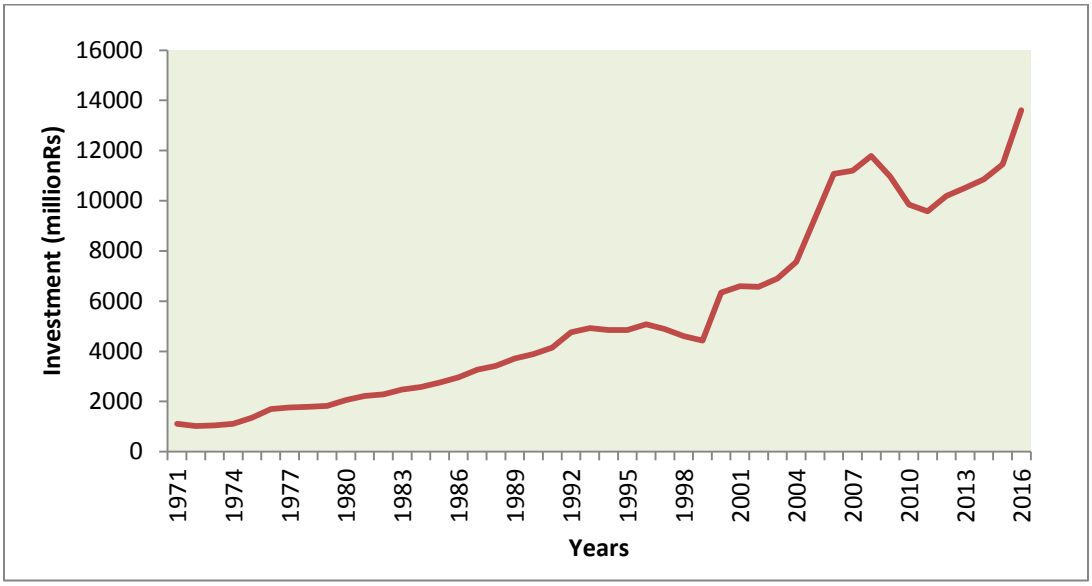


Figure 5.6 : Gross fixed Capital Formation of Pakistan



5.3 Augmented Dickey Fuller Test of Unit Root

It is essential to know the order of integration for the analysis of cointegration, in which all series must have same order of integration I (d). Therefore we applied the Augmented Dickey Fuller test of unit root on our data series. For this purpose all data series is transformed into logarithm except inflation.

The ADF test result shows that we cannot reject the null hypothesis of Unit root at 5% significance level because the t-statistics values of each series (LGDP, LX, LDCPS, L π , LL and LK) are greater than the ADF critical values recommended by Mackinnon. So we conclude that $\{x_t, e_t\}$, (where x_t represents all variables that are used in the study) are weakly dependent processes or these processes are independent of stochastic and deterministic trends like unit roots means all the series are non-stationary at level. Now take

first difference of variables to test the unit root at first difference and it can be seen that t-statistics of each series is less than the critical vales of ADF, so we can reject the null hypothesis of non-stationary and concluded that all series have same order of integration that is I(1) (See Table 5.1).

Table 5.1: Augmented Dickey Fuller (ADF) Test of Unit Root

Level				
Variables	***Constant,Trend***	***Lags***	***ADF /ρ τ -stat***	***Decision***
$\mathbf{LRY_t}$	C,t	0	-2.45	Non stationary
$\mathbf{LRX_t}$	C,t	1	-3.06	Non stationary
$\mathbf{LL_t}$	C,t	0	-0.84	Non stationary
$\mathbf{LK_t}$	C,t	1	-3.34	Non stationary
$\mathbf{LDCPS_t}$	C,t	0	-1.41	Non stationary
$\boldsymbol{\pi_t}$	No C,t	0	-1.61	Non stationary
First Difference				
Variables	***Constant,Trend***	***Lags***	***ADF /ρ τ -stat***	***Decision***
$\mathbf{\Delta LRY_t}$	C	0	-7.11	I(0)
$\mathbf{\Delta LRX_t}$	C	1	-9.25	I(0)
$\mathbf{\Delta LL_t}$	No C,t	1	-2.81	I(0)
$\mathbf{\Delta LK_t}$	C	0	-5.14	I(0)
$\mathbf{\Delta LDCPS_t}$	No C,t	2	-3.97	I(0)
$\mathbf{\Delta\pi_t}$	No C,t	1	-8.47	I(0)

Note: L is for log and Δ shows first difference. ADF τ<–3.52 for C and t both , ADF τ<–2.93 for C only , and ADF τ<–1.95 for no C,t ,at the 5 percent level of significance.

5.4 Cointegration Analysis

Before turning to the empirical estimations of co integration, its been suggested to find the lag (k) order of vector autoregressive (VAR) models, when they are at levels, which represents a critical stage of MLE i-e Johansen maximum likelihood procedure. In literature its recommended to use Akaike Information Criterion(AIC) and Schwarz Information Criterion(SIC) for selecting the lag length of the VAR system which can only be achieved

through minimization of concerned criterias . In many cases , both of the criteria's suggest the use of VAR with the same order of lags while the others with different choice criterias recommend the one with the smaller lag order. The reason is as for example, if we use VAR of greater order i.e. 3, 4, 5,or 6 it would become the greater cause of over parameterization, that is a condition which becomes more acute in those cases where the sample size is countable or finite.

Additionally, as the data is taken annually (1971-2016), the lag length for the VAR system is determined by considering AIC and SBC. Both criteria suggest different lags in the VAR ,i-e according to AIC and SBC , 5 and 1 lag is determined respectively see table (5.2). so we will consider k as 1 ,following above description. Moreover, in Table (5.3) we checked autocorrelation ,where the results show that there is no serial correlation when the VAR lags taken are 5. The problem of autocorrelation doesn't appear even at lag order 1.

Table 5.2 : VAR Lag Order Selection

Endogenous variables: LRY LRX LK LL LDCPS INF
Sample: 1971 2016

Lag	LogL	LR	FPE	AIC	SC	HQ
0	27.10750	NA	1.44e-08	-1.029634	-0.778868	-0.938319
1	269.2836	401.6579*	6.29e-13*	-11.08700	-9.331638*	-10.44780
2	299.9082	41.82874	9.18e-13	-10.82479	-7.564824	-9.637690
3	346.1097	49.58213	7.71e-13	-11.32243	-6.557860	-9.587434
4	388.3731	32.98603	1.17e-12	-11.62796	-5.358789	-9.345070
5	468.8159	39.24039	6.57e-13	-13.79590*	-6.022131	-10.96512*

* indicates lag order selected by the criterion

Table 5.2.1 VAR Residual serial correlation LM Test

Sample: 1971 2016

Lags	LM-Stat	Prop
1	58.32082	0.0107
2	57.39985	0.0132
3	27.11071	0.8573
4	29.95906	0.7506
5	45.75576	0.1278

Probs from chi-square with 36 df.

In the cointegration test we used the third model as explained by the Johansen (1995), Table 5.3a is reporting the results of Maximal eigenvalue statistics and Table 5.3b reflects trace statistics ,both of these are Johnson Maximal Likelihood ratio tests employed for testing the cointegrating relationships between the variables. The results indicate that there exist two CI relationships as explained by trace and one cointegrating relationship exists if we rely on maximum eigen values, between real GDP, real exports, labour, real investment, DCPS, and inflation. Although both tests report different number of cointegrating vectors yet we chose trace test because it is more powerful than maximum-eigen value test and it contains all k-r values of the least Eigen vector. Again in case of non-normality as explained by Hubrick et al. (2001) and Chueng and Lai (1993) , trace test is preferred over maximum-eigen value test. In this study we consider the results of trace test having two cointegrating relationships. That is because the null hypothesis $H_{o=}$ $r \leq 1$ and $r \leq 2$ is overruled against the alternative $r \geq 2$ and $r \geq 3$ one-to-one at 5 % significance level.

Table 5.3a: Johansen Maximum Likelihood Test of Cointegration(Trace test)

	Trace Statistics			
Null	**Alternative**	**Chi-square**	**5% Critical value**	**Prob.****
r=0	r ≥ 1	136.8241	95.75366	0.0000
r ≤ 1	r ≥ 2	78.96541	69.81889	0.0078
r ≤ 2	r ≥ 3	46.89653	47.85613	0.0614
r ≤ 3	r ≥ 4	23.79517	29.79707	0.2092
r ≤ 4	r ≥ 5	11.90060	15.49471	0.1618
r ≤ 5	r ≥ 6	2.900693	3.841466	0.0885

Note: Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Table 5.3b: Johansen Maximum Likelihood Test of Cointegration(Eigenvalue Test)

	Maximal Eigenvalue Test			
Null	**Alternative**	**Chi-square**	**5% Critical value**	**Prob.****
r=0	r=1	57.85866	40.07757	0.0002
r ≤ 1	r=2	32.06888	33.87687	0.0809
r ≤ 2	r=3	23.10136	27.58434	0.1692
r ≤ 3	r=4	11.89457	21.13162	0.5587
r ≤ 4	r=5	8.999904	14.26460	0.2862
r ≤ 5	r=6	2.900693	3.841466	0.0885

Note: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

5.5 Long Run Equation

Cointegration test in the case of multiple cointegrating(CI) vectors are often challenging to interpret. In such case, the first vector is used for long run export led growth function, normalized by LRY (real GDP*)*. From the cointegration analysis we obtain long run coefficients of our variables for the desired GDP growth function that are given below. Chi-Square values are reported in parentheses.

$$LRY_t = \underset{(4.54)}{0.417814}LRX_t + \underset{(7.27)}{0.455273}LK_t + \underset{(7.09)}{1.459530}LL_t - \underset{(21.49)}{0.014175}\pi_t + \underset{(1.20)}{0.108689}LDCPS_t \quad \ldots \quad \ldots \quad 5.1$$

Observing the above equation equation 5.1, it can be seen that Real Exports(X) have significantly positive relationship with RGDP in a way that for 1 % increase in the real exports there will be 0.41% increase in the real GDP of Pakistan, that is a strong support towards ELGH in the longrun. There is significant positive relationship between real investment (K) and RGDP. If there is 1 % increase in the K then there will be 0.45 % increase in the RGDP . There is significant positive relationship between Labor Force participation rate(L) and RGDP showing that if there is 1 % increase in the L the RGDP will boost up by 1.45 % , similarly in case of Domestic credit to Private sector ratio(% age of GDP) 'DCPS' the situation appears same,as by 1% increase in DCPS ,the RGDP enhances by 0.108 %. On the other hand there exists negative relationship between inflation and RGDP as if 1% increase in inflation there will be 0.01 % decrease in the RGDP.

As explained in literature in case of Pakistan ,ELGH is supported in the longrun. Some studies conducted recently in past on Pakistan like Khan and Saqib (1993), used

simultaneous equation model and proved that there exists a solid relationship between exports and economic growth of Pakistan. Shirazi and Manap (2004) also found the same in case of longrun. Pakistan as a developing economy with unlimited natural resources , by efficient use of labor , a contribution in the capital is observed and quality product production provides an incentive towards export to developed or developing economies, which definitely play a vital role in the GDP growth. Exports are a key component of aggregate demand (AD) in any economy. Rising exports will lead to an increase in AD and are a cause towards higher economic growth. Export growth can also have a knock-on effect to 'service industries' that somehow is related, similarly plays crucial role in employment.The positive coefficient of 0.41% of real exports ,shows significant contribution in RGDP of Pakistan and stresses the need that by developing the Export sector this contribution can significantly improve.

As per expectations and relying on the theoretical and empirical evidence, it indicates that the relationship between labour force and capital formation towards RGDP is positive (Romer, 1986; Lucas, 1988; Rebelo, 1991;Smith 2001). Adequate amount of capital is one of the initial basic needs for the economic growth.Capital flow is seen because of savings and savings as out of income. The enhancement in the capital means increase in production and raised production is indication towards more output or Growth. This is because with more capital available, a given number of workers will be able to produce more output, ceterus peribus.

Looking at inflation ,which shows a reduction in the Real GDP of Pakistan is commonly observed among economies because GDP is the total production that occurs in an economy thus as a result of inflation price rise, this will increase the cost of factors of production (like raw material, labor and capital, ect). This means that people will buy less of

that commodity due to the increase in its price (basic law of demand and supply). If we aggregate this phenomenon for all goods across all sectors we see a huge drop in aggregate production which leads to a slowdown in the economy and hence reducing the GDP.

The contribution of of domestic credit to private sector as ratio to GDP is positive as expected theoretically. The results suggest that in the long-run, DCPS is essential to growth. This is a confirmation about the theoretical expectation of classical and monetarists views on the role of government in the macro economy. The positive contribution of DCPS on growth of real GDP in the long-run may be due to the fact that the private sectors do more productive investments, efficiently use technology, create employment opportunities, increase output and growth. This is because most of government expenditures are seen on consumption rather than investment in infrastructures.(Peter,2015)

5.6 Dynamic Error Correction Model (ECM)

Following is the error correction model of the study in equation 5.2. The ECM represents two parts that are short run dynamics and long run.

The t- statistics of parameters are in parenthesis.

$$\Delta LRY_t = \underset{(-5.07)}{-0.115282} + \underset{(4.59)}{0.098981}\Delta LRX_t + \underset{(5.59)}{0.240627}\Delta LK_t + \underset{(2.70)}{0.621176}\Delta LL_t - \underset{(-4.40)}{0.213826}\Delta LDCPS_t$$

$$- \underset{(-5.56)}{0.149844}\, \mathrm{E}CM_{t-1}$$

R^2 = 0.71 F = 19.39 Auto $\chi^2_{(1)}$ = 1.29 Norm $\chi^2_{(2)}$ = 0.50 Hetero $\chi^2_{(1)}$ = 0.19

In the equation 5.2 the t-statistics of differenced independent variables shows the short run estimates and t-statistics of lagged error correction term (ECM) indicates long run relationship that is derived from the long run equation of our study. The following equation is estimated with one lag length that is chosen on the basis of diagnostics tests. The results of diagnostic test can be seen below equation 5.2.

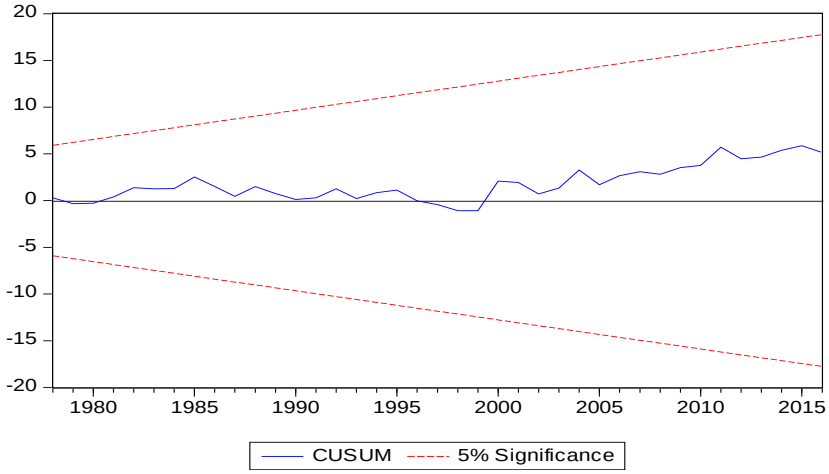
The short run equation (5.2) is tested through the above mention diagnostic tests for the sake of reliable and accurate results. To be specific, we applied several diagnostic tests to check validity and reliability of model and test the hypotheses of non autocorrelated, homoskedastic and normally distributed residuals. The serial correlation hypothesis is tested by using the Lagrange-Multiplier test (up to the maximum lag), Next, ARCH test is applied to detect the hetroskedasticity and the Jarque-Bera test is applied to check the normality. So first the Breusch Godfrey LM test has been applied on the residuals of the model to test the autocorrelation and from the $(\chi^2_{(1)})$ that is (1.29) we cannot reject the null hypothesis of no autocorrelation. Joint significance is checked through F test which appears as 19 in this model. The $\chi^2_{(1)}$ of Heteroskedasticity test is 0.19 showing that we cannot rejects the null hypothesis of no Heteroskedasticity. To test normality of residual Jarque-Bera test has been applied and chi square value appears as 0.50 so we cannot rejects the null hypothesis and conclude that residuals are normal. This information takes us to believe that the estimated ECM is stable and significant enough for the prior analysis.

The results also indicates that coefficient of error correction term (ECM (-1)) is negative and significant at 5 % level which validates that there exist a long run relationship between variables. Further, the value of estimated coefficient of error correction term is

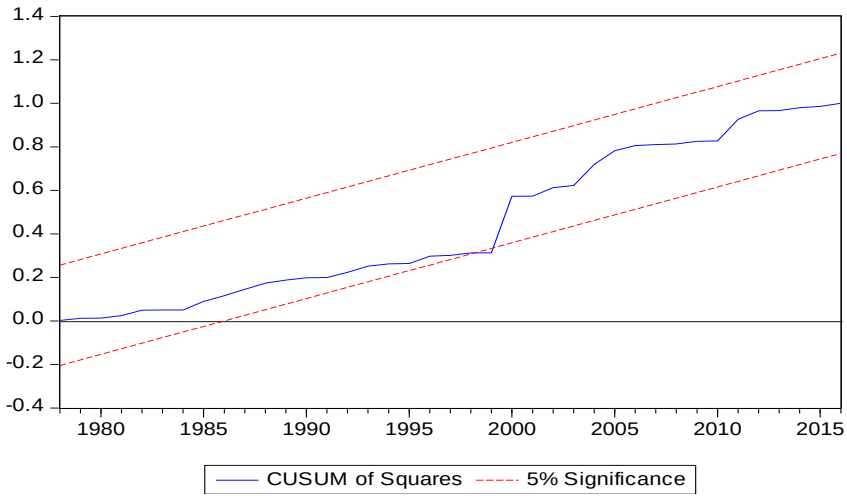
0.149 % which shows a slow speed of adjustment to the long run equilibrium. Its mean error term is correcting its previous disequilibrium to the long term.

For observing the structural shifts in the model parameters following tests have been designed for detecting the nonzero mean of recursive residuals. The Cumulative sum of Recursive residual (CUSUM) and CUSUM of squares tests have been applied to test the mean and variance stability of the model. If the CUSUM and CUSUM of Squares are away from zero mean line means the underlying model is unstable. Those are given below in figures 5.7.a and 5.7.b.

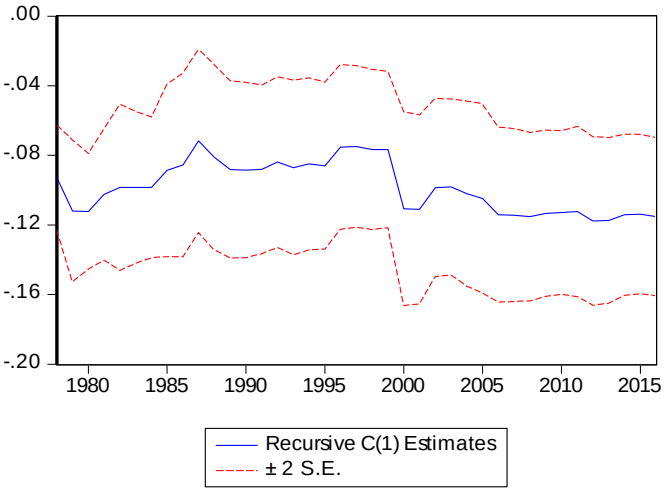
Figures 5.7.a : CUSUM Test of Mean Stability

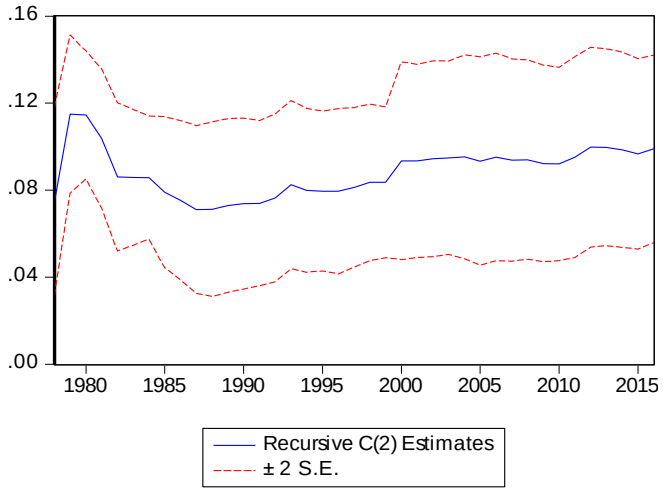


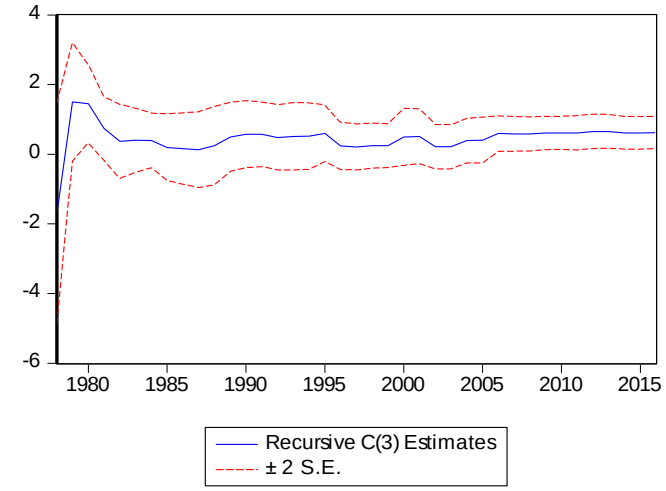
Figures 5.7.b : CUSUM Test of Variance Stability

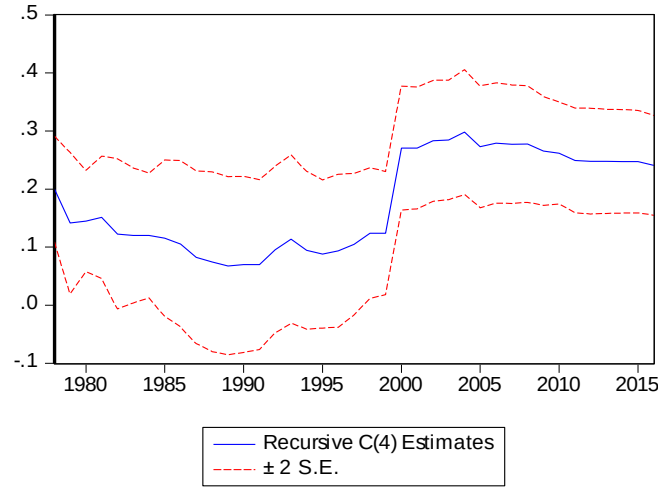


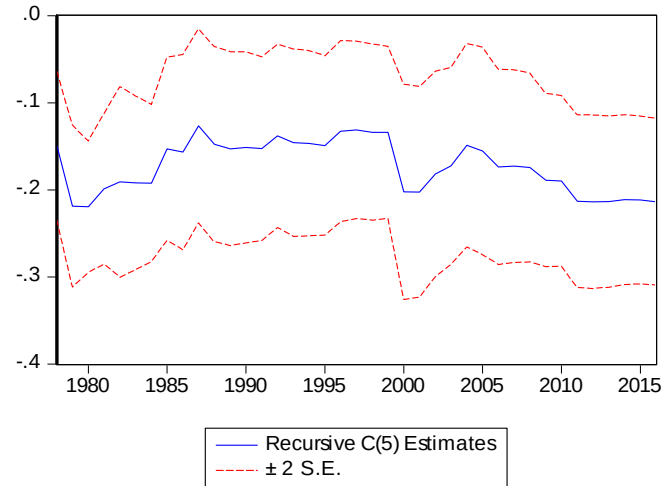
Further stability testing is as under for each variable ,

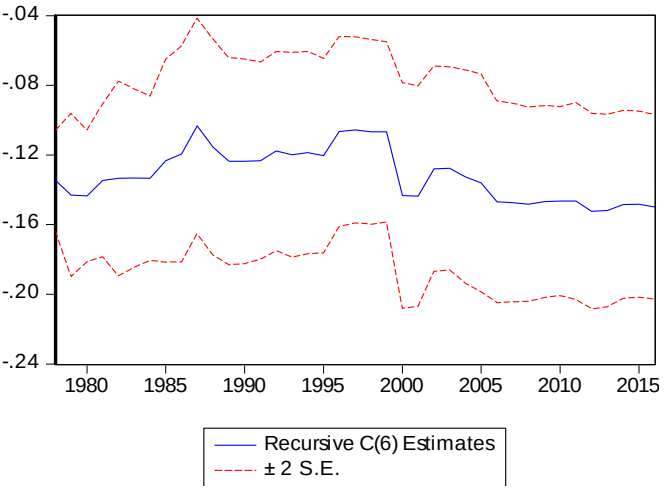












5.7 Testing for Super Exogeneity:

The parameters of reduced form model sometimes don't remain constant because of structural breaks like political shifts, any financial change in economy, disaster etc. Hence the model that loses constancy of parameters in such situations cannot be appropriate for policy analysis [Lucas (1976)]. This creates the situation where concept of super-exogeneity becomes crucial, because it has empirical concerns for Lucas's critique, instability of Export led Growth function, and invariance in the parameter of interest.

By reviewing different studies we came across two types of tests that are used to examine the existence of super-exogeneity. First one is the non-stability in the parameters of Conditional Density $\mathbf{C_D}$ function and the stability in the parameters of $\mathbf{M_D}$ function. To validate the said process a $\mathbf{M_D}$ function can simply be obtained by flipping over the $\mathbf{C_D}$ function. So, in the presence of super-exogeneity a stable $\mathbf{C_D}$ function of GDP growth cannot be interpreted as a re-parameterization because the re-parameterization is a function of parameters depending upon time and some other the causal structural parameters of $\mathbf{M_D}$ process. Therefore, by inverting conditional model the steady marginal model cannot be obtained. Now, if the $\mathbf{C_D}$ function is not invertible into $\mathbf{M_D}$ model, then it can be used as a confirmation of super-exogeneity .[Hendry and Ericsson (1991)]. Therefore, to find out that a $\mathbf{M_D}$ process is not stable while on the other hand a $\mathbf{C_D}$ stable process is enough to test super-exogeneity, Parez (2000). Additionally, the existence of super-exogeneity confirms the weak exogeneity of currently dated regressors as well, Qayyum (2005).

Second one is to test super-exogeneity of parameters of concern against the external shocks such as military regimes, oil price shocks or global shocks that creates instability in the parameters of $\mathbf{M_D}$ function. Now a $\mathbf{M_D}$ function can be developed by adding these

dummies in the $\mathbf{M_D}$ process. Then add these significant dummies into the $\mathbf{C_D}$ function and check their significance by using a conventional joint F-statistics, Engle and Hendry (1993). Hence, if these dummy variables are insignificant in the $\mathbf{C_D}$ function then it suggests the super-exogeneity of $\mathbf{C_D}$ process.

In the dynamic model the currently dated variables appeared as dependant on Real GDP are Real Exports (X) , Real Investment or Real gross fixed capital formation (K) , Domestic credit to private sector ratio as percent of GDP (DCPS) ,and labor (L). Therefore, to test the super- exogeneity , firstly the test are done for stability of $\mathbf{M_D}$ processes of these four variables and show that the marginal models are instable in the presence of identified external shocks and secondly, the stability of GDP growth model (Equation 5.2).

For testing of super-exogeneity for the parameter of the GDP growth model against the known identified shocks, such as inflation shock 1973, political instability 2009 and drought effect 1976 etc , which can affect the constancy of the $\mathbf{M_D}$ process. Gujarati (2009), has proposed different methods of dummy variables. While performing the tests for super exogeneity on the parameters of interest, the method of dummy variables proposed by Gujarati had also been used by Hendry and Ericsson (1991). The individual significance of dummy variables is tested by using t-statistics, while the joint significance of these dummies is checked through F statistics.

The tests started with 4^{th} order auto regressive models of LC, LK ,LDCPS and LL following Ericsson and Hendry (1991) and Qayyum (2005).They have used autoregressive models in their studies to test the super exogeneity.

General to specific methodology is adopted to obtain the final models.

T statistics are in Parenthesis.

$$\Delta LRX_t = \underset{(2.6)}{0.029281} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5.3)$$

R^2 = 0.00 Auto $\chi^2_{(1)}$ = 2.42 Norm $\chi^2_{(2)}$ = 133.6

$$\Delta LL_t = \underset{(2.63)}{0.376860}\Delta LL_{t-2} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5.4)$$

R^2 = 0.14 Auto $\chi^2_{(1)}$ = 1.08 Norm $\chi^2_{(2)}$ = 12.44 Hetero $\chi^2_{(1)}$ = 0.23

$$\Delta LK_t = \underset{(3.13)}{0.020153} + \underset{(1.57)}{0.233831}\Delta LK_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5.5)$$

R^2 = 0.05 Auto $\chi^2_{(1)}$ = 0.96 Norm $\chi^2_{(2)}$ = 42.43 Hetero $\chi^2_{(1)}$ = 0.15 $F_{Statistic}$ =2.46

$$\Delta LDCPS_t = \underset{(-0.97)}{0.0005624} + \underset{(1.01)}{0.147342}\Delta LDCPS_{t-1} \quad \ldots \quad \ldots \quad \ldots \quad (5.6)$$

R^2 = 0.02 Auto $\chi^2_{(1)}$ = 2.93 Norm $\chi^2_{(2)}$ = 2.53 Hetero $\chi^2_{(1)}$ = 0.37 $F_{Statistic}$ =1

As the numbers of coefficients are inadequate for testing Heteroskedasticity so the results of are not reported here for the above equations. Now for the constancy of the estimated parsimonious models can be tested for the number of significant dummies for each model. The outcomes are presented in the following equations while taking into account only significant dummies and dropping out the insignificant one to obtain desired equation.

For Real Exports,

$$\Delta LRX_t = \underset{(2.56)}{0.021673} + \underset{(6.04)}{0.342397} Dx_{1973} \quad \ldots \quad \ldots \quad \ldots \quad (5.7)$$

R^2 = 0.46 Auto $\chi^2_{(1)}$ = 0.91 Norm $\chi^2_{(2)}$ = 6.44 Hetero $\chi^2_{(1)}$ = 0.28 $F_{Statistic}$ =36.5

For Labour Force,

$$\Delta LL_t = \underset{(2.89)}{0.394012} \Delta LL_{t-2} + \underset{(2.36)}{0.015460} DL_{1996} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5.8)$$

R^2 = 0.24 $F_{Statistic}$ =36.5 Auto $\chi^2_{(1)}$ = 0.23 Norm $\chi^2_{(2)}$ = 17.46 Hetero $\chi^2_{(1)}$ = 0.58

For Domestic Credit to Private sector ratio,

$$\Delta LDCPS_t = \underset{(1.38)}{0.186397} \Delta LDCPS_{t-1} - \underset{(2.99)}{0.104480} Ddcps_{2009} \quad \ldots \quad \ldots \quad \ldots \quad (5.9)$$

R^2 = 0.18 Auto $\chi^2_{(1)}$ = 0.89 Norm $\chi^2_{(2)}$ = 1.43 Hetero $\chi^2_{(1)}$ = 0.03

For Real Investment,

$$\Delta LK_t = \underset{(4.14)}{0.022498} + \underset{(2.11)}{0.076990} Dk_{1976} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5.10)$$

R^2 = 0.09 Auto $\chi^2_{(1)}$ = 1.57 Norm $\chi^2_{(2)}$ = 28.88 Hetero $\chi^2_{(1)}$ = 0.02 $F_{Statistic}$=4.48

As seen that the dummy variable D_{1973} (indicating the international market cotton increased demand) that enters significantly the M_D process of Exports (see Equation 5.7) and dummy variables that indicates Labour effectiveness because of Agricultural Crop revision

policies after cotton crop (Cotton leave curl virus attack) (D_{1996}) is significant in the marginal equation 5.8.Similarly D_{1976} [3]& D_{2009} [4] for RK and DCPS respectively are also significant in marginal process.(Equation 5.9 and 5.10).The dummies significance is the implication towards non-constancy of M_D process against the specific shocks that are known.

5.7.1 Checking Invertabalities

Super exogeneity is that the estimated conditional model remains stable and consistant under the influence of external shocks that happened in marginal models. Now to check whether the desired estimated model can be inverted or not ,we inverted conditional model into marginal models by using $\Delta \boldsymbol{LRX_t}, \Delta \boldsymbol{LDCPS_t}$, $\Delta \boldsymbol{LL_t}$ **and** $\Delta \boldsymbol{LK_t}$ as dependent variable individually while $\Delta \boldsymbol{LRY_t}$ as independent variable in each model.

5.7.1.1 Invertibility of Real Exports:

Considering the conditions , The preferred model (Equation 5.2) is inverted by considering Real Exports ΔLRX_t as dependent variable and ΔLRY_t as independent variable. The resulting model appears as follow, **t** statistics in parenthesis(.)

$$\Delta LRX_t = \underset{(0.79)}{0.111157} + \underset{(3.11)}{2.097771}\Delta LRY_t - \underset{(-1.50)}{1.729548}\Delta LL_t + \underset{(1.93)}{0.512592}\Delta LDCPS_t$$

$$-\underset{(-2.58)}{0.650121}\Delta LK_t + \underset{(0.81)}{0.137582}ECM_{t-1} + \underset{(4.98)}{0.280525}Dx_{1973} \quad \ldots \quad \ldots \quad (5.11)$$

$R^2 = 0.62$ Auto $\chi^2_{(1)} = 0.02$ Norm $\chi^2_{(2)} = 2.00$ Hetero $\chi^2_{(1)} = 0.003$ $F_{Statistic} = 10.67$

[3] D_{1976} shows the positive shock as after oil shock and political distress in Pakistan ,In 1975-76 the capital market becomes stable and quick rise in Gross fixed capital formation is observed

[4] D_{2009} shows negative shocks as political instability was observed as Musharraf Government ended and Afghan refugee crises was also reported as a result the credit ratios in the domestic and private sector are effected.

After inverting the model, although the estimated model cleared almost all the diagnostic tests but it can be noted that the variables such as ΔLL_t , $\Delta LDCPS_t$ & ECM_{t-1} become insignificant keeping in mind that these are significant in preferred model but dummy variable Dx_{1973} introduced specifically as significant in this model, the reason behind was to check its significance also in conditional model which later reveals the instability of Marginal model of Exports, as Dx_{1973} proved insignificant in C_D function (Equation 5.15).

5.7.1.2 Invertibility of Labor:

Here labour ΔLL_t is taken as dependant variable , the dummy DL_{1996} is introduced which proved significant in the following M_D function.the variables like ΔLK_t proved insignificant indicating the instability of this model.

$$\Delta LL_t = \underset{(3.41)}{0.053400} + \underset{(3.04)}{0.271273}\Delta LRY_t - \underset{(-2.12)}{0.032815}\Delta LRX_t + \underset{(2.45)}{0.081551}\Delta LDCPS_t$$

$$- \underset{(-1.47)}{0.050585}\Delta LK_t + \underset{(3.49)}{0.066}ECM_{t-1} + \underset{(2.35)}{0.015230}DL_{1996} \quad \dots \quad \dots \quad \dots \quad (5.12)$$

R^2 = 0.34 Auto $\chi^2_{(1)}$ = 0.15 Norm $\chi^2_{(2)}$ = 51.6 Hetero $\chi^2_{(1)}$ = 0.22 $F_{Statistic}$ =3.32

5.7.1.3 Invertibility of DCPS :

$$\Delta LDCPS_t = \underset{(-5.41)}{-0.319207} - \underset{(-4.08)}{1.458279}\Delta LRY_t + \underset{(2.51)}{1.579095}\Delta LL_t + \underset{(1.78)}{0.271242}\Delta LK_t$$

$$+ \underset{(1.90)}{0.130838}\Delta LRX_t - \underset{(-5.5)}{0.394618}ECM_{t-1} + \underset{(-2.55)}{0.280525}Ddcps_{2009} \quad \dots \quad (5.13)$$

R^2 = 0.55 Auto $\chi^2_{(1)}$ = 0.029 Norm $\chi^2_{(2)}$ = 2.24 Hetero $\chi^2_{(1)}$ = 0.06 $F_{Statistic}$ =7.80

Here, $\Delta LDCPS_t$, is taken as dependant variable in the M_D function, the Equation 5.13 also proved to be instable because of insignificance of variables like ΔLRX_t and ΔLK_t. The $Ddcps_{2009}$ is introduced which is significant for the DCPS variable, but proved insignificant later in the C_D function.

5.7.1.4 Invertibility of Real Investment

For checking the invertibility of the ΔLK_t , the dynamic error correction model is inverted by considering the ΔLK_t as dependent variable and ΔLRY_t *is* moved on the right side of the equation.

The result of the marginal model can be seen as following,

$$\Delta LK_t = \underset{(2.27)}{0.166522} + \underset{(5.49)}{1.763829}\Delta LRY_t - \underset{(-3.21)}{0.203336}\Delta LRX_t + \underset{(1.73)}{0.266530}\Delta LDCPS_t$$

$$-\underset{(-1.42)}{0.929853}\Delta LL_t + \underset{(2.31)}{0.206400}ECM_{t-1} + \underset{(2.04)}{0.015230}Dk_{1976} \quad \ldots \quad \ldots \quad (5.14)$$

R^2 = 0.51 Auto $\chi^2_{(1)}$ = 0.038 Norm $\chi^2_{(2)}$ = 0.45 Hetero $\chi^2_{(1)}$ = 0.004 $F_{Statistic}$=6.76

Again the equation 5.14, shows the instability of this marginal density function , the Dummy Dk_{1976} proved significant for real investments as the policies were revised in the following year showing positive impacts.The variables like Labour and DCPS are insignificant considering t values.

So, the marginal models for each independent variable from the dynamic error correction model has been estimated above with relevant class of shocks and interventions. The results proved that dummies like Dx_{1973}, Dk_{1976}, Dl_{1996} *and* $Ddcps_{2009}$, significantly enter in the marginal processes. Finally, to check the stability of the estimated dynamic error correction model or the preferred Conditional model, these four dummies are incorporated

into the ECM ,which proved the stability of C_D function and the model can be used for policy implications i-e Super Exogeneity holds for Export led Growth model. The estimation results of the model with dummies is shown below

$$\Delta LRY_t = \underset{(-4.76)}{-0.113733} + \underset{(3.10)}{0.097088}\Delta LRX_t + \underset{(5.25)}{0.254172}\Delta LK_t - \underset{(-3.50)}{0.192715}\Delta LDCPS_t$$

$$+\underset{(2.88)}{0.721811}\Delta LL_t - \underset{(-5.30)}{0.148349}ECM_{t-1} - \underset{(-0.84)}{0.010256}Dk_{1976} - \underset{(-1.41)}{0.016161}Dl_{1996}$$

$$+\underset{(0.30)}{0.003807}Ddcps_{2009} + \underset{(0.11)}{0.001854}Dx_{1973} \quad \ldots \quad \ldots \quad \ldots \quad (5.15)$$

R^2 = 0.73 Auto $\chi^2_{(1)}$ = 1.32 Norm $\chi^2_{(2)}$ = 0.42 Hetero $\chi^2_{(1)}$ = 0.06 $F_{Statistic}$=10.71

5.8 Conclusion

This chapter basically focused on the econometric technique of Super Exogeneity that whether the Export led Growth model of this study can be used for policy analysis or not ?, The estimated results at the last highlights that those dummies that are significant in the marginal processes of ΔLRX_t , ΔLK_t , $\Delta LDCPS_t$ andΔLL_t , become insignificant when added to the estimated parsimonious model. As because of including these identified external shocks into the M_D processes caused instability in the parameters of the marginal model but the impact of these shocks is captured by each individual marginal model that is the reason these dummies are insignificant in preferred conditional model. Thus it can be inferred that the estimated Export led Growth model can be used for policy analysis that is basically Super exogeneity.

Chapter 6

Conclusion and Policy Recommendations

6.1 Introduction

This study empirically verified the Export-led Growth Hypothesis (ELGH) in case of Pakistan by the implication of advance econometric techniques. Through cointegration analysis, both in the long run and short run the theory is positively proved and as a confirmation to literature and economist views. The dynamic error corrections model basically confirmed the short run relationship between Real GDP and Real Exports along with other independent variables (labour, Real Investment and DCPS). Additionally, the CUSUM, the CUSUM of squares, and the dummy variable method are applied stability testing of the known model.

A central part of this analysis dealt with the super-exogeneity testing for the Conditional model parameters. The preferred model appears to be stable but on the other side the marginal model parameters does not passed the stability tests. This is how a known C_D model can be used for policy Analysis in case of Pakistan.

6.2 Results and Recommendations

The prime purpose of this study is to reinvestigate the relationship between real exports and real GDP using annual time series data on Pakistan and to check the model effectiveness by the application of Super Exogeneity. The results of empirical analysis have

shown verification of ELG hypothesis in this specific case. Considering yearly data ranging from 1971 to 2016, different tests verified the presence of a long run association between RGDP and real capital, labor force, DCPS, exports i-e, the results shows that variables under the concern are Co-integrated and hence a common linear trend exists. (i-e in the long term they move together).Moreover, the existence of CI between GDP and exports through Johnson CI test justifies the application of the dynamic ECM approach and hence also proved the short run relationships between the preferred variables.

The main questions that arise after conducting this whole study are like, how the empirical findings of this study can be economically interpreted? Can these estimated results be explained in terms of the economic development of Pakistan in the next coming decades of this century OR this study can be of any help to policy makers?

The obvious answer to the first is that the exports not only explain cyclical changes (short-term) in GDP Growth or output but can also explain the long-term trend. Moreover, the concept that the results attained through the application of unrestricted ECM specify that all variables of that model were significant and follow the same sign as expected which corroborates that investment (k), DCPS and Labor force play a significant role in the determination of country wide GDP growth in the long run, and also indicates that exports are mainly significant in the concern study. It's soundly accepted that a number of factors, such as accumulation of capital, highly developed infrastructure, private enterprise, innovation, and labor development etc., are key factors in determining economic growth. Whereas, in this particular study it's emphasized that the proof found from supply side entails that growth was primarily determined by the traditional FOP's and, though Exports act as an additionally supportive growth engine, the impact is comparatively limited which needs attention by the policy makers.

Above all, The analysis of reliability checks in conditional models of exogeneity in the case of ELGH shows that our parameter estimates were reliable and the dynamic error correction model consisting of Exports is super exogenous with respect to growth in Pakistan. This shows that our estimated dynamic error correction model (ECM) can be employed for future policy analysis in the Pakistan and was a justification to Super Exogeneity.

References:

Adams, N. A. (1973).A Note on Trade as a Handmaiden of Growth. *Economic Journal*, 83, 329 (March): 210-12.

Afzal, M., & Hussain, I. (2010). Export-led Growth Hypothesis: Evidence from Pakistan. *Journal of Quantitative Economics*, *8*(1), 130-147.

Ahmad, J.,& Kwan, A. C. (1991). Causality between Exports and Economic Growth: Empirical Evidence from Africa. *Economics Letters*, 37(3), 243-248.

Ahmad, J., & Harnhirun, S. (1996). Cointegration and Causality between Exports and Economic Growth: Evidence from the ASEAN countries. *The Canadian Journal of Economics/Revue Canadienne d'Economique*, *29*, S413-S416.

Ahmed, Q. M., Butt, M. S., Alam, S., & Kazmi, A. A. (2000). Economic Growth, Export, and External Debt Causality: The Case of Asian Countries [with Comments]. *The Pakistan Development Review*, 591-608.

Akbar, M., Naqvi, Z. F., & Din, M. U. (2000). Export Diversification and the Structural Dynamics in the Growth Process: The Case of Pakistan [with Comments]. *The Pakistan Development Review*, 573-589.

Bahmani-Oskooee, M. (1993). Export growth and economic growth: An Application of Cointegration and Error-Correction Modeling. *The Journal of Developing Areas*, *27*(4), 535-542.

Balassa, B. (1978). Exports and Economic Growth: Further Evidence. *Journal of Development Economics*, *5*(2), 181-189.

Boltho, A. (1996). Was Japanese Growth Export-led?. *Oxford Economic Papers*, *48*(3), 415-432.

Bhagwati, J. (1978). Anatomy and Consequences of Exchange Control Regimes: Liberalization Attempts and Consequences. *Cambridge,* MA: Ballinger.

Burney, N. A. (1996). Exports and Economic Growth: Evidence from Cross–Country Analysis. *Applied Economics Letters*, *3*(6), 369-373.

Campbell, J. Y., & Perron, P. (1991). Pitfalls and Opportunities: What Macroeconomists should know about Unit roots. *NBER Macroeconomics Annual*, *6*, 141-201.

Cheung, Y. W., & Lai, K. S. (1993). Finite-Sample Sizes of Johansen's Likelihood Ratio Tests for Cointegration. *Oxford Bulletin of Economics and statistics*, *55*(3), 313-328.

Choong, C. K., Yusop, Z., & Liew, V. K. S. (2005). Export-led Growth Hypothesis in Malaysia: An Investigation using Bounds Test. *Sunway Academic Journal*, *2*, 13-22.

Davidson, R., & MacKinnon, J. G. (1993). Estimation and Inference in Econometrics.

De Gregorio, J. (1992). Economic Growth in Latin America. *Journal of Development Economics*, *39*(1), 59-84.

Dickey, D. A. And Fuller, W. A. (1979). Distribution Of The Estimators For Autoregressive Time Series With A Unit. *Journal of the American Statistical Association*, 77, Pp. 427-431

Dutt, S. D. and Ghosh, D. 1996. The Export Growth-Economic Growth Nexus: A Causality Analysis. *Journal of Developing Areas*, 30: 167–181

Economic survey of Pakistan(various issues), Karachi: State Bank of Pakistan.

Engel, R. F. And Granger, C. W. J. (1987). Cointegration and Error Correction Representation, Estimation and Testing. *Econometrica*, 55, 251-76.

Engle, R F, Hendry, D F And J. F Richard, (1983). Exogeniety, Econometrica, 51, 2. 277-304.

Ericsson, N R, Hendry, D F And G. M. Mizon (1998) , Exogeniety, Cointegration, and Economics Policy Analysis, *Journal of Business and Economics Statistics*,Vol. 16. No. 4.

Ericsson, N. R., 1991, Cointegration, Exogeniety, and Policy Analysis: An Overview, *Journal of Policy Modelling*, 14, 251-280.

Feder, G. (1983) On Exports and Economic Growth. *Journal of Development Economics*, 12, 59-73.

Fosu, A. K. (1990) Exports and Economic Growth: The African Case. *World Development Journal*, Vol.18, Pp.831-35.

Ghatak, S., & Price, S. W. (1997). Export Composition and Economic Growth: Cointegration and Causality Evidence for India. *Review of World Economics*, *133*(3), 538-553.

Gonçalves, R., & Richtering, J. (1987). Intercountry Comparison of Export Performance and Output Growth. *The Developing Economies*, *25*(1), 3-18.

Helleiner, G. K. (1986). Outward Orientation, Import Instability and African Economic Growth: An Empirical Investigation. *Theory and Reality in Development*, 139.

Heller, P. S., & Porter, R. C. (1978). Exports and Growth: An Empirical Re-Investigation. *Journal of Development Economics*, *5*(2), 191-193.

Helpman, E., & Krugman, P. R. (1985). *Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and The International Economy*. MIT Press.

Hendry, D. F., & Ericsson, N. R. (1991). Modeling the Demand for Narrow Money in the United Kingdom and the United States. *European Economic Review*, 35(4), 833-881.

Hendry, D., (1995) , Dynamic Econometrics, Oxford University Press Ch. 5.

Henriques, I., & Sadorsky, P. (1996). Export-led Growth or Growth-Driven Exports? The Canadian Case. *Canadian Journal of Economics*, 540-555.

Jansen, E. S., & Teräsvirta, T. (1996). Testing Parameter Constancy and Super Exogeneity in Econometric Equations. *Oxford Bulletin of Economics and Statistics*, 58(4), 735-763.

Jawad, M., & Qayyum, A. (2015). Modeling the Impact of Policy Environment on Inflows of Worker's Remittances in Pakistan: A Multivariate Analysis.(PIDE Mphil thesis)

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control 12.*

Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica*, 59, 1551-1580.

Johansen, S. And Juselius, K. (1990).Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money, *Oxford Bulletin Of Economics and Statistics*, 52, 2 (May): 169-210.

Keesing, D. B. (1967). Outward-looking Policies and Economic Development. *The Economic Journal*, 303-320.

Khalkhali, S. A., & Dar, A. A. (2012). On the Effectiveness of Regulatory Policies: Some Empirical Results. *The Business & Management Review*, *2*(2), 53.

Khan, A. H. And Saqib, N. (1993). Exports and Economic Growth: The Pakistan Experience, *International Economic Journal*, 7, 3 (Autumn) Pp. 53-64.

Kormendi, R. C., & Meguire, P. G. (1985). Macroeconomic Determinants of Growth: Cross-Country Evidence. *Journal of Monetary Economics*, *16*(2), 141-163.

Kravis, I. B. (1970). Trade as a Handmaiden of Growth: Similarities between the Nineteenth and Twentieth Centuries. *The Economic Journal*, *80*(320), 850-872.

Krueger, A. O. (1978). Foreign Trade Regimes and Economic Development: Liberalization Attempts and Consequences. Cambridge, MA: Ballinger.

Kwan, A. C., & Kwok, B. (1995). Exogeneity and the Export-led Growth Hypothesis: The Case of China. *Southern Economic Journal*, 1158-1166.

Lucas, Jr., R.E., 1979. Econometrics Policy Evaluation: A Critique, *Journal of Monetary Economics*

Lucas, R. E. (1976, January). Econometric Policy Evaluation: A Critique. In *Carnegie-Rochester Conference Series on Public Policy* (Vol. 1, pp. 19-46). North-Holland.

Lucas, R. E. (1998). On the mechanics of Economic Development. *Econometric Society Monographs*, *29*, 61-70..

Maddala, G. S., & Kim, I. M. (1998). *Unit roots, Cointegration, and Structural Change* (No. 4). Cambridge University Press.

Marin, D. (1992). Is the Export-led Growth Hypothesis Valid for Industrialized Countries?. *The Review of Economics and Statistics*, 678-688.

Medina-Smith, E. J., & CNUCED. (2001). *Is the Export-led Growth Hypothesis valid for Developing Countries?: A Case study of Costa Rica*. UN.

Michaely, M. (1977). Exports and Growth: An Empirical Investigation. *Journal of Development Economics*, *4*(1), 49-53.

Moosa, I. A. (1999). Is the Export-led Growth Hypothesis valid for Australia?. *Applied Economics*, *31*(7), 903-906.

Nurkse, R., Haberler, G., & Stern, R. M. (1962). Equilibrium and Growth in the World Economy. Harvard University Press.

Qayyum, A. (2005). Modelling the Demand for Money in Pakistan. *The Pakistan Development Review*, 44 : 3 (Autumn) Pp. 233–252.

Qubtia,M.(2017). A Re-examination of the Empirical Evidence of Export led Growth Hypothesis.(PIDE Mphil Thesis).

Quddus, M. A., Saeed, I., & Asghar, Z. (2005). An Analysis of Exports and Growth in Pakistan [with Comments]. *The Pakistan Development Review*, 921-937.

Ricardo, D. (1891). *Principles of political economy and taxation*. G. Bell.

Sampath, R. K., & Anwar, M. S. (2000). Exports and Economic Growth. *The Indian Economic Journal*, *47*(3), 79-88.

Sargan, J. D. (1964). Three-stage Least-squares and Full Maximum Likelihood Estimates. *Econometrica: Journal of the Econometric Society*, 77-81.

Shahbaz, M., Azim, P., & Ahmad, K. (2011). Exports-led Growth Hypothesis in Pakistan: Further Evidence. *Asian Economic and Financial Review*, *1*(3), 182.

Shirazi, N. S., & Manap, T. A. A. (2005). Export-led Growth Hypothesis: Further Econometric Evidence from South Asia. *Developing Economies*, 43(4), 472-488.

Siddiqui, S., Zehra, S., Majeed, S., & Butt, M. S. (2008). Export-Led Growth Hypothesis in Pakistan. *The Lahore Journal of Economics* , 13(2) pp. 59-80

Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: Journal of the Econometric Society*, 1-48.

Sinha, D. (1999). Export Instability, Investment and Economic Growth in Asian Countries: A Time series Analysis (No. 799). Center Discussion Paper.

State Bank of Pakistan (Various Issues) Annual Report. Karachi: State Bank of Pakistan.

Sukar, A., Ahmed, S., & Hassan, S. (2011). The Effects of Foreign Direct Investment on Economic Growth: The Case of sub Sahara Africa. *Southwestern Economic Review*, *34*, 61-74.

Tahir, M., Khan, H., Israr, M., & Qahar, A. (2015). An Analysis of Export led Growth Hypothesis: Cointegration and Causality Evidence from Sri Lanka. *Advances in Economics and Business*, *3*(2), 62-69.

Thomas I. Palley,(2011). The Rise and Fall Of Export-Led Growth. Working Paper No. 675, New America Foundation.

Toda, H. Y., & Yamamoto, T. (1995). Statistical Inference in Vector Autoregressions with Possibly Integrated Processes. *Journal of Econometrics*, *66*(1), 225-250.

Xu, Z. (1996). On the Causality between Export Growth and GDP Growth: An Empirical Reinvestigation. *Review of International Economics*, *4*(2), 172-184.

Yaghmaian, B., & Ghorashi, R. (1995). Export Performance and Economic Development: An Empirical Analysis. *The American Economist*, *39*(2), 37-45.

Appendix A:

Complete Data of Variables used:

years	RGDP	RX	L	Inf	RK	DCPS
1971	7988.762	314.2594	31.51	4.692	1108.087	25.26353
1972	8213.945	506.4513	31.60	9.695	1023.419	29.10023
1973	9243.627	1171.135	31.54	29.975	1047.187	26.53343
1974	9283.572	1070.695	31.75	26.732	1118.429	20.57787
1975	9244.477	855.2449	32.23	11.657	1348.387	19.15593
1976	9707.707	837.9678	32.71	11.770	1695.52	21.9316
1977	9976.881	752.4567	33.19	7.793	1760.285	23.40666
1978	10898.84	802.8847	33.32	6.632	1789.957	22.25968
1979	11298.02	981.0383	33.07	10.711	1831.948	24.81321
1980	12260.71	1225.658	32.77	12.360	2061.524	23.40714
1981	12963.01	1364.351	32.19	11.100	2223.035	24.03953
1982	13595.62	1101.796	31.82	4.671	2289.529	24.70285
1983	14600.76	1380.07	31.35	7.284	2474.725	26.37627
1984	15679.21	1394.577	30.59	5.667	2584.966	24.21806
1985	16688.88	1342.407	30.37	4.354	2754.376	27.78218
1986	17427.85	1679.743	30.28	3.598	2965.293	29.78608
1987	18717.11	2071.382	29.86	6.294	3270.792	27.64355
1988	20774.24	2412.883	29.65	10.390	3422.422	26.3686
1989	21448.05	2512.844	28.96	6.040	3710.627	24.91286
1990	22491.46	2797.667	28.44	12.660	3890.967	24.15733
1991	23804.47	3225.289	28.28	10.580	4143.415	22.32179
1992	25551.04	3622.159	28.14	9.830	4753.388	23.61733
1993	25765.46	3399.754	27.96	11.272	4928.748	24.55221
1994	27150.3	3546.736	27.79	13.016	4847.712	24.00602
1995	28495.23	3835.762	28.45	10.790	4853.936	24.20712
1996	29224.58	4062.726	29.41	11.802	5078.377	24.69398
1997	29938.66	4010.784	29.70	7.813	4892.874	24.64622
1998	30620.54	4267.299	29.39	5.736	4606.764	25.11394
1999	31779.07	4221.616	29.06	3.584	4427.266	25.47432
2000	39948.17	4632.412	28.97	4.409	6341.927	22.3361
2001	42098.73	5390.7	28.48	3.540	6593.25	21.7755
2002	43004.19	5417.684	29.61	3.100	6571.113	21.67395
2003	45673.52	6110.482	29.61	4.571	6898.67	24.59728
2004	50529.25	6351.662	30.41	9.272	7568.181	28.73612
2005	53285.64	7001.869	30.41	7.919	9304.329	28.64556
2006	62413.86	7481.32	32.22	7.771	11067.22	26.84999
2007	65128.54	7255.318	31.82	12.004	11193.68	27.84321

years	RGDP	RX	L	Inf	RK	DCPS
2009	68784.3	7210.62	32.81	11.730	10970.74	22.72279
2010	69339.1	7543.762	32.98	11.378	9849.312	21.41292
2011	76532.89	8881.082	32.98	11.007	9582.399	18.12633
2012	75621.29	7961.822	32.83	7.357	10190.69	16.93732
2013	78635.1	8315.307	32.88	8.623	10506.68	16.47023
2014	81091.27	8357.101	32.28	4.526	10852.9	15.90242
2015	84746.62	7419.778	32.3	2.685	11455.72	15.38188
2016	87711.36	6530.579	32.3	2.900	13613.73	15.3

Source: *State Bank of Pakistan*