



**ADDIS ABABA UNIVERSITY**  
**COLLEGE OF BUSINESS AND ECONOMICS**  
**AN MBA PROGRAM IN FINANCIAL SERVICES**

**MACROECONOMIC FACTORS AFFECTING LOAN COLLECTION  
PERFORMANCES OF THE DEVELOPMENT BANK OF ETHIOPIA**

**BY**  
**EBBA REGASSA**

**A Thesis Submitted to Addis Ababa University College of Business  
and Economics in Partial Fulfillment of the Requirements for the  
Degree of Masters in Business Administration with Specialization in  
Financial Services**

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# **MACROECONOMIC FACTORS AFFECTING LOAN COLLECTION PERFORMANCES OF THE DEVELOPMENT BANK OF ETHIOPIA**

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**SCHOOL OF GRADUATE STUDIES**

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**APPROVED BY BOARD OF EXAMINER**

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Examiner

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Signature

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Examiner

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Signature

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## **STATEMENT OF DECLARATION**

I, the undersigned, would like to certify that this thesis entitled ‘Macroeconomic Factors Affecting Loan Collection Performances of the Development Bank of Ethiopia’ is my original work and complies with the regulations of the University and meets accepted standards with respect to originality. All materials used as sources of information in the preparation of this thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

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## **ENDORSEMENT**

This thesis has been submitted to Addis Ababa University School of Graduate Studies for examination with my approval as an advisor of the University to the candidate.

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## LIST OF TABLES

Table 1: Lag Length Selection for the Model.....	29
Table 2: ADF Unit Root Test at Level.....	30
Table 3: Unit Root Test at First Difference .....	31
Table 4: Johansen Cointegration Test for Trace Statistics.....	32
Table 5: Johansen Co-integration Test by Maximum Eigenvalue Approach.....	33
Table 6: Number of Cointegrating Equations based on the Johansen Co-integration test Using Assumptions for Data Trend.....	33
Table 7: Estimates for Coefficients of Co-integrating Equation (Long Run Model) .....	37
Table 8: Significance Test for the Long Run Model .....	38
Table 9: Summary of Hypotheses Results in long run dynamics .....	39
Table 10: Speed of Adjustment by Which Variables Converge to Their Equilibriums) and Period of Full Adjustment.....	42
Table 11: Vector Error Correction Estimates of the Whole Short Run Regression Models .....	43
Table 12: Estimates of Coefficients in the Short Run Model When D(LNLC) is Taken as Dependent Variable .....	44
Table 13: Estimated Coefficients of the Short Run Model with their P-values.....	44
Table 14: VEC Residual Serial Correlation LM Test.....	46
Table 15: VAR Residual Heteroskedasticity Tests.....	46
Table 16: VAR Residual Normality Test.....	46
Table 17: Summary of Diagnostic Tests.....	46

## **LIST OF FIGURES**

Figure 1: Conceptual Framework of the Study.....	18
Figure 2: Trend Analysis of the Time Series Variables.....	30
Figure 3: Stability Test for the Model.....	45

## **LIST OF ABBREVIATIONS AND/OR REPRESENTATIONS**

ADF = Augmented Dickey-Fuller test

CF = Capital Formation

DBE = Development Bank of Ethiopia;

ECT = Error Correction Term;

FX = Foreign Currency Supply;

GD = Gross Domestic Product (GDP);

LC = Loan Collection Performances of DBE;

LN = Natural Logarithmic Representation of Variables;

SV = Domestic Saving;

VAR = Variable Auto Regression; and

VECM = Vector Error Correction Model.

# TABLE OF CONTENT

Acknowledgement.....	iv
Statement of Declaration .....	v
Endorsement.....	vi
List of Tables .....	vii
List of Figures .....	viii
List of Abbreviations and/or Representations.....	ix
Appendixes.....	xii
Abstract.....	1
<b>1. Introduction .....</b>	<b>2</b>
1.1 Background of the Study.....	2
1.2 Background of the Development Bank of Ethiopia .....	3
1.3 Statement of the Problem .....	4
1.4 Objectives of the Study .....	6
1.4.1 General Objective.....	6
1.4.2 Specific Objectives.....	6
1.5 Research Question.....	6
1.6 Hypotheses .....	6
1.7 Significance of the study.....	7
1.8 Scope and Limitations of the Study .....	7
1.9 Organization of the Study .....	8
<b>2. Literature Review .....</b>	<b>9</b>
2.1 Theoretical Explanations on Project Finance and its Repayments .....	9
2.2 Empirical Evidences on Factors Affecting Loan Collection Performances of Development Banks.....	14
2.2.1 Bank and Customer Specific Factors Affecting Loan Collection Performances of Development Banks .....	14
2.2.2 Empirical Evidences on Macroeconomic Factors Affecting Loan Collection Performances of Development Banks.....	15
2.2.3 Empirical Evidences on Factors Affecting Loan Collection Performances of DBE .....	16
2.3 Conceptual Framework .....	18

<b>3. Research Design and Methodology .....</b>	<b>19</b>
3.1 Type and Source of Data.....	19
3.2 Research Methodology.....	19
3.3 Model Specification .....	20
3.4 Definition of variables.....	26
<b>4. Presentation and Analyses of Research Data.....</b>	<b>28</b>
4.1 Introduction.....	28
4.2 Lag Length Selection .....	28
4.3 Unit Root Test.....	29
4.4 Co-integration Test.....	31
4.5 Estimation of the VAR Model .....	34
4.5.1 Estimations Based on Standard VAR .....	35
4.5.2 Estimations Based on the Restricted VAR .....	35
4.5.3 Long-Run Relationships .....	36
4.5.4 Short Run Relationships.....	42
4.6 Stability Test .....	44
4.7 Diagnostic Tests .....	45
4.8 Results of the Study .....	47
<b>5. Summary, Conclusion and Recommendations.....</b>	<b>50</b>
5.1 Summary .....	50
5.2 Conclusion .....	51
5.3 Recommendations.....	52
<b>References.....</b>	<b>55</b>

## APPENDEIXIES

Annex 1: Raw Data used for the Study.....	59
Annex 2: Detailed Results for the Johansen Cointegration Test .....	60
Annex 3: ADF Unit root test on LNLC at level.....	63
Annex 4: ADF Unit root test for LNLC at First Difference .....	65
Annex 5: ADF Unit root test for LNGD at Level.....	66
Annex 6: ADF Unit root test for LNGD at First Difference.....	68
Annex 7: ADF Unit root test for LNSV at Level.....	69
Annex 8: ADF Unit root test for LNSV at First Difference .....	71
Annex 9: ADF Unit root test on LNFX at Level .....	72
Annex 10: ADF Unit root test for LNFX at First Difference .....	73
Annex 11: ADF Unit root test for LNCF at Level.....	74
Annex 12: ADF Unit root test for LNCF at First Difference .....	75
Annex 13: Matrix of VAR Model with its Coefficients .....	77
Annex 14: VAR Residual Heteroskedasticity Test (White test).....	79
Annex 15: VAR Residual Normality Test .....	80

## **Abstract**

*Macroeconomic variables like real Gross Domestic Product (GDP), domestic saving, foreign currency supply and capital formation are major indicators that show the level of economic performance of a country. This study investigates effects of such macroeconomic variables on loan collection performances of the Development Bank of Ethiopia to show to what extent these variables contribute towards loan collection endeavor of the Bank. The research methodology used for the study is a quantitative research approach by using primarily VAR model. The raw data on loan collection and macroeconomic variables used for the study were collected from DBE and the NBE including observations of 42 years on annual bases ranging from 1975 to 2017. Results of the study were obtained by making unit root test, co-integration test, estimations of VECM, etc. Accordingly, the study indicates that while GDP and foreign currency supply have positive and significant effects on loan collection, domestic saving has positive but insignificant to influence loan collection performances of the Bank in the long run. Capital formation, on the other hand, has negative but insignificant influence on the dependent variable. Growths in macroeconomic variables like those included in this study and their smooth operations are important indicators for the healthy economic movements. Thus, growth in GDP would have been reflected on the loan collection performances of DBE due to the fact that the growth of the economy and smooth operations of the macroeconomic variables stimulate all microeconomic factors to operate in similar direction with the macroeconomic variables. Accordingly, findings of the study indicate that the growth in real GDP, for instance, does not confirm this general truth due to the fact that, despite successive growth in the economy of Ethiopia, reports show that NPLs ratio of DBE is growing and surpassing the appetite set by supervisory organ of the Government. Hence, in line with the previous studies, DBE should give prior attention and work towards to its own internal and customer specific factors, in addition to macroeconomic variables so as to address the problems that the bank faces related to loan collection performances of projects financed by the Bank.*

**Keywords:** Loan collection performance, macroeconomic variables-GDP, foreign currency supply, domestic saving and capital formation.

# 1. Introduction

## 1.1 Background of the Study

Development banks play an important role in supporting development programs of a country through provision of financial resources for project financing. Theoretically, according to Gittinger (1982, p. 3), projects are said to be the cutting edge of development. Developing countries need to implement a number of development projects so as to reduce the impact of poverty on the poor. Implementation of projects require sustainable source of capital of which owner equity and bank loan are said to be the two key sources of capital. Debt servicing, on the other hand, is primarily based on the cash-in-flow of the project after the project commenced its operations. From the cash generated by the project as cash in-flows, according to Gittinger (1982 p.150), the major component of cash out outflows as the debt servicing or payment for loans include interest, commitment fee, and repayment of principal to the bank that have lent money to support the project.

Ethiopia is one of the developing countries in which provision of credit to projects aimed at promoting the development agenda of the country plays an important role. To this end, project financing, irrespective of the sources of finance and the owner of the project, is said to be the key element of the development program in which the promoter implements to run successful business. Hence, the capital outlay used as a source of finance for projects should be recovered from the cash generated by the financed projects and bank loans should be repaid together with all financial obligations arising from contractual agreements.

Project financing can be described as the financing of the development or exploitation of a right, natural resource or other asset where the bulk of the financing is to be provided by way of debt and is to be repaid principally out of the assets being financed and their revenues, (Dentons, 2013). Moreover, project financing is also described as the raising of finance on a limited recourse basis, for the purposes of developing a large capital- intensive infrastructure project, where the borrower is a special purpose vehicle and repayment of the financing by the borrower will be dependent on the internally generated cash flows of the project, ([www.hsbcnet.com](http://www.hsbcnet.com)).

Most frequently project finance comes from a combination of equity of the investor and bank loans based on the capacity of the investor to raise capital from own sources and the risk appetites of the

lending bank, (www.doi.gov). Accordingly, the equity requirement standards set by lending banks, depending on the risk profiles of the planned projects to be financed, entail the proportion of the equity required as compared to the loans to be secured from banks. Thus, the higher the risk, the greater the share of the equity contribution of the promoter will be required by the lending banks. In general terms, according to Milanović, et al (2016), project finance is also known as the structured finance, since it requires such structure of debt and shareholders' equity enabling the cash flow of the project to be adequate to the service of debt. In practice, the project finance is usually used for capital intensive activities when the ones responsible for a project are the loan insolvent for traditional forms of financing or are not ready to take risks and loan commitments. In the project finance model, total risks of the project are distributed to several partners, and thus risks are decreased to the level acceptable to each partner. Accordingly, financing projects requires a well established proportion of debt to equity to establish adequate source of capital required to establish a given project which should ultimately be recovered.

Most of the financed projects are expected to generate different benefits of which cash in-flows by such projects is of paramount importance to recover, among other things, the capital outlay invested on the projects. One of the most common sources of fund for project financing is a bank loan which has to be settled within the agreed upon loan repayment tenors and based on the cash generation capacity of the project. Projects geared at generating profits should settle their debt obligations from their positive cash in-flows. Consequently, projects financed by the Development Bank of Ethiopia (DBE herein after) are among those projects that are expected to meet their debt servicing obligations from their operational cash in-flows which in turn can bust loan collection performances of DBE. This study, thus, tries to investigate some macroeconomic factors that can positively or adversely affect loan collection performance of the DBE.

## **1.2 Background of the Development Bank of Ethiopia**

The DBE was established in May 1909 as a private financial institution to support development of the country in agriculture and trade, make the people self-sufficient and increase wealth of the government (DBE, 2009) and took the present day form by going through different changes.

Currently DBE provides project financing services by its four customer relationship management directorates. The 13 districts and 110 branch offices were also engaged in providing project and SME financing.

DBE-Government owned development financial institution in Ethiopia- normally finances projects in the priority areas of the Government in sectors which include commercial agriculture, manufacturing industries, agro-processing industries, extractive industries or mining (DBE, 2015), integrated industrial parks and Small and Medium Enterprises financings whereby the latter two sectors are introduced to the bank very recently so that their impacts on loan collection performance of the bank are not known. Projects in the other sectors of the economy are expected to have positive cash flows which would be enough, among other things, to settle their debt obligations. Currently it is observed, however, that the loan repayment performances of some projects which were financed by the Bank become apparently poor as a result of which the non-performing loans (NPLs) of the bank is rising both in amount and ratios.

Here, experiences from DBE show us that projected cash flows of all projects financed by the bank are positive and sufficiently enough to provide debt services. Moreover, under normal circumstances it is imperative that projects with good operational performances would generate sufficient income that would be used for settling debt obligations. On the contrary the non-performing loans (NPLs) of the DBE, the proxy that indicate the poor loan collection performances of the bank, are piling up from time to time due to bank and borrowers' specific factors. As bank and customer specific factors were addressed by empirical studies carried out by some researches including Abafita (2003), Asfaw, et al (2016) and Shirega (2016) in one way or other, such bank and customer specific factors were excluded from this paper and due emphases are given to macroeconomic variables as the later factors were not given coverage in empirical studies related loan collection performances of development banks in general and DBE in particular. Thus, this study has focused on the assessment of the effects of some macroeconomic variables like gross domestic products, supply of foreign currency, domestic saving, and capital formation on loan collection performances of the DBE.

### **1.3 Statement of the Problem**

DBE finances projects that participate in businesses in the priority area of the Government by mobilizing financial resources from both international and domestic sources as such projects are expected to contribute to the economic development endeavor of the nation through generation of benefits which mainly includes creation of job opportunities to the needy labor force, generation of income to the nation in the form of tax and foreign exchange earnings. As resources are limited, all

DBE financed projects should repay their loan obligations of the bank as per the terms and conditions stipulated in the loan contract so as to create room for the bank to finance other development projects in similar economic sectors to meet the increasing demand for loanable fund by both local and foreign investors. Recently, the NPLs of the bank are increasing both in amount and ratios as compared to total loan portfolio of the bank. Available information (DBE, 2014-17<sup>1</sup>) indicate that the NPLs of DBE stood at Birr 1.8 billion, Birr 3.5 billion, Birr 5.6 billion and Birr 8.5 billion for the fiscal years ended June 30, 2014-2017 respectively which also respectively represent an NPLs ratio of 8.0%, 12.8%, 17.6% and 14.9% for the same periods indicating that the asset quality of DBE is deteriorating from time to time. Such increments in NPLs both in ratios and absolute terms (or deterioration in asset quality of the bank) reveal that there would be a time where the bank become unable to finance other development projects from its own mobilized fund unless bailed out by the Government.

There are evidences that indicate financial institutions in general and banks in particular are important financial intermediaries which link the supply of and demand for financial resources which could have contributions to the overall economic development of the people and the nation. The roles of development banks in economic development are indispensable. Thus, despite their roles, well functioning banks accelerate economic growth, while poorly functioning banks impede economic progress and exacerbate poverty; effective loan repayment is an indicator of good business performance; and poor loan repayment might cause poor performance in the financial institutions, leading to bank failure (Isaac, 2011).

On the other hand, empirical studies show that bank specific factors which include weak credit risk management, easily admitted borrowers [poor assessment of borrower's creditworthiness], poor credit monitoring, excessive risk appetite by the bank, compromised integrity in approving credit, rapid credit growth, poorly negotiated and lenient credit terms; and borrower specific factors like credit culture of customers, lack of knowledge and related experience of borrower for the proposed business, willful default, loan diversion, lack of commitment on the side of the promoter and project management problem were the factors have contributed to the prevalence of NPLs, Arega, et al (2016). Furthermore, factors like educational level of borrowers, repayment period of the loan, availability of other source of income, sector, and purpose of the loan determine successful loan repayment performance of borrowers of DBE, Gebremedhin (2010). Likewise, factors that include loan processing time, type of management, experience of project manager, education level of

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<sup>1</sup> Loan Portfolio Concentration Reports of DBE for the Fiscal Years ended June 30, 2014-2017

project manager, project implementation period, project follow-up, size of loan, proportion of bank loan in relation to that of the owners' equity in financing the project have effects on loan repayment performances of projects in different degrees, (Shirega, 2016). But there are no empirical studies that reveal the effect of macroeconomic variables on loan collection performances of development banks. This study, therefore, tries to investigate macroeconomic variables that have effects on loan collection performances of DBE either positively or negatively.

## **1.4 Objectives of the Study**

### **1.4.1 General Objective**

The general objective of this research was to determine the relationships that some attributes of the macroeconomic factors which have determinant effects on the loan collection performances DBE from the projects financed by the bank.

### **1.4.2 Specific Objectives**

The specific objectives of this research paper are:

- 1) To analyze the effect of GDP on loan collection performances of DBE;
- 2) To examine whether foreign currency supply has effect on loan collection performances of DBE;
- 3) To investigate whether domestic saving has effect on loan collection performances of DBE; and
- 4) To evaluate whether capital formation has effect on loan collection performances of DBE.

## **1.5 Research Question**

What are the relationships and linkages that would exist between the macroeconomic variables (explanatory variables) and loan collection performances of DBE, the explained or dependent variable?

## **1.6 Hypotheses**

The study has set the following hypotheses based on objectives of the research and research question outlined herein above.

- 1)  $H_0$ : The GDP of Ethiopia has no contribution to loan collection performance of the DBE;
- 2)  $H_0$ : A foreign currency supply to the economy of Ethiopia has no contribution to loan collection performance of the DBE; and
- 3)  $H_0$ : Domestic saving in Ethiopia has no contribution to loan collection performance of the DBE;
- 4)  $H_0$ : Capital formation in Ethiopia has no contribution to loan collection performance of the DBE.

### **1.7 Significance of the study**

Understanding the nature of macroeconomic variables as determinant factors affecting loan collection performances of DBE can give areas of concern for major stakeholders [policy makers and senior management of the bank] so as concentrate efforts on value adding endeavors.

This study, therefore, can provide additional information on the nature and the probable effects of macroeconomic variables on loan repayment performances of DBE from projects financed by the bank.

### **1.8 Scope and Limitations of the Study**

The study tries to give focuses to the investigation of the effects of four macroeconomic variables namely real GDP, foreign currency supply, domestic saving and capital formation on loan collection performances by DBE. Limitations of the study includes, although at the outset it was planned to do so, due to time and financial constraints, some other bank and/or customer related determinants like the grace and loan repayment periods that the bank gives to projects, the type and values of collateral requirements for all loans, the type and nature of corporate governance exercised by the bank, compliance checking for fund utilization (for equity of borrowers and bank loans), the project rehabilitation mechanisms employed by the Bank as and when required to do so, technical knowledge of project managers related to the specific nature of projects, technical competence of human resources for the day to day operations of projects, projects ownership: expatriates vs. local investors and other bank and customer specific factors may contribute to the poor loan collection performances of the bank, but these factors were not included into the assessment.

## **1.9 Organization of the Study**

This paper is organized under five major parts; starting with chapter one which gives introduction to the paper, followed by chapter two where review of literature related to factors affecting loan repayment performances of projects in general and macroeconomic variables in particular are made. Chapter three presents the methodology of the study where as chapter four presents analyses of the data on macroeconomic variables in relation to loan collection performances of DBE and the final chapter provides summary of the study, conclusion and recommendations.

## 2. Literature Review

### 2.1 Theoretical Explanations on Project Finance and its Repayments

The collectively known as the *multilateral development banks (MDBs)* which include the World Bank and four regional banks: the Inter- American Development Bank, the Asian Development Bank, the African Development Bank, and the European Bank for Reconstruction and Development are working towards realizing the mission ‘our dream is a world free of poverty, (Babb, 2009 p.1). The MDBs are major players in the controversial field of economic development. The MDBs devise straightforward policy prescriptions that are adopted by the governments of developing countries of which the World Bank- the biggest, oldest, and best known of the MDBs provides financing for development projects and programs around the globe, (Babb, 2009 p.6).

Recent time reports show that there are huge gap in channelling the global financial resources to the end users for project financing. Accordingly, one report released by the United Nations “...worldwide financial resources are held particularly in the form of assets in the hand of developed counties that offer low returns which accounts to the stock of financial assets of \$218 trillion, and annual global savings of \$22 trillion. Parts of these savings could be channeled towards long-term investments in the real economy. To this end, existing and new development banks are needed to bridge finance from end-savers to development projects. Such bridging should be done by development banks at all levels – national, regional and international – in order to provide the financing needed in the developing world. Development banks can thus be key players for development by providing long-term financing directly from their own funding sources, by tapping into new sources and by leveraging additional resources, including private, through the co-financing of projects with other partners,” (UNCTAD<sup>2</sup>, December, 2016 as cited from the Intergovernmental Committee of Experts on Sustainable Development Financing, 2014).

Moreover, the issue of development in the third world economies is a much discussed agenda among economists and politicians across the world. It is well believed that to accelerate sustainable economic development in such economies a number of projects have to be established. To this end,

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<sup>2</sup>UNCTAD =United Nation Conference on Trade and Development

governments and development agencies exert all possible efforts on project identifications and formulations, but the success of such development project depends on a number of factors out of which, based on the arguments given by Gittinger, (1982 p. 3) perhaps the most difficult single problem confronting project administrators in developing countries is implementing development programs, much of which can be traced to poor project preparation.

Once the project appraisal is identified as one of difficulties in implementing development projects, the source of fund for project finance and its uses should thoroughly be indicated in the appraisal document so that fund utilization for the intended project becomes an easy task. As described by Yescombe (2014 p.5), project finance is, therefore, the financing of projects that are dependent on project cash flows for repayment, as defined by the contractual relationships within each project. By their very nature, these types of projects rely on a large number of integrated contractual arrangements for successful completion and operation. The contractual relationships must be balanced with risks distributed to those parties best able to undertake them, and should reflect a fair allocation of risk and reward. All project contracts must fit together seamlessly to allocate risks in a manner which ensures the financial viability and success of the project.

Moreover, Yescombe (2014 p. 6) quoted from the rating agency Standard & Poor's that project finance is non-recourse financing of a single asset or portfolio of assets where the lenders can look only to those specific assets to generate the flow needed to service its fixed obligations, chief of which are interest payments and repayments of principal. Lenders' security and collateral is usually solely the project's contracts and physical assets. Lenders typically do not have recourse to the project's owner, and often, through the project's legal structure, project lenders are shielded from a project owner's financial troubles. Project-finance transactions typically are comprised of a group of agreements and contracts between lenders, project sponsors, and other interested parties who combine to create a form of business organization that will issue a finite amount of debt on inception, and will operate in a focused line of business over a finite period.

Once projects are financed, then the main concern that get due attention of the financier is the debt repayment performance of these projects. For large and complex and expensive projects [for example, power plants, chemical processing plants, mines, transportation infrastructure, environment, and telecommunications infrastructure], according to the Basel Committee on Banking Supervision, (November, 2005, p. 61) project finance is a method of funding in which the lender looks primarily to the revenues generated by a single project, both as the source of

repayment and as security for the exposure. In such transactions, the lender is usually paid solely or almost exclusively out of the money generated by the contracts for the facility's output which means that repayment depends primarily on the cash flow and on the collateral value of the assets of the project.

It is also believed that there are a number of factors that affect loan collection performances of a given development bank. Among these factors, the agency theory has attracted attentions of many scholars; the theory which discloses that directors and managers may make decisions in the way that may not contribute to the interest of that particular bank. Accordingly, in relations to management of joint stock companies, Adam Smith (1776) explained that the trade of a joint stock company is always managed by a court of directors. This court, indeed, is frequently subject, in many respects, to the control of a general court of proprietors. But the greater part of those proprietors seldom pretend to understand anything of the business of the company, and when the spirit of faction happens not to prevail among them, give themselves no trouble about it, but receive contentedly such half-yearly or yearly dividend as the directors think proper to make to them. This total exemption from trouble and from risk, beyond a limited sum, encourages many people to become adventurers in joint stock companies, who would, upon no account, hazard their fortunes in any private copartnery. Such companies, therefore, commonly draw to themselves much greater stocks than any private copartnery can boast of. The directors of such [joint-stock] companies, however, being the managers rather of other people's money than of their own, it cannot well be expected that they should watch over it with the same anxious vigilance with which the partners in a private copartnery frequently watch over their own. Like the stewards of a rich man, they are apt to consider attention to small matters as not for their master's honour, and very easily give themselves a dispensation from having it. Negligence and profusion, therefore, must always prevail, more or less, in the management of the affairs of such a company. It is upon this account that joint stock companies for foreign trade have seldom been able to maintain the competition against private adventurers. They have, accordingly, very seldom succeeded without an exclusive privilege, and frequently have not succeeded with one. Without an exclusive privilege they have commonly mismanaged the trade. With an exclusive privilege they have both mismanaged and confined it.

With respect to the conceptual framework related to the agency theory, moreover, Zogning (2017 p. 1) by citing from works of Eisenhardt (1989) has explained that the interests of the actors and

the organization they represent as the actors who work in an organization have utility maximization logic and seek to get what is in their best interest; even it is perhaps not in the best interest of the organization; and from works of Barnard (1938) related to cooperation in organizations he has shown that the agency theory focuses on the conflict between objectives, created by various individuals who, while engaged in these organizations, seek for what is in their best interest. However, this approach adds new complexities to the clichés that exist within the organization.

According to Pike Richard and Neal Bill (2006), potential conflict arises where ownership is separated from management: the ownership of most large companies is widely spread while the day-to-day control of the business rests in the hands of a few managers who usually own a relatively small proportion of the total shares issued giving rise to a concept termed as managerialism: self-serving behavior by managers at the expense of shareholders. Moreover, Watson and Head (2010) further described that the agency problem occurs when managers make decisions that are not consistent with the wealth maximization objectives of the shareholders. Related to public limited companies, Watson and Head (2010) have shown that there are three important features that contribute to the existence of the agency problems. These are: 1) divergence of ownership and control, whereby those who own the company (shareholders) do not manage the company but appoint agents (managers) to run the company on their behalf; 2) the goals of the managers (agents) differ from those of the shareholders (principals)-human nature being what it is, managers are likely to look to maximize their own wealth rather than the wealth of shareholders; 3) asymmetry of information exists between agent and principal- managers, as a consequence of running the company on a day-to-day basis, have access to management accounting data and financial reports, whereas shareholders only receive annual reports, which may be subject to manipulation by the management. According to these authors, when these three factors are considered together, it should be clear that managers are in a position to maximize their own wealth without necessarily being detected by the owners of the company. Asymmetry of information makes it difficult for shareholders to monitor managerial decisions, allowing managers to follow their own welfare maximizing decisions.

Thus, related to banks, one can safely deduce that directors and managers would make business decisions based upon corruption and nepotism driven approaches in seeking to maximize their own utility by forfeiting or compromising the profit maximization objectives of banks which they represent and to enable few segments of economic actors to access to financial resources of banks.

With no doubt the overall growth in an economy of a country is a good indicator for health economic performances of that country. Growth in real GDP represents the market value of goods and services annually produced by the country.

In line with this it is to be noted that different reports indicate that the Ethiopian economy has grown with double digits for the last decade. According to the World Bank, for instance, the Ethiopian Economy is continued to expand nearly in double digits<sup>3</sup> (for instance at 12.6% in 2005 and 10.30% in 2014) where such economic growth was driven mainly by the service sector from supply side and the public investment from the demand side, (World Bank, 2015) and the average growth rate of the real GDP for the period 2004-2016 was 10.5%, (World Bank, 2016).

It is apparently believed that such improved movements in the general economic performances of a country will have positive impacts on performances of actors in the economy. Thus, economic theories reveal that the general economic growth of a nation will have a multiplier effect on other economic activities of that nation. From this theoretical notion, one can safely deduce that an economic growth of the country, measured in growth of real GDP, would have to have a positive impact on performances of business organizations. A research made in UK, however, has reached at exactly an opposite conclusion. According to the research made by Issah and Antwi (2017, p. 11) to predict the relationship between firm performance and macroeconomic variables on public listed companies in UK indicate that real GDP, among other variables incorporated into the study, has significant and negative impacts on the future earnings of a firm where the negative coefficient implies that as economic activity increases the future earnings of a firm will decrease.

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<sup>3</sup> The Ethiopian economy was grown at 12.50% in 2005, 10.30% in 2014 and 8% in 2016

## **2.2 Empirical Evidences on Factors Affecting Loan Collection**

### **Performances of Development Banks**

#### **2.2.1 Bank and Customer Specific Factors Affecting Loan Collection**

##### **Performances of Development Banks**

Empirically, literature on determinants affecting loan collection performances of development banks is very limited. Much of the research output available on development finance are related to fund utilizations and factors affecting loan collection performances of small and medium sized enterprises financed by micro-finance institutions. Proxy literatures related to loan repayment performances of customers of micro finance institutions and that of commercial banks were used to provide some possible glimpses into the nature of factors affecting loan collection performances of development banks. Accordingly, Pasha and Negese (2014) have studied performance of loan repayment determinants in Ethiopian Micro Finance and their study shows that there were significant association between the dependent variable [loan repayment performances of microenterprises] and factors like education level, loan diversion, loan size, time laps between loan application and disbursement, repayment period and all business types. And, there were significance difference between defaulters and factors like age, family size, business experience, repeatedly borrowing, and supervision. Similarly, Abafita (2003) indicated that loan diversion and loan amount are significant factors that undermine loan repayment performances, while income, loan supervision, suitability of repayment period, and literacy level are important and significant factors that enhance the probability of repayment.

There are a number of factors that can affect performances of banks. According to Evans (2014) performance of commercial banks can be affected by internal and external factors which can be classified into bank specific (internal) and macroeconomic variables. The internal factors are individual bank characteristics which affect the bank's performance, these factors are basically influenced by the internal decisions of management and board. The external factors are sector wide or country wide factors which are beyond the control of the company and affect the profitability of banks.

Moreover, according to Ochung (2013, pp. 39-40), factors that includes the amount of time taken for the loan to be approved, location of business operations, the interest rates charged on the loan,

type of loan (fixed/variable interest), firm performance, inflation levels in the economy, investment opportunities, the amount of loan advanced, the loan repayment period, the speed of loan approvals in the bank, the information requested by the bank, the amount of information provided by the applicant, the availability of the information requested from the loan applicant, age of the borrower, number of years the customer has banked with the bank, the performance of the bank in form of performing loans, the kind of collateral pledged as security for the loan, the type of account a customer maintains, proportion of negotiation fees, maturity period of the loan, and grace period before repayment starts affected the level of loan repayment among customers of commercial banks in Kenya to a very great extent.

Some empirical studies on determinants of NPLs [the main consequences of poor loan repayment performances of banks] of commercial banks in Ethiopia portrays that factors like underdeveloped credit culture, poor credit assessment, aggressive lending, botched loan monitoring, lenient credit terms and conditions, compromised integrity, weak institutional capacity, unfair competition among banks, willful defaults by borrowers and their knowledge limitation, fund diversion for unexpected purposes and overdue financing has significant effect on NPLs, Wondimagegnehu (2012) as cited by Arega, et al (2016).

### **2.2.2 Empirical Evidences on Macroeconomic Factors Affecting Loan Collection Performances of Development Banks**

Like that of bank and customer specific determinants affecting loan collection performances of development bank from financed projects, empirical studies related to macroeconomic factors are also limited. Available empirical studies, however, give more emphasis to macroeconomic factors affecting profitability of commercial banks by considering profitability as a proxy for bank performances. Among these empirical studies, one study carried out in Kenya with equity bank in focus (Evans, 2014) shows that macroeconomic factors have insignificant effect on bank profitability in Kenya; specifically, economic growth (real GDP) and inflation have a positive insignificant effect whereas exchange rate has a negative insignificant effect at 5 % level. Moreover, a study made by Christine Nanjala (2015) concludes that (1) though real GDP indicates the economic growth of the country, its increase does not have a significant effect on profitability of commercial banks; (2) real interest rates have a significant negative influence on profitability of quoted commercial banks in Kenya indicating that a rise in real interest rates

results to reduction in bank profitability and vice versa. Rise in interest rates could cause loans to be expensive thus reducing loan demand and eventually affecting interest revenue to banks. Further, rise in interest rates causes rise in loan repayments which can increase default rates by bank customers which negatively affects profitability; (3) a rise in exchange rate influences a rise in bank profitability (ROA). As the value of the Kenya shilling against the US dollar decreases, it has a positive impact on the exports of the country. This helps to boost up the exports of the country. While due to the decrease in the value of Kenya shilling, the imports become dearer and expensive for the country which lowers unnecessary imports to the country. Further rise in exchange rate would mean an increase in foreign exchange earnings and gains by banks which improves their profitability.

Another study made in Ghana (Grace Ofori, 2016) also indicates that macroeconomic variables like money supply do not have a significant effect on loan performance, though the relationship between loan performance and money was found to be positive implying that money supply does not affect loan performances. Grace Ofori (2016) has also compared rate of economic growth with loan performances and indicated that when there is a slow growth of GDP in an economy, the level of bad debts increases.

### **2.2.3 Empirical Evidences on Factors Affecting Loan Collection**

#### **Performances of DBE**

Specific to the Development Bank of Ethiopia very few empirical findings are available which show factors affecting loan collection performances of the bank. Accordingly, Arega, et al (2016) have shown that bank specific factors like weak credit risk management, easily admitted borrowers [poor assessment of borrower's creditworthiness], poor credit monitoring-failure to properly monitor what the borrower is doing with the money, excessive risk appetite by the Bank, compromised integrity in approving credit, rapid credit growth, poorly negotiated and lenient credit terms; and borrower specific factors like credit culture of customers, lack of knowledge and related experience of borrower for the proposed business, willful default, loan diversion, lack of commitment on the side of the promoter and project management problem were the factors which have impact on the prevalence of NPLs. Furthermore, according to Gebremedhin (2010) factors like educational level of borrowers, repayment period of the loan, availability of other source of income, sector, and purpose of the loan determine successful loan repayment performance of

borrowers of DBE, North Region positively and significantly while other variables such as gender and household size have positive sign, but are not statistically significant.

Moreover, another research thesis prepared by Shirega (2016) indicates that loan processing time is an important factor that affects the successful implementation of projects and it has a significant impact on production and revenue schedule of the project. This in turn affects the repayment performance of the project and it is the cause for a number of rescheduling of loan repayment period. Furthermore, with respect to some variables related to management of a project like type of management (owner versus hired manager), experience of project manager and education level of project manager the study made by same person concluded that projects managed by employed managers are less successful in loan repayment performance than projects managed by owner managers; more years of managerial experience has an impact on the successful loan collection performance of the bank; projects managed by managers with educational level of BA/BSC degree or above have successful loan repayment performance than projects managed by managers with educational level of diploma or below. With respect to factors related to project implementation period, project follow-up, size of loan and proportion bank loan in relation to that of the owners' equity in financing the project, the same study also reveals that delayed project implementation period leads to decreased loan repayment performance; DBE financed projects that were repeatedly supervised or followed-up have successful loan repayment performances; most of the defaulted projects have no sufficient permanent working capital so that the amount of loan has an impact on successful loan repayment performance of the DBE-financed projects; as the debt-to-equity ratio of defaulted and successful projects in loan repayment performances is similar, the impact of this factor is insignificant on loan repayment performances of projects, (Shirega, 2016).

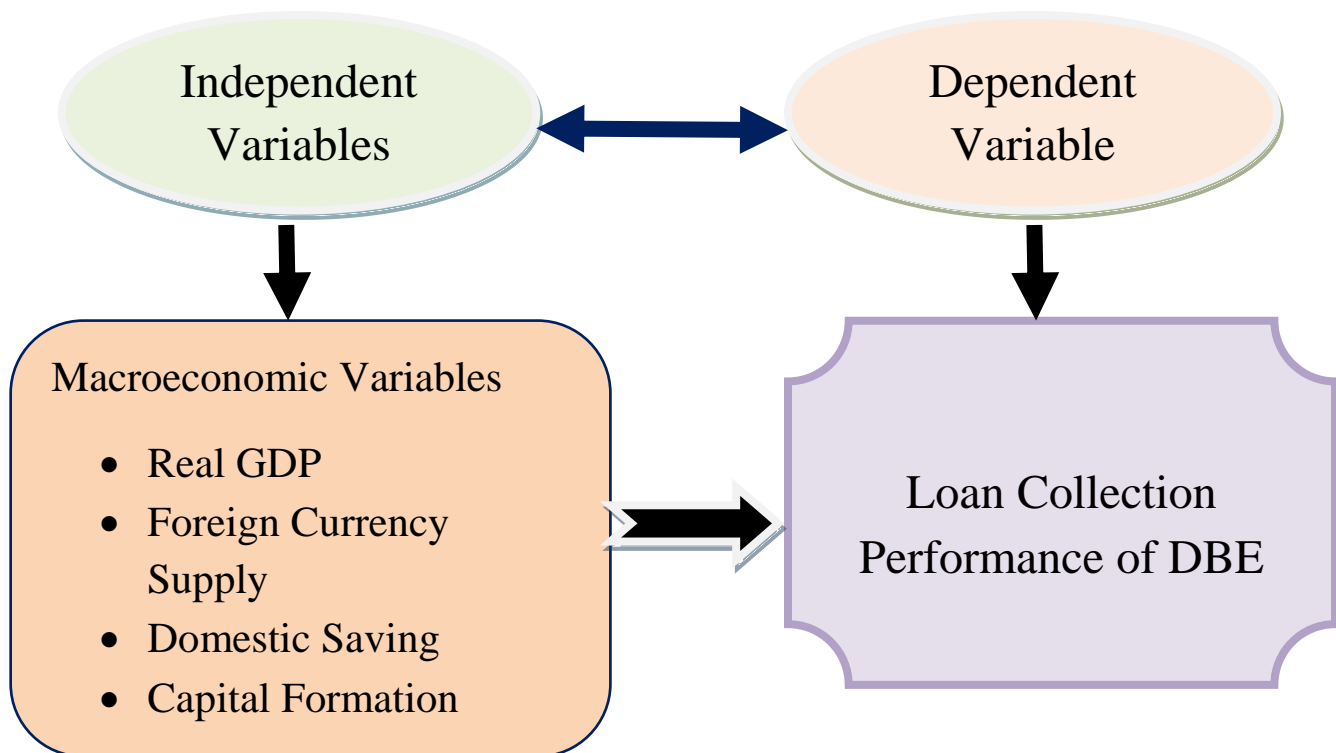
Again, the study has drawn some important conclusions with respect to factors related to availability and distance of raw materials from the project, market arrangements and distances for the output of projects financed by DBE. Accordingly, projects financed by DBE have not faced raw material problem for defaulter or the successful projects implying that input raw material availability has low influence on successful loan collection performance of the bank; the distance of the project from raw material site has insignificant influence on loan collection performance of the bank; export oriented projects are more successful in loan repayment than those projects which sell their products locally; market accessibility for products of projects has high influence on success of loan repayment performances of DBE-financed projects, that is, projects facing market

accessibility for their products are defaulters while projects that were not facing market accessibility for their products are successful; and distance of the project from product market has insignificant effect on their success or failure of the projects in loan repayment performance.

### 2.3 Conceptual Framework

After having a brief look at the literature related to macroeconomic and bank and customer specific factors influencing loan performances of banks, a conceptual model is formulated to illustrate the direction of impacts that may exist between macroeconomic variables and loan collection performances of DBE. The macroeconomic variables included into the model as independent variables are real gross domestic product (GDP), foreign currency supply and domestic saving while the dependent variable is loan collection performance of DBE.

Figure 1: Conceptual Framework of the Study



### **3. Research Design and Methodology**

This chapter gives due emphases to the overall research design and methodology of the research. It also tells us the type and source of data, discloses research question, portrays research hypotheses, and it gives definitions to the variables chosen for the study including their estimation and estimation techniques.

#### **3.1 Type and Source of Data**

The study has employed secondary data for loan collections which were collected from the annual credit performance reports of DBE (June 30, 2010-2017) and Zena Limat Bank (October, 2009). The other secondary data on the macroeconomic variables were also collected from the National Bank of Ethiopia. The raw data collected from the disclosed sources includes annual data of 42 years spanning from the year 1975-2017.

#### **3.2 Research Methodology**

Applying appropriate methodology for the time series data analysis is the most crucial part of the time series data analysis as wrong specification of the model or application of wrong methods may lead to biased conclusions emanated from unreliable estimates of the model. Accordingly, the research methodology employed here in analysis of the time series data collected for the study is a quantitative research technique. A quantitative research, according to the definition given by Bhattacharjee (2012, p. 39), is one of the research paradigms aimed at, among other things, analyzing quantitative data using the relevant econometric models to test the proposed hypotheses through analyses and evaluations of results. This author further explained that quantitative research validates constructs based on correlation or factor analysis of pilot test data. Quantitative research involves making a use of tools like regression. To this end, Koop (2006, p.49) argues that regression is an important tool that financial researchers use to understand the relationship among two or more variables where their empirical works involve time series data and he further argues that regression is particularly useful when there are many variables and the interactions between them are complex. Hence, in line with these theoretical provisions, this study makes a use of a quantitative research through multiple regression technique.

### 3.3 Model Specification

To capture effects of macroeconomic variables on loan collection performances DBE from projects financed by the bank, the macroeconomic variables namely: GDP, foreign currency supply, capital formation and domestic saving were used in the study.

The quantitative research used by this study employs a VAR model, a model used for multivariate time series data whereby each variable is a linear function of past lags of itself and other variables, in which different tests were made using EVIEWS 10th version to analyse and capture the inter-linkages between the dependent variable (loan collection performances of DBE) and independent variables (GDP, foreign currency supply, domestic saving, and capital formation) and to show the significance of the relationship of the independent variables on the dependent variable. Accordingly, different statistical tests including serial correlation LM test, unit root test, Johansen co-integration test, stability tests and diagnostic tests were conducted so as to make an appropriate conclusion on the influences that the captioned macroeconomic variables can impose on loan collection performances of DBE.

#### 3.3.1 Mathematical Representation of the Model

The mathematical relationship between the dependent and the independent variables of the study can be set forth by the following function:

$$LC = f(GD, FX, SV, CF) \dots\dots\dots (1)$$

This mathematical relationship is further modified to accommodate the past lags of the LC, the dependent variable, and that of other variables. This modification is made to fit to the basic characteristics of the VAR model in which case each variable is a linear function of past lags of itself and other variables. Hence, the representation of mathematical relationship between variables becomes:

$$LC_t = f(LC_{t-i}, GD_{t-i}, FX_{t-i}, SV_{t-i}, CF_{t-i}) \dots\dots\dots (2)$$

$$GD_t = f(LC_{t-i}, GD_{t-i}, FX_{t-i}, SV_{t-i}, CF_{t-i}) \dots\dots\dots (3)$$

$$FX_t = f(LC_{t-i}, GD_{t-i}, FX_{t-i}, SV_{t-i}, CF_{t-i}) \dots\dots\dots (4)$$

$$SV_t = f(LC_{t-i}, GD_{t-i}, FX_{t-i}, SV_{t-i}, CF_{t-i}) \dots\dots\dots (5)$$

$$CF_t = f(LC_{t-i}, GD_{t-i}, FX_{t-i}, SV_{t-i}, CF_{t-i}) \dots\dots\dots (6)$$

This model, however, has been transformed into natural logarithmic expression as designations of variables by the natural logarithms reduce the multiplicative relationships to additive ones to make appearances of the transformed variables more symmetric in which residuals of the regression model become normal. Thus, the multiple regression representation of the model using the natural logarithmic function of the variables in Vector Auto Regression (VAR) model using level data with one lag<sup>4</sup> (as determined in section 3.3.3), is given as:

$$\ln LC_t = \alpha_1 + \beta_1 \ln LC_{(t-1)} + \beta_2 \ln GD_{(t-1)} + \beta_3 \ln FX_{t-1} + \beta_4 \ln SV_{(t-1)} + \beta_5 \ln CF_{(t-1)} + \theta ECT_{(t-1)} + \varepsilon \dots (7)$$

$$\ln GD_t = \alpha_2 + \gamma_1 \ln LC_{(t-1)} + \gamma_2 \ln GD_{(t-1)} + \gamma_3 \ln FX_{t-1} + \gamma_4 \ln SV_{(t-1)} + \gamma_5 \ln CF_{(t-1)} + \theta ECT_{(t-1)} + \varepsilon \dots (8)$$

$$\ln FX_t = \alpha_3 + \delta_1 \ln LC_{(t-1)} + \delta_2 \ln GD_{(t-1)} + \delta_3 \ln FX_{t-1} + \delta_4 \ln SV_{(t-1)} + \delta_5 \ln CF_{(t-1)} + \theta ECT_{(t-1)} + \varepsilon \dots (9)$$

$$\ln SV_t = \alpha_4 + \pi_1 \ln LC_{(t-1)} + \pi_2 \ln GD_{(t-1)} + \pi_3 \ln FX_{t-1} + \pi_4 \ln SV_{(t-1)} + \pi_5 \ln CF_{(t-1)} + \theta ECT_{(t-1)} + \varepsilon \dots (10)$$

$$\ln CF_t = \alpha_5 + \Omega_1 \ln LC_{(t-1)} + \Omega_2 \ln GD_{(t-1)} + \Omega_3 \ln FX_{t-1} + \Omega_4 \ln SV_{(t-1)} + \Omega_5 \ln CF_{(t-1)} + \theta ECT_{(t-1)} + \varepsilon \dots (11)$$

Where:

- LN is the natural logarithmic function tagged to the endogenous variables of the chosen model;
- $\alpha_1, \alpha_2, \alpha_3, \alpha_4,$  and  $\alpha_5$  are the intercept of the equations for the models  $\ln LC_t, \ln GD_t, \ln FX_t, \ln SV_t, \ln CF_t$ , respectively;
- $\beta_1, \beta_2, \beta_3, \beta_4$  and  $\beta_5$  are the coefficients of independent variables in the equation  $\ln LC_t$ ;
- $\gamma_1, \gamma_2, \gamma_3, \gamma_4$  and  $\gamma_5$  are the coefficients of independent variables in the equation  $\ln GD_t$ ;
- $\delta_1, \delta_2, \delta_3, \delta_4$  and  $\delta_5$  are the coefficients of independent variables in the equation  $\ln FX_t$ ;
- $\pi_1, \pi_2, \pi_3, \pi_4$  and  $\pi_5$  are the coefficients of independent variables in the equation  $\ln SV_t$ ;
- $\Omega_1, \Omega_2, \Omega_3, \Omega_4$  and  $\Omega_5$  are the coefficients of independent variables in the equation  $\ln CF_t$ ;
- $LC_t$ , is the dependent variable, Loan collection performance of projects financed by DBE over the period of data set;
- $GD_t, FX_t, SV_t$  and  $CF_t$  are the independent variables standing for the real GDP, foreign currency supply, domestic saving and capital formation over the period of data set respectively;

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<sup>4</sup> The number of lags indicated here is determined by the system using the modified LR test statistic, final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ).

- $LC_{(t-1)}$ ,  $GD_{(t-1)}$ ,  $FX_{(t-1)}$ ,  $SV_{(t-1)}$ , and  $CF_{(t-1)}$  are the lagged variable of loan collection performance, GDP, foreign currency supply, domestic saving and capital formation respectively;
- $ECT_{(t-1)}$  is the error correction term;
- $\theta$  is coefficient of the short run co-integrating equation;
- $t$  is the total number of observations in the dataset; and
- $\varepsilon$  is Error term of the equation.

### 3.3.2 Significance Tests

For a multiple regression model like the model that has been set in this study, the explanatory variables are believed to influence the dependent variable. To confirm this general truth, the study examines whether or not the data collected on independent variables are significant enough to influence the dependent variable.

To examine whether we have a viable explanatory model, the following null and alternative hypotheses are set:

$H_0: \beta_n = 0$  and  $H_1: \beta_n \neq 0$  (that is  $H_1$ : At least one of the  $\beta_n$  is nonzero for  $n = 1; 2; 3; \dots$ ).

The p-value, the value representing the probability that a random chance could explain the result, is used to make the acceptance–rejection decision. In general, a **p-value** of 5% or lower is considered to be statistically significant implying that we reject the null hypothesis that there's no difference between the means and conclude that a significant difference does exist. Thus, we reject  $H_0$  if the p-value is less or equal to the cut-off rate for significance,  $p \leq 5\%$ , and we do not reject  $H_0$  if  $p > 5\%$  significance level.

### 3.3.3 Lag Length Selection

Choosing an appropriate lag length is important in VAR model to determine the extent of the influence of past values of all endogenous variables of the model. The optimal number of lags can be selected by using available lag length selection criteria so that selection of optimum length of lags minimizes autocorrelation of residuals of the model. The lag selection is made by using the most popular criteria which include Akaike Information Criterion (AIC), Schwarz Bayesian

Information Criterion (SBIC) and Hannan-Quinn information criterion (HQIC), sequential modified Likelihood Ratio test statistic (LR) and Final Prediction Error (FPE).

### 3.3.4 Unit Root Test

A time series data is said to be stationary when its values are tend to revert to the long run mean value and properties of data series are not affected by the change in time while the non-stationary time series data do not tend to return to the long run average value so that the mean, variance and co-variance of the data also change over time. Related to macroeconomic variables, Bhatta and Shrestha (2018) have shown that the volume of GDP, consumption, consumer price index, etc. exhibit a strong upward or downward movement overtime with no tendency to revert to a fixed mean so that these variables are non-stationary series. They further explained that non-stationary time series data are said to have a unit root so that such a time series data are examined by conducting unit root test.

Before making analyses using regression models, it is important that one has to test whether the time series data are stationary or not. Therefore, according to Hill, et al (2011, p. 482), the main reason why it is important to know whether a time series is stationary or non-stationary before one embarks on a regression analysis is that there is a danger of obtaining apparently significant regression results from unrelated data when non-stationary series are used in regression analysis. Moreover, Chris Brooks (2008 p. 319) has pointed out that the use of non-stationary data can lead to *spurious regressions*. A spurious regression indicates that, if standard regression techniques are applied to non-stationary data, the end result could be a regression that ‘looks’ good under standard measures (significant coefficient estimates and a high  $R^2$ ), but which is really valueless. If the variables employed in a regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will not be valid.

The common assumption used in many time series analyses is that the data are stationary. A stationary time series is a situation in which the mean, the variance and autocorrelation structures of the data are constant over time. Thus, most of the estimations of the econometric models are based on the assumption that the time series data can be made stationary through the use of mathematical transformations. Hill, et al (2011, p. 477) indicate that looking at the sample means of time series variables is a convenient indicator as to whether a series is stationary or non-stationary, but a formal hypothesis testing can be made by means of unit root test.

Accordingly, Bhatta and Shrestha (2018 p. 75) emphasized that methods commonly used to analyze the stationary time series data cannot be used to analyze non-stationary series. Hence, they further paraphrased that selection of methods of analysis of time series data primarily depends upon results of the unit root tests.

A unit root test is carried out to check whether the time series data used for the variables in the study are non-stationary and possess unit roots which may have been resulted from autocorrelation problem. There are many tests to determine whether the time series data used by the study are stationary or non-stationary. According to Hill, et al (2011, p. 484), however, the most popular one is the Dickey–Fuller test. Thus, this paper used the Augmented Dickey–Fuller (ADF) test so as to provide statistical evidence on the stationarity or non-existence of unit root for the time series data used by research.

The null hypothesis for ADF is  $\delta = 0$  and the alternative hypothesis is  $\delta < 0$  where  $\delta$  is coefficient of the lag value of the dependent variable implying that if we fail to reject the null hypothesis it means that the series is non-stationary whereas rejection of the hypothesis indicates the series is stationary. Regarding the use of p-value to reject the null hypothesis requires that the p-value is less than or equal to a specified significance level, often 5%, or 1% or even 10% ( $p \leq 5\%$ , or  $p \leq 1\%$ , or  $p \leq 10\%$ ).

### **3.3.5 Co-integration Test**

Co-integration is said to exist when the linear combination of non-stationary random variables result in stationary variable<sup>5</sup>, and the combined variables are said to be co-integrated. For the existence and influences of co-integrated variables, Chris Brooks (2008) explains that, in practice, many financial variables contain one unit root, and are thus I(1), so that a set of variables is defined as co-integrated if a linear combination of them is stationary. Many time series are non-stationary but ‘move together’ over time -- that is, there exist some influences on the series (for example, market forces), which imply that the two series are bound by some relationship in the long run. A co-integrating relationship may also be seen as a long-term or equilibrium phenomenon, since it is possible that co-integrating variables may deviate from their relationship in the short run, but their association would return in the long run.

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<sup>5</sup> Stationary variables are those variables whose values tend to revert to their long run average values and properties of the time series data are not affected by the change in time.

Moreover, according to Bhatta and Shrestha (2018) two or more variables may form long term equilibrium relationship even though they may deviate from the equilibrium in the short run and if these variables are linked to form an equilibrium relationship spanning the long run, these variables are said to be co-integrated; one variable drags the other over the period and hence, both of them share the same movement.

The study has used the Johansen test to check the existence of co-integration. Selection of the Johansen test is made in line with the arguments of Bhatta and Shrestha (2018) whereby they argue that the test addresses the weaknesses observed in the Engle-Granger methodology, the earlier versions of the co-integration tests and it is based on the relationship between the rank of matrix and its characteristics roots.

### **3.3.6 Vector Error Correction Model (VECM)**

The vector autoregressive model is a general framework used to describe the dynamic interrelationship among stationary variables. To carry out analyses of time series data, therefore, stationarity of the data must be determined. Whenever a long run co-integrative relationship among variables exists and the time series data are not stationary, a vector error correction model (VECM) is applied. VECM provides us with important information on the dynamic relationship between any co-integrated variables and used to estimate both the short term and long term effects of one time series variable on another. Bhatta and Shrestha (2018) stress that if the time series data are not stationary, then the vector autoregressive framework needs to be modified to allow consistent estimation of the relationships that could exist among variables of the series. If the time series data are non-stationary, such data can be converted into a stationary series by differencing; and if a time series becomes stationary after differencing one time or two time, then the series is said to be integrated of order one denoted by  $I(1)$ , and order two denoted by  $I(2)$  respectively. Taking differences of non-stationary time series data and using the OLS method after making all the variables stationary is an appropriate way of analyzing the short run dynamic relationship that exist among the variables. The VECM is just a special case of the VAR model for variables that are stationary in their differences.

The main point of the VECM analysis is the error correction term (the one period lagged error terms) from the estimated co-integrating equations. These lagged terms provide an explanation of the short run deviations from the long-run equilibrium.

The VECM model is used to examine both short and long run dynamics of co-integrated time series variables, (Engle and Granger, 1987). According to these authors, the Error Correction Term (ECT) relates to the fact that last period deviation from long run equilibrium (i.e., the error) influences the short run dynamics of the dependent variable. And, the coefficient of the ECT measures the speed of adjustment, the speed at which the dependent variable returns to equilibrium after a change in the independent variable.

A research paper prepared by Kahase (2017), by citing from Asteriou (2007) shows that error correction model is important and popular due to the fact that it is convenient model to correct from the disequilibrium of the previous period; if the variables are co-integrated and confirmed as stationary at first difference it has the power to resolve the problem of spurious regression; it fits for the time series data sets; and it is used to measure the speed of adjustment and prevents the errors in the long run relationship from the disequilibrium of prior period if and only if the variables are co-integrated and stationary at first order.

The ECM consists of two parts: the long-run co-integrating coefficients which are used to derive the long-run *co-integrating relationship* and the short run coefficients which are also used for the *analyses of short-run relationships*.

### 3.4 Definition of variables

- 1) ***Loan Collection***: It is the dependent variable of the study and it is the amount of loan in Birr that DBE has collected in annum from current and previous demands where the current demand is the amount of loan that has matured for collection while the previous demand is the overdue balance whose repayment period has been surpassed the time frame stipulated in the loan contract. Loan collection is a means to achieve asset quality of the bank whereby management of the bank is concerned with the quality of loans since it provides earnings for the bank.
- 2) ***Gross Domestic Product***: It is an independent variable of the study. It is the broadest measure of economic activities as a total spending on final goods and services produced within the country during the specified period of time. The four major categories of spending added to GDP are consumption, investment, government purchases of goods and services, and net exports of goods and services, (Andrew, et.al 2008). A high GDP value of a country is an important indication for the economy of that country to be strong but a drop in GDP indicates

that the economy is weak. The GDP data considered in this study is the national GDP data in Birr taken as measured by the expenditure approach.

- 3) ***Foreign Currency***: It is an independent variable of the study. It is the amount of hard currencies in Birr that has been supplied by the National Bank of Ethiopia to all actors for their hard currency demands for international trade and procurements of investment items and raw materials for local industries in a given period of time, a year.
- 4) ***Domestic Saving***: It is an independent variable of the study. It is the amount of Birr that all economic actors in the country have saved during a particular period of time.
- 5) ***Capital formation***: It is also an independent variable of the study. It is the amount of Birr that all economic actors in the country have invested in Ethiopia during a particular period of time.

## **4. Presentation and Analyses of Research Data**

### **4.1 Introduction**

This chapter presents the effects or contributions of macroeconomic variables through analyses of such effects brought by gross domestic product, foreign currency supply, domestic saving and capital formation on the loan collection performances of the DBE using annual time series data of 42 years for the period 1975–2017.

To begin with, evaluations and estimations of the chosen econometric model, different analyses and tests were carried out for the purposes of understanding the peculiar nature of the data used in the study. These include determination of the optimum lag variables, co-integration test, unit root test, vector error corrections, test for dynamics relationship among variables, and estimation of the model. Stability test for the model is also carried out to check whether the model used in this study is dynamically stable to the nature of the endogenous variables. Moreover, diagnostic test is made to check whether the residuals of the model meet the required statistical tests.

### **4.2 Lag Length Selection**

First of all, it is imperative to determine the optimum number of lags to be included into the VAR model. Thus, lag selection is used to determine the influence of past values of all endogenous variables of the VAR model. Symmetric lags (the same lag lengths) are used for all variables in all equations of the model. Selection of optimum length of lags helps to know the extent to which past values of the series can impose influences on the current estimation of the model. Accordingly, the result captured by the software in use indicates that the optimum number of lag length selected for variables in the model is at 1 order of integration as depicted by all the most commonly used lag selection criteria envisaged in the system [sequential modified Likelihood Ratio test statistic (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn information criterion (HQIC)]. Details of the output of the system in which optimum number of lags is determined are given by table 1 hereunder.

**Table 1: Lag Length Selection for the Model**

Lag	LogL	LR	FPE	AIC	SIC	HQIC
0	-73.91405	NA	3.56e-05	3.945702	4.156812	4.022033
1	75.14265	253.3964*	7.28e-08*	-2.257132*	-0.990473*	-1.799148*
2	90.53699	22.32179	1.25e-07	-1.776849	0.545360	-0.937212
3	117.9333	32.87556	1.31e-07	-1.896664	1.481094	-0.675373

Source: Researcher's own computation by running Eviews10.0

Where:

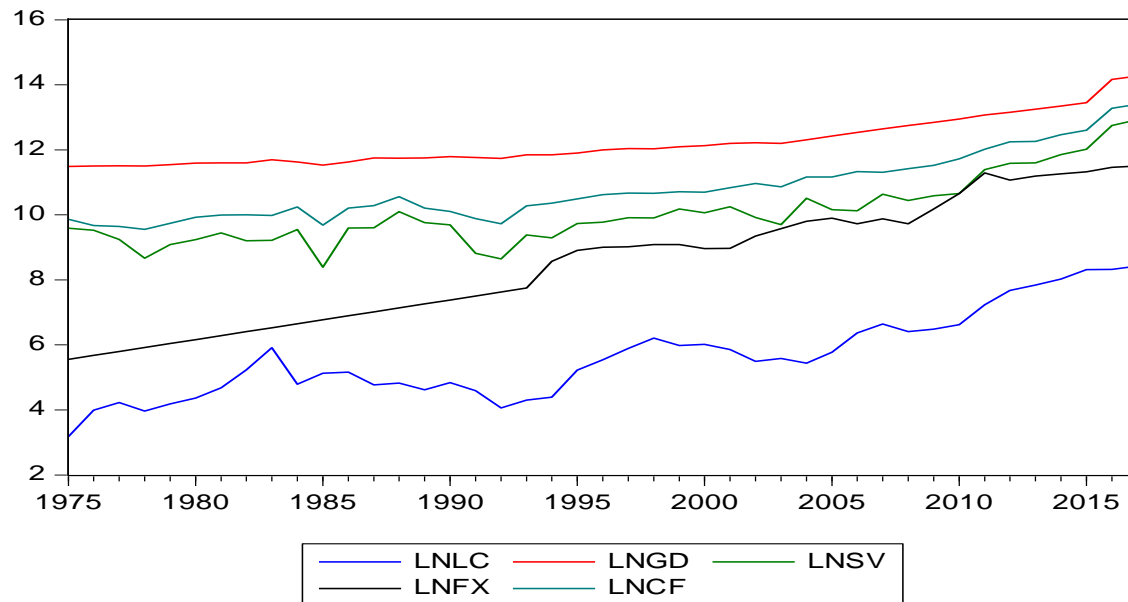
- ✓ The symbol \* indicates the lag order selected by the criterion
- ✓ Endogenous variables: LNLC, LNGD, LNFX, LNSV and LNCF
- ✓ LR: Sequential modified Likelihood Ratio test statistic (each test at 5% level)
- ✓ FPE: Final Prediction Error
- ✓ AIC: Akaike Information Criterion
- ✓ SIC: Schwarz Information Criterion
- ✓ HQIC: Hannan-Quinn Information Criterion

Thus, the system has selected the lag order 1 for all variables as an appropriate and optimum number of lags to show the extent of impulse responses of the past values of these variables and these orders shall be used to make analyses and estimates of the VAR model.

### **4.3 Unit Root Test**

As paraphrased in section 3.3.5 of this paper, the existence of unit root in the time series variables used for this study is tested by employing the Augmented Dickey-Fuller test. Due to the fact that values of the endogenous variables have trends with the passage of time, (see figure 2), tests for unit roots for all these variables are made by applying the trend and intercept approach of the ADF test model at zero order of integration [or at level] and at one order of integration [or first difference level] and results of the findings are given by tables 2 and 3 hereunder.

Figure 2: Trend Analysis of the Time Series Variables



Source: Prepared from the data injected into the software, Eviews10.0

Table 2: ADF Unit Root Test at Level

Name of the Series	Intercept (Constant)					Constant and Linear Trend					Order of Integration
	Critical Value at			ADF test stat and Probability values		Critical Value at			ADF test stat and Probability values		
	1%	5%	10%	t-value	P-value	1%	5%	10%	t-value	P-value	
LNLC	-3.5966	-2.9332	-2.6049	-0.65307	0.8474	-4.1923	-3.5208	-3.1913	-1.8976	0.6381	I(0)
LNGD	-3.5966	-2.9332	-2.6049	3.79170	1.0000	-4.1923	-3.5208	-3.1913	1.2289	0.9999	I(0)
LNSV	-3.6010	-2.9350	-2.6058	-1.00805	0.9959	-4.1923	-3.5208	-3.1913	-2.2721	0.4392	I(0)
LNFX	-3.5966	-2.9331	-2.6049	-0.42979	0.8945	-4.1985	-3.5236	-3.1929	-4.2337	0.0091	I(0)
LNCF	-3.5966	-2.9332	-2.6049	-0.28066	0.9192	-4.1985	-3.5230	-3.1929	-3.5084	0.0517	I(0)

Source: Researcher own Compilation prepared from output of the Eviews 10.0

There are two ways of determining the existence of unit roots for the series: making use of ADF test statistics and probability values. In order to apply either of the two methods, the null hypothesis ( $H_0$ ) for the test is should be known and in fact the  $H_0$  is variables are not stationary or the variables have unit roots. And, the decision criteria for the analyses will be: we cannot reject the null hypothesis, if the value of the ADF test statistics (in absolute terms) is less than the corresponding t-values at the envisaged level of significance at 1%, 5% and 10% and also the P-value of the test is more than five percent for the variable in question.

Accordingly, as one safely observe from table 3 herein above, the ADF unit root test at level shows that the t-values of the ADF test for the endogenous variables are less than the corresponding t-values of the model at 1%, 5% and 10% level of significance [in absolute terms] except for the variable LNGD and the P-values of the test are more than five percent signifying that time series variables for the model are non-stationary and possess unit roots for both the intercept (constant), and intercept and trend approaches of the ADF test models. The value of the ADF test statistics of the variable LNGD, in absolute terms is found to be more than the corresponding t-values at the significance of 1%, 5% and 10% for the intercept method. Thus, though the variable LNGD does not meet the requirements of the ADF test to signify that the variable is non-stationary, the non-stationary of the LNGD is confirmed from its p-value; where the p-value of the variable is 100%, which is absolutely more than 5%, thus there is no reason to reject the null hypothesis.

**Table 3: Unit Root Test at First Difference**

Variable	Intercept (Constant)					Constant and Linear Trend					Order of Integration
	Critical Value at			ADF test stat and Probability value		Critical Value at			ADF test stat and Probability value		
	1%	5%	10%	t-value	P-value	1%	5%	10%	t-value	P-value	
D(LNLC)	-3.6010	-2.9350	-2.6058	-6.3554	0.0000	-4.1985	-3.5236	-3.1929	-6.3461	0.0000	I(1)
D(LNGD)	-3.6010	-2.9350	-2.6058	-5.2542	0.0001	-4.1985	-3.5236	-3.1929	-6.7149	0.0000	I(1)
D(LNSV)	-3.6010	-2.9350	-2.6058	-8.4740	0.0000	-4.1985	-3.5236	-3.1929	-9.0626	0.0000	I(1)
D(LNFX)	-3.6010	-2.9350	-2.6058	-5.3572	0.0001	-4.1985	-3.5236	-3.1929	-5.3597	0.0004	I(1)
D(LNCF)	-3.6010	-2.9350	-2.6058	-5.3572	0.0001	-4.1985	-3.5236	-3.1929	-5.2852	0.0005	I(1)

Source: Researcher own Compilation prepared from output of the Eviews 10.0

On the other hand, a further unit root test is made at difference as given by table 4 herein above. The t-values of the ADF test for the series at first difference, in absolute terms, are greater than the corresponding t-values of the system at the 1%, 5% and 10% significance level and the p-values of the test are less than 5% implying that the variables under consideration are stationary and do not possess unit roots at first order of integration [I(1)] for both the ADF testing approaches, namely: the intercept (constant), and the intercept and trend.

#### 4.4 Co-integration Test

Co-integration test, the test which evaluates the long term equilibrium relationship of two or more variables whereby a movement in one variable would drag the other variable over the period and

hence both of them share the same movement, is made by using Johansen test which is based on the relationship between the rank of matrix and its characteristics roots. By the Johansen test two forms known as the trace and the maximum eigenvalue tests were applied where both of these tests address the co-integration presence hypothesis by posing different questions. The two tests examine whether the number of linear combinations (say,  $k$ ) to be equal to a given other value (say,  $k_0$ ) and thus,  $H_0: k = k_0$ . To this end the null hypothesis we set is:  $k_0 = 0$  [which means that there is no co-integration] and the test examines whether the null hypothesis can be rejected. If the null hypothesis is rejected, then we can conclude that there exists at least one co-integration in the long term equilibrium relationship between the variables. The difference between the trace and the maximum eigenvalue tests lies in the way we set alternative hypotheses for both tests while the null hypotheses are similar for both tests ( $H_0: k = k_0$  for both tests). Accordingly, the alternative hypotheses for both tests are  $H_A: k > k_0$  and  $H_A: k > k_0 + 1$  for trace and maximum eigenvalue tests respectively.

As discussed in section 4.4 herein above, it is confirmed that the series is non-stationary and possesses unit roots. Further to confirm the existence of long run relationship in the series, the Johansen cointegration test is made by running the software and the obtained results are summarized by the results captured by table 4, 5 and 6 below:

**Table 4:** Johansen Co-integration Test for Trace Statistics

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value at 0.05	Prob.**
None *	0.615770	108.2988	88.80380	0.0010
At most 1 *	0.459748	69.08172	63.87610	0.0171
At most 2 *	0.411566	43.83718	42.91525	0.0403
At most 3	0.253184	22.09528	25.87211	0.1375
At most 4	0.218838	10.12590	12.51798	0.1216
Trace test indicates 3 co-integrating equations at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: Researcher's own computation by running Eviews10.0

**Table 5: Johansen Co-integration Test by Maximum Eigenvalue Approach**

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value at 0.05	Prob.**
None *	0.615770	39.21712	38.33101	0.0395
At most 1	0.459748	25.24454	32.11832	0.2723
At most 2	0.411566	21.74190	25.82321	0.1580
At most 3	0.253184	11.96938	19.38704	0.4180
At most 4	0.218838	10.12590	12.51798	0.1216
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				

Source: Researcher's own computation by running Eviews10.0

**Table 6: Number of Co-integrating Equations based on the Johansen Co-integration test Using Assumptions for Data Trend**

Data Trend	None		Linear	
	No Intercept, No Trend	Intercept, No Trend	Intercept, No Trend	Intercept, Trend
Trace test	4	3	2	3
Maximum Eigenvalue test	0	0	0	1

Source: Researcher's own computation by running Eviews10.0

By looking at the three tables (table 4, 5 and 6) shown herein above, it is possible to give interpretations and explanations for the results. Accordingly, the trace statistics approach for the Johansen Co-integration test given by table 4 above shows that there is no reason to accept the null hypotheses (the numbers of co-integrating equations are none, at most 1 and at most 2 as given by the system) due to the fact that the p-values of the Johansen co-integration test for these hypothesized numbers of co-integrating equations are found to be 0.10%, 1.71%, and 4.03% respectively and are obviously below 5% significance level. The hypotheses for the number of co-integrating equations given by the system as 'there are at most three and at most four co-integrating equations', however, have to be accepted due to the reason that the p-values of these hypotheses are found to be 13.75% and 12.16%. But the at most three hypothesized number of co-integrating equations tends to be accepted more confidently as it has the highest p-value at the 5% level of significance.

On the other hand, the maximum eigenvalue statistics of the Johansen Co-integration test given by table 5 above shows there is no evidence to accept the null hypothesis ( $H_0$ : there is no co-integrating equation) due to the fact that the p-values of the Johansen co-integration test for captioned statistics is found to be 3.95% which is also below the 5% significance level. On the contrary, there are no reasons to reject the other hypotheses for the test (set by the system) as the p-values of these tests are found to be 27.23%, 15.80%, 41.80% and 12.16% for the hypothesized number of co-integrations that could exist at most 1, at most 2, at most 3 and at most 4 respectively at 5% significance level signifying acceptances of the hypotheses.

Likewise, the summary result of the Johansen test for co-integration using assumptions for data trend (table 6) shows that there are a number of co-integrative relationships among the variables of the model in the long run, in particular for the Johansen trace test at different scenarios of data trend (no trend and linear trend). The existence of co-integration, therefore, implies that we have to reject the null hypothesis which obviously hypothesizes that there are no co-integrations among variables.

In conclusion, based on the Johansen co-integration tests, there are long run equilibrium relationships among the endogenous variables [loan collection, real GDP, domestic saving, foreign currency supply and capital formation]. As long run co-integration relationship among variables were identified, it certainly leads us to apply the vector error correction model (VECM) to examine how deviations of the long run are corrected and thereby to estimate the level of influence of macroeconomic variables on loan collection performances of DBE thereby answering the research question and test the hypotheses of the study.

#### **4.5 Estimation of the VAR Model**

Vector autoregressive models (VAR models) are used to estimate econometric models based on the multivariate time series variables where each variable is a linear function of past lags of itself and that of the other variables. It is important to know some properties and types of the VAR model before embarking into estimation of the model. Accordingly, we can distinguish two types of VAR models: unrestricted (or standard VAR) and restricted VAR model whereby the latter is also known as Vector Error Correction Model (the VECM). By means of the Johansen test, if co-integrated variables are not detected, analysis and estimation of the model will be made based on regression of these variables at their respective first differences applying unrestricted (or standard)

VAR models while if the tested variables are found co-integrating we have to develop a restricted VAR model. According to Engle and Granger (1987, p.66), restricted VAR test is similar to a two step estimator (that is, estimations of the long run and the short run dynamics) and they further assert that the test is used to show whether the error correction term is significant and the test requires specification of the full system dynamics whereby a first order system is assumed.

#### **4.5.1 Estimations Based on Standard VAR**

As long as co-integrating variables are dictated by using the Johansen co-integration test, estimation of the model using standard VAR is not applicable to the time series variables used for this particular study. Instead, a restricted VAR, the VECM is used to estimate coefficients of the VAR model developed for the study, as presented in the following section.

#### **4.5.2 Estimations Based on the Restricted VAR**

The necessary condition to apply the restricted VAR model (which is also termed as the VECM) for estimation purposes, there should be integrative relationship among variables; variables should have to have long-run stochastic trends. Accordingly, as shown in section 4.5, the existence of a long run co-integrative relationship among variables was identified, so, we can apply the restricted VAR model. The restricted VAR model provides important information on the dynamic relationship between co-integrating variables and it is used to estimate both the short term and long term effects of one time-series variable on another. When such time-series variables are set at first order of integration [I(1)] and there exists a co-integrative relationship, then the VECM can be developed. Accordingly, the models for the co-integrating equation (CE) and the VECM of the study are presented hereunder.

##### **1) Mathematical Representation of the CE**

To make a reliable estimation of the CE, first of all the mathematical representation for ECT must be determined. Accordingly, the mathematical representation of the ECT will be:

$$ECT_{(t-1)} = [LNLC(-1) - \lambda_1 LNGD(-1) - \lambda_2 LNSV(-1) - \lambda_3 LNFX(-1) - \lambda_4 LNCF(-1) - \mu] \dots\dots(12)$$

Where:

$\lambda_i$  = Coefficients of the long run model

$\theta$  = Coefficients of the ECT

$\mu$  = Error term.

## 2) Mathematical Representation of the Restricted VAR (VECM)

The restricted VAR of the study which is also known as VECM model can mathematically set in the following manner:

$$D(LNLC)_t = \alpha_1 + \sum \beta_1 D(LNLC)_{t-1} + \sum \beta_2 D(LNGD)_{t-1} + \sum \beta_3 D(LNSV)_{t-1} + \sum \beta_4 D(LNFX)_{t-1} + \sum \beta_5 D(LNCF)_{t-1} + \theta ECT_{(t-1)} + \varepsilon_{1,t} \dots \dots \dots (13)$$

$$D(LNGD)_t = \alpha_2 + \sum \gamma_1 D(LNLC)_{t-1} + \sum \gamma_2 D(LNGD)_{t-1} + \sum \gamma_3 D(LNSV)_{t-1} + \sum \gamma_4 D(LNFX)_{t-1} + \sum \gamma_5 D(LNCF)_{t-1} + \theta ECT_{(t-1)} + \varepsilon_{2,t} \dots \dots \dots (14)$$

$$D(LNSV)_t = \alpha_3 + \sum \delta_1 D(LNLC)_{t-1} + \sum \delta_2 D(LNGD)_{t-1} + \sum \delta_3 D(LNSV)_{t-1} + \sum \delta_4 D(LNFX)_{t-1} + \sum \delta_5 D(LNCF)_{t-1} + \theta ECT_{(t-1)} + \varepsilon_{3,t} \dots \dots \dots (15)$$

$$D(LNFX)_t = \alpha_4 + \sum \pi_1 D(LNLC)_{t-1} + \sum \pi_2 D(LNGD)_{t-1} + \sum \pi_3 D(LNSV)_{t-1} + \sum \pi_4 D(LNFX)_{t-1} + \sum \pi_5 D(LNCF)_{t-1} + \theta ECT_{(t-1)} + \varepsilon_{4,t} \dots \dots \dots (16)$$

$$D(LNCF)_t = \alpha_5 + \sum \Omega_1 D(LNLC)_{t-1} + \sum \Omega_2 D(LNGD)_{t-1} + \sum \Omega_3 D(LNSV)_{t-1} + \sum \Omega_4 D(LNFX)_{t-1} + \sum \Omega_5 D(LNCF)_{t-1} + \theta ECT_{(t-1)} + \varepsilon_{5,t} \dots \dots \dots (17)$$

Where:

$\alpha_i$  = Constant terms for the short run models,

$\beta_i, \gamma_i, \delta_i, \pi_i,$  and  $\Omega_i$  are Coefficients of the independent variables of the models when  $D(LNLC), D(LNGD), D(LNSV) D(LNFX)$  and  $D(LNCF)$  are taken as target variables respectively,

$\lambda_i$  = Coefficients of the long run model

$\theta$  = Coefficient of the ECT

$\varepsilon_i$  = The error term.

Once the mathematical representations of the models are set in line with the requirements of the VAR model, it is possible to provide estimations for the ECT and VECM for the variables of the time series by running the Eviews. Such estimations of the models will help us to indicate the long-run and short-run dynamics of the equilibrium relationships of the variables. Thus, the ECM consists of two parts: the long-run co-integrating coefficients which are used to derive the long-run *co-integrating relationship*; and the short run coefficients which are also used for the *analyses of short-run relationships*. These relationships are discussed in the following two sub-sections.

### 4.5.3 Long-Run Relationships

Analysis of the outputs of the VECM from the Eviews starts with the ECT which is obviously a one period lagged error terms from the estimated co-integrating equations. These lagged terms provide an explanation of the short run deviations from the long-run equilibrium. Accordingly, estimates of coefficients of the ECT for the long run model are given by the following table.

Table 7: Estimates for Co-integrating Equation (Long Run Model)

Co-integrating Equation	LNLC(-1)	LNGD(-1)	LNSV(-1)	LNFX(-1)	LNCF(-1)	C
Coefficients of the CE	1.000000	1.803080	4.378259	1.085594	-9.563196	22.13399
Standard Errors		(1.71087)	(0.97366)	(0.37403)	(2.03051)	
T-statistics		[1.05389]	[4.49669]	[2.90240]	[-4.70974]	

Source: Researcher’s own computation by running Eviews10.0

The coefficients of the CE as given by table 7 above relate to the fact that last period deviation from long-run equilibrium (of course, the error) which influences the short-run dynamics of the dependent variable. Thus, the coefficients of ECT (where ECT is the OLS residuals obtained from the long-run co-integrating regression) measure the extent to which the short run equilibrium deviates from the long-run equilibrium. Thus, the mathematical representation of the CE is given as:

$$ECT_{(t-1)} = [1.0*LNLC(-1) - 1.8*LNGD(-1) - 4.4*LNSV(-1) - 1.1*LNFX(-1) + 9.6*LNCF(-1) - 22.1] \dots\dots\dots(18)$$

And, the Johansen long run CE is given as:

$$LNLC(-1) = 1.8*LNGD(-1) + 4.4*LNSV(-1) + 1.1*LNFX(-1) - 9.6*LNCF(-1) + 22.1 \dots\dots\dots(19)$$

This Johansen long run CE (and table 7 given above) show that the dependent variable loan repayment performances of the bank (LNLC) has positive relationship with the independent variables represented by LNGD, LNSV and LNFX; while it has negative relationship with LNCF.

Though equation #19 given herein above shows that the long run relationships which could exist between the dependent and independent variables of the model, being the LNLC is taken as target variable, significances of an individual independent variable should be confirmed so as to make appropriate inferences. Accordingly, the following table shows results of the significance test.

Table 8: Significance Test for the Long Run Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGD	-0.962890	0.373089	-2.580860	<b>0.0137</b>
LNFX	0.301899	0.141551	2.132789	<b>0.0393</b>
LNSV	0.179346	0.381725	0.469829	0.6411
LNCF	1.203777	0.802373	1.500271	0.1416
R-squared	0.868243	Adjusted R-squared		0.858107

Source: Researcher's own computation by running Eviews10.0

Table 8 shows that the p-values of the variables LNGD and LNFX are 0.0137 and 0.0393 respectively. Obviously both of these p-values are less than 0.05 so that the two variables are significant to influence the variable LNLC at 5% level of significance. On the other hand, the p-values of the variables LNSV and LNCF are 0.6411 and 0.1416 respectively showing that these independent variables are not significant enough to influence the variable LNLC at 5% level.

Here, by combining directions of the long run dynamic relationships existing between the dependent variable and the independent variables as given by table 7 with that of the p-values given by table 8 above, as summarized by table 9 below, we can deduce that both LNGD and LNFX have positive and significant effects on loan repayment performances of DBE. Thus, there is no evidence to accept their respective null hypotheses. On the contrary, although LNSV has positive relationship with LNLC, its impact is insignificant to influence loan collection performances of the bank from bank-financed-projects in the long run. Hence there is no evidence to reject the null hypothesis. The Variable LNCF, on the other hand, has negative relationship with loan collection performances and its influence is insignificant. Thus, there is no reason to reject the null hypothesis. To sum up the long run relationship, the summary result is given by table 9 below.

Table 9: Summary of Hypotheses Results in long run dynamics

Null Hypothesis ( $H_0$ )	Significances of the Hypothesized effects on LNLC	Study Result			
		Directions of the influence	P-value	Significance	Decision
LNGD has no contribution to loan collection performances of DBE	Insignificant	+	<b>0.0137</b>	Significant	<b>Reject <math>H_0</math></b>
LNFX has no contribution to loan collection performances of DBE	Insignificant	+	<b>0.0393</b>	Significant	<b>Reject <math>H_0</math></b>
LNSV has no contribution to loan collection performances of DBE	Insignificant	+	0.6411	Insignificant	Don't reject $H_0$
LNCF has no contribution to loan collection performances of DBE	Insignificant	-	0.1416	Insignificant	Don't reject $H_0$

Source: Researcher's own conclusion based on the study results

When we look into the long run model, based on the result obtained from the outputs of the Eviews, two independent variables (LNGD and LNFX) have long run effects on loan collection performances at 5% level of significance. The probable explanations that could be given are summarized as follows:

- 1) Movements in economic performances as evidenced by economic growths in the country represented by a proxy of real GDP have positive and statistically significant effect on loan collection performances of DBE signifying that, under normal circumstances, a growth in GDP will be accompanied by a decline in default rate. This finding somehow disagrees with the empirical findings of Nanjala (2015) in which he has shown that an increase in GDP of a country does not have significant effect on profitability of commercial banks in Nairobi by taking profitability of commercial banks in Nairobi as a proxy for successful loan collection performances, other factors being kept constant but agrees with the empirical findings of Ofori (2016) in which he has indicated that when there is a slow growth of GDP in an economy, the level of bad debts increases. Conversely, thus, a growth in GDP reduces the level of bad debts. Moreover, it disagrees with the empirical findings of Issah and Antwi (2017, p. 11) in which they have shown that an increase in real GDP will decrease the future earnings of a firm.

The positive relationship observed between GDP and loan collection performances also supports the notion that an expansion in an economy will have a spillover effect on other economic performances. According to various sources including the World Bank (2015) and the National Bank of Ethiopia (2017) the Ethiopian economy was continuously expanding over the last decade. The growth was driven mainly by an increase in the

growth in service sector and the public investment. The Bank has financed long term investment projects which have also huge contributions to the growth in investment which has played a prominent role in the growth of the economy. Despite there exists a positive relationship between GDP and loan collections, the reason as to why the growth observed in the economy of the country has not impacted the currently seen huge NPLs ratios in books of accounts of DBE is not clear. But, in line with the conclusions made by Asfaw, et al (2016), this study suggests that borrowers have diverted incomes generated by the DBE financed projects for unintended purposes. This issue requires, however, further investigation. At this moment, however, there is no reason to accept the null hypothesis. That is GDP has a positive impact on loan collection performances of DBE.

- 2) There exists a significant positive relationship between foreign currency supply and loan collection performances of the DBE in the long run. A 10% increase in foreign currency supply will result in 3% increase in loan collections. The relationship shows the expected results as foreign currency supply play a pivotal role for on time procurement of investment items by DBE financed projects from foreign suppliers for smooth and on time operations of such projects so that projects will commence loan repayments as per contractual agreements.
- 3) There exists a non-significant positive relationship between domestic saving and loan collection performances in the long run. Though not significant, a 10% increase in domestic saving will result in a 1.8% increase in loan collections. The probable reason for the non-significance of this relationship could be attributed to the fact that, being other factors kept constant, DBE does not mobilize public fund by its own in the form of saving which could be used as a source of loanable fund in one hand and as source of loan collection from its borrowers when their loan accounts mature for repayments in another, though few recent time attempts are underway to open customer accounts for its borrowers to be used for the disclosed purposes. The positive relationship which exists between domestic saving and loan collection performances of the bank, however, could be attributed to funds saved in other banks have been used for loan repayments by DBE financed projects.
- 4) There exists a non-significant negative relationship between capital formation and loan repayment performances in the long run. Although the direct effect of capital formation on

loan collection performances of the bank is found to be insignificant, reverse causation can be stronger. This argument, however, should be confirmed by other studies.

The probable reasons for the insignificances of the contributions of LNSV and LNCF could be attributed to the fact that both variables are parts and parcels of the LNGD variable. This conclusion is made by looking simply at the definitions of the concepts of saving and capital formation given by Krugman and Wells (2013, p.710) even without conducting a multicollinearity test. According to these authors, therefore, savings are sources of funds that are made available for investment spending that constitutes financial capital which is obviously one of the three kinds of capital<sup>6</sup>. Capital formation (or investment), on the other hand, are physical capitals consisting of constructions of residential and non-residential buildings; purchases of producers' durable equipments; and changes in inventories. Accordingly, as both saving and capital formation are major components of the real GDP of a country, it is no surprise for the existence of such insignificances due to the problem of multicollinearity.

Moreover, as indicated above, there exists a non-significant negative relationship between capital formation and loan collections performances in the long run. An increase in capital formation will move loan collection performances in opposite direction, that is, an increase in capital formation nationally decreases loan collection performances of projects. The probable reason may be attributed to the fact that national investment of Ethiopia mainly includes investments in the construction industry which mainly incorporates constructions of roads, railways, dams, and residential houses. For the fiscal year 2016/17, for instance, the construction industry has contributed 70.9% to the investment made in the industry sector (NBE, 2017). The construction projects, however, are not in the priority lists of the bank to be eligible for financing. Thus, the negative relationship should not be surprised due to the fact that capital formation has nothing to contribute to the loan collection performances of the Bank.

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<sup>6</sup> The three kinds of capital are physical capital, human capital, and financial capital which consists of manufactured resources (buildings and machines); improvements in labour force (generated by education and knowledge); and funds from savings available for investment respectively.

#### 4.5.4 Short Run Relationships

Results of the short run relationship dynamics will generally be given by the vector error correction model (VECM). The VECM helps to investigate the short run relationship between dependent and independent variables. If we get co-integrating relationship in the long run, we can estimate the VECM which is important to show the short run relationship between any co-integrating variables.

Thus, the coefficients of EC given by table 10 below measure the speed of adjustment of these variables towards the long-run equilibrium relationship among the variables as such coefficients measure the speed at which the dependent variable returns to equilibrium after a change in the independent variables.

Table 10: Speed of Adjustment by Which Variables Converge to Their Equilibriums) and Period of Full Adjustment

Error Correction	D(LNLC(-1))	D(LNGD(-1))	D(LNSV(-1))	D(LNFX(-1))	D(LNCF(-1))
Coefficients of the CE	-0.141101	-0.057481	-0.255286	-0.039462	-0.087148
Standard Errors	(0.06372)	(0.02101)	(0.06806)	(0.03671)	(0.03800)
T-statistics	[-2.21444]	[-2.73569]	[-3.75101]	[-1.07484]	[-2.29320]
Speed of adjustment	14.11%	5.75%	25.52%	3.94%	8.71%
Period of full adjustment	7.09 years	17.42 years	3.92 years	25.38 years	11.48 years

Source: Results obtained by running Eviews10.0 and researcher's own computations

Coefficients of the error correction terms for the differenced dependent variables were found to have negative signs indicating that they are error correcting. The values for the coefficients of CE for the variables D(LNLC(-1)), D(LNGD(-1)), D(LNSV(-1)), D(LNFX(-1)) and D(LNCF(-1)) are -0.141101, -0.057481, -0.255286, -0.039462 and -0.087148 respectively. Accordingly, these variables can gradually converge to their equilibriums at the rate of 14.11%, 5.75%, 25.52%, 3.94% and 8.71% respectively. Full period of adjustments required to converge these vvariables to their equilibrium dynamics is a period of about 7.09, 17.42, 3.92, 25.38 and 11.48 years respectively in same order.

Consequently, coefficients for the ECM as portrayed by table 11 below describe how deviations from the long-run relationship that affect the changes on them in short run. Thus, table 11 shows the short run error correction model for the VAR model whereby the differenced variables of the

model; namely: D(LNLC), D(LNGD), D(LNSV), D(LNFX), D(LNCF) are taken as target variables whereas the differenced variables of the same model at first order of integration are considered as independent variables. Therefore, by running the Eviews, we have found the estimated coefficients of VECM.

Table 11: Vector Error Correction Estimates of the Whole Short Run Regression Models

Variables	D(LNLC)		D(LNGD)		D(LNSV)		D(LNFX)		D(LNCF)	
	Coefficient	Value	Coefficient	Value	Coefficient	Value	Coefficient	Value	Coefficient	Value
CE	$\theta_1$ [C(1)]	-0.141101	$\theta_2$ [C(8)]	-0.057481	$\theta_3$ [C(15)]	-0.255286	$\theta_4$ [C(22)]	-0.039462	$\theta_5$ [C(29)]	-0.087148
D(LNLC(-1))	$\beta_1$ [C(2)]	0.080317	$\gamma_1$ [C(9)]	0.068545	$\delta_1$ [C(16)]	0.341343	$\pi_1$ [C(23)]	0.019401	$\Omega_1$ [C(30)]	0.133109
D(LNGD(-1))	$\beta_2$ [C(3)]	-0.553483	$\gamma_2$ [C(10)]	0.066477	$\delta_2$ [C(17)]	0.414352	$\pi_2$ [C(24)]	-0.593384	$\Omega_2$ [C(31)]	0.487529
D(LNSV(-1))	$\beta_3$ [C(4)]	0.123388	$\gamma_3$ [C(11)]	0.165984	$\delta_3$ [C(18)]	0.249040	$\pi_3$ [C(25)]	-0.106789	$\Omega_3$ [C(32)]	0.231273
D(LNFX(-1))	$\beta_4$ [C(5)]	0.390449	$\gamma_4$ [C(12)]	-0.097890	$\delta_4$ [C(19)]	-0.156602	$\pi_4$ [C(26)]	0.064402	$\Omega_4$ [C(33)]	-0.060363
D(LNCF(-1))	$\beta_5$ [C(6)]	-0.229839	$\gamma_5$ [C(13)]	-0.382861	$\delta_5$ [C(20)]	-1.593350	$\pi_5$ [C(27)]	0.489193	$\Omega_5$ [C(34)]	-0.906877
Constant Term	$\alpha_1$ [C(7)]	0.088778	$\alpha_2$ [C(14)]	0.087584	$\alpha_3$ [C(21)]	0.148781	$\alpha_4$ [C(28)]	0.133246	$\alpha_5$ [C(35)]	0.108821

Source: Researcher's own compilation from output obtained by running Eviews10.0 (for details see annex 13)

And, the mathematical representations of the differenced models of the variables (VAR model with substituted coefficients) are given bellow:

$$D(LNLC) = -0.14*(1.0*LNLC(-1) + 1.8*LNGD(-1) + 4.4*LNSV(-1) + 1.1*(LNFX(-1) - 9.6*LNCF(-1) + 22.1)) + 0.08*D(LNLC(-1)) - 0.55*D(LNGD(-1)) + 0.12*D(LNSV(-1)) + 0.39*D(LNFX(-1)) - 0.23*D(LNCF(-1)) + 0.09 \dots\dots\dots 20$$

$$D(LNGD) = -0.06*(1.0*LNLC(-1) + 1.8*LNGD(-1) + 4.4*LNSV(-1) + 1.1*(LNFX(-1) - 9.6*LNCF(-1) + 22.1)) + 0.07*D(LNLC(-1)) + 0.07*D(LNGD(-1)) + 0.17*D(LNSV(-1)) - 0.1*D(LNFX(-1)) - 0.38*D(LNCF(-1)) + 0.09 \dots\dots\dots 21$$

$$D(LNSV) = -0.26*(1.0*LNLC(-1) + 1.8*LNGD(-1) + 4.4*LNSV(-1) + 1.1*(LNFX(-1) - 9.6*LNCF(-1) + 22.1)) + 0.34*D(LNLC(-1)) + 0.41*D(LNGD(-1)) + 0.25*D(LNSV(-1)) - 0.16*D(LNFX(-1)) - 1.59*D(LNCF(-1)) + 0.15 \dots\dots\dots 22$$

$$D(LNFX) = -0.04*(1.0*LNLC(-1) + 1.8*LNGD(-1) + 4.4*LNSV(-1) + 1.1*(LNFX(-1) - 9.6*LNCF(-1) + 22.1)) + 0.02*D(LNLC(-1)) - 0.59*D(LNGD(-1)) - 0.11D(LNSV(-1)) + 0.06*D(LNFX(-1)) + 0.49*D(LNCF(-1)) + 0.13 \dots\dots\dots 23$$

$$D(LNCF) = -0.09*(1.0*LNLC(-1) + 1.8*LNGD(-1) + 4.4*LNSV(-1) + 1.1*(LNFX(-1) - 9.6*LNCF(-1) + 22.1)) + 0.13*D(LNLC(-1)) + 0.49*D(LNGD(-1)) + 0.23*D(LNSV(-1)) - 0.06*D(LNFX(-1)) - 0.91*D(LNCF(-1)) + 0.11 \dots\dots\dots 24$$

And, to make inferences, here we also need to find the p-values for estimated coefficients of the co-integrated equation with speed of adjustment (short run models). Hence, the p-values of the

D(LNLC) when taken as a target or independent variable and that of the whole VAR model are given by tables 12 and 13 hereunder.

Table 12: Estimates of Coefficients in the Short Run Model When D(LNLC) is taken as Dependent Variable

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGD)	1.005968	0.600136	1.676235	0.1019
D(LNSV)	0.302466	0.240358	1.258396	0.2159
D(LNFX)	0.422751	0.251538	1.680663	0.1010
D(LNCF)	-0.854548	0.542963	-1.573860	0.1238

Source: Researcher's own compilations from an output obtained by running Eviews10.0

For the short run model of D(LNLC), as it can be clearly seen from table 12 given herein above, all of the p-values of the endogenous variables are more than 5% revealing that there are no significant macroeconomic variables at the 5% level of significance to impose impacts on loan collection performances of DBE either positively or negatively at the short run.

Table 13: Estimated Coefficients of the Short Run Model with their P-values

Dependent Variables	Independent Variables	Values of the Coefficients	Std. Error	t-Statistic	Prob.
D(LNLC(-1))	CE	-0.141101	0.063718	-2.214443	0.0281
	D(LNLC(-1))	0.080317	0.151838	0.528964	0.5975
	D(LNGD(-1))	-0.553483	0.601314	-0.920455	0.3586
	D(LNSV(-1))	0.123388	0.281920	0.437670	0.6622
	D(LNFX(-1))	0.390449	0.277402	1.407517	0.1611
	D(LNCF(-1))	-0.229839	0.650585	-0.353280	0.7243
	C	0.088778	0.080842	1.098170	0.2737

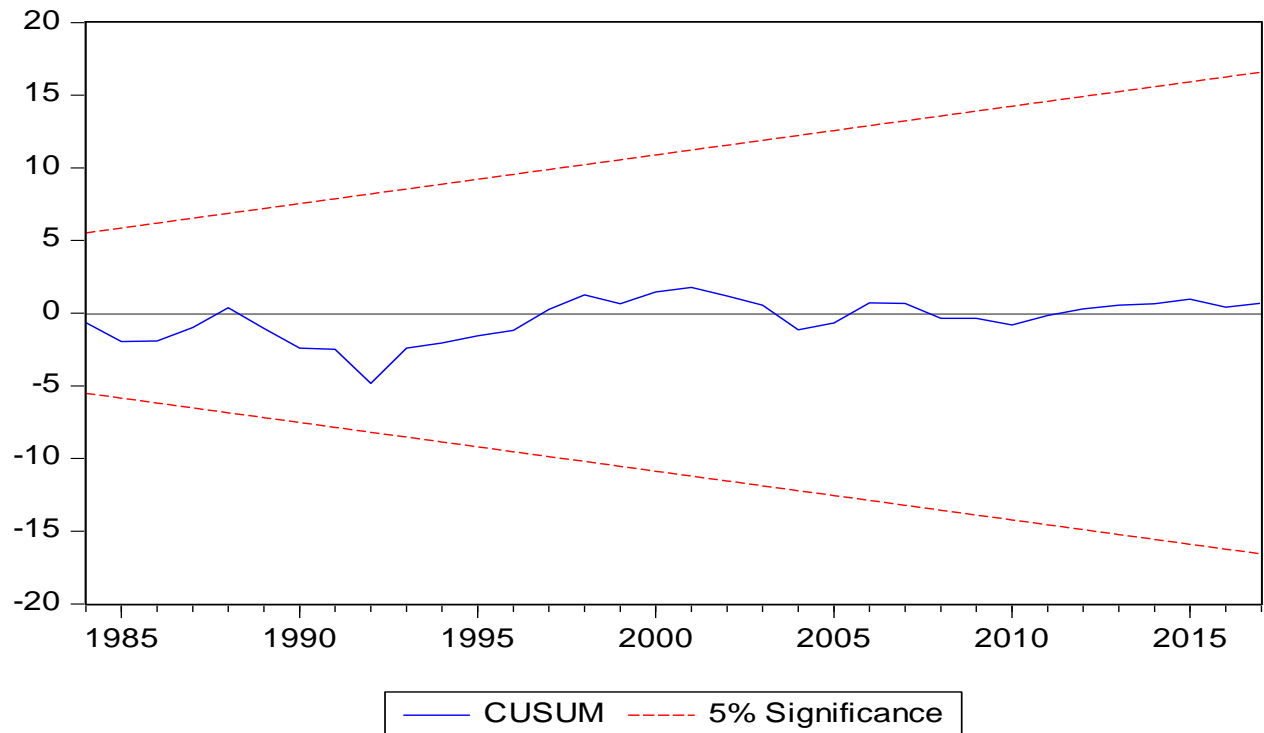
Source: Researcher's own computation by running Eviews10.0

Results of the analysis given by table 13 above show that, in the short run, for the D(LNLC(-1)) model, there are no independent variables found to be significant to influence the dependent variable in the short run.

## 4.6 Stability Test

Stability of the model used for the study is tested by using the cumulative sum (CUSUM) test to check whether the model is dynamically stable.

Figure 3: Stability test for the Model



The graph shown by figure 3 herein above shows the cumulative sum of the parameters used in the study are found to lie between the 5% critical lines and we can conclude that the model is said to be dynamically stable. Furthermore, as long as the plots of the tests statistics are within the 5% critical bound; the null hypothesis of all coefficients of the regression cannot be rejected and thus stable. Therefore, the coefficients of the error correction model are stable.

## 4.7 Diagnostic Tests

### 4.7.1 VEC Residual Serial Correlation LM Test

As shown by table 14 below, the p-value for the VEC residual serial correlation LM test is 50.90% indicating that there is no serial correlation in the residuals.

Table 14: VEC Residual Serial Correlation LM Test

VEC Residual Serial Correlation LM Tests						
Sample: 1975 2017						
Included observations: 41						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	24.28576	25	0.5029	0.973277	(25, 94.4)	0.5090
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	24.28576	25	0.5029	0.973277	(25, 94.4)	0.5090
*Edgeworth expansion corrected likelihood ratio statistic.						

Source: Researcher's own computation by running Eviews10.0

### 4.7.2 Heteroskedasticity Tests

As given by table 15 below, the white heteroskedasticity test shows that the p-value of the test is 25% indicating that residuals of the variables are free from the problem of heteroskedasticity.

Table 15: VAR Residual Heteroskedasticity Tests

VAR Residual Heteroskedasticity Tests (Includes Cross Terms)		
Joint test		
Chi-squared	Degree of Freedom	Prob.
316.0831	300	0.2507

Source: Researcher's own computation by running Eviews10.0

### 4.7.3 Normality Test

For the variables LNLC, LNSV, and LNCF the P-value of the Jarque Bera statistics are 0.9520, 0.1115, and 0.9093 which are more than 5% implying that we cannot reject the null hypothesis [H0: The residual of the model is normally distributed]. The remaining two variables are not normally distributed.

Table 16: VAR Residual Normality Test

Component	Jarque-Bera Statistics	d. f	Prob.
LNLC	0.098315	2	0.9520
LNGD	585.9067	2	0.0000
LNSV	4.386781	2	0.1115
LNFX	7.355794	2	0.0253
LNCF	0.190066	2	0.9093

Source: Researcher's own computation by running Eviews10.0

Table 17: Summary of Diagnostic Tests

Type of Test	Model	Null Hypothesis	P-value	Statistical Inference
Serial Correlation	LNLC	There is no serial correlation in the residual of the model	0.5090	As the P-value is greater than 5%, there is no reason to reject the null hypothesis. This means that the residuals of the model are not serially correlated.
	LNGD			
	LNSV			
	LNFX			
	LNCF			
Heteroskedasticity	LNLC	Residuals of the model have no Heteroskedasticity	0.2507	The P-values are more than 5% for all of the models; so we can conclude that we cannot reject the null hypothesis. Thus, the models have no the problem of the heteroskedasticity.
	LNGD			
	LNSV			
	LNFX			
	LNCF			
Normality	LNLC	Residuals of the model are not normally distributed	0.9520	Normally distributed
	LNGD		0.0000	Not normally distributed
	LNSV		0.1115	Normally distributed
	LNFX		0.0253	Not normally distributed
	LNCF		0.9093	Normally distributed

Source: Researcher's own compilation from results obtained by running Eviews10.0

#### 4.8 Results of the Study

The undertaken tests and analysis of the data indicate that:

1. By making a use of sequential modified Likelihood Ratio test statistic, Final Prediction Error, Akaike Information Criterion, Schwarz Information Criterion and Hannan-Quinn information criterion, the optimum lag length selected for the study is 1.
2. By making a use of Breusch-Godfrey serial correlation LM test, the P-value of the Chi-squared of each variable is greater than the 5% level of significance indicating that the estimated regression line of the model is free from the problem of serial or auto correlations.
3. The ADF tests for the endogenous variables signify that the time series variables for the model are non-stationary and possess unit roots.
4. The trace statistics approach for the Johansen Co-integration test indicates that there are three co-integrating equations at 5% level of significance.
5. Coefficients of the error correction terms for the differenced dependent variables were found to have negative signs (as shown by table 10) indicating that they are error correcting. The negative value for the coefficient of CE for the variables:

- 5.1  $D(LNLC(-1))$  is -0.141101 showing that when loan collection temporarily deviates from its long run equilibrium, it can gradually converge to its equilibrium at the rate of 14.11%. This rate is a speed of adjustment for co-integrating equation in the error correction term indicating that 14.11% deviation from the actual loan collection performance from its equilibrium value is eliminated every year, as a result of which full adjustment requires a period of about 7.09 years.
  - 5.2 The speed of adjustment for  $D(LNGD(-1))$  is -0.057481 indicating that  $D(LNGD(-1))$  can gradually converge to its equilibrium at the rate of 5.74%. And, at this speed full adjustment requires a period of about 17.42 years.
  - 5.3 The speed of adjustment for  $D(LNSV(-1))$  is -0.255286 indicating that  $D(LNSV(-1))$  can gradually converge to its equilibrium at the rate of 25.52% and the full adjustment requires a period of about 3.92 years.
  - 5.4 The speed of adjustment for  $D(LNFX(-1))$  is -0.039462 indicating that the variable  $D(LNFX(-1))$  can gradually converge to its equilibrium at the rate of 3.94% and the full adjustment requires a period of about 25.38 years.
  - 5.5 The speed of adjustment for  $D(LNCF(-1))$  is -0.087148 indicating that  $D(LNCF(-1))$  can gradually converge to its equilibrium at the rate of 8.71% and the full adjustment requires a period of about 11.48 years.
  - 5.6 For most cases the periods required as full adjustments for the models are more than ten years indicating that the deviations from the long-run equilibrium are adjusted back to their respective equilibriums at slow paces in subsequent years. Such relatively slow paces of adjustments may be attributed to the structural rigidities in the Ethiopian economy which are common features in most developing countries, (Hebret, 2015).
6. There are no significant macroeconomic variables at the 5% level of significance to impose impacts on loan collection performances of DBE either positively or negatively in the short run.
  7. There are only two independent variables namely LNGD and LNFX have long run effects on loan collection performances at 5% level of significance implying that economic growths in Ethiopia has positive and statistically significant influence on loan collection performances of DBE. Likewise, there exists a significant positive relationship between foreign currency supply and loan collection performances in the long run. A 10% increase in foreign currency

supply will result in 3% increase in loan collections. The relationship shows the expected results as foreign currency supply play a pivotal role for on time procurement of investment items by DBE financed projects from foreign suppliers for smooth and on time operations of such projects so that projects will commence loan collections as per contractual agreements.

## 5. Summary, Conclusion and Recommendations

### 5.1 Summary

Analyses made based on the research data of the study shows that the optimal lag length is obtained at 1; the estimated regression line of the model is free from the problem of serial or auto correlations; the time series variables for the model are non-stationary and possess unit roots; variables of the time series have three co-integrating equations; in the short run, coefficients of the error correction terms for the differenced dependent variables have negative signs indicating that they are error correcting; there are no significant relationships between the dependent and independent variables in the short run; a growth in GDP has positive and significant influence on loan collection performances of DBE from the bank-financed-projects in the long run; there exists a significant positive relationship between foreign currency supply and loan collection performances of DBE in the long run; and the variables LNSV and LNCF are not significant to impose influences on loan collection performances of projects financed by the DBE in the long run.

The VECM indicates that all the independent variables namely [D(LNGD(-1)), D(LNSV(-1)), D(LNFX(-1)), and D(LNCF(-1))] tend to have long run influences on loan collection performances of the DBE with speed of adjustments of 5.75%, 25.52%, 3.94% and 8.71% which will be met after a period of 17.4 years, 3.92 years, 25.38 years and 11.48 years respectively in same order.

As mentioned, GDP and foreign currency have significant impacts on loan collection performances of the bank. Thus, the growth in GDP of Ethiopia has positive contribution to the loan collection performances of projects financed by DBE. This finding somehow disagrees with the empirical findings of Nanjala (2015) which shows that an increase in GDP of a country does not have significant effect on profitability of commercial banks in Nairobi by taking profitability of commercial banks in Nairobi as a proxy for successful loan repayment performances, other factors being kept constant. But it agrees with the empirical findings of Ofori (2016); according him, when there is a slow growth of GDP in an economy, the level of bad debts increases. Conversely, thus, a growth in GDP reduces the level of bad debts. In actual senses, the growth in GDP would have resulted in low level of NPLs of the bank. But DBE has huge amount of NPLs in its books of account. This paradox may be seen in line with the conclusions made by Asfaw, et al (2016)

which suggests that borrowers have diverted incomes generated by the DBE financed projects for unintended purposes, though this issue requires further investigation. Or, it may be seen in line with the study made by Issah and Antwi (2017) which portrays that an increase in real GDP in UK will decrease the future earnings of a firm.

Likewise, there exists a significant positive relationship between foreign currency supply and loan collection performances in the long run. An increase in foreign currency supply, other factors being remained constant, will increase the loan collection performances of projects financed by DBE. The relationship shows the expected results as foreign currency supply play a pivotal role for timely procurements of investment items by DBE financed projects from foreign suppliers helps smooth and on time operations of such projects so that projects will commence loan repayments as per contractual agreements.

There exists a non-significant positive relationship between domestic saving and loan collection performances in the long run. Though not significant, an increase in domestic saving, other factors being kept constant will increase the loan collection performances of DBE.

There exists also a non-significant negative relationship between capital formation (or investment) and loan collection performances in the long run. An increase in capital formation nationally decreases loan collection performances of DBE due to the fact that national investment of Ethiopia mainly includes investments in the construction industry which are not in the priority lists of the bank to be eligible for financing. Thus, the negative relationship is due to the fact that capital formation has nothing to contribute to the loan collection performances of the Bank.

## **5.2 Conclusion**

Different reports including that of the World Bank indicate that the Ethiopian economy has grown with nearly a double digit for the last decade. Economic theories reveal that the general economic growth of a nation will have multiplier effect on other economic activities of that nation. From this theory, one can safely deduce that an economic growth of the Country, measured in growth of real GDP, would have to have a positive impact on loan collection performances of DBE. A growth in GDP is an important indicator of economic health of the nation as it represents the market value of goods and services annually produced by the country. This healthy economic movement is expected to be reflected on the loan collections of DBE to be made from bank-financed projects.

This notion emanates from the fact that the growth of the economy stimulates all microeconomic factors to operate in similar direction with GDP. Consequently findings of the study confirm this general truth. Moreover, the study reveals that growth in GDP has a positive impact on loan collection performances of DBE at 5% level of significance. In contrary to the findings of the study, the NPLs ratio of DBE at the end of the period covered under this study is nearly 15%. Even though it is beyond the scope of this study unofficial reports show that as at June 30, 2018 the NPLs ratio of DBE became nearly 40%. These reports show that the NPLs ratio of DBE has surpassed the 5% single digit set by the National Bank of Ethiopia as a maximum threshold of NPLs ratio to be maintained by all banks under its supervision. The reasons for the differences observed between findings of the study and the reality on the ground can be seen in line with empirical findings made by Asfaw, et al (2016). Accordingly, it is possible to conclude that borrowers have intentionally diverted project investment funds and/or incomes generated by the financed projects for unintended purposes. As envisaged in the literature review part, other borrower specific factors like poor credit culture, lack of knowledge and experience, willful default, lack of commitment, and project management problems can be considered for poor loan collection performances of the Bank. Moreover, bank specific factors like poor credit assessment, aggressive lending, botched loan monitoring, lenient credit terms and conditions, compromised integrity and weak institutional capacity as cited by Asfaw, et al (2016) from the works of Wondimagegnehu (2012) can be taken for poor loan collection performance of DBE.

### **5.3 Recommendations**

This study has been made with all its limitations and has shown some indications of the macroeconomic variables that were expected to have influential impacts on loan collection performances of projects financed by DBE. Accordingly, the study has come with important findings that may attract attentions of all stakeholders in general and policy makers in particular so as to support loan collection endeavours of DBE. Hence, the study recommends that:

- 1) The study has shown that a growth in GDP and loan collection performances of DBE have positive and significant relationship signifying that the growth in GDP should have been brought about a declining trend in the NPLs ratio of DBE. This positive and significant relationship determined to exist between the two variables (GDP and loan collection) does not truly reflect the current asset quality of the bank. As shown by various empirical findings

customers might have diverted project funds and/or incomes of projects. Hence, DBE should strengthen its customer relationship management endeavours and supervision of DBE-financed projects so as to minimize diversions of investment funds and the incomes generated by the projects so that such funds could properly be used for implementation of projects and as a source for loan repayments by borrowers.

- 2) DBE finances projects in line with the priority area of the Government which export their products to foreign markets which ultimately help the nation to earn hard currencies so that availing hard currencies for such projects for their hard currency demands to be used for procurements of investment items and raw materials from foreign markets will help borrowers of the Bank to commence operations of their projects smoothly. Smoothly operating projects have high tendencies for loan repayments as long as they were properly flowed-up.
- 3) As it can be seen from empirical studies bank specific factors including poor credit risk management, easily admitted borrowers [poor assessment of borrower's creditworthiness], poor credit monitoring, excessive risk appetite by the bank, compromised integrity in approving credit, rapid credit growth, poorly negotiated and lenient credit terms; and customer specific factors including credit culture of customers, lack of knowledge and related experience of borrower for the proposed business, wilful default, loan diversion and lack of commitment have also influential impacts on loan repayment performances of the Bank. Hence, DBE should give prior attention to and work towards the bank and customer specific factors, in addition to macroeconomic variables, so as to address the issues related to loan collection problems of DBE.
- 4) Growths in macroeconomic variables like those included in this study and their smooth operations are important indicators for the health economic movements. Thus, growth in GDP would have been reflected on the loan collections due to the fact that the growth of the economy and smooth operations of the macroeconomic variables stimulate all microeconomic factors to operate in similar direction with the macroeconomic variables. Findings of the study related to the growth in real GDP, however, do not strongly support the reality on the ground in accordance with this general truth so that further study is required to find out the reason behind this issue.
- 5) Further study is also recommended to investigate the impact of bank and/or customer specific related determinants like the grace and loan repayment periods that the Bank gives to projects,

the type and values of collateral requirements for all loans, the type and nature of corporate governance exercised by the Bank, compliance checking for fund utilization (for equity of borrowers and bank loans), the project rehabilitation mechanisms employed by the Bank as and when required to do so, technical knowledge of project managers related to the specific nature of projects, technical competences of human resources for the day to day operations of projects, projects ownership: expatriates vs. local investors and other bank and customer specific factors on loan collection performances of the Bank.

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## Annex 1: Raw Data used for the Study

Year	Original Loan Collection and Macroeconomic Data					Transformed Data into Logarithmic Form				
	LC	GD	SV	FX	CF	LNLC	LNGD	LNSV	LNFX	LNCF
1975	24.05	97,651.00	14,645.00	290.49	19,176.00	3.1801	11.4892	9.5919	5.6716	9.8614
1976	54.06	98,835.00	13,736.00	336.62	15,866.00	3.9901	11.5012	9.5278	5.8190	9.6719
1977	68.71	99,589.00	10,347.00	387.03	15,407.00	4.2299	11.5088	9.2445	5.9585	9.6426
1978	52.65	99,233.00	5,815.00	442.37	14,116.00	3.9637	11.5052	8.6682	6.0921	9.5551
1979	65.72	102,859.00	8,849.00	507.80	16,959.00	4.1854	11.5411	9.0881	6.2301	9.7386
1980	78.78	108,023.00	10,241.00	595.50	20,453.00	4.3667	11.5901	9.2342	6.3894	9.9259
1981	107.61	108,920.00	12,665.00	694.22	21,880.00	4.6785	11.5984	9.4466	6.5428	9.9933
1982	187.20	109,170.00	9,901.00	821.65	22,075.00	5.2322	11.60099	9.2004	6.7113	10.0022
1983	369.26	120,202.00	10,062.00	943.78	21,632.00	5.9115	11.6969	9.2165	6.8499	9.9819
1984	120.41	111,616.00	13,959.00	1058.19	28,002.00	4.7909	11.6228	9.5439	6.9643	10.2400
1985	169.18	101,803.00	4,397.00	1152.81	16,067.00	5.1310	11.5308	8.3887	7.0500	9.6845
1986	175.24	111,910.00	14,746.00	1302.22	27,052.00	5.1662	11.6255	9.5987	7.1718	10.2055
1987	117.66	126,611.00	14,806.00	1479.23	29,350.00	4.7678	11.7489	9.6028	7.2993	10.2870
1988	124.43	125,936.00	24,303.00	1694.53	38,448.00	4.8237	11.7435	10.0984	7.4352	10.5571
1989	101.55	126,868.00	17,383.00	1955.43	27,202.00	4.6206	11.7509	9.7632	7.5784	10.2110
1990	126.29	132,336.00	16,144.00	2257.56	24,516.00	4.8386	11.7931	9.6893	7.7220	10.1071
1991	98.86	128,347.00	6,746.00	2624.72	19,684.00	4.5937	11.7625	8.8167	7.8727	9.8876
1992	58.17	125,406.00	5,678.00	2,050.28	16,754.00	4.0634	11.7393	8.6444	7.6257	9.7264
1993	73.83	139,412.00	11,848.00	2,316.01	29,027.00	4.3018	11.8452	9.3799	7.7476	10.2760
1994	81.01	139,480.00	10,828.00	5,286.90	31,469.00	4.3946	11.8457	9.2899	8.5730	10.3568
1995	185.64	147,455.00	16,837.00	7,399.65	35,958.00	5.2238	11.9013	9.7313	8.9092	10.4901
1996	255.32	162,373.00	17,530.00	8,107.58	40,856.00	5.5425	11.9977	9.7717	9.0006	10.6178
1997	361.62	169,247.00	20,221.00	8,237.81	43,065.00	5.8906	12.0391	9.9145	9.0165	10.6705
1998	497.81	167,917.00	19,994.00	8,841.49	42,821.00	6.2102	12.0312	9.9032	9.0872	10.6648
1999	397.08	178,513.00	26,419.00	8,839.82	44,834.00	5.9841	12.0924	10.1818	9.0870	10.7107
2000	411.10	184,881.00	23,494.00	7,814.44	44,195.00	6.0188	12.1275	10.0645	8.9637	10.6964
2001	350.80	198,595.00	28,248.00	7,829.43	50,811.00	5.8602	12.1990	10.2488	8.9656	10.8359
2002	242.47	201,840.00	20,357.00	11,470.75	57,784.00	5.4909	12.2152	9.9212	9.3476	10.9645
2003	266.29	197,604.00	16,277.00	14,427.18	52,050.00	5.5846	12.1940	9.6975	9.5769	10.8600
2004	230.31	220,782.00	36,728.00	18,112.96	70,593.00	5.4394	12.3049	10.5113	9.8044	11.1647
2005	323.32	248,698.00	25,838.00	19,963.48	70,719.00	5.7786	12.4240	10.1596	9.9017	11.1665
2006	582.88	277,396.00	25,020.00	16,759.04	83,153.00	6.3680	12.5332	10.1274	9.7267	11.3284
2007	764.79	310,115.00	41,662.00	19,514.94	81,346.00	6.6396	12.6447	10.6373	9.8789	11.3065
2008	606.85	344,775.00	34,245.00	16,735.51	91,086.00	6.4083	12.7506	10.4413	9.7253	11.4196
2009	655.91	379,362.00	39,690.00	26,434.27	100,693.00	6.4860	12.8462	10.5889	10.1824	11.5198

Year	Original Loan Collection and Macroeconomic Data					Transformed Data into Logarithmic Form				
	LC	GD	SV	FX	CF	LNLC	LNGD	LNSV	LNFX	LNCF
2010	750.13	419,218.00	42,392.00	42,350.09	123,118.00	6.6202	12.9461	10.6547	10.6537	11.7209
2011	1,386.57	475,648.00	88,843.00	79,945.54	165,380.00	7.2346	13.0724	11.3946	11.2891	12.0160
2012	2,155.19	517,027.00	107,641.00	64,119.02	207,608.00	7.6756	13.1559	11.5866	11.0685	12.2434
2013	2,539.95	568,432.00	108,777.00	72,649.20	210,908.00	7.8399	13.2506	11.5971	11.1934	12.2592
2014	3,053.55	626,977.00	140,049.00	77,877.97	259,173.00	8.0241	13.3487	11.8497	11.2629	12.4653
2015	4,087.32	692,222.00	165,251.00	82,741.82	296,901.00	8.3156	13.4477	12.0152	11.3235	12.6012
2016	4,109.07	1,422,602.00	344,876.00	95,054.99	585,665.00	8.3210	14.1680	12.7509	11.4622	13.2805
2017	4,560.09	1,577,107.00	410,313.00	98,750.85	662,837.00	8.4251	14.2711	12.9247	11.5004	13.4043

## Annex 2: Detailed Results for the Johansen Co-integration Test

Sample (adjusted): 1977 2017					
Included observations: 41 after adjustments					
Trend assumption: Linear deterministic trend (restricted)					
Series: LNLC LNGD LNSV LNFX LNCF					
Lags interval (in first differences): 1 to 1					
<b>Unrestricted Cointegration Rank Test (Trace)</b>					
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value at 0.05	Prob.**	
None *	0.615770	108.2988	88.80380	0.0010	
At most 1 *	0.459748	69.08172	63.87610	0.0171	
At most 2 *	0.411566	43.83718	42.91525	0.0403	
At most 3	0.253184	22.09528	25.87211	0.1375	
At most 4	0.218838	10.12590	12.51798	0.1216	
Trace test indicates 3 co-integrating eqn(s) at the 0.05 level					
* denotes rejection of the hypothesis at the 0.05 level					
**MacKinnon-Haug-Michelis (1999) p-values					
<b>Unrestricted Co-integration Rank Test (Maximum Eigenvalue)</b>					
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value at 0.05	Prob.**	
None *	0.615770	39.21712	38.33101	0.0395	
At most 1	0.459748	25.24454	32.11832	0.2723	
At most 2	0.411566	21.74190	25.82321	0.1580	
At most 3	0.253184	11.96938	19.38704	0.4180	
At most 4	0.218838	10.12590	12.51798	0.1216	
Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 0.05 level					
* denotes rejection of the hypothesis at the 0.05 level					
**MacKinnon-Haug-Michelis (1999) p-values					
<b>Unrestricted Co-integrating Coefficients (normalized by b'*S11*b=I):</b>					
LNLC	LNGD	LNSV	LNFX	LNCF	@TREND(76)
-1.038025	-0.689949	-5.186530	3.706376	8.853172	-0.646477
1.853312	3.230130	-1.723404	0.955474	-4.682357	-0.067197

-0.290020	1.477296	-3.411253	-4.079350	5.014384	0.444764
2.098545	0.401250	1.393575	-0.224894	-3.693476	0.054395
1.037820	-11.08921	-1.575980	-2.865537	8.611277	0.319103
<b>Unrestricted Adjustment Coefficients (alpha):</b>					
D(LNLC)	0.145835	-0.118488	0.008324	-0.079130	-0.068387
D(LNGD)	0.023251	-0.029279	0.036944	0.038728	-0.014251
D(LNSV)	0.192055	0.097077	0.173191	0.030485	-0.001416
D(LNFX)	-0.058507	-0.008011	0.094956	-0.038209	0.002624
D(LNCF)	0.048435	0.050103	0.088533	0.030532	-0.041769
1 Cointegrating Equation(s):			Log likelihood	75.32979	
<b>Normalized co-integrating coefficients (standard error in parentheses)</b>					
LNLC	LNGD	LNSV	LNFX	LNCF	@TREND(76)
1.000000	0.664674	4.996537	-3.570604	-8.528861	0.622795
	(1.59497)	(0.89632)	(0.80214)	(1.79642)	(0.11073)
<b>Adjustment coefficients (standard error in parentheses)</b>					
	D(LNLC)	-0.151381			
		(0.05343)			
	D(LNGD)	-0.024135			
		(0.01980)			
	D(LNSV)	-0.199358			
		(0.06169)			
	D(LNFX)	0.060732			
		(0.03082)			
	D(LNCF)	-0.050276			
		(0.03453)			
2 Cointegrating Equation(s):			Log likelihood	87.95206	
<b>Normalized co-integrating coefficients (standard error in parentheses)</b>					
LNLC	LNGD	LNSV	LNFX	LNCF	@TREND(76)
1.000000	0.000000	8.649919	-6.089531	-12.22906	1.029071
		(1.50597)	(1.28557)	(2.33269)	(0.17699)
0.000000	1.000000	-5.496498	3.789716	5.566928	-0.611241
		(1.04580)	(0.89275)	(1.61991)	(0.12291)
<b>Adjustment coefficients (standard error in parentheses)</b>					
	D(LNLC)	-0.370975		-0.483349	
		(0.10046)		(0.15620)	
	D(LNGD)	-0.078399		-0.110618	
		(0.03909)		(0.06078)	
	D(LNSV)	-0.019444		0.181063	
		(0.12118)		(0.18843)	
	D(LNFX)	0.045884		0.014489	
		(0.06301)		(0.09798)	
	D(LNCF)	0.042581		0.128423	
		(0.06826)		(0.10615)	
3 Co-integrating Equation(s):			Log likelihood	98.82301	
<b>Normalized co-integrating coefficients (standard error in parentheses)</b>					
LNLC	LNGD	LNSV	LNFX	LNCF	@TREND(76)
1.000000	0.000000	0.000000	7.625940	-4.131715	-0.943880
			(1.67124)	(1.20904)	(0.21839)

0.000000	1.000000	0.000000	-4.925633 (0.99264)	0.421560 (0.71812)	0.642450 (0.12971)
0.000000	0.000000	1.000000	-1.585619 (0.28495)	-0.936118 (0.20614)	0.228089 (0.03724)
<b>Adjustment coefficients (standard error in parentheses)</b>					
D(LNLC)			-0.373389 (0.10134)	-0.471052 (0.17104)	-0.580573 (0.30454)
D(LNGD)			-0.089113 (0.03704)	-0.056041 (0.06251)	-0.196155 (0.11130)
D(LNSV)			-0.069673 (0.10442)	0.436918 (0.17623)	-1.754199 (0.31379)
D(LNFX)			0.018345 (0.05316)	0.154768 (0.08971)	-0.006662 (0.15973)
D(LNCF)			0.016905 (0.06072)	0.259213 (0.10248)	-0.639564 (0.18247)
4 Co-integrating Equation(s):			Log likelihood		104.8077
<b>Normalized co-integrating coefficients (standard error in parentheses)</b>					
LNLC	LNGD	LNSV	LNFX	LNCF	@TREND(76)
1.000000	0.000000	0.000000	0.000000	-0.260850 (0.73321)	-0.019607 (0.04904)
0.000000	1.000000	0.000000	0.000000	-2.078651 (0.54256)	0.045457 (0.03629)
0.000000	0.000000	1.000000	0.000000	-1.740965 (0.20162)	0.035910 (0.01349)
0.000000	0.000000	0.000000	1.000000	-0.507592 (0.18078)	-0.121201 (0.01209)
<b>Adjustment coefficients (standard error in parentheses)</b>					
D(LNLC)			-0.539447 (0.13584)	-0.502803 (0.16484)	-0.690846 (0.29846)
D(LNGD)			-0.007841 (0.04785)	-0.040501 (0.05806)	-0.142185 (0.10513)
D(LNSV)			-0.005699 (0.14527)	0.449150 (0.17629)	-1.711716 (0.31919)
D(LNFX)			-0.061837 (0.07174)	0.139436 (0.08705)	-0.059909 (0.15762)
D(LNCF)			0.080978 (0.08351)	0.271464 (0.10133)	-0.597015 (0.18348)

### Annex 3: ADF Unit root test on LNLC at level

#### Intercept (Constant)

Null Hypothesis: LNLC has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max.lag = 9)				
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*	
		-0.653070	0.8474	
Test critical values:	1% level	-3.596616		
	5% level	-2.933158		
	10% level	-2.604867		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNLC)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLC(-1)	-0.030233	0.046293	-0.653070	0.5174
C	0.293454	0.264554	1.109241	0.2740
R-squared	0.010550	Mean dependent var	0.124880	
Adjusted R-squared	-0.014186	S.D. dependent var	0.373036	
S.E. of regression	0.375672	Akaike info criterion	0.926249	
Sum squared resid	5.645190	Schwarz criterion	1.008996	
Log likelihood	-17.45124	Hannan-Quinn criter.	0.956579	
F-statistic	0.426501	Durbin-Watson stat	1.825300	
Prob(F-statistic)	0.517447			

For this ADF test at level with intercept only,

- The P-value > 5%, do not reject the null hypothesis ( $H_0$ )
- The ADF test statistics is less than the critical value [ $0.653 < 3.5966$ ], we cannot reject the null hypothesis.
- At level the variable LNLC has a unit root → the variable LNLC is not stationary.

#### Trend and Intercept

Null Hypothesis: LNLC has a unit root			
Exogenous: <b>Constant, Linear Trend</b>			
Lag Length: 0 (Automatic - based on SIC, max lag =9)			
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*
		-1.897596	0.6381
Test critical values:	1% level	-4.192337	
	5% level	-3.520787	
	10% level	-3.191277	
*MacKinnon (1996) one-sided p-values.			

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNLC)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLC(-1)	-0.183686	0.096799	-1.897596	0.0652
C	0.763971	0.367867	2.076759	0.0445
@TREND("1975")	0.017913	0.010000	1.791234	0.0810
R-squared	0.085764	Mean dependent var		0.124880
Adjusted R-squared	0.038880	S.D. dependent var		0.373036
S.E. of regression	0.365712	Akaike info criterion		0.894808
Sum squared resid	5.216066	Schwarz criterion		1.018927
Log likelihood	-15.79097	Hannan-Quinn criter.		0.940303
F-statistic	1.829284	Durbin-Watson stat		1.684322
Prob(F-statistic)	0.174035			

- For this ADF test at level with intercept and trend,
  - ✓ The P-value is more than the critical value ( $0.6381 > 5\%$ ), so we do not reject the null hypothesis ( $H_0$ );
  - ✓ The (absolute) value of test statistics is less than the (absolute) test critical value at 5% level ( $1.897596 < 3.520787$ ), we cannot reject the null hypothesis.

#### Annex 4: ADF Unit root test for LNLC at First Difference

##### Intercept (Constant)

Null Hypothesis: D(LNLC) has a unit root				
Exogenous: <b>Constant</b>				
Lag Length: 0 (Automatic - based on SIC, max. lag= 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-6.355377	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values; Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNLC,2); Method: Least Squares; Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLC(-1))	-0.973517	0.153180	-6.355377	0.0000
C	0.104850	0.060281	1.739356	0.0899
R-squared	0.508759	Mean dependent var		-0.017215
Adjusted R-squared	0.496163	S.D. dependent var		0.515446
S.E. of regression	0.365871	Akaike info criterion		0.874478
Sum squared resid	5.220600	Schwarz criterion		0.958067
Log likelihood	-15.92681	Hannan-Quinn criter.		0.904917
F-statistic	40.39082	Durbin-Watson stat		2.026601
Prob(F-statistic)	0.000000			

##### Trend and Intercept

Null Hypothesis: D(LNLC) has a unit root; Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic - based on SIC, max.lag=9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-6.346051	0.0000
Test critical values:	1% level		-4.198503	
	5% level		-3.523623	
	10% level		-3.192902	
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNLC,2); Method: Least Squares; Date: 09/29/18 Time: 11:17;				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLC(-1))	-0.978250	0.154151	-6.346051	0.0000
C	0.024467	0.122221	0.200186	0.8424
@TREND("1975")	0.003681	0.004860	0.757394	0.4535
R-squared	0.516065	Mean dependent var		-0.017215
Adjusted R-squared	0.490594	S.D. dependent var		0.515446
S.E. of regression	0.367887	Akaike info criterion		0.908276
Sum squared resid	5.142962	Schwarz criterion		1.033659
Log likelihood	-15.61965	Hannan-Quinn criter.		0.953933
F-statistic	20.26145	Durbin-Watson stat		2.048025
Prob(F-statistic)	0.000001			

## Annex 5: ADF Unit root test for LNGD at Level

### Intercept (Constant)

Null Hypothesis: LNGD has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max.lag = 9)				
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*	
		3.791698	1.0000	
Test critical values:	1% level	-3.596616		
	5% level	-2.933158		
	10% level	-2.604867		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNGD)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGD(-1)	0.092450	0.024382	3.791698	0.0005
C	-1.057983	0.296915	-3.563256	0.0010
R-squared	0.264395	Mean dependent var	0.066237	
Adjusted R-squared	0.246004	S.D. dependent var	0.117768	
S.E. of regression	0.102261	Akaike info criterion	-1.676122	
Sum squared resid	0.418295	Schwarz criterion	-1.593376	
Log likelihood	37.19857	Hannan-Quinn criter.	-1.645793	
F-statistic	14.37697	Durbin-Watson stat	2.461021	
Prob(F-statistic)	0.000495			

### Intercept and Trend

Null Hypothesis: LNGD has a unit root				
Exogenous: <b>Constant, Linear Trend</b>				
Lag Length: 0 (Automatic - based on SIC, max. lag=9)				
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*	
		1.228917	0.9999	
Test critical values:	1% level	-4.192337		
	5% level	-3.520787		
	10% level	-3.191277		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNGD)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGD(-1)	0.077943	0.063425	1.228917	0.2265

C	-0.899651	0.704936	-1.276217	0.2094
@TREND("1975")	0.000841	0.003386	0.248286	0.8052
R-squared	0.265555	Mean dependent var		0.066237
Adjusted R-squared	0.227892	S.D. dependent var		0.117768
S.E. of regression	0.103482	Akaike info criterion		-1.630083
Sum squared resid	0.417635	Schwarz criterion		-1.505964
Log likelihood	37.23174	Hannan-Quinn criter.		-1.584588
F-statistic	7.050676	Durbin-Watson stat		2.428864
Prob(F-statistic)	0.002433			

## Annex 6: ADF Unit root test for LNGD at First Difference

### Intercept (Constant)

Null Hypothesis: D(LNGD) has a unit root				
Exogenous: <b>Constant</b>				
Lag Length: 0 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-5.254158	0.0001
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNGD,2)				
Method: Least Squares				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGD(-1))	-0.827511	0.157496	-5.254158	0.0000
C	0.056288	0.021192	2.656177	0.0114
R-squared	0.414469	Mean dependent var		0.002221
Adjusted R-squared	0.399455	S.D. dependent var		0.153068
S.E. of regression	0.118620	Akaike info criterion		-1.378235
Sum squared resid	0.548756	Schwarz criterion		-1.294647
Log likelihood	30.25383	Hannan-Quinn criter.		-1.347797
F-statistic	27.60618	Durbin-Watson stat		2.008565
Prob(F-statistic)	0.000006			

### Intercept and Trend

Null Hypothesis: D(LNGD) has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic - based on SIC, max.lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-6.346051	0.0000
Test critical values:	1% level		-4.198503	
	5% level		-3.523623	
	10% level		-3.192902	
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNGD,2)				
Method: Least Squares				
Date: 09/29/18 Time: 11:17				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGD(-1))	-1.087554	0.161961	-6.714900	0.0000
C	-0.042332	0.035679	-1.186478	0.2428
@TREND("1975")	0.005255	0.001610	3.263882	0.0023
R-squared	0.542675	Mean dependent var		0.002221
Adjusted R-squared	0.518605	S.D. dependent var		0.153068
S.E. of regression	0.106203	Akaike info criterion		-1.576581
Sum squared resid	0.428602	Schwarz criterion		-1.451197
Log likelihood	35.31990	Hannan-Quinn criter.		-1.530923
F-statistic	22.54596	Durbin-Watson stat		2.020112
Prob(F-statistic)	0.000000			

## Annex 7: ADF Unit root test for LNSV at Level

### Intercept (Constant)

Null Hypothesis: LNSV has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max.lag = 9)				
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*	
		1.008054	0.9959	
Test critical values:	1% level	0.079906		
	5% level	-0.373728		
	10% level	-0.687787		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNSV)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNSV(-1)	0.079906	0.079268	1.008054	0.3198
D(LNSV(-1))	-0.373728	0.171476	-2.179473	0.0356
C	-0.687787	0.790001	-0.870615	0.3894
R-squared	0.111123	Mean dependent var	0.082851	
Adjusted R-squared	0.064340	S.D. dependent var	0.444479	
S.E. of regression	0.429942	Akaike info criterion	1.220024	
Sum squared resid	7.024316	Schwarz criterion	1.345408	
Log likelihood	-22.01050	Hannan-Quinn criter.	1.265682	
F-statistic	2.375294	Durbin-Watson stat	2.036581	
Prob(F-statistic)	0.106657			

### Intercept and Trend

Null Hypothesis: LNSV has a unit root				
Exogenous: <b>Constant, Linear Trend</b>				
Lag Length: 0 (Automatic - based on SIC, max. lag=9)				
Augmented Dickey-Fuller test statistic		t-Statistic	Prob.*	
		-2.272095	0.4392	
Test critical values:	1% level	-4.192337		
	5% level	-3.520787		
	10% level	-3.191277		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNSV)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNSV(-1)	-0.274486	0.120807	-2.272095	0.0287
C	2.263783	1.048259	2.159564	0.0370
@TREND("1975")	0.026000	0.009380	2.771771	0.0085
R-squared	0.164612	Mean dependent var	0.079353	
Adjusted R-squared	0.121771	S.D. dependent var	0.439610	

S.E. of regression	0.411976	Akaike info criterion	1.133044
Sum squared resid	6.619232	Schwarz criterion	1.257163
Log likelihood	-20.79392	Hannan-Quinn criter.	1.178539
F-statistic	3.842438	Durbin-Watson stat	2.335624
Prob(F-statistic)	0.029979		

## Annex 8: ADF Unit root test for LNSV at First Difference

### Intercept (Constant)

Null Hypothesis: D(LNSV) has a unit root				
Exogenous: <b>Constant</b>				
Lag Length: 0 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-8.474041	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNSV,2)				
Method: Least Squares				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNSV(-1))	-1.295333	0.152859	-8.474041	0.0000
C	0.105607	0.068185	1.548839	0.1295
R-squared	0.648044	Mean dependent var		0.005800
Adjusted R-squared	0.639020	S.D. dependent var		0.715745
S.E. of regression	0.430031	Akaike info criterion		1.197634
Sum squared resid	7.212156	Schwarz criterion		1.281223
Log likelihood	-22.55150	Hannan-Quinn criter.		1.228072
F-statistic	71.80937	Durbin-Watson stat		1.979963
Prob(F-statistic)	0.000000			

### Intercept and Trend

Null Hypothesis: D(LNSV) has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic - based on SIC, max.lag=9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-9.062621	0.0000
Test critical values:	1% level		-4.198503	
	5% level		-3.523623	
	10% level		-3.192902	
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNSV,2)				
Method: Least Squares				
Date: 09/29/18 Time: 11:17				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNSV(-1))	-1.367732	0.150920	-9.062621	0.0000
C	-0.143913	0.137226	-1.048728	0.3009
@TREND("1975")	0.011595	0.005604	2.069110	0.0454
R-squared	0.683682	Mean dependent var		0.005800
Adjusted R-squared	0.667033	S.D. dependent var		0.715745
S.E. of regression	0.413008	Akaike info criterion		1.139658
Sum squared resid	6.481884	Schwarz criterion		1.265041
Log likelihood	-20.36298	Hannan-Quinn criter.		1.185315
F-statistic	41.06609	Durbin-Watson stat		2.050885
Prob(F-statistic)	0.000000			

## Annex 9: ADF Unit root test on LNFX at Level

### Intercept (Constant)

Null Hypothesis: LNFX has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-0.429787	0.8945
Test critical values:	1% level		-3.596616	
	5% level		-2.933158	
	10% level		-2.604867	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNFX)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFX(-1)	-0.007839	0.018240	-0.429787	0.6697
C	0.205736	0.158921	1.294585	0.2029
R-squared	0.004597	Mean dependent var		0.138781
Adjusted R-squared	-0.020288	S.D. dependent var		0.201447
S.E. of regression	0.203480	Akaike info criterion		-0.300049
Sum squared resid	1.656167	Schwarz criterion		-0.217303
Log likelihood	8.301025	Hannan-Quinn criter.		-0.269719
F-statistic	0.184717	Durbin-Watson stat		1.718506
Prob(F-statistic)	0.669657			

### Intercept and Trend

Null Hypothesis: LNFX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-4.233659	0.0091
Test critical values:	1% level		-4.198503	
	5% level		-3.523623	
	10% level		-3.192902	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNFX)				
Method: Least Squares				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFX(-1)	-0.565617	0.133600	-4.233659	0.0001
D(LNFX(-1))	0.418814	0.149842	2.795036	0.0082
C	3.201891	0.729639	4.388319	0.0001
@TREND("1975")	0.079463	0.018948	4.193795	0.0002
R-squared	0.338745	Mean dependent var		0.138571
Adjusted R-squared	0.285129	S.D. dependent var		0.203945
S.E. of regression	0.172435	Akaike info criterion		-0.585121
Sum squared resid	1.100156	Schwarz criterion		-0.417943
Log likelihood	15.99498	Hannan-Quinn criter.		-0.524244
F-statistic	6.318062	Durbin-Watson stat		2.154431
Prob. (F-statistic)	0.001435			

**Annex 10: ADF Unit root test for LNFX at First Difference  
Intercept (Constant)**

Null Hypothesis: D(LNFX) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-5.430576	0.0001
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNFX,2)				
Method: Least Squares				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFX(-1))	-0.864270	0.159149	-5.430576	0.0000
C	0.119401	0.039073	3.055869	0.0040
R-squared	0.430583	Mean dependent var		-0.002664
Adjusted R-squared	0.415983	S.D. dependent var		0.267784
S.E. of regression	0.204643	Akaike info criterion		-0.287545
Sum squared resid	1.633278	Schwarz criterion		-0.203956
Log likelihood	7.894672	Hannan-Quinn criter.		-0.257106
F-statistic	29.49115	Durbin-Watson stat		1.940362
Prob. (F-statistic)	0.000003			

**Intercept and Trend**

Null Hypothesis: D(LNFX) has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-5.359754	0.0004
Test critical values:	1% level		-4.198503	
	5% level		-3.523623	
	10% level		-3.192902	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNFX,2); Method: Least Squares				
Sample (adjusted): 1977 2017; Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFX(-1))	-0.864156	0.161231	-5.359754	0.0000
C	0.123223	0.071838	1.715291	0.0944
@TREND("1975")	-0.000174	0.002736	-0.063747	0.9495
R-squared	0.430644	Mean dependent var		-0.002664
Adjusted R-squared	0.400678	S.D. dependent var		0.267784
S.E. of regression	0.207308	Akaike info criterion		-0.238871
Sum squared resid	1.633103	Schwarz criterion		-0.113488
Log likelihood	7.896864	Hannan-Quinn criter.		-0.193214
F-statistic	14.37105	Durbin-Watson stat		1.940730
Prob. (F-statistic)	0.000023			

## Annex 11: ADF Unit root test for LNCF at Level

Intercept (Constant)

Null Hypothesis: LNCF has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max. lag=9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			2.245941	0.9999
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNCF)				
Method: Least Squares				
Sample (adjusted): 1976 2017				
Included observations: 42 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCF(-1)	0.091289	0.040646	2.245941	0.0306
D(LNCF(-1))	-0.339058	0.167659	-2.022303	0.0502
C	-0.862719	0.432010	-1.996989	0.0530
R-squared	0.140711	Mean dependent var		0.091033
Adjusted R-squared	0.095485	S.D. dependent var		0.219535
S.E. of regression	0.208791	Akaike info criterion		-0.224612
Sum squared resid	1.656558	Schwarz criterion		-0.099228
Log likelihood	7.604538	Hannan-Quinn criter.		-0.178954
F-statistic	3.111306	Durbin-Watson stat		1.983645
Prob(F-statistic)	0.056059			

Intercept and Trend

Null Hypothesis: LNCF has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-1.011399	0.9314
Test critical values:	1% level		-4.192337	
	5% level		-3.520787	
	10% level		-3.191277	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNCF); Method: Least Squares; Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCF(-1)	-0.096612	0.095524	-1.011399	0.3181
C	0.851817	0.884977	0.962531	0.3417
@TREND("1975")	0.079463	0.018948	4.193795	0.0002
R-squared	0.127053	Mean dependent var		0.084354
Adjusted R-squared	0.082286	S.D. dependent var		0.221119
S.E. of regression	0.211826	Akaike info criterion		-0.197352
Sum squared resid	1.749944	Schwarz criterion		-0.073233
Log likelihood	7.144390	Hannan-Quinn criter.		-0.151857
F-statistic	2.838125	Durbin-Watson stat		2.367218
Prob. (F-statistic)	0.070675			

## Annex 12: ADF Unit root test for LNCF at First Difference

### Intercept (Constant)

Null Hypothesis: D(LNCF) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-7.485484	0.0000
Test critical values:	1% level		-3.600987	
	5% level		-2.935001	
	10% level		-2.605836	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNCF,2)				
Method: Least Squares				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCFX(-1))	-1.160142	0.154986	-7.485484	0.0000
C	0.104388	0.036614	2.851052	0.0069
R-squared	0.589614	Mean dependent var		0.007641
Adjusted R-squared	0.579091	S.D. dependent var		0.338098
S.E. of regression	0.219350	Akaike info criterion		-0.148750
Sum squared resid	1.876455	Schwarz criterion		-0.065161
Log likelihood	5.049367	Hannan-Quinn criter.		-0.118311
F-statistic	56.03247	Durbin-Watson stat		1.968891
Prob. (F-statistic)	0.000000			

### Intercept and Trend

Null Hypothesis: D(LNCF) has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic - based on SIC, max. lag = 9)				
Augmented Dickey-Fuller test statistic			t-Statistic	Prob.*
			-8.288165	0.0000
Test critical values:	1% level		-4.198503	
	5% level		-3.523623	
	10% level		-3.192902	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNCF,2)				
Method: Least Squares				
Sample (adjusted): 1977 2017				
Included observations: 41 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCF(-1))	-1.282263	0.154710	-8.288165	0.0000
C	-0.038897	0.068679	-0.566354	0.5745
@TREND("1975")	0.006976	0.002890	2.413724	0.0207

R-squared	0.644169	Mean dependent var	0.007641
Adjusted R-squared	0.625441	S.D. dependent var	0.338098
S.E. of regression	0.206920	Akaike info criterion	-0.242612
Sum squared resid	1.627007	Schwarz criterion	-0.117228
Log likelihood	7.973539	Hannan-Quinn criter.	-0.196954
F-statistic	34.39614	Durbin-Watson stat	1.958352
Prob. (F-statistic)	0.000000		

### Annex 13: Matrix of VAR Model with its Coefficients

Vector Error Correction Estimates					
Sample (adjusted): 1977 2017					
Included observations: 41 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
Co-integrating Equation			CointEq1		
LNLC(-1)			1.000000		
LNGD(-1)			1.803080		
			(1.71087)		
			[ 1.05389]		
LNSV(-1)			4.378259		
			(0.97366)		
			[ 4.49669]		
LNFX(-1)			1.085594		
			(0.37403)		
			[ 2.90240]		
LNCF(-1)			-9.563196		
			(2.03051)		
			[-4.70974]		
C			22.13399		
Error Correction:	D(LNLC)	D(LNGD)	D(LNSV)	D(LNFX)	D(LNCF)
CointEq1	-0.141101	-0.057481	-0.255286	-0.039462	-0.087148
	(0.06372)	(0.02101)	(0.06806)	(0.03671)	(0.03800)
	[-2.21444]	[-2.73569]	[-3.75101]	[-1.07484]	[-2.29320]
D(LNLC(-1))	0.080317	0.068545	0.341343	0.019401	0.133109
	(0.15184)	(0.05007)	(0.16218)	(0.08749)	(0.09056)
	[ 0.52896]	[ 1.36899]	[ 2.10473]	[ 0.22176]	[ 1.46986]
D(LNGD(-1))	-0.553483	0.066477	0.414352	-0.593384	0.487529
	(0.60131)	(0.19829)	(0.64227)	(0.34647)	(0.35863)
	[-0.92046]	[ 0.33526]	[ 0.64514]	[-1.71265]	[ 1.35940]
D(LNSV(-1))	0.123388	0.165984	0.249040	-0.106789	0.231273
	(0.28192)	(0.09296)	(0.30112)	(0.16244)	(0.16814)
	[ 0.43767]	[ 1.78545]	[ 0.82705]	[-0.65741]	[ 1.37546]
D(LNFX(-1))	0.390449	-0.097890	-0.156602	0.064402	-0.060363
	(0.27740)	(0.09148)	(0.29629)	(0.15984)	(0.16545)
	[ 1.40752]	[-1.07013]	[-0.52854]	[ 0.40292]	[-0.36484]
D(LNCF(-1))	-0.229839	-0.382861	-1.593350	0.489193	-0.906877
	(0.65058)	(0.21453)	(0.69489)	(0.37486)	(0.38802)
	[-0.35328]	[-1.78461]	[-2.29294]	[ 1.30500]	[-2.33719]
C	0.088778	0.087584	0.148781	0.133246	0.108821
	(0.08084)	(0.02666)	(0.08635)	(0.04658)	(0.04822)
	[ 1.09817]	[ 3.28547]	[ 1.72305]	[ 2.86056]	[ 2.25697]
R-squared	0.236352	0.232996	0.424014	0.203853	0.263825
Adj. R-squared	0.101591	0.097642	0.322370	0.063356	0.133912
Sum sq. resids	3.989755	0.433843	4.551705	1.324581	1.419216
S.E. equation	0.342558	0.112961	0.365888	0.197379	0.204308

F-statistic	1.753858	1.721388	4.171543	1.450943	2.030779
Log likelihood	-10.41471	35.07075	-13.11604	12.18927	10.77461
Akaike AIC	0.849498	-1.369305	0.981270	-0.253135	-0.184127
Schwarz SC	1.142059	-1.076744	1.273831	0.039426	0.108434
Mean dependent	0.108171	0.067558	0.082851	0.138571	0.091033
S.D. dependent	0.361407	0.118915	0.444479	0.203945	0.219535
Determinant resid covariance (dof adj.)	5.93E-08				
Determinant resid covariance	2.33E-08				
Log likelihood	69.43964				
Akaike information criterion	-1.436080				
Schwarz criterion	0.235697				
Number of coefficients	40				

## Annex 14: VAR Residual Heteroskedasticity Test (White test)

VAR Residual Heteroskedasticity Tests (Includes Cross Terms)					
Date: 11/24/18 Time: 13:54					
Sample: 1975 2017					
Included observations: 42					
Joint test:					
Chi-sq		df		Prob.	
316.0831		300		0.2507	
Individual components					
Dependent	R-squared	F(20,21)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.560325	1.338127	0.2564	23.53364	0.2634
res2*res2	0.517590	1.126571	0.3935	21.73877	0.3549
res3*res3	0.456684	0.882576	0.6085	19.18072	0.5101
res4*res4	0.563041	1.352974	0.2486	23.64774	0.2581
res5*res5	0.523140	1.151905	0.3745	21.97188	0.3420
res2*res1	0.706685	2.529766	0.0201	29.68076	0.0752
res3*res1	0.590321	1.512980	0.1768	24.79347	0.2094
res3*res2	0.424462	0.774378	0.7145	17.82738	0.5988
res4*res1	0.545514	1.260303	0.3013	22.91159	0.2932
res4*res2	0.662895	2.064759	0.0535	27.84160	0.1132
res4*res3	0.441229	0.829124	0.6608	18.53162	0.5524
res5*res1	0.691637	2.355083	0.0289	29.04877	0.0868
res5*res2	0.483575	0.983208	0.5137	20.31013	0.4387
res5*res3	0.503233	1.063666	0.4437	21.13577	0.3892
res5*res4	0.325977	0.507811	0.9323	13.69105	0.8458

## Annex 15: VAR Residual Normality Test

VAR Residual Normality Tests				
Orthogonalization: Cholesky (Lutkepohl)				
Null Hypothesis: Residuals are multivariate normal				
Sample: 1975 2017				
Included observations: 42				
Component	Skewness	Chi-sq	df	Prob.*
1	-0.118255	0.097889	1	0.7544
2	3.521070	86.78555	1	0.0000
3	-0.647869	2.938142	1	0.0865
4	0.574312	2.308839	1	0.1286
5	-0.100455	0.070639	1	0.7904
Joint		92.20106	5	0.0000
Component	Kurtosis	Chi-sq	df	Prob.
1	2.984399	0.000426	1	0.9835
2	19.88822	499.1211	1	0.0000
3	3.909832	1.448640	1	0.2287
4	4.698227	5.046955	1	0.0247
5	2.738765	0.119427	1	0.7297
Joint		505.7366	5	0.0000
Component	Jarque-Bera	df	Prob.	
1	0.098315	2	0.9520	
2	585.9067	2	0.0000	
3	4.386781	2	0.1115	
4	7.355794	2	0.0253	
5	0.190066	2	0.9093	
Joint	597.9376	10	0.0000	

\*Approximate p-values do not account for coefficient estimation