CHAPTER 3
RESEARCH METHODOLOGY

3.1. Introduction

This study is focused on examining the role of financial sector development in manufacturing exports of BRICS countries over the period of 26 years (1990- 2015). To examine the role of financial development in exports of manufacturing goods in BRICS countries, a comparative time series analysis is done over the study period. But prior to this comparative analysis, trend and pattern of macroeconomic variables included in study is analyzed using simple line chart and a financial development index for each BRICS country is also constructed. Trend and pattern of variables is analyzed to get in-depth understanding of the variables. Financial development index for each BRICS country is constructed to have a standard measure of financial sector development. For the purpose of construction of financial development index of each BRICS country, three macroeconomic variables are taken into consideration. They are market value of domestic listed companies (as % of GDP), domestic credit to private sector (as % of GDP) and broad money (as % of GDP). The weights of these variables are obtained by principal component analysis approach (PCA). After construction of financial development index for each BRICS country, the role of financial development is empirically examined on manufacturing exports. To examine the role of financial development on trade of manufactured goods Auto Regressive Lag (ARDL) model is applied (Pearson et al., 2001). But before applying ARDL model, stationarity of time series is also checked and lag length selection criteria for models

also performed to decide the adequate number of lags for models. The detailed process of this methodology is explained ahead:

3.2. Time Period, Data Sources and Variables of the Study

3.2.1 Time Period of Study

For this analysis, annual time series data is considered from of 1990-2015 for BRICS nations.

3.2.2 Data Sources

Secondary data is used in this study and the data sources are World Bank database (2019) and Fred Economic database (2020).

3.2.3. Definitions of Variables Considered in Study

3.2.3.1. Broad Money (% of GDP) - Broad money is the total sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency deposits of resident sectors other than the central government; bank and traveller's checks; and other securities such as certificates of deposit and commercial paper.

3.2.3.2 Market Capitalization of Listed Domestic Companies (% of GDP) - Market capitalization (also known as market value) is the share price times the number of shares outstanding (including their several classes) for listed domestic companies. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies are excluded. Data are end of year values.

3.2.3.3. Domestic Credit to Private sector (% of GDP) - Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other financial corporations are finance and leasing companies, money lenders, insurance corporations, pension funds, and foreign exchange companies.

3.2.3.4. Manufactures Exports (% of Merchandise Exports) - Manufactures comprise commodities in SITC sections 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods), excluding division 68 (non-ferrous metals).

3.3. Methodology of the Study

In this study, first objective is to analyze trend and pattern of macroeconomic variables used in the study for each BRICS country. To analyze trend and pattern of variables simple line chart is used. The second objective is to construct the financial development index of each BRICS countries to measure and make comparison of the financial development of BRICS countries. Last objective is to check relationship between financial sector development and manufacturing exports in each BRICS

country. Research methodology of each objective is explained below elaborately and in a sequential manner:

3.3.1. Methodology to Analyze the Trend and Pattern of Variables

First objective of the study is to analyze the trend and pattern of variables used in this study. To analyze the trend and pattern of variables line charts are used as line charts provide very easy picture of the trend and pattern of variables over the study period which makes it very easy to analyze and compare the data.

3.3.2. Methodology for Construction of Financial Development Index

To analyze and compare the level of financial development of BRICS countries, Financial development index of these countries are constructed. For this the applied method involves below mentioned five steps: -

Step 1 - At first yearly data is taken for broad money % of GDP, domestic credit to private sector % of GDP and market capitalization % of GDP for each BRICS Countries from 1992 to 20015 (Russia financial development index is from 1993 onwards).

Step 2 -At second step, weights of proxies of financial development obtained through Principal Component Analysis.

Step 3 - Then, obtained weights are multiplied by corresponding variable value.

Step 4 - At last step, value obtained through multiplication are added and divided by the total weight.

Step 5 - Obtained value is financial development value for that country in that year.

3.3.3. Methodology to Examine the Relationship between Financial Development and Manufacturing Exports of BRICS Countries

One of the objectives of the study is to empirically examine the relationship between financial sector development and trade of manufacturing goods in BRICS nations over the study period. To fulfil this objective following step are performed: -

Step 1- Firstly, financial development index and manufacturers exports (% of merchandise exports) are considered as proxy of financial development and manufacturing exports of BRICS countries respectively over the study period (1990 – 2015).

Step 2- Next, stationarity of all data series is checked using ADF test of stationarity.

Step 3 - At third step, optimum lag length selection is decided by using optimal lag length criteria.

Step 4 - In next step, bounds test for co-integration (ARDL model) is applied to check the co-integration between financial development and manufacturing exports for each BRICS country.

Step 5 - After checking co-integration among variables, long-run and short-run relationship is checked with the help of ARDL.

Step 6 -Directional causality is checked between financial sector development and manufacturing exports for the countries where co-integration exists, VAR granger causality test is applied to check directional causality.

Step 7 - At last, to check any miss specification in the model, diagnostic tests (normality, heteroscedasticity, serial correlation and stability tests) are applied.

3.4. Model Specification

Based on literature the relationship between manufacturing exports and financial development can be specified as follows: -

$$LME = \beta_0 + \beta_1 LFDI + \varepsilon_t \quad (3.1)$$

Where,

LME is log of manufactures exports (% of merchandise exports) used as the proxy of manufacturing exports.

LFDI is log of financial development index used as proxy of financial development.

β_0 is intercept, β_1 is trend and ε_t is error term.

3.5. Tools and Techniques Used in the Study

3.5.1. Line Chart and Descriptive Statistics

To understand the behavior of raw data line chart and descriptive statistics are important. In this study also, line charts and descriptive statistics are used. Line charts are used to analyze the trend and pattern of variables and financial development index. And descriptive statistics are used for comparative analysis of financial development index of BRICS nations. In descriptive statistics mean, median mid value, standard deviation and Skewness information is provided. So, to understand the behavior of raw data line chart and descriptive statistics are important to explain. In this study, Line chart are plotted with the help of MS-Excel software.

3.5.2. Principal Component Analysis (PCA)

PCA is an indicator reduction technique to study observed indicators that would result in smaller number of interpretable components (Sricharoen & Buchenrieder, 2005).

Generally, the size of eigenvalue reflects the size of variance in the principal components. The first component describes the largest proportion of total variability in the set of considered indicators. The next component describes the next largest amount of variability not described by the first principal component, and so on. In this study. PCA technique is applied to construct the financial development index. With the help of PCA approach, component scores of each variable are calculated and based on these component scores financial development index is constructed for each BRICS country. It will represent the overall financial development of each BRICS country and this measure also deals with multicollinearity and over parameterization (Ang & Mckibbin, 2007).

3.5.3. Unit Root Test (ADF Test)

Stationary testing is one of the important assumptions of standard regression analysis. Most of the macroeconomic time series are often not found stationary. Therefore, as a preliminary test it is important to check the stationarity of time series variables to avoid getting bias and estimates or spurious result. Unit root test also helps to decide the further technique to be considered for the study e.g., if data is stationary of I (2), ARDL model will crash. A stationary time series has mean, variance and autocorrelation constant over a period of time. There are many tests available to check stationarity of time series like Phillips-Perron test, KPSS test, Augmented Dickey Fuller (ADF) test, Zivot–Andrews test etc. In this study, ADF test is applied to examine each variable for the presence of unit root as this test is most popular among unit root tests.

3.5.4. Auto Regressive Distribution Lag Model (ARDL)

In this study, an attempt is also made to check cointegration between variables using bounds test for co-integration technique. It is applied to check whether financial development has any long run or short run effect on manufacturing exports. There are a few approaches to check the existence of long run relationship among variables like Engle and Granger co- integration test (1987), Johansen co-integration test (1988), Philips and Hansen co-integration test (1990) which concentrates on cases where variables are integrated of order I (1) and large sample size.

In this study, ARDL model is applied as it is considered most appropriate procedure for this study (Pesaran et. al 2001).

ARDL model is applied because of following reasons:

i. In ARDL long run relationships are estimated by focusing on the dynamics of single equation, where the long run and short run dynamics are estimated jointly.

ii. This study has small sample size of 26 years and ARDL model is appropriate to deal with small size. (Gounder, 2002; Pattichis ,1999; Tang, 2001)

iii. ARDL technique is applicable in both cases whether regressor in the model is I (0) or I (1). However, the procedure will however crash in the presence of I (2) series.

iv. In ARDL, all variables are assumed to be endogenous.

Co-integration testing among ME (Manufacturing exports) and FDI (Financial development index) involves the following steps:

At first, unrestricted error correction model is estimated. An ARDL representation of equation (3.2) can be specified as follows:

$$\Delta LME = \beta_0 + \sum_{i=1}^{q_1} \beta_1 \ LME_{t-1} + \sum_{i=0}^{q_2} \beta_2 \ LFDI_{t-1} + \ \theta_1 \ LME_{t-1} + \theta_2 \ LFDI_{t-1} + \varepsilon_t \quad (3.2)$$

Where,

LME is log form of manufacturers exports (% of merchandise exports) used as proxy of manufacturing exports.

LFDI is log form of financial development index used as proxy of financial development.

q_1 and q_2 are denoted as lag lengths.

ε_t is error term.

Δ is the difference operator.

Here, the null hypothesis of no co integration defined as $H_0 = \delta_1 = \delta_2 = 0$ *is* tested against the alternative hypothesis $H_1 = \delta_1 \neq \delta_2 \neq 0$ of co integrating relationship. The co-integration test is based on Wald statistics or F-statistics. The F-test has non-standard distribution. Thus, Pesaran et al. (2001) has proposed two critical values (upper bounds value and lower bounds value) for co integration test. If the obtained F-statistic value is higher than the upper critical bound value, alternative hypothesis of co-integrating relationship between variables will be accepted. If the F- statistic value is than the lower critical bounds, null hypothesis of no cointegration relation will be accepted. However, if F-statistic value lies between lower and upper bounds, then the test is said to be inconclusive.

If co-integration exists between the variables, coefficients and error correction model are estimated.

$$LME = a_0 + a_1 t + \sum_{i=1}^{m} a_i \; LME_{t-i} + \sum_{i=0}^{p} \emptyset_i \; LFDI_{t-i} + v_t \qquad (3.3)$$

The auto regressive distributed lag model estimates $(P+1)^k$ number of regressions to obtain the optimal lags for each variable, where 'P' is the maximum lags to be used and 'k' is number of variables in the equation 3 (Shrestha and Chowdhury, 2005). The model is selected based on the SBC or AIC. SBC considers smallest lag length and AIC maximum lag length (Shrestha and Chowdhury, 2005). Once co-integrating relationship is obtained among variables, the long run and ECM estimates of the ARDL model are obtained.

3.5.5. Vector Auto Regressive (VAR) Granger Causality Block Exoginity Test

The co-integrating relationship reveals the existence or non-existence relationship, but does not shows the direction of causal relationship between the variables. So, in order to know the direction of relationship between the manufacturing exports and financial development VAR Granger Causality block exoginity test is employed in this study. The framework of this test is mentioned ahead:

If causality (or causation) runs from ME to FD, it takes the form,

$$\Delta LME_t = a + \sum_{i=1}^{p} a_i \; \Delta LME_{t-1} + \sum_{j=1}^{q} \beta_j \; \Delta LFDI_{t-j} + \; u_t \qquad (3.4)$$

If causality (or causation) runs from FD to ME,

$$\Delta LFDI_t = a + \sum_{i=1}^{r} \gamma_i \ \Delta LFDI_{t-1} + \sum_{j=1}^{s} \delta_j \ \Delta LME_{t-j} + \ v_t \qquad (3.5)$$

In the above equations (3.4 and 3.5),

LME is log of manufacturers exports (% of merchandise exports) used as proxy of manufacturing exports.

LFDI is log of financial development index used as proxy of financial development.

u_{tt} and v_t are white noise residuals.

Lag lengths for each variable are p, q, r and s.

The null hypothesis that is tesedt in this case is that LME variable does not granger cause variable LFDI and variable LFDI does not granger cause variable LME. In this model, a significant F statistic (< 0.05) will show causation from LME to FDI and LFDI to LME (Hassapis et al. 1999). At last, diagnostic tests are performed in this study to check any misspecifications in models.

3.5.6. Diagnostic Tests

At last, some diagnostic tests are also performed to ensure that models are not miss specified. In this study, serial correlation, normality, heteroscedasticity and stability of the models is checked. To check the serial correlation LM test is applied. Heteroskedasticity of the model is checked by Breusch-pagan test. Normality of models is examined by Jarque-Bera test which is important to check the the problem

of spurious relation. At last, to evaluate the parameter stability of models CUSUM and CUSUMSQ are graphically plotted (Brown et al. 1975). Estimated parameters obtained from ESM model may not be stable. Hence, these unstable parameters may result in model misspecification which can provide bias results.