"AN INVESTIGATION OF THE LONG-RUN RELATIONSHIP BETWEEN CAPITAL MARKET INDICES AND MACROECONOMIC VARIABLES IN ZIMBABWE"

Mendel University in Brno

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Dedication

I dedicate this piece of work for my late mother, Gogo Mandigo, who did not live to see me sail through in life. Mum, your contribution to the nature of a person I am, is beyond comprehension. I would also like to thank my dearest family for their unwavering support and encouragement. Profoundly to Martha M Mandigo, Jaison Mandigo, Melody N Mandigo, Eunice Mandigo,Abigal Mandigo and Jaison B Mandigo (Senior). Your love, support and prayers are far beyond price.

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Declaration

Herewith I declare that I have written my final thesis: "AN INVESTIGATION OF THE LONG-RUN RELATIONSHIP BETWEEN CAPITAL MARKET INDICES AND MACROECONOMIC VARIABLES IN ZIMBABWE" by myself and all used sources and data are quoted in the list of references. I agree that my work will be published in accordance with Section 47b of Act No. 111/1998 Coll. on Higher Education as amended thereafter and in accordance with the Guidelines on the Publishing of University Student Theses.

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Abstract

MANDIGO, NAISON M. *"An Investigation of the Long-run Relationship between Capital Market Indices and Macroeconomic Variables in Zimbabwe." Brno, 2017. 90p. Diploma Thesis Mendel University in Brno.*

The hash economic conditions in Zimbabwe, marred with perpetual cash crisis, little to no foreign direct investments (FDI's), high unemployment rates, absence of the Central Bank roles and local currency has piqued my interests to study the long-run relationship of capital market indices and macroeconomic variables, in such conditions. The literature review analysed different research work that were done in health economics about the same subject but with different variable matrix structure and methods. Most of the studies confirmed the short/ long-run relationship between capital market indices and macroeconomic variables.

An *ARDL* method was employed on the subject matter, and interesting results were obtained that are at variance with most of the existing empirical results in the literature. For example, most of the studies confirmed a significant relationship between the exchange rate, interest rate and stock index but this research showed otherwise. Moreover, this work filled the existing gap in the literature on the relationship between the mining index and macroeconomics variables. Furthermore, it has been noted that consumer price index and exchange rates have a negative long-run relationship with the mining index. A way for further research of this nature in countries with the same or similar economic conditions as of Zimbabwe has been set in motion and needed for an abstract conclusions on the variations noted by this work.

Keywords

ARDL, Stock Index, Consumer Price Index, Exchange Rate, Inflation Rate, Mining Index, Interest Rate, Industrial Index, Granger Causality.

Abstrakt

MANDIGO, NAISON M. *,,Identifikace dlouhodobho vztahu index kapitlovho trhu a vybranch makroekonomickch ukazatel Zimbabwe. Brno, 2017, diplomov prce, Mendelova universita v Brn.*

patn ekonomick situace Zimbabwe, asto zasaen krizemi, tm bez plivu pmch zahraninch investic (PZI), vysok mra nezamstnanosti, nefunkn role centrln banky a mstn mny ovlivnila zjem diplomanta studovat dlouhodob vztah index kapitlovho trhu a makroekonomickch ukazatel. Pehled literatury analyzuje vzkumn prce, zabvajc se zkoumanou problematikou. Vtina studi potvrzuje krtkodob / dlouhodob vztahy mezi indexy kapitlovch trh a makroekonomickmi promnnmi.

Byla pouita metoda *ARDL*. Zskan vsledky jsou v nkterch aspektech rozdln od stvajcch empirickch studi na podobn tma. Napklad vtina studi potvrdila vznamn vztah mezi smnnm kurzem, rokovou sazbou a akciovm indexem, ale tato prce ukzala opak. Tato prce vypluje mezeru v literatue o vztahu mezi dlnm indexem a vybranmi makroekonomickmi ukazateli. Dle bylo potvrzeno, e index spotebitelskch cen a smnn kurzy maj negativn dlouhodob vztah s dlnm indexem. Cesta pro dal vzkum tto povahy v zemch se stejnmi nebo podobnmi ekonomickmi podmnkami jako v Zimbabwe je dal cestou pokraovn empirickho vzkumu provedenho v tto prci.

Klov slova

ARDL metoda, akciov index, index spotebitelskch cen, inflace, smnn kurzy, dln index, rokov sazby, prmyslov index, Granger causality.

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1 CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND OF THE STUDY

This section intends to explain two things: a brief history of the Zimbabwean Stock Market (ZSE) and the Macroeconomic environment of Zimbabwean economy.

1.1.1 The Zimbabwean Stock Exchange (ZSE):

The Zimbabwe Stock Exchange (ZSE) was established in 1896 and it is one of the oldest stock market in the Africa. The ZSE operates according to the Securities Act (Chapter 24:25) and it is an active member of the Committee of SADC Stock Exchanges (CoSSE), a consortium body of Botswana, South Africa, Mauritius, Zambia and Namibia stock markets. It is supervised by an internal body, Securities Exchange Commission of Zimbabwe (SECZ). The SECZ is a statutory body established in terms of the Securities Act. Members of the ZSE are licensed by SECZ, which also determines the level of capitalization required for practising members of the ZSE and other regulatory statutes. SECZ has the power to intervene in the event when irregularities arises, misconduct of licensed members, financial difficulties, and termination of membership participation on ZSE. The ZSE supervises and monitors the trading process to insure transparency on the market and to prevent manipulation of the market in line with good corporate governance of listed companies. All trades for listed securities by members of the ZSE are declared to the ZSE.

By 2013, there were 79 active companies on the ZSE, which was a 30% reduction from 2007 number. Many companies have been suspended due to various reasons which ranges from, mismanagement to compliance issues with listing desideratum. Currently, there are 59 companies trading on the ZSE which represent a 25% drop in the number of listed companies since 2013 when the same researcher conducted another research on optimum portfolio construction on the ZSE[1]. The major cause of this curtailment, is a harsh economic climate Zimbabwe is experiencing dating back to the 1990's.

[1] "Incomplete Optimal Portfolio Construction using Mathematical and Statistical methods: A case study of the Zimbabwe Stock Exchange"

1.1.2 Macroeconomic Climate in Zimbabwe

To understand the prevailing macroeconomic conditions in Zimbabwe one has to go back in history to pick a better glimpse of what actually brought Zimbabwe to where it is today. In the late 1990's, the Zimbabwean economy began to accelerate in a reverse way. There are three major events that took place and worsen the economic conditions in Zimbabwe thus destabilize the once strongest economy in Southern Africa. The compensation of war veterans in 1997 by $ZW 50 000 ($USD 5 000), participation of Zimbabwean solders in domestic dispute in DRC (1997) and the seizer of white owned farmers (2000-). The first two events had an impact on the economy in that the money used to finance those two activities was not budgeted for in the ficus of that period. The Reserve Bank of Zimbabwe (RBZ) printed money to carter for those events and this has lead to demand pull inflation. The last event jeopardize the strong agriculture base of the country, thus intensifying the situation. Zimbabwe is an agro-based economy. Thus, the dwindling of agricultural output since 1998 and subsequently, has led to cost push inflation due to importation of raw materials for production by local firms which were once available locally.

2006-2008 are the worst economic years in the history of Zimbabwean economy. The Inflation rate in July and mid November 2008 soars at 231,150,888.87% and 79,600,000,000%[2] respectively. A series of devaluation of the local currency has been made four times in a space of 2 years. Prices continues to sky-rocket up until the local money has been rejected by citizens opting for other countries currencies (US dollar (USD), South African Rand (ZAR), Great Britain Pound (GBP), etc).

From 2009, the country dollarized the economy prices stabilizes. The Zimbabwean economy borrowed the USD credibility to restore economic sanity and bringing down inflation. Empirically, dollarization is regarded as an efficient instrument of solving credibility problem by abolishing the national money and taking over the dollar, which is backed by the US Federal Reserve system, Paul DE Grauwe(2014, pg 47). In Zimbabwe it worked well as evidenced by the stabilization of inflation in year 2009 to a single digit for the first time in the history of Zimbabwe after independence.

[2] "Zimbabwe inflation 'incalculable"'. BBC News. 27 November 2007

In subsequent years after 2009, Zimbabwean economy has gone under a series of economic growth and decline which is not a novel feature of an incomplete monetary union. Dollarization indeed has many benefits especially if the Federal Reserve System will intervene as a lender of last resort and have some trading stabilazation agreements with a country in question, for example, the United States and Panama agreement[3]. Since the RBZ ability to implement its own monetary policy or exchange rate adjustments were paralysed, it became difficult for the government of Zimbabwe to control deflationary pressures that were hitting Zimbabwean economy since 2013. Adopting the U.S. dollar in Zimbabwe did not bring advantages like, opening of financial system to capital flows and mobility due to the instability of its international political podium. Capital mobility promotes financial intermediation, competition and efficiency among institutions, and helps restore confidence in the financial system. It also encourages integration of the financial system with the rest of the world which gives a domestic capital markets an even plateau to meet global financial market standards[4].

Serious liquidity problems hit the Zimbabwean Banking sector since last year. In its unwavering efforts in trying to easy the illiquid hammering the financial sector and economy. During the beginning of this year, the RBZ announced the idea of bring back some small denomination of Zimbabwean currency in circulation to easy out cash woes. However, with lack of trust from the citizen in the monetary authority (due to the 2007/08 trauma), the public reacted by major demonstrations and countless strikes that seriously destabilize the peace and destroys properties worth millions of dollars in the country.

Cash withdrawal limits were pegged at $USD50 a day since February this year, external money transfers were banned and also excessive imports duties were installed in an effort to curb the rapid cash outflows of the USD to neighbouring countries. The situation was even made worst by the continuously depreciation of the ZAR (since May 2015) against the USD on the international market in the same aforementioned period,thus making South African products more competitive on Zimbabwean market, henceforth widening the trade deficits of Zimbabwean current account since South Africa is the main trading partner of Zimbabwe.

[3]http://www.focus-economics.com/countries/panama

[4]http://web.calstatela.edu/faculty/rcastil/Econ462/DollarLA.htm

On the 26th of November 2016, the Reserve Bank of Zimbabwe (RBZ) took a bold step in informing the public that they will introduce the Bond Notes and Coins on the 28th of November 2016. From the press statement of RBZ, the new legal tender will be obtained through the normal banking system and the following information was extracted in the same document:

1. The Bond notes shall be in denomination of $1 ,$2 and $5, but $5 note shall be released some day in the future,

2. There will be $10 million worthy of $2 Bond notes and $2 million worthy of $1 Bond Coins,

3. No new accounts shall be opened for Bond notes and coins, the same USD account will be used,

4. A maximum cash withdrawal limit was begged at $50 Bond per day or $150 Bonds notes per week, and

5. The exchange rate of Bond to USD was pegged at 1:1.

Thus, the money in circulation now is the traditional USD and the Zimbabwean money called Bonds which is available in small denominations.

In the history of dollarization, Zimbabwe is not the first country to have challenges that has led to the issuing of small domestic money to stimulate public expenditure. The Panamanian government albeit dollarized their economy, they begun minting their own coins in an attempt to sustain public spending. However, circulation of coins in the domestic economy is more of a symbolic measure and will not really offset the challenges of dollarization.

Literature has shown empirically that, the sustainability of a fully dollarized economy will depend upon how successfully the government implements fiscal discipline, including tax and expenditure reforms. Improved supervision and regulation of the financial system can provide stability and promote confidence that the system can respond to financial crises and sudden capital outflows. Diversification of exports and the promotion of competitiveness is also important to encourage investment and economic growth. Consequently, dollarization does not stand alone as a remedy for economic maladies. It might buy some time in the short run; however, it must be accompanied

Figure 1: Zimbabwean world's largest denomination

Source: www.ebay.com

by a series of structural reforms in order to achieve economic growth and development in the long term. Of which all the above are just but a near impossibility (if not impossible) conditions to achieve or set in Zimbabwe currently. With current ill relations between Zimbabwe, and EU, Britain and the US, the current economic situations seems to be insurmountable in the near possible future.
Figure 1 above, shows the largest denomination issued by the RBZ in November 2008. This money has been devalued several times by slashing many zeros before. Factoring in four times devaluations that were done, the actual money should have $1 * 10^{48}$ zero's.

Table 1, below shows the historical movement of GDP growth and Inflation rate from 2001 to 2016. The left hand of the table, shows the economic dynamics before dollarization and however dollarization era. Table 1, shows that Zimbabwean government has never been in good books in stabilizing its macroeconomic fundamentals since independence. It was only after dollarization (2009), a single digit inflation rate was attained since three decades of independence. However, other macroeconomic fundamentals like unemployment, GDP growth, economic stabilization, etc, are still far from being fixed even after dollarization.

Table 1: The table showing the movement the GDP Growth and Inflation of Zimbabwe from 2001/16

Year	GDP (%)	Inflation Rate (%)	Year	GDP (%)	Inflation Rate(%)
2001	1.44	112.1	2009	5.3	-7.5
2002	-8.89	198.93	2010	2.4	2.7
2003	-17.2	598.75	2011	11.9	3.2
2004	-6.9	132.75	2012	10.6	3.87
2005	-2.2	587.84	2013	4.5	1.65
2006	-3.5	1261.11	2014	3.9	-0.22
2007	-3.3	66212.3	2015	1.5	-2.47
2008	-17.7	$7.906*10^{11}$	2016	-	-

1.2 Objectives of the Study

The main objective of this work is to determine whether there is a long-run relationship that exist on key Zimbabwean Capital Market indices (stock index (SI), industrial index (II) and mining index (MI)) with selected macroeconomics indices (consumer price index (CPI), interest rates (IR), exchange rates (ER), and Inflation (IF)). Three models shall be developed with capital market indices and dependent variables and macroeconomic variables as independent variables. The models shall be analysed to see if they are suitable for predictive purposes. The initial model system set is as follows:

$$\begin{bmatrix} SI_{t_1} \\ II_{t_2} \\ MI_{t_3} \end{bmatrix} = \begin{bmatrix} \beta_0 \\ \gamma_0 \\ \delta_0 \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{14} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} \end{bmatrix} \begin{bmatrix} CPI_t \\ IR_t \\ ER_t \\ IF_t \end{bmatrix} + \begin{bmatrix} \lambda_t \\ \mu_t \\ \nu_t \end{bmatrix} \tag{1.2.1}$$

1.3 Research questions and proposed hypotheses

The following hypothesis and research questions shall be answered in this study:

1. $H_{A1,B}$: Does stock market index Granger causes macroeconomic variables or vice versa,

2. $H_{A2,B}$: Does industrial index Granger causes macroeconomic variables or vice versa, and

3. $H_{A2,B}$: Does mining index Granger causes macroeconomic variables or vice versa, and

Summing the above proposed hypotheses which describe the direction of possible causality in the aforementioned variables. Each pair of independent variable and a set of dependent variables shall be analysed independently.

1.4 Chapters Layout

This Thesis is organized as follows:

a) Chapter 1: Provides Background of the study: ZSE, Zimbabwean macroeconomic climate, Objectives of the Study, Research questions and proposed hypotheses,

b) Chapter 2: Covers the literature reviews of independent(CPI, IF, IR & ER) and dependent(SI, II & MI) variables and analysis of variables,

c) Chapter 3: Detailed explanation of Variables, identifies the scope of study, and presents the research methodology and the econometric model set-up,

d) Chapter 4: Interpretation of Empirical results,

e) Chapter 5: Discusses on major findings, and

f) Summary and Final Conclusions.

1.5 Concluding Remarks

From what have been describe in this chapter about a brief history of the Zimbabwean economy, this piece of work shall be confined in the era of dollarization (2009 to date). Monthly data shall be used, meaning there will be 96 observations from each variable.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter shall present the reviews of previous researchers on the relationship of selected macroeconomic variables (consumer price index, inflation, exchange rate and interest rates) and market indices (industrial index, stock index and mining index). The methodologies applied in determining the relationship and prominent findings shall be evaluated as well.

2.2 Stock Market Index

The stock market index and and their interlinked relationship with macroeconomic variables has been a subject of attraction for research in economical sciences after the pioneering work of Fisher (1930), who hypothesized that equity is a form of an asset that can be hold to hedge against catastrophic economic situations like inflation. On the same notion, Mandelbrot (1963) and Fama (1965) research proved that fluctuations in the value of stock are due to significant changes in the economic environment which explains cluster effect of the stock. Osinubi and Amaghionyeodiwe, (2002), in their study of Stock Market Development and Long-Run Growth in Nigeria, showed a strong between an indicator of the level of economic activities within a country and that the direction of broad macroeconomic variables such as savings rates, exchange rates and economic growth are picked up by the stock market.

Without loss of generality, one can conclude that there is a link between stock market index and macroeconomic variables. But, the extend to which they are related, in some similar and or different economies, when investigated using the same and or different methodologies and how results differs in one discourse set of similar or almost similar circumstances, has piqued interest to academias and research practitioners in different spectrum. Henceforth, extensive research on this matter in the whole body of economics and finance is skyrocketing.

2.2.1 Empirical Results of Stock Market Index and Macroeconomic Variables

Sohail and Zahir (2010) investigated the long run and short run relationships between Karachi stock exchange in Pakistan and macroeconomic variables (consumer price index, real effective exchange rate, industrial production index, money supply and three month treasury bills rate). Using the methodology of the co-integration test and vector error correction model (VECM) they noted that in their results,there exists three long-run relationship among variables, and that consumer price index, real effective exchange rate and industrial production index bears a positive impact on stock prices, at the same time money supply and three month treasury bills rate had a negative impact on stock prices in the long run. These results are in agreement with those of Hussain et al. (2011), who also noted that in their research, interest rate and stock price have the same relationship, using the same methodology. The research was conducted by using three months Treasury bill rate as proxy and the data ranged from November 1991 to June 2008. The result revealed that three month Treasury bill rate had a negative significant long-run impact on stock prices in Pakistan.

Furthermore, Aamir et al. (2011) they determine the impact of macroeconomic indicators (exchange rate and inflation) on stock market of Pakistan. They used yearly data from 1995 to 2010 for exchange rate of USD, real interest rate and Karachi stock exchange 100 index. They applied the same methodology of Sohail and Zahir (2010) and they found that there exist a significant impacts in the short-run and long run-relationship of exchange rate and inflation rate with stock market.

In addition, Srinivasan (2011), applied the Johansen and Juselius multivariate co-integration techniques and Error correction model on quarterly data set over a period 1991 to 2010 of Indian Stock market and some selected macroeconomics variables. His results using co-integration test showed that the NSE-Nifty share price index has a significantly positive long-run relationship with money supply, interest rate, industrial index, and the US stock market index. But there was noted in the same study, a significant negative relation of NSE-Nifty share price index and exchange rate in the long run. Concurrently, the ECM showed a strong unidirectional causation running from interest rate and the US stock market return to NSE stock market re-

turn of India. In other words, interest rate affect US market and this in turn affect NSE stock market return of India. Again, the result by Srinivasan showed a significant short-run causality between money supply and interest rate, inflation and money supply, and the US stock market and exchange rate. In short, the selected macroeconomic variables of India and US stock market affect NSE-Nifty share price index of India.

Tajana Barbi and Iva ondi-Jurki (2011), analysed the relationship between stock market indices and macroeconomic variables of selected CEE countries (Croatia, Czech Republic, Hungary, Poland and Slovenia), using the Johansen co-integration framework and the Granger causality test. And test for bilateral long-run equilibrium relationships between stock market index and set of macroeconomic variables (inflation rate, broad money supply, money market interest rate and foreign currency reserves). Their findings concluded that there is an acceptable long-run relationship between stock market indices and macroeconomic variables, exhibited in Poland and Czech Republic, yet, in other countries in their study, the results were negative. Notwithstanding, the results of Granger (non) causality reveal that:

i) There is no causal connexion amid any macroeconomic variates and stock index in Croatia, Hungary and Poland,

ii) money supply and foreign exchange prime stock index in Czech Republic, while inflation rate and money market interest rate lead Slovene stock index,

iii) none of stock market indices might be used as a leading indicator of inflation rate, and eventually

iv) stock market index drive money market interest rate in Hungary and Czech Republic, foreign exchange reserves in Slovenia and money supply in Poland.

A multiple regression method was employed in showing the consequence of independent variables(inflation, interest rate, and exchange rate) to the de-

pendent variables (Jakarta Composite Index, agriculture sector, and basic industry sector stock price) in Indonesia Stock Exchange by Dhira Dwijayanti et al. (2012). Monthly time series data obtained from the Bank of Indonesia and Yahoo Finance over a 5 year period (2007- 2011 inclusive). Their results indicated a significant relationship between macroeconomics variable (inflation, interest rate, and exchange rate) and stock price in JCI, agriculture sector (AALI.JK), and basic industry sector (JPFA.JK). The change in inflation bears a positive impact, while at the same time a change in interest rate bears a negative sway to the stock price.

Of notable interest is the work of Zakaria and Shamsuddin (2012), they examined the relationship between stock market index volatility in Malaysia market along with selected macroeconomic volatilities (GDP, inflation, exchange rate, interest rates, and money supply) using monthly data over a period of 13 years (January 2000 to June 2012). Using the regression analysis model, it showed that only money supply volatility is significantly related to stock market volatility. The volatilities of macroeconomic variables as a group are not significantly related to stock market volatility. This can imply that stock market volatility is not influenced by the macroeconomic variables of Malaysia. This agrees with the stock market of Turkey (Byksalvarci and Abdioglu (2010)), who concluded that stock market price of turkey can not be determined by the selected macroeconomic variables (foreign exchange rate, gold price, broad money supply (M_2), industrial production index and consumer price index). Henceforth no uni/bidirectional relationship between stock market index and selected macroeconomics variables in Turkish Stock Market.

Alam (2013) examines the role of macroeconomic variables and features of firm in explaining stock market return in South East Asian (SEA) countries, which are Indonesia, Malaysia, Singapore and Thailand. A monthly time series data from July 2003 to June 2011 was used. He used 7 macroeconomic variables which are, *changes in money supply (M_1 and M_2)*, *growth rate of industrial production*, *change in exchange rate*, *change in consumer price index* as the proxy for inflation, *short-term and long-term interest rates*, *change in term structure*, and *growth rate of crude oil price* for his analysis. His discoveries pointed a significant relation amongst portfolio stock returns and macroeconomic variables were not reliable in the aforementioned periods. The results were highly reliant on country, period and assortment of

assets (portfolio).

Johansen's co-integration test and vector error correction model (VECM) were applied in investigating the long-run equilibrium relationship of stock market index and macroeconomic variables by Naik (2013) on Indian stock Market. The monthly data of five macroeconomic variables namely *industrial production index, inflation, money supply, short term interest rate, and exchange rates*, and India stock index for a period of 18 years (1994-2011, inclusive) was used. The co-integration analysis conducted squarely showed that macroeconomic variables and stock market index are co-integrated, and long-run equilibrium relationship indeed exists. Furthermore, it was found that the stock index was in the period, directly related to the money supply and industrial production, in spite of an inverse relation that was drawn with inflation. The exchange rate and the short-term interest rate were found to be non significant in impelling the stock index, hence no causal link as indeed shown in the work of Zakaria and Shamsuddin (2012) and Byksalvarci and Abdioglu (2010) on Malaysian and Turkey Stock Markets correspondingly. Moreover, Granger causality test by Naik showed that other macroeconomic variables causes the stock index volatility both in short-run and long-run.
Everlyne Ngarea et al. (2014) conducted a panel study is to investigate the role of stock market development on economic growth in Africa. They used an annual data of 36 countries, of which 18 have stock markets, in over the period 1980-2010. Their results concluded that:

i) Stock markets drives the economy and countries without stock markets are lagging behind in economical development than countries with stock markets,

ii) Developed countries with stock markets grows less in comparison with small countries with stock markets,

iii) Stock market development and economic growth are positively correlated,

iv) Investment, human capital development, and economic liberalisation bears a positive weight on economic growth in the Africa region,

v) Macroeconomic instability (inflation) and government public consumption impact economic growth negatively, and

vi) Countries that have good institutions that shuns corruption tends to grow faster, than those without.

In view of these findings, they concluded that it is recommended that countries in African region to grow they need to put in place institutional sources to establish stock markets and foster their growth, thus addressing the macroeconomic fundamentals.

Similarly, Luis Miguel Marques et al. (2013), investigated the relationship between stock market development and economic growth for Portugal between the years 1953 to 2011 using the vector autoregressive (VAR) modelling, Granger Causality, variance decomposition and Impulse Response functions. The results showed that the physical replacement of the local currency due to the integration in the European Monetary union (EMU), prove to be an economic regime change. In addition, there was evidence of bidirectional causality between the stock market and economic growth. Meanwhile, no evidence noted from bank financing to economic growth. This contradicts with the work Yang and Yi (2008), when using an annual Korean data from 1971 to 2002, examined the financial development/economic growth relationship in the Korean economy. The findings of the study provide evidence that there is a *one-directional* relationship between the stock market and economic growth, running from the stock market to growth unlike the *bi-directional* relationship established in Luis Miguel Marques et al. (2013).

Forson and Janrattanagul (2014), noted a long run equilibrium relationship of Thai stock exchange index and these macroeconomic variables, consumer price index, interest rate, money supply (M_2) and industrial production index using Johansen co-integration test and vector error connection model (VECM) on a 20 year period data. They adopted the methodology of Toda and Yamamoto (1995) augmented Granger causality test having Thai stock exchange Index as a dependent variable and macroeconomic variables independent variables. In their study, it was found that Thai stock exchange index and selected macroeconomic variables were co-integrated and have a significant equilibrium relationship over a long run. simultaneously, Money

supply had a strong positive relationship, in spite of the negative relationship shown by the industrial production index and consumer price index in relation to depended variable. Subsequently, a causal relationship was bidirectional between industrial production index and money supply. Unilateral causal relationship between consumer price index and industrial production index, industrial production and consumer price index, money supply and consumer price index, and consumer price index and Thai stock exchange index.

Rudra P et al. (2015), in their paper, the examines the linkages between economic growth, oil prices, depth in the stock market and macroeconomics indicators: real rate of interest, real effective exchange rate and real interest rate. On the methodological part, they used a panel autoregressive model to test Granger causality for the G-20 countries spanning from 1961 to 2012. It was shown by their study that a strong long-run economic relationship between economic growth, oil prices, stock market depth, real effective exchange rate, inflation rate, and real interest rate. Furthermore, in the long-run economic growth was found to response to any deviation in the long-run equilibrium relationship that is found to exist between the different measures of stock market depth, oil prices, and other macroeconomic variables. To sum it all, a clear evidence was found that economic growth responds to various measures of stock market depth, thereby give room to oil price volatility and deviations in the real effective exchange rate, inflation, and real interest rate.

Sirine & Jamel (2016), run an ARDL model over a monthly data spanning from 2008-2014 to investigate the relationship between macroeconomic, demographic variables and the Tunisian stock Index just after the global financial crisis. In conclusion, it has been found that the Tunisian stock market index, macroeconomic and demographic indicators are co-integrated, this therefore implies that, a long-run relationship exists between them. Meanwhile, there exist a negative effect of long-run coefficients of inflation rate, budget deficit, and the number of unemployed graduates, notwithstanding that, money supply and the number of non-resident entries had a positive effect on the Tunisian stock market index. Finally, outcome from the VECM put it that, Tunisian stock market index is influenced positively by money supply and a second integration of number of unemployed graduates and negatively by first integration of the same variable. In addition, second order difference of money supply, inflation rate, of number of non-resident entries

(first order difference) and the number of unemployed graduates also also has the same effect on the Tunisian stock market index.

Niranjan Phuyal (2016), also noted that the Nepalese stock market index has a long run equilibrium relationship with a set of macroeconomic variables, like inflation rate, interest rate and remittance flow with the short term disequilibrium corrected by 1.79% on monthly basis. He further showed that there is Granger causality relation between variables in the short run. And the stock market index was affected by the lag values of NEPSE index up to six levels and remittance income, which was shown by the results of the Wald test. To arrive at his conclusions, he applied the methodology of Johansen's co-integration method. Similarly on the thematic issue, but differently on the methodological notion and variable matrix, Md. Nazmul Haque (2016), used the Johansen multivariate co-integration tests and VECM to determine whether macroeconomic variables (Money Supply and Deposit Interest Rate) has an impact on the Share Price Index of Dhaka Stock Exchange. His results showed that long-run co-integration relationship exists between Bangladesh stock market index (DSE General Index) and chosen variables. Furthermore, a 10.78% speedy of adjustment of any disequilibrium towards long run equilibrium state was noted to be related to stock prices in the long-run. VECM, suggested that deposit interest rate as being negatively related to stock prices, whereas money supply (M_2) was positively related to stock prices in the long-run. Short-run causal relationship between independent and depended variables was also established. Hence establish similar results like those of Niranjan Phuyal (2016).

2.3 Industrial Index

Industrial Index is considered as one of the measures of the economic activity in a given country. It has a direct link with all macroeconomic variables and it fluctuations indicates the movements of economic output in a country. Industrial production is one of the important economic indicators in an economy, it is uninfluenced by prices as it measures the actual volume of output in goods- producing industries. Goods- producing industries make up some 40% of real GDP (Bloomberg, 2015).

2.3.1 Empirical Results of Industrial Index and Macroeconomic Variables

Ahmet Ozcan(2012), in his study of the relationship between macroeconomic variables and Istanbul Stock Exchange Industry Index (ISEII), used a series of monthly data from 2003 to 2010 (96 observations). Interest rates, consumer price index, money supply, exchange rate, gold prices, oil prices, current account deficit and export volume were the selected macroeconomic variables for the study. It has been found from his results that, there is indeed a long run equilibrium relationship between the ISE industry index and selected macroeconomic variables. The methodology of the Johansen's Cointegration Analysis was used.

A series of monthly data spanning from January 2003 to December 2013 of Turkish CPI and Industrial/ Production Price Index (PPI) was used in the work of Volkan Ulke & Ugur ERGUN (2014), to investigate relationship between the two. In their analysis, they used the unit root test (ADF, PP), Johansens co-integration test and vector error correlation model (VECM). VECM suggests that their variables were all stationary at first level, I(1). The co-integration test, Johansen's co-integration test indicated a long run relationship between variables. On the same time, VECM indicates that there is unidirectional long run relationship from CPI to PPI for Turkey and linear unidirectional long run causality between variables. On the other hand VEC Granger causality test indicates no causality in short run. Since their findings emphasis on consumer price index as primary indicator for price changes, thus, a change in the CPI in short run does not affect PPI. On the contrary it has impacts in the long-run. Their results speculated a demand pull inflation in long run for Turkey.

Korhan Gokmenoglua et al. (2015), used unit-root test, Philips-Perron (1988), the Johansen (1988) co-integration approach and Granger causality test to determine the relationship between Industrial Production, GDP, Inflation and Oil Price in Turkey. Data from 1961 to 2012 was used in the study and all variables were integrated of order one, I(1). The findings confirmed a long-run relationship among these variables. The Granger causality test illustrates the unidirectional relationship from oil price to industrial production index.

Md. Tasnimul Hasan et al (2016), studies a data from January 2002 through June 2013 to investigate the relationship between industrial production index and CPI, thus delineates the effect of inflation on industry level production by using the methodology of the Error Correction Mechanism and Granger Causality analysis. Their studies indicated that the relationship between consumer price index and production index is not spurious. In addition, the results of Error correction model shows a positive long run relationship between co-integrated variable consumer price and production in both co-integration methods. Moreover, Error correction model has been applied to estimate short-run and long-run, the coefficient of long run relation was found to be significant, however for short-run.

Furthermore, their findings reveals the existence of bilateral Granger causality between consumer price index and production index up to some lags, thereafter, there was no causality link between variables. Analogously, the results proves to be at even with independent work of Mallik and Chowdhury (2001) and Ahmed and Mortaza (2005), which exhume that bilateral Granger causality exists between consumer price index and production index up to a certain lags, of which after that, there is no causality between two variables.

2.4 Mining Index

The mining index represent the average performance of all mining activities in Zimbabwe. Its fluctuations represent the economic activities happening in the mining sector in Zimbabwe. According to the Geological Survey of Zimbabwe (1990) is believed to have more than 500 individual deposits of base metals and minerals. The Survey clearly showed that Zimbabwe is a country tremendously blessed with vast and diverse precious stones ranging from gold, chrome, lithium, asbestos and caesium, as well as high-quality emeralds and other minerals and metals. Since independence mining sector has contributed an average of about 40% of total exports Hawkins (2009), the major share coming from gold and other minerals such as ferro-chrome, nickel and platinum.

The discovery of 88 000 (which is believed to be approximately 25% of the

World deposit)[5] hectares of diamond fields in 2008 in Zimbabwe had brought the mining sector in Zimbabwe on a new era that dropped the attention of the of the whole world. Surprising, 10% (8 800) of the 88 000 hectares has being mined since 2009, but the revenues did little to no change to the macroeconomic problems in Zimbabwe. Hence the phenomena 'natural resource curse' is justified, meaning countries heavily endowed with natural resources like oil and minerals were being out performed in economic growth by countries with little or no resource at all Auty (1993).

2.4.1 Empirical Results of Industrial Index and Macroeconomic Variables

In literature, mining development index was investigated its impact on economic growth of a nation. Most of research are centred on the paradox widely referred to as the 'Resource Curse' in literature. A study by Mills (2010) highlighted this phenomena on a study of the Nigerian mining sector. His study have shown that although Nigeria had earned an estimate of US$ 400 billion from oil for the past 40 years, the majority of Nigerians are surviving by less than a US$1 per day. In addition Mills said, 'Nigeria would have been better- by some estimates the economy would have been 25% bigger- if the Niger delta had no oil'. Thus implying that rich mineral resource endowments did prevent economic growth.

Deserving mentioning is the work of George Mavrotas et al (2011). In their study, they used a panel study of 56 developing countries to investigate the link between natural (mining) resources, institutional development, and economic growth over the period 1970-2000. Their results indicated that both point-source (oil and minerals) and diffuse-type (agriculture and forests) natural resource dependence retard the development of democracy and good governance, which in-turn jeopardize economic growth. Analogously, their results are similar to those of Magai and Alejandro (2011), who noted that even though Tanzanian mining sector accounts for nearly half of the country's exports and places it among Africa's largest exporters. Also, ordinary Tanzanians have seen little benefit from their country's exports boom. Henceforth, there is a widespread resource curse exhibited in developing economies.

[5] http://www.theafricareport.com/news-analysis/the-story-of-zimbabwe-marange-diamonds-pollution-politics-power.html

Bahram Shakouri and Soheilakhoshnevis Yazdi (2012), used the Co-integration technique, Error Correction Model, and Granger causality over an annual time series data from 1959 2008. Their aim was to investigates the causality relationship between mining (index) exports, industrial exports, imports and economic growth for Iranian economy. Their results showed that mining exports and imports is linked to economic growth. In other words, the growth in mining exports sectors Granger causes economic growth which, in turn, promotes the growth of Iranian economy. In comparison from this study, industrial index is not an independent variable and consumer price index is used as a proxy for GDP, making this study a novel in the literature body.

Bimal Chandra Roy et al (2013) , delve into the *'haste generalization fallacy'* of the 'paradox of resource curse', they noted that there are problems with measurement issues (a black box approach-measures resource intensity in relation to GDP and exports: Wright and Czelusta (2004)) and the use of period averages vs. panel data (Sachs & Andrew W. 1997, Maloney, 2001; & Neumayer, 2004) which indeed lead to a *'non sequitar fallacy'*. Furthermore, their study noted that the main issue is normally on 'point-source resources' which are normally associated with bad institutional governance. In conclusion, they concluded that minerals themselves are not to blame for problems of rent seeking and corruption. Instead, it is largely the manner in which policy makers and businesses view minerals that determines the outcomes, thus induce the volatility of the mining index.

Steven Deller (2014), took a somewhat different approach in his study on the impact of non-oil and gas mining activity on U.S rural (non-metropolitan), such that, does mining foster rural growth?. By employing the simple Barro-type growth framework and allowing spatial heterogeneity in the underlying growth process. He noted that that the global least square results suggest that higher dependency on non-oil and gas mining is associated with higher rates of income growth over 2000 to 2011 time period. However the results were consistency in all regions, with positive growth exhibited in the eastern part of the U.S and the converse in the western part with no relationship observed in the pacific west.

Mining sector foster rural development as was witnessed in Zimbabwe in the 2009-2012, after the discovery of diamond in Marange-Chiyadzwa. Roads, Hotels, new houses structures and development of community amenities like

schools and clinics. Chiyadzwa before the discovery of diamonds was an ugly-abandoned remote area with no any economic activities. The place achieved a national spot light due to the advent of the precious mineral (2006)[6] that has seen influx of many people around the country and some fro neighbouring countries. More than 10 000 illegal miners infested in Chiyadzwa before the government protect the area from further looting. Below are the pictures showing Marange before and after the diamonds discovery:

Figure 2: Chiyadzwa houses before the discovery of diamonds

Source: Internet

Figure 3: Chiyadzwa houses after the discovery of diamonds

Source: Internet

Mahonye and Mandishara (2015), investigated the economic growth model in Zimbabwe using human capital, population growth, political rights, property rights and percentage of mineral export to total exports as their variables. They used an Ordinary Least Squares (OLS) for a 1970-2008 data and add

[6]http://www.theafricareport.com/news-analysis/the-story-of-zimbabwe-marange-diamonds-pollution-politics-power.html

to the literature the same notion of resource curse in Zimbabwe. They failed to reject the the hypothesis that mineral resources have a negative impact on growth using both variables used to proxy resource abundance.

Natlia HLAVOV (2016), selected a a sample of 48 countries from sub-Sahara region in Africa and divided them into two cohort, such that, 13 economies dependent on mineral resources and 35 countries in the group of other economies. Employing a regression analysis, in the group of countries dependent on mineral resources, he results of correlation and regression analysis were not statistically significant. In the group of other economies, only a weak interdependence between indicators has been identified. Hence, her results concluded that a change in the rate of mineral resources in total export affects only a small part of changes in the economic growth of the country.

Based on her studies, it is not possible to conclude that the dependence on exports of raw materials causes low growth rates of economies in Sub-Saharan Africa. Henceforth, the she concluded that the lower the growth rates in Sub-Saharan Africa cannot be ascribed to their one-sided focus on raw materials. Thus contradict the work of Mahonye and Mandishara (2015), which concluded otherwise in their study. Natlia (2016) used a panel study yet Mahonye and Mandishara (2015) used the OLS, thus the difference in results is expected.

2.5 Chapter Summary

A reveal of related literature of dependent, independent variables and commonly methodology used by previous researchers has been carried out and the following can be concluded:

2.5.1 Stock Index

Most researchers in the body of literature used stock index as a dependent variable in similar studies (Sohail and Zahir (2010), Aamir et al (2011), Zakaria and Shamsuddin (2012), Luis Miguel Marques et al. (2013), Forson and Janrattanagul (2014), etc.). The question on whether the macroeconomic indices affect the Stock index both in the short and long-run dominated the body of literature. Most commonly used variables are: consumer price index,

exchange rate, inflation rate, money supply and industrial production index. Also, the common methodological framework used by many studies is the Johansen co-integration test and vector error connection model (VECM) (Sohail and Zahir (2010), Forson and Janrattanagul (2014),etc), others like Zakaria and Shamsuddin (2012), used the regression analysis model, Sirine & Jamel (2016), used an ARDL model and Everlyne Ngarea et al. (2014) used a panel study. The results differs depending on the methodological approach and prevailing economic conditions in the context of the study. For instance, Zakaria and Shamsuddin (2012) concluded that macroeconomic variables are not significantly related to stock market volatility, yet Sohail and Zahir (2010) using almost the same variables but different methodology concluded otherwise.

2.5.2 Industrial Index/ Production Industrial Index

Studies on industrial index or production industrial index relationship with some macroeconomic are somewhat fewer in both academic and industrial research fraternity, Korhan Gokmenoglua et al. (2015). The work of Ahmet Ozcan (2012), used the industrial index as a dependent variable together with a number of macroeconomic variables which is similar to this study. In most studies, industrial index and consumer price index are variables under consideration but mostly in oil economies (Md. Tasnimul Hasan et al (2016), Volkan Ulke & Ugur ERGUN (2014), etc) . The relationship between industrial production index with other macroeconomic variables is an advancing research issue in many oil economies. Consumer price index, inflation rate, GDP, money supply, oil prices and net exports are the most commonly used macroeconomic variables, notwithstanding that this study will use, consumer price index, inflation, interest rates and exchange rates, in non-oil economy which is a different lookout. Furthermore, the industrial production index is used as an independent variable in many studies, this shows the novelty of this study and its contribution to the body of literature, in variable structure and nature of economy. Finally, the methodology of Johansen's co-integration test and VECM are mostly used in the literature.

2.5.3 Mining Index:

The most dominating studies in the body of literature on the mining index is the, 'resource curse paradox', since the pioneering work of Auty (1993), which was later advanced by Sachs and Warner(1995). This issue of resource endowment curse is a hot topic in literature as many studies have confirmed that countries with abundance natural resources are lagging economically to those with little to no resources, for example Russia vs Czech republic. The former is endowed with all precious mineral resources yet economically it is lagging behind the latter. Economic growth is the main variable of interest in such studies and other variables are human capital, population growth, political rights, property rights and percentage of mineral export to total exports Mahonye and Mandishara (2015), which are more of demographic variables. On the other hand, this study will be taking a different view in investigating the mining index in-line with different set of variables. Thus fill the gap existing in the body of literature.

Table 2 on the next page, shows some of the main papers used in the literature review. The following are the interpretation of the author's acronyms: IPI: Industrial Production Index, TBR: Treasury Bill Rate, SR: Short Run Relationship, LR: Long Run Relationship, DIR: Deposit Interest Rate, UR: Unemployment Rate, HC: Human Capital, PR: Property Rights, (M)JC: Multivariable Johansen's Co-integration, GC: Granger Causality, Ms: Money Supply, OP: Oil Price, NR: No relationship between Variables, MR: Mixed Results, HC: Human Capital, PS:Political Stability, BMs:Broad Money Supply, MRM: Multivariate Regression Model.

Note that some of the acronyms are defined in Chapter 1 and in Literature as well. Also, the relationship indicated in Table 2 are shown as short/long-run without specifying whether it is positive or negative or unidirectional or bidirectional as it has been explained earlier therein.

Table 2: Summary of the main results of the papers presented

Independent Variable	Author/Year	Main Variables	Methodology	Conclusions
Karachi Stock Exchange	Sohail & Zahir (2010)	CPI,ER,IPI,Ms,TBR	JC& VECM	LR
NSE-Nifty Share Price Index	Srinivasan (2011)	Ms,IR,IPI	JC, MJC	SR& LR
Pakistan Stock Index	Aamir et al. (2011)	ER, IR	JC and VECM	SR& LR
CEE Countries Stock Indices	Barbi & Jurki (2011)	IF, BMs, IR and FCR	JC	MR
Indonesia Stock Exchange	Dwijayanti et al. (2012)	IF,ER,IR	MRM	LR
Malaysian Stock Exchange	Zakaria & Shamsuddin (2012)	IR,GDP,ER,IF,Ms	RA	NR
South East Asian Stock Indices	Alam (2013)	Ms,IPI,ER,CPI,OP,IR	JC& VECM	NR
Indian Stock Market Index	Naik (2013)	IPI,IF,Ms, IR, ER	JC & VECM	NR
Portugal Stock Index	Luis M Marques et al.(2013)	GDP,ER,IR	VAR,GC,VD& IR	LR
36 African Stock Indices	Everlyne Ngarea et al. (2014)	HC,IF,PS	Panel Study	MR
Thai Stock Index	Forson and Janrattanagul (2014)	CPI, IR,IPI, Ms	JC, VECM	LR
G-20 Stock Indices	Rudra P et al.(2015)	RIR,RER,RRIR	PARM	SR& LR
Tunisian Stock Index	Sirine & Jamel (2016)	UR,Ms,IF	ADRL& VECM	LR
Dhaka Stock Index	Md. Nazmul Haque (2016)	Ms,DIR	JMC and VECM	LR
Istanbul Exchange Industry Index	Ahmet Ozcan(2012)	IR,CPI,Ms,ER,GP,OP,NX	JC	LR
Turkish Industrial Price Index	V Ulke& ERGUN (2014)	IPI	PP,JC,VCEM,GC	LR
Turkish Industrial Price Index	K Gokmenoglua et al.(2015)	IF,OP,GDP	GC,PP,JC	LR
Dhaka Consumer Price Index	Md. T Hasan et al(2016)	IPI	ECM& GC	SR& LR
Nigerian Mining Sector	Mills (2010)	Economic Growth	VECM	RCP
56 Development countries	G Mavrotas et al(2011)	EG	Panel Study	RCP
U.S Rural Mining	Steven Deller (2014)	RD	Barro-type growth	MR
Zimbabwe EG	Mahonye& Mandishara(2015)	PG,PR,HC,ME	OLS	RCP
48 Sub-Sahara Countries ECG	Natlia HLAVOV(2016)	EGM	RA	NRCP

Source: Author's Elaboration.

2.6 Conclusion

As was discussed therein, the novelty of this research is based on its choice of dependent variables and independent variables. Also, the macroeconomic environment perpetrating in which this study is been done. In most studies in the literature, the macroeconomic conditions in which the studies had been done are stable, which is different from this study. Most of African economics are in shambles and thus this study will be a panacea as a framework in studying other African economies.

3 CHAPTER THREE: DATA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter present a detailed explanation of variables, expected signs of independent variables in the models and presents the research methodology and the econometric model set-up.

3.2 Dependent Variables

Companies listed on the ZSE can be grouped into five cohorts namely, retailing, manufacturing, telecommunications, mining and finance and banking. For the sake of this thesis, let:
V_i=$\{v_1, ..., v_l\}$ a set of listed retailing companies,
W_i=$\{w_1, ..., w_m\}$ a set of listed manufacturing companies,
X_i=$\{x_1, ..., x_n\}$ a set of listed telecommunication companies,
Y_i=$\{y_1, ..., y_o\}$ a set of listed mining companies, and
Z_i=$\{z_1, ..., z_p\}$ a set of listed finance and banking companies

a) Stock Index A stock index used in this thesis was obtained by averaging the daily movement prices of all listed counters on the ZSE for the aforementioned period. The index includes counters from financial services sectors, industrial sector and mining sectors. The Stock Index is not officially computed by the ZSE authorities but it was computed by the author in excel. Thus, the stock index was computed as follows at any time t:

$$SI_t = \frac{\Sigma_{i=1}^{l} v_i + \Sigma_{i=1}^{m} w_i + \Sigma_{i=1}^{n} x_i + \Sigma_{i=1}^{o} y_i + \Sigma_{i=1}^{p} z_i}{l + m + n + o + p} \tag{3.2.1}$$

b) Industrial Index

The Industrial index tracks daily price changes in the stocks of different listed companies drawn from various sectors of the economy ranging from Agro-Industry, Conglomerates, Financial services, Insurance,

Property and Retail. This index is officially calculated by the ZSE authorities and it is issued on a daily basis as follows at any time t:

$$II_t = \frac{\Sigma_{i=1}^{l} v_i + \Sigma_{i=1}^{m} w_i + \Sigma_{i=1}^{n} x_i + \Sigma_{i=1}^{o} y_i + \Sigma_{i=1}^{p} z_i}{l + n + m + p} \tag{3.2.2}$$

c) Mining Index

The Mining index tracks stock price movements of 4 listed companies involved in the mining industry. The indices performed well upon inception in 2009 with the Mining index reaching an annual high of 300.00 points. This statistics is calculated by the ZSE officials as follows at any time t:

$$MI_t = \frac{\Sigma_{i=1}^{o} y_i}{o} \tag{3.2.3}$$

3.3 Independent Variables

a) Inflation Rate

Inflation is the rate at which the general level of prices for goods and services is rising and, consequently, the purchasing power of currency is falling[6].

An increase in inflation will lead to the increase of nominal interest rates.Thus the discount rate used in determining the intrinsic values of stocks will increase as well, henceforth reducing the net present value of net cash flows leading to lower stock prices. As an illustration, suppose the price elasticity of demand of a listed firm's products is high, an increase in inflation will definitely cause a decline in a firm's sales, consequently the net income, and finally its stock price. This negative relationship of stock and inflation was initially hypothesized by Fama (1981) as a function of the relationship between unexpected inflation and real activity in the economy. Therefore inflation is expected to be negatively associated to stock index. Moreover, in some research conducted, CPI was taken as a proxy for inflation, and for that matter, CPI is also one of the depended variable.

[6]http://www.investopedia.com/terms/i/inflation.asp

b) Interest Rate

It is the annualized cost of credit or debt-capital computed as the percentage ratio of interest to the principal[7]. For this thesis, the weighted lending rate is going to be used since it is regarded as the official interest rate used in Zimbabwe. It is the sum of minimum nominal lending rates weighted by individual bank's loan book sizes and published by the Reserve Bank of Zimbabwe. The Reserve Bank of Zimbabwe does not have an official discount rate, thus the weighted lending rate is used.

The relationship between the interest rate and stock index is well documented in the literature. If interest rates goes up, this will results in the falling of stock prices since high interest rates have a tendency of upsurge the opportunity cost of holding money, through substitution effect of stocks for interest bearing securities. Interests rates are regarded as an indicator of how the financial sector risk is, in an economy. They are an important macroeconomic variables since they are directly related to economic growth. In borrower view, it is the cost of borrowing and in the lenders sight, it is the reward for lending. The interest rate is expected to be negatively associated to stock index under normal circumstances.

c) Exchange Rate

Another macroeconomic variable used in this study is the exchange rate which in this case is the bilateral nominal rate of exchange of the US dollar (USD) against one unit of a foreign currency, in particular the South African Rand (ZAR). The reason being that South Africa is the Zimbabwean main trading partner. In 2015, Zimbabwe exported $2.72 Billion and imported $5.87 Billion, of the total exports, 37% went into the South African Market and almost 68% of the imports were coming from the same destination[8]. In most cases, the volatility of exchange rates affect the trade balance of a country by either making a country an expensive nation or otherwise. In the case of a depreciation, stock prices will decline due to inflation expectations. Indeed, importer industries will experience higher costs owing to the slumping of the local currency which will eventually yield lower earnings and or scaling down

[7]http://www.businessdictionary.com/definition/interest-rate.html
[8]http://atlas.media.mit.edu/en/profile/country/zwe/

of business operations, and drive the share prices down. In turn, since the stock exchange is a set of different companies in various sectors, the market tends to react negatively to the currency depreciation. On the other side of the coin, exporting companies benefit from currency depreciation because because domestic goods and services will be cheaper to foreign customers. Thus, the impact of exchange rates is a two sided coin whose overall impact is depended upon the size of import and export depended companies. In other words, effect of exchange rate on stock index is two sided, it can be either a positive or a negative relationship. Holding all other things constant, in this thesis the relationship the exchange rates and depended variables was expected to be negatively related due to the appreciation of the USD against the ZAR since the first quarter of 2009.

d) Consumer Price Index

It is a measure of changes in the purchasing-power of a currency and the rate of inflation. It relates the prevailing prices of a basket of goods and services in different time periods, and indicates the effect of inflation/deflation on the purchasing power of selected bundle of goods[7]. In this manner, the rising of goods and services will lead the CPI to raise as well and otherwise is also valid. Since the CPI covers prices of both goods and services its rising will mean a rise in stock index since share prices will be rising as well. The relationship of the CPI and all depended variables is expected to be negative because of the current deflationary periods that has been experienced in Zimbabwe.

3.4 Data

The data used in the thesis was obtained from the Zimbabwe Stock Exchange (ZSE) and The Reserve Bank of Zimbabwe (RBZ). Data of Industrial Index, stock Index and Mining Index are from the ZSE and others are obtained from the RBZ. The data constitutes 96 monthly observations from 2009 to 2016 inclusive.

3.5 Econometric Tests and Model Set-Up

This section intends to explain the tests and econometric model set-up to be done in this thesis. Preliminary Time Series trend analyses shall be per-

formed using the Cox Stuart to determine the nature of the trend of the data. Other Time Series Tests as, Unit Root Test, Serial Correlation Tests, Hetroscedacity Tests, Normality Tests and Granger Causality Tests shall also be performed prior and after the model/set up. Some Tests are required to be performed before the analysis and others after the analysis.

3.5.1 The Cox Stuart Test

Consider a Time Series of a sequence of random independent observations 'n' given as follows: X_1, X_2, X_3,..., X_n, arranged in a particular order, such as the order in which the random variables are observed. If we want to test whether a trend exist or not, we group the observations in pairs as follows: (X_1, X_{1+m}); (X_2, X_{2+m}); (X_3, X_{3+m}); ....; (X_{m-1}, X_{n-1}); (X_{n-m}, X_n), where,

$$m = \begin{cases} \dfrac{(n+1)}{2} & \text{where n is old, and} \\ \dfrac{n}{2} & \text{where n is even.} \end{cases}$$

Note that if "n" is an odd number, we will eliminate the middle random variable using the the above formula to locate the number. A trend had 3 states, such that, upward or downward trend and no trend. If for any pair of random observations from the set, such that, (X_j, X_{j+m}), exhibit a upward trend, then, $X_{j+m} > X_j = 0$, we replace the pair with a " + " sign, otherwise with a " − " sign. In the former situation the trend is said to be a monotonic increasing sequence (hence upward trend) otherwise monotonic decreasing sequence (downward trend). If however, $(X_j = X_{j+m})$, such that $X_{j+m} - X_j = 0$, then there will be no a trend.

The test statistics of the Cox Stuart is given by:

T = Total number of "+", and that $T \sim$Bin$(n, \frac{1}{2})$, the hypotheses are given by:

H_0: There is no Trend present,

H_1: There is a Trend present,

Note that the upper-tailed test is used to detect a monotonic increasing trend (upward trend) and lower-tailed test is used to detect a monotonic decreasing trend (downward trend). A two-tailed test is used when the direction of the trend is not specified.

The main reason of the choice of this non-parametric test is that its assumptions are not rigid to fulfil on any data set and they are[9]

1. The random variables $X_1, X_2, \ldots, X_n$ are mutually independent,

2. The measurement scale of $X_{j's}$ is at least ordinal,

3. Either the $X_{j's}$ are identically distributed or there is a trend, and

4. The later random variables are more likely to be greater than instead of less than the earlier random variables or vice versa.

3.5.2 Unit Root Test

Before running the model on Time Series data, it is important to check the stationary of the data by the unit root test. If the data is not stationary, in most cases there is a problem of Spurious regression between unrelated variables. For example, in summer, the sales of ice-creams will rise and also the number of children's drowning in swimming pools will rise, if one regress the two incident the model will produce high significant results but in actual fact the variables are not related. Thus we will obtain high R^2 and inflated t-tests due to the correlation between trends (V Adamec, 2014, pg 68-69). Therefore it is important to determine the stationarity of data before working with the data. If the data is not stationary, then the concept of difference will be applied. In this thesis, the extension of the Augmented Dickey-Fuller

[9]http://msu.edu/-songweix/consulting-summ/signtest.pdf

(ADF) test shall be used. Augmented Dickey -Fuller (ADF) is an extension of Dickey -Fuller test and differs from the latter due to the fact that the latter assumes uncorrelated error terms which is unrealistic when dealing with economic data.

Suppose Y_t has a trend, the model with a constant and a trend is going to be considered in this work in unit root testing. With a model wit a trend and a constant, changes of the depended variable is regressed with an independent variables including a trend variable, β_{2t}, lagged level, γY_{t-1} and sum of lagged variables, $\alpha_i \Sigma \Delta Y_{t-1}$, as shown below:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \gamma Y_{t-1} + \alpha_i \Sigma \Delta Y_{t-1} + \varepsilon_t$$

The null and alternative hypotheses are as follows:

H_0: $\phi = 1$ [Unit root-Variable is not stationary]

H_1: $\phi < 1$ [No unit root-Variable is stationary]

We accept the H_0 that is if the coefficient is one and this concludes that the variable is not stationary, otherwise we accept the H_1 that the variables are stationary and continue in carrying out performing the model. If we accept the H_0, it means that after the first difference the hypothesis will be:

H_0: $\phi = \mathrm{I}(2)$ [Unit root-Variable is not stationary at first difference]

H_1: $\phi < \mathrm{I}(1)$ [No unit root-Variable is stationary at first difference]

Thus, the H_0 of unit roots of 2 is rejected when the test-statistic is less than α (0.1, 0.05 and 0.01) at the 1%, 5% and 10% significant level. Nonetheless, the H_0 of unit roots of 2 will not be rejected. The rationale is: smaller the test-statistic, the higher the opportunity that the H_0 of unit root of 2 will be rejected. However, it is recomended that the first difference is well appropriate since by over differencing the series the quality of data is lost.

3.5.3 Serial Correlation Test

Breusch-Godfrey Serial Correlation LM Test shall be use to test the presence of serial correlation because it is a flexible test, covering autocorrelation of higher orders and applicable whether or not the regressors include lags of the dependent variable. Since there will be lagged depended variable on the right hand side of the model, the parameters of the model will be inflated in such a way that the concept of best linear unbiased estimates (BLUE) is jeopardized, due to high t-ratios. As an illustration of the test using a two variable regression model, even though many variables and lagged values of the depended variables can be added (Gujarati, 2004). Consider the model below:

$$Y_t = \beta_1 + \beta_2 X_t + \mu_t,$$

and suppose the error term μ_t have a p^{th}-order autoregressive, $AR(p)$, as follows,

$$\mu_t = \rho_1 \mu_{t-1} + \rho_2 \mu_{t-2} + \ldots + \rho_p \mu_{t-p} + \varepsilon_t,$$

where ε_t, is an error term following a white noise distribution, such that $\varepsilon_t \sim N_{iid}(0, \sigma_t^2)$ and $cov(\varepsilon_i \varepsilon_j) = 0, i \neq j$, (Gaussian white noise distribution), the the H_0 and H_1 tested will be:

$$H_0 = \rho_1 = \rho_2 = \ldots = \rho_p = 0$$

$$H_1 = \rho_1 = \rho_2 = \ldots = \rho_p \neq 0,$$

for at least one i, such that, $i \in [1, p]$. In very large samples, technically infinite sample sizes, the BG have been proven to approximate a χ^2 with p degrees of freedom which are the number of order of an AR model, such that:

$$(n - p)R^2 \sim \chi_p^2.$$

Also note that this test is based on the Lagrange Multipliers, a principle involving formulating equations and solve them using the concept of partial derivatives.

3.5.4 Hetroscedacity Test

Homoscedacity is the concept variance in the OLS modelling. The opposite of it is the hetroscedacity, which means time depended variance. This problem

is common in time series data as it involves a sequence of observations over time. Thus the issue of variance of the series being constant may be violated and have a time depended variance instead of a time invariant variance. The main problem with hetroskedacity is that it increases the variance of parameters, hence the concept of minimum variance will be at overridden, inflating $t - tests$ and increases the probability of making 'Type 1 Error'. Hence, inferential analysis from such a model will be unworthy. In this work, the Breusch-Pagan test shall be used. This test was formally known as the Y-proportionality factor. The test has two test statistics that yields the same results, namely the LM-χ^2 statistics and the F-test statistics given below:

$$LM = nR^2 \sim \chi^2(k),$$

and,

$$F = \frac{R^2_{e^2}/k}{(1 - R^2_{e^2})/(n - k - 1)} \sim F(k; n - k - 1).$$

respectively. In all cases, R^2, n, k and e^2 represent: the coefficient of determination, sample size, number of degrees of freedom and finally squared auxiliary model of residuals (resp) given by:

$$e_i^2 = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \ldots + \alpha k X_{ki} + \mu_i$$

The hypothesis of the tests are given by:

$$H_0 : \varepsilon_t = \sigma_k^2$$

[Homoskedastic of error terms]

$$H_1 : \varepsilon_t = \sigma_t^2$$

[Hetroskedastic of error terms]

3.5.5 Normality Test

The data should be tested for normality of residuals. In this thesis, the Jarque-Bera (JB) test shall be used. The rationality of the JB is that it test the skewness and kurtosis of the distribution simultaneously. This test is a non-parametric test hence it is flexible and does not comes with rigid assumptions behind it and it is designed to test normality in time series

innovation. If the data is normal, then the following holds, coefficient of skewness $k_3 = 0$ and coefficient of kurtosis $k_4 = 0$, after correction for 3. The test statistics of the JB test is given by:

$$JB{=}k_3^2{+}k_4^2{=}\frac{T}{6}\left(\frac{\hat{\mu}_3}{\hat{\mu}_2^{3/2}}\right)^2+\frac{T}{24}\left(\frac{\hat{\mu}_4}{\hat{\mu}_2}-3\right)^2\sim\chi_2^2,$$

note that the distribution has 2 degrees of freedom and $\hat{\mu_3}$ and $\hat{\mu_4}$ are are the estimates of third and fourth central moments. The hypothesis associated with this tests are:
H_0 : Residuals are normally distributed, and H_1 : Residuals are not normally distributed.

3.5.6 Cointegration Test

According to the Engle and Granger (1987), co-integration is defined abstractly as follows:
Suppose a set of $I(1)$ variables $(x_{1t}, x_{2t} \ldots, x_{kt})$, then if $\exists$ a linear combination of all vars with $\vec{\beta}$, such that, $\beta_1 x_{1t} + \ldots + \beta_k x_{kt} = \vec{\beta'}\vec{x_t}$.... trend stationary, and $\beta_j \neq 0$, $\forall\ j \in [1, k]$. The the $x's$ are said to be co-integrated of order $CI(1, 1)$, if and only if:

1. $\vec{\beta'}\vec{x_t}$ is a trend stationary variable,

2. $|\beta| \in [1, k]$, such that defined to some scale, and then if $\beta' x_t$ is trend stationary, and also $c(\beta'\vec{x_t})$ with $c \neq 0$, implying that the linear combination of co-integrating relationship is stationary,

3. Generally $\vec{x} \sim I(d)$ and $\beta'\vec{x} \sim I(d - b)$ with $b > 0$. Hence the $x's$ are $CI(d, b)$, and lastly

4. The definition is symmetric in the vars, such that there is no interpretation of endogenous or exogenous vars- a simultaneous relationship is described.

From the definition above, a vector component of $\vec{\beta'}\vec{x_t}$ is said to exhibit a trend stationarity that is if after subtracting a deterministic component of the trend, the process will be automatically $I(0)$.

After determining the appropriate lag length, based of the lag number that fulfil a number of information criteria such as the AIC, BIC or HIC, cointegration technique is applied to determine whether the time series exhibit a stationarity process of a common shared trend. The methods of Engle and Granger are applicable for testing the cointegration of a single equation term structure. It is the method of Johansen that extended the mono-equation cointegration technique into a system of equation cointegration analysis. Albeit, the Engle and Grangers dual error correction model that is applicable in multivariate context, the Johansen procedure is built upon the VECM in testing for the existence of at least a long run relationship among variables. To be more precisely, the VECM is borne to be a full representation of the information likelihood which allows the analysis of the cointegration of the whole system in a single step and does not required rigid normality assumptions of variables before it can be used. Thus gives a more efficient estimators of cointegrating vectors than would be the case in when using the Engle and Granger's methodological framework Maysami and Koh (2000). Furthermore, the Johansen method doesn't require a priori (distribution nature) assumptions of endogenity or exogenity of variables. Henceforth, the applicability of the Johansen multivariate model in cointegration analysis is justifiable in this thesis, and it is based on the following model framework:

$$\Delta X_t = \mu + \Phi D_t + \Pi X_{t-p} + \Gamma_{p-1}\Delta X_{t-p+1} + \ldots + \Gamma_1 \Delta X_{t-1} + \varepsilon_t,$$

$\forall t \in [1, T]$, where

$$\Gamma_t = \Pi_1 + \ldots + \Pi i$$

$\forall i \in [1, p-1]$, and

$$\Pi = \Pi_1 + \ldots + \Pi_p - 1$$

is an identity matrix. Note that the ΔX_t represent the $I(1)$ series, the matrix Γ_i constitutes the short run adjustment parameters, and Π is a matrix of long term equilibrium relationship information among variables. Furthermore, Γ can be expressed as a product of two $n \times r$ matrices, such that $\alpha_{(n\times r)}$ and $\beta_{(n\times r)}$, henceforth Π=$\alpha_{n\times r}$ $\beta'_{(n\times r)}$, The matrix $\beta'_{(n\times r)}$ will be of r cointegration vectors, whereas that of $\alpha_{(n\times r)}$ represents the speed of adjustment to equilibrium of parameters. The magnitude of impact of matrix $\Pi_{(n\times r)}$

will be determined as the coefficient of the lagged levels of a non-linear least squares regression of ΔX_t on lagged differences and levels. As according to Johansen (1998), the optimisation (minimax) of parameters $\Gamma_1, \Gamma_2, \ldots, \Gamma_{k-1}$ eventually converges to an OLS regression of the form $\Delta X_t + \alpha_{(n\times r)}\beta'_{(n\times r)}X_{t-k}$ on lagged differences. The work of Gan et al (2006) is at even with Johansen.

There are two main tests used to test the cointegration of variables, namely the Trace Test and the Maximum Eigenvalue Test. The criteria behind these methods differs stating from the hypotheses. The maximum eigenvalue test is more centred on looking at the model with the most eigenvalue and the same will be carried out for further analysis. On the other hand the trace statistics methods indicates the number of cointegrated models and non when run (Helmut Ltkepohl, 2001). The hypothesis of the tests are as follows:

$$\begin{aligned} H_0 &: rank(\Pi) = 0 \\ H_1 &: rank(\Pi) = 1, \end{aligned}$$

$$\begin{aligned} H_0 &: rank(\Pi) = \tau_0 \\ H_1 &: \tau_0 < rank(\Pi) \leq n, \end{aligned}$$

the first hypothesis correspond to the maximum eignvalue test and the later to the trace test. The the latter H_1, n represents the maximum number of possible cointegrating vectors. In this thesis, my cointegration analysis shall be based on the trace test owing to its nature of showing the number of cointegrating equations. Moreover, its test statistic's is based on the asymptotic distribution of the trace of a matrix, based on functions of a standard Wiener processes (Johansen Econometrica 1995, p. 1555). It uses the Likelihood ratio (LR) statistics similar to that of the maximum eigenvalue method and it is given by:

$$LR(\tau_0, n) = -T \sum_{i=\tau_0+1}^{n} ln(1 - \lambda_i),$$

where T is the trace of a matrix, λ_i the i^{th} eigenvalue and n is as before.

3.5.7 Granger Causality Tests

After determining the relationship between the capital markets indices and the macroeconomics variables, the succeeding objective of this study is to determine whether the macroeconomic variables used in this study are valuable in predicting future movement of the defined capital markets indices of the ZSE. This is done by the Granger causality, Granger causality is a test used to determine whether one time series can forecast another. In a more strictly sense, the method helps to quantifying the useful information in one series in prediction the other, by incorporating past values of the variable. Apparently, on a two variable model set-up, X_t and Y_t, if incorporating past values of X_t improves the prediction of the current value of Y_t, thenX_t Granger causes Y_t. Therefore, precedence is used to identify the direction of causality from information in the data.

Since the VAR system is a linear prediction that predicts current values based on the the linear function of present and past influential variables, meaning present values are estimated based on their own past values and the values of other influential variables, Roebroek et al. (2005). The concept is useful in this thesis since capital markets indices and macroeconomics variables are believed to have properties of some memoryless distribution, such that the past and the present information of the time series has a significant influence on the future movements of the series.

As for an illustration on how the Granger Causality test is used to test the lead-lag relationship between variables X_t and Y_t, such that, does

$$X_t \longrightarrow Y_t \ldots (1)$$

or

$$Y_t \longrightarrow X_t \ldots (2)$$

or

$$X_t \Longleftrightarrow Y_t \ldots (3)$$

1 and 2 are uni-directional movements and 3 is a bilateral movement. The relationship can be "loosely" termed an equivalence relationship of the variables. In a model framework set-up, it would be as shown below:

$$\Delta X_t = \alpha_x + \sum_{i=1}^{k} \beta_{x,i} \Delta X_{t-i} + \sum_{i=1}^{k} \omega_{x,i} \Delta Y_{t-i} + \varphi_x ECT_{x,t-i} + \epsilon_{x,t} \ldots (4)$$

and

$$\Delta Y_t = \alpha_y + \sum_{i=1}^{k} \beta_{y,i} \Delta X_{t-i} + \sum_{i=1}^{k} \omega_{y,i} \Delta Y_{t-i} + \varphi_y ECT_{y,t-i} + \epsilon_{y,t} \ldots (5)$$

Equation 4, is in line with the unidimensional relation $Y_t \rightarrow X_t$ (Y Granger causes X), and Equation 5, the reverse of the precedence. Like before, ΔX_t and ΔY_t are $I(1)$'s of the time series variable and φ_x / φ_y are parameters of the ECT term, that measuring the error correction mechanism that drives X_t and Y_t back to their long run relationship. The hypothesis of equations 4 & 5 will be $H_0 : \sum_{i=1}^{k} \omega_{x,i} = 0$ and $H_0 : \sum_{i=1}^{k} \omega_{y,i} = 0$ against $H_1 : \sum_{i=1}^{k} \omega_{x,i} \neq 0$ and $H_1 : \sum_{i=1}^{k} \omega_{y,i} \neq 0$ respectively. The H_0 of equation 4, literally means the lagged therms ΔY do not belong to the model (the same with equation 5, but on a reverse notion). If H_0 is rejected in the first equation 4, and not in equation 5, then the conclusion will be $Y_t \longrightarrow X_t$, the reverse holds (unidirectional relationship). Also, if we do not reject H_0 if all equations, then it means there is causal independence of variables. Finally, if H_0 is rejected in all equations then there will be a feedback system ($X_t \Longleftrightarrow Y_t$, bilateral causal relationship). We use the F-test for this test.

3.6 Econometric Model-Structure

This thesis shall use the methodology of Abduh & Omar (2012). In their paper in investigate the short run and long run relationship between stock market and economic growth, they applied the ARDL citing the the fact that it is more suitable to small sample space. Like a miraculous coincidence, their sample space had 96 observations just like this study. The ARDL models consist of an autoregressive part and a regression with distributed lags over a set of other variables. The ARDL model regresses a variable over its own past plus the present and past values of a number of exogenous variables (Abduh

& Omar, 2012). Further, the fact that the ARDL works with different levels of cointegration makes it more suitable in modelling economic data since it is rarely to have $I(0)$ economic data. Thus the initial model set-up to be tested are as follows:

$$SI_t = \beta_0 + \beta_{11}CPI_t + \beta_{12}IR_t + \beta_{13}ER_t + \beta_{14}IF_t + \lambda_t \ldots (6)$$

$$II_t = \gamma_0 + \beta_{21}CPI_t + \beta_{22}IR_t + \beta_{23}ER_t + \beta_{24}IF_t + \mu_t \ldots (7)$$

$$MI_t = \delta_0 + \beta_{31}CPI_t + \beta_{32}IR_t + \beta_{33}ER_t + \beta_{34}IF_t + \nu_t \ldots (8)$$

Where SI_t is the stock index, II_t is the industrial index, MI_t is the mining index, CPI_t is the consumer price index, IR_t is the interest rate, IF_t is the inflation rate, ER_t is the exchange rate and λ_t, μ_t and ν_t are error terms. Pesaran, Shin, & Smith, 2001 suggested that a bound testing method with an equation of any long-run relationship may be given by the following equations,

(Equation 9 for Stock Index)

$$\Delta SI_t = \alpha_0 + \sum_{j=0}^{p} \beta_j \Delta CPI_{t-j} + \sum_{j=0}^{p} \gamma_j \Delta IR_{t-j} + \sum_{j=0}^{p} \delta_j \Delta ER_{t-j} + \sum_{j=0}^{p} \phi_j \Delta IF_{t-j} + \alpha_1 CPI_{t-1} + \alpha_2 IR_{t-1} + \alpha_3 ER_{t-1} + \alpha_4 IF_{t-1} + \mu_t \ldots (9)$$

(Equation 10 for Industrial Index)

$$\Delta II_t = \alpha_0 + \sum_{j=0}^{p} \beta_j \Delta CPI_{t-j} + \sum_{j=0}^{p} \gamma_j \Delta IR_{t-j} + \sum_{j=0}^{p} \delta_j \Delta ER_{t-j} + \sum_{j=0}^{p} \phi_j \Delta IF_{t-j} + \alpha_1 CPI_{t-1} + \alpha_2 IR_{t-1} + \alpha_3 ER_{t-1} + \alpha_4 IF_{t-1} + \mu_t \ldots (10)$$

(Equation 11 for Mining Index)

$$\Delta MI_t = \alpha_0 + \sum_{j=0}^{p} \beta_j \Delta CPI_{t-j} + \sum_{j=0}^{p} \gamma_j \Delta IR_{t-j} + \sum_{j=0}^{p} \delta_j \Delta ER_{t-j} + \sum_{j=0}^{p} \phi_j \Delta IF_{t-j} + \alpha_1 CPI_{t-1} + \alpha_2 IR_{t-1} + \alpha_3 ER_{t-1} + \alpha_4 IF_{t-1} + \mu_t \ldots (11)$$

Note that p is the appropriate lag length and Δ if the $I(1)$ of variables. After that, depth analysis will be carried out using the impulse response functions as was mentioned earlier in Chapter 1, the Cholesky one standard deviations shall be used as it traces the ripple effect one time shock injection on the current and future values of the endogenous variables.

3.7 Conclusions

At this juncture the stationarity of the data has not yet been performed, thus the methodology approach toggles between the ARDL and or the VECM. If the data happens to be a combination of $I(0)'$s and $I(1)'$s the ARDL model will be used. If it so happen, this thesis shall follow the methodology of Abduh & Omar (2012) and Muhamad Abduh et al. (2015) of estimating the ARDL and the ECM. However, if the data is found to be all $I(1)'s$, the VECM model shall be performed following the methodological aspect of Md. Nazmul Haque (2016). A very unlikely situation is the use of the OLS, a situation that will happen if all the data are stationary at level, such that $I(0)'$s.

4 CHAPTER FOUR: ANALYSIS OF RESULTS

4.1 Introduction

The roadmap of this chapter shall be as follows: The initial step shall be the descriptive of the data, trend analysis and some important measures of central tendency will be taken into account. Follow up will be depth analysis of the data using advanced econometrics models. In this part all the model assumptions and the analysis of parameter stability and their significance shall be tested. A number of tests shall be conducted here. Finally, model stability, forecasting power and its precision shall be analysed thereof.

4.2 Descriptive Analysis

This section present preliminary analysis of the data. The most of the measures of central tendency are being taking into account.

4.2.1 Summary Statistics

Table 3, below shows the summary statistics of the data:

Table 3: The table showing the Summary Statistics of Variables

Variable	Min	Max	Q_1	Q_2	Q_3	Mean	Std
SI	16.25	53.24	30.96	34.72	43.27	36.49	8.53
MI	19.25	279.03	43.72	84.22	154.78	102.34	70.28
II	89.97	222.53	132.28	147.97	165.28	149.62	31.39
CPI	89.40	101.20	93.97	97.00	99.75	96.43	3.80
EX	6.552	15.832	7.587	9.304	11.493	9.893	2.66
IF	-4.5000	5.3000	-1.6525	0.2500	3.1250	0.5065	2.72
IR	9.475	16.040	9.475	12.035	14.182	11.55	2.99

Note that, Q_1, Q_2 and Q_3 represents the lower, middle (median) and upper quartile of the data set. Q_1 and Q_3 represent the length of the Box Plot of the data set, their difference implies the Interquartile Range (IQR), a useful statistics which shows how the data is distributed along its outliers. The

greater the difference in most cases the larger the variation of the data, as shown by the MI series. Also, the position of Q_2 in relation to Q_1 and Q_2 gives a rough picture of the skewness of the data without any tests conducted.

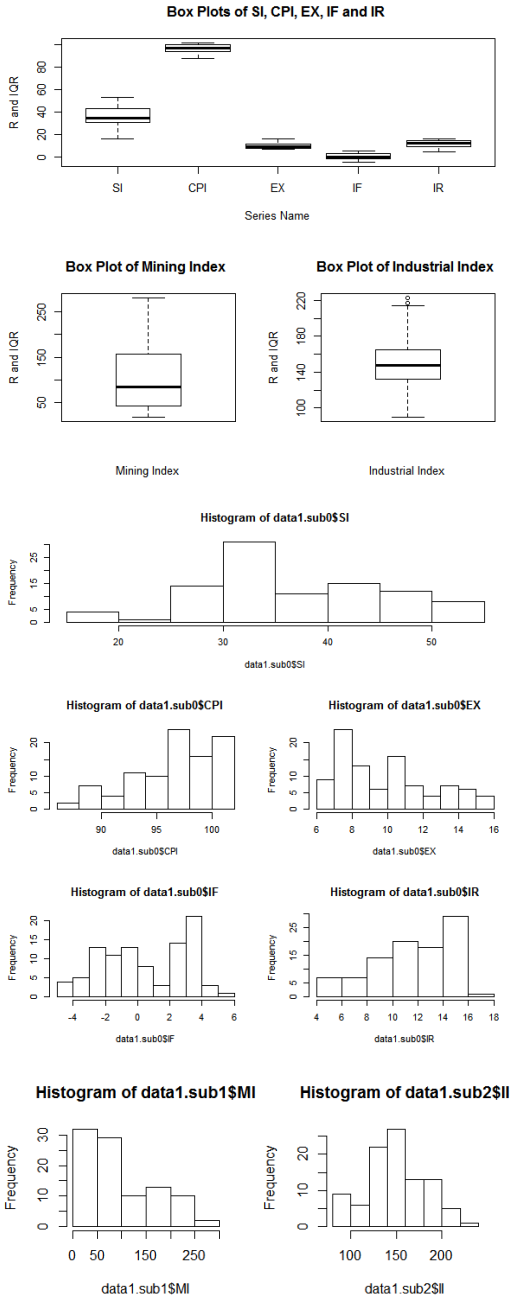
Of notable interest is the MI series, there is a greater disparity in the data set which is being exhibited by a large standard deviation figure of 70.28. A standard deviation is a statistics that measures the deviation of the data set from the mean. A large standard deviation implies that the data deviate greatly from its focal point which is the mean. In financial time series, a series with a greater standard deviation is considered to be more volatile. In comparison, to the EX series, the range, IQR and the standard deviation of the series are very small, implying that the series is less volatile than the MI. These variation can be easily displayed by means of histograms and boxplots as shown in the following figure 4 and table 4 below:

Table 4: The table showing the Range and IQR of Variables

Variable	Range	IQR
SI	36.99	12.31
MI	259.78	106.06
II	132.56	6.33
CPI	11.8	5.78
EX	9.28	3.906
IF	9.8	4.75
IR	6.5655	4.707

From Fig 4, it is easily noticed the the Range and IQR of all independent variables are very small, implying that the data is clustered over a small range an indication of less variability as mentioned earlier above. The results from the Table 4 confirms the results. However as of the independent variables there is an indication of a greater disparity in the data set, implying the series volatilities are more than that of the independent variables. The least IQR of 3.906 is been exhibited in the EX in independent variables and in II in dependent variables which is 6.33. From Fig 4, the histograms shows also how the data is spread which bear the same explanation as depicted above. Like what has been said, the skewness of the data can easily be read from a histogram, for example, looking on the MI and IR one can conclude

Figure 4: Histograms and Box Plots of the variables



that the former is positively skewed and the latter negatively skewed. Using the same notion, one can also conclude that the II is approximately the bell shaped Gaussian distribution.

4.2.2 Variance-Covariance relationship of variables

The analysis goes on to investigate the variance-covariance matrix of the variables with special attention to the covariances of variables as they indicate the co-movements of the variables with time. In multivariate portfolio construction and management, the understanding of how the assets in a portfolio co-movement is very important. In Econometrics Science it is important in the sense that one can detect the presence of multicollinearity of independent variables which can be shown by a high positive value between two variables. It is also important to note that the variance-covariance matrix of variables is symmetric along the main diagonal in table 6 represented by bold numbers. These numbers represents the variances of variables and the off diagonal elements represents the covariance between two variables, for example, the $Cor(SI, EX) = 10.91$ and the $var(SI) = 72.84$.

Table 5: The table showing the variance-covariance of the variables

	SI	CPI	EX	IF	IR	MI	II
SI	**72.84**						
CPI	17.20	**14.41**					
EX	10.91	3.77	**7.08**				
IF	-6.84	2.71	-4.03	**7.38**			
IR	12.44	10.55	1.99	2.68	**8.87**		
MI	...	**-200.28**	**-148.78**	29.34	**-136.75**	**4939.37**	...
II	...	57.10	-20.65	14.93	47.13	...	**985.22**

From table 6, it can be noted that there is a high co-movement between the MI and the macroeconomic variables. Also an interesting aspect is that the co-movement is in a negative direction, implying that if one is raising the other one will be going down. Taking for example the covariance between MI and EX ($Cov(MI, EX) = Cov(EX, MI) = -148.78$) which is high and the economic implication for this is that, if the ER goes up, the performance of the MI goes down. As mentioned earlier that South Africa is the main

trading partner of Zimbabwe so the appreciation of the USD made Zimbabwe an expensive nation on its export market, thus affecting the export industry of which Mining is one of them, thus this lead to the under performing of the MI.

From this variance covariance matrix one can deduce the strength of the variables under consideration. The matrix above is not bounded but it can be bounded by standardizing it to get the correlation coefficient matrix $\mathbf{R^2}$ which will be bounded between $-1 \cap +1$, such that, $\mid \mathbf{R^2} \mid \leq \mathbf{1}$. Henceforth to find the correlation between the EX and MI we can divide the $cov(EX, MI)$ by the product of the standard deviations of the two variables as shown below:

$$R^2_{\mathbf{(ex,mi)}} = \frac{cov(EX, MI)}{\sqrt{var(EX)var(MI)}} = \frac{-148.78}{\sqrt{(4939.37)(7.08)}} = -0.7955,$$

which is a very high negative correlation between the variables. There is also a notable high negative correlation between the CPI and the MI of -0.75, these trends are not directly related (spurious correlation). The possible explanation for this could be that, since the dollar had been appreciating against the ZAR, imports in the goods markets were cheap since they were bought at a cheaper prices from South Africa and the prices go down which however upsurge the CPI yet the MI was going down. The rationality behind this is, suppose retailer 'X' in Zimbabwe was importing goods at an exchange rate of $\$1USD : 8.5ZAR$, if the USD appreciated against the ZAR to $\$1USD : 13ZAR$, this will mean that the retailer is initial endowment will change as he enters the market and have more goods on the same amount of money he has, normally this will drive down the prices in Zimbabwean goods market as retailers would want to maximize on the volumes of sales. Maybe this may be used to explain why Zimbabwean Economy has been experiencing continuously deflationary periods.

Furthermore most of the consumer basket goods that constitute the CPI are importated from SA, yet the mining Industry is an export one. This therefore explain why these series tend to be going in different direction under the aforementioned economic conditions that were hovering in Zimbabwe in the selected period.

Other correlations between variables variables were in the following intervals $0 < \mathbf{R^2} < \mathbf{0.5}$ and others were in the interval $-4 < \mathbf{R^2} < \mathbf{0}$ which is a good feature for analysis. Note also in table 6, spaces with '...' indicates the correlation between dependent variables. Since this is not part of the analysis of this work, I decided to ignore them. However the interacting effects of dependent variable is good to analyse as it foster a good picture of how dependent variables are related especially in multivariate analysis.

4.3 Preliminary Trend Test: The Cox Stuart Test

Although the Cox-Stuart test is a least powerful test with a testing power of 0.78 (WOODWARD, WA, 2012), it is regarded as a very robust test in trend analysis. Thus being applicable in a number of situations. R does not have a function to perform the Cox-Stuart test. Thus, I followed the following algorithm to carry out the test in **RStudio**.

Trend.Analysis.test =function (x) method = Cox-Stuart test for trend analysis
leng = length(X)
apross = round(leng) if (apross == 1)
delete = (length(X)+1)/2 (*if length is and odd number delete the element*)
$X = x_i$[-delete](*delete the* $x_i's$ *is element*)
half = length(x)/2
$xHalf1 = X$[1:half] (*first element to the middle element of the data array*)
$xHalf2 = X$[(half+1):(length(X))]
difference = $xHalf1 - xHalf2$ (*note* $xHalf1$ *and* $xHalf2$ *are partitions of* X)
signs = sign(difference)
signs = signs[signs ! =0] (*the number of signs different from zero*)
pos = signs[signs>0]
neg = signs[signs<0]
if (length(pos) < length(neg)) (*number of positive and number of negatives*)

prop = pbinom(length(pos), length(signcorr), 0.5)
names(prop) = "Increasing trend, p-value"
else

prop = pbinom(length(neg), length(signcorr), 0.5)

names(prop) = "Decreasing trend, p-value"

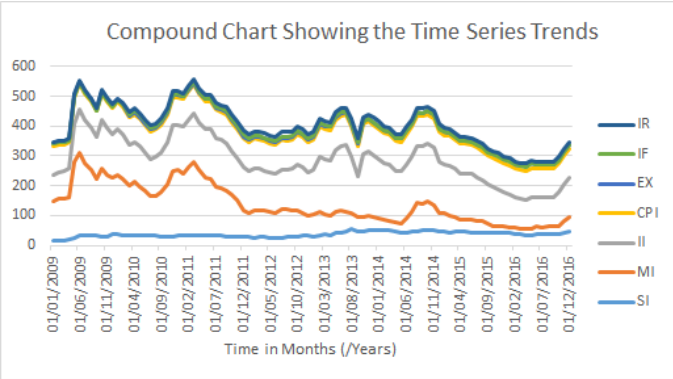
What the above code do is, initially a vector of the data set is being dened, and if the length of this vector is odd, we locate the middle value and discard it, however we continue to the next stage. After that, the vector of the data set is partitioned into two, one from the first element to the middle value in this case lets say, 'm', and the other one will start from $(m+1)$ to the length of the vector. Then we will subtract the last partition from the first, then the output will be a sequence of $1's$ with either a negative or a positive. Then, the number of the positive and negatives will be counted, we then take the smaller number from the results and calculate the test statistics using the binomial distribution, with the smaller of the negatives or positives being the variable. The sum of the negatives and positives will be the sample space and the probability of success is 0.5. If we take the number of positives as our realisation value, then we will be testing for a decreasing trend, otherwise the up-ward trend. The results of the tests are shown in the table 6 below:

Table 6: The Cox Stuart Test Results

Trend	'-ves'	'+ves'	Test Statistics	Decision	Conclusion
SI	0	48	$3.55e^2$	Accept H_0	Upward Trend
CPI	13	35	0.0010	Accept H_0	Upward Trend
EX	3	45	$6.57e^2$	Accept H_0	Upward Trend
IF	17	31	0.0297	Accept H_0	Downward Trend
IR	34	14	0.0028	Accept H_0	Upward Trend
MI	48	0	$3.55e^2$	Accept H_0	Downward Trend
II	48	0	$3.55e^2$	Accept H_0	Downward Trend

It is important to note that the hypothesis are interchanged from the ones that were mentioned in the methodology section. This is because I reversed the difference between the partitioned vectors. Thus the results above are in line with the following hypotheses, H_0 : 'There is a Trend' vs H_1 : 'No Trend'. From Table 6, a strictly upward trend was exhibited in SI, CPI, EX and IR as the tests statistics were lower that the conventional $pvalue = 0.05$. However a strictly negative trend was exhibited in other variables as shown in Fig 5.

Figure 5: Time plots of the variables in the Period



The movement of the series are shown in Fig 5 above, it is apparent that the SI is exhibiting an upward trend and the MI a downward trend as concluded in the Cox Stuart Test, as well as in other Trends.

This section concludes the descriptive statistics of the data section. The following section will delve into the depth analysis of the data.

4.4 Empirical Analysis

The data of this work is divided into 3 sets, with different depended variables and similar explanatory variables. In this section 3 different analysis shall be presented. II_{sub1}, MI_{sub2} and SI_{sub3} refers to the subset 1, 2 and 3 respectively.

4.4.1 ARDL Models

The first 2 models were run using the SIC information criteria as mentioned earlier about the advantage of using this information criteria. However, the last model SI_{sub3} was determined using the AIC, owing to the nature of the model which was selected by the SIC. Initially, all models were run including the trend, but the trend was found to be insignificant, I re-run the model without the trend. In all cases, the model R^2 improved. Although the Cox Stuart Test indeed concluded that there is a trend, in all cases, the trend was excluded.

5 variables for each each model implies that my $ARDL$ model would looks like, $ARDL(p, q, r, s, t)$, where $p - t \in (0, 1, 2 \ldots)$, and represent the order of lagging. The first integer value will represent the order of lagging of the depended variable, and subsequently will be the independent variables. The models generated are: $II_{sub1} : ARDL(1, 0, 0, 0, 0), MI_{sub2} : ARDL(4, 0, 0, 0, 0)$ and $SI_{sub2} : ARDL(6, 3, 12, 0, 1)$. From the Subset 1, it means, the depended variables was lagged once and other variables were not lagged backwards.

4.4.2 Bound Test of Co-integration

Since my data is a mixture of $I(0)'$s and $I(1)'$s, the initial step is to do a Bound test of co-integration. Table 7 below shows the results obtained. Note

Table 7: The table showing Critical Values and F-test statistics

Significant Level	$I(0)_{1\%}$	$I(1)_{1\%}$	$I(0)_{5\%}$	$I(1)_{5\%}$	$I(0)_{10\%}$	$I(1)_{10\%}$
Critical value	3.74	5.06	2.86	4.01	2.45	3.52
Variable	K	F-Test Value				
II_{sub1}	4	3.2294				
MI_{sub2}	4	7.9427				
SI_{sub3}	4	3.9427				

that $I(0)$ and $I(1)$ in the table represents the lower and upper bound of the values of the test. To make a decision, we conclude by comparing the $F-test$ and the values in the table. If the $F - test < I(0)_{\alpha\%}$, we can conclude that there is no long run relationship, if $F - test > I(1)_{\alpha\%}$, it means there is long-run relationship of variables, otherwise ($I(0)_{\alpha\%} < F - test < I(1)_{\alpha\%}$) the test is inconclusive just like in the Durban Watson Test of autocorrelation.

Table 7 shows the $F-tests$ values from II_{sub1} and SI_{sub3} at the 5% level are between the lower and upper bound. On the other hand the value of MI_{sub2} is significantly above the upper bonds of all levels of significant. If this is the scenario, we continue to test for a long-run relationship of variables and it is the long coefficients and the error correction coefficient that will determine the next step.

4.4.3 Long-run Relationship Analysis

Table 8 below represent the long-run cointegration between capital market indices and selected macroeconomics variables. In every subset, there are

Table 8: The table showing Long-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	P-value
1		II_{sub1}		
CPI	11.839723	4.657213	2.542234	0.0127***
EX	-13.3970	3.022901	-4.431799	0.0000***
IF	-7.4451	2.752834	-2.704509	0.0082***
IR	-5.496536	5.848161	-0.939874	0.3498
C	-790.1176	374.0767	-2.1121	0.0375**
2		MI_{sub2}		
CPI	-8.892665	3.895065	-2.283059	0.0250**
EX	-16.466274	2.339424	-7.038602	0.0000***
IF	-1.345540	2.179160	-0.617458	0.5386
IR	-1.679878	5.047591	-0.332808	0.7401
C	1144.200082	312.281812	3.663998	0.0004***
3		SI_{sub3}		
CPI	6.862672	2.400547	2.858796	0.0059***
EX	0.903865	1.471087	0.614420	0.5414
IF	0.545463	1.473434	0.370199	0.7126
IR	-6.894290	2.859227	-2.411243	0.0191**
C	-550.048705	202.172508	-2.720690	0.0086***

significant long-run variables implying that there exist a long-run relationship between the depended variables and some macroeconomic variables. Also note that *, ** and ***, means that the coefficient is significant at the 10%, 5% and 1% level. The long-run co-integrating models for are:

$$Cointeq = II_t - (11.8397^{*}CPI_t - 13.3969^{*}EX_t - 7.4451^{*}IF_t - 5.4965^{*}IR_t$$

$$-790.1176)\ldots(1)$$

$$Cointeq = MI_t - (-8.8927^{*}CPI_t - 16.4663^{*}EX_t - 1.3455^{*}IF_t - 1.6799^{*}IR_t$$

$$+1144.2001)\ldots(2)$$

$$Cointeq = SI_t - (6.8627^{*}CPI_t + 0.9039^{*}EX_t + 0.5455^{*}IF_t - 6.8943^{*}IR_t$$
$$-550.0487) \ldots (3)$$

4.4.4 Short-run Relationship Analysis

Table 9, and10 , shows the results of the vector error correlation model. The error correlation term ECT_t in all cases is highly significant and negative as expected. If this term was positive and insignificant, this would mean that there is no long-run relationship between the selected capital markets and macroeconomic variables. This ECT_t it means that there exists a notable high speed of adjustment toward the long-term equilibrium following a short-run shock, and this deviation in long-run equilibrium is corrected, by 25.66%, 42.03% and 16.67% in II_t, MI_t and SI_t respectively in a given month. The results attests a stable long-run relationship among variables.

Table 9: The table showing Short-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	P-value
		II_{sub2}		
$D(CPI_t)$	3.038029	1.302847	2.331839	0.0220**
$\Delta(EX_t)$	-3.437592	1.038826	-3.309114	0.0014***
$D(IF_t)$	-1.910376	0.844376	-2.262469	0.0261**
$D(IR_t)$	-1.410391	1.462463	-0.964394	0.3375
$ECT_{(t-1)}$	-0.256596	0.064299	-3.990684	0.0001***
		MI_{sub2}		
ΔMI_{t-1}	0.352846	0.095733	3.685747	0.0004***
ΔMI_{t-2}	-0.013082	0.098314	-0.133059	0.8945
ΔMI_{t-3}	0.203498	0.097459	2.088026	0.0399**
ΔCPI_t	-3.737774	1.762094	-2.121211	0.0369**
ΔEX_{t-}	-6.921120	1.618973	-4.275008	0.0001***
ΔIF_t	-0.565559	0.922723	-0.612924	0.5416
ΔIR_t	-0.706088	2.115856	-0.333713	0.7394
ECT_{t-1}	-0.420321	0.073109	-5.749225	0.0000***

Table 10: The table showing Short-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	P-value
ΔSI_{t-1}	0.147885	0.118990	1.242837	0.2190
ΔSI_{t-2}	-0.155129	0.108464	-1.430237	0.1581
ΔSI_{t-3}	0.268234	0.110452	2.428509	0.0183**
ΔSI_{t-4}	-0.218232	0.109856	-1.986526	0.0518**
ΔSI_{t-5}	0.175307	0.114473	1.531417	0.1312
ΔCPI_t	-0.444605	0.462202	-0.961927	0.3401
ΔCPI_{t-1}	0.059516	0.541118	0.109986	0.9128
$\Delta CPIt-2$	-1.003731	0.461038	-2.177110	0.0336**
EX_t	0.940533	0.710062	1.324579	0.1906
ΔEX_{t-1}	-0.423410	1.134322	-0.373271	0.7103
ΔEX_{t-2}	1.156015	1.159936	0.996620	0.3232
ΔEX_{t-3}	0.030790	1.214951	0.025342	0.9799
ΔEX_{t-4}	1.120911	1.255247	0.892980	0.3756
ΔEX_{t-5}	-1.217866	1.274739	-0.955384	0.3434
ΔEX_{t-6}	-1.493932	1.265675	-1.180344	0.2428
ΔEX_{t-7}	1.677007	1.320614	1.269869	0.2093
ΔEX_{t-8}	0.212922	1.257234	0.169358	0.8661
ΔEX_{t-9}	-1.800751	1.166329	-1.543948	0.1281
ΔEX_{t-10}	2.675778	1.212314	2.207166	0.0313**
ΔEX_{t-11}	-2.115534	0.862458	-2.452911	0.0173**
ΔIF_t	0.090927	0.227791	0.399169	0.6913
ΔIR_t	-0.572315	0.330733	-1.730442	0.0890*
ECT_{t-1}	-0.166697	0.055133	-3.023550	0.0037***

4.4.5 Short-run Causality of variables

To determine whether there is short-run causality among variables in the short-run a Wald Test was used for coefficient restriction. Only short run significant coefficients were selected for the test and in all the cases, the null hypothesis was rejected, which assumes that there is no casual effect in favour of the alternative hypothesis which says that there is casual effect among variables in the short-run. The table 11 shows the results of the test.

Table 11: Short-run Causality Test

Model	Test Statistics	Value	df	P-Value
	F-statistic	49.84925	(5, 83)	0.0000
MI_t	Chi-square	249.2463	5	0.0000
	F-statistic	92.81758	(4, 89)	0.0000
II_t	Chi-square	371.2703	4	0.0000
	F-statistic	26.83009	(10, 57)	0.0000
SI_t	Chi-square	268.3009	10	0.0000

4.4.6 Model Diagnostic Testing

Normality, heteroscedasticity and serial correlation tests were performed to ensure the validity of the model. Table 12 shows the results obtained. Results

Table 12: The table showing Long-run Coefficients

Item	Test Applied	$II_{p-value}$	$MI_{p-value}$	$SI_{p-value}$
Normality	Jarque bera	0.6532	0.1436	0.8018
Serial correlation	LM test	0.1029	0.2096	0.0815
Heteroscedasticity	Breusch-Pagan	0.2614	0.5326	0.2732
Functional form	Ramsey's RESET	0.7670	0.1780	0.2913

in Table 12 indicates that all common economic model problems have not been detected. The model residuals follows a gaussian distribution, serially uncorrelated and have constant variance (homoscedastic). Moreover, the model is correctly specified with regards to the functional form test.

4.4.7 Model Coefficients Stability

The stability of the coefficients of the models were tested using the CUMSUM test and CUMSUM of Squares Test. The former takes the cumulative sum of residuals values against the confidence interval bounds, at each point. The model is said to be stable that is if the cummulative sum of residuals indicated by the blue line lies inside the red inclined straight dotted lines. More so, the CUMSUM of Squares test is used to ascetain the robustness of the CUSUM test, by accessing the cumulative variance around the regression. All the tests are shown in the graphical form.

Fig 6 and 7, shows that the models II_t and MI_t coefficients are stable at

Figure 6: CUSUM and CUSUM of Squares Plot Plot for II_{sub1} Model

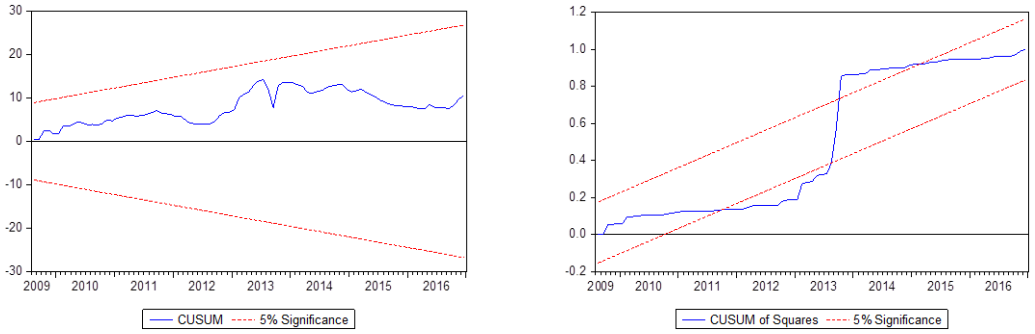
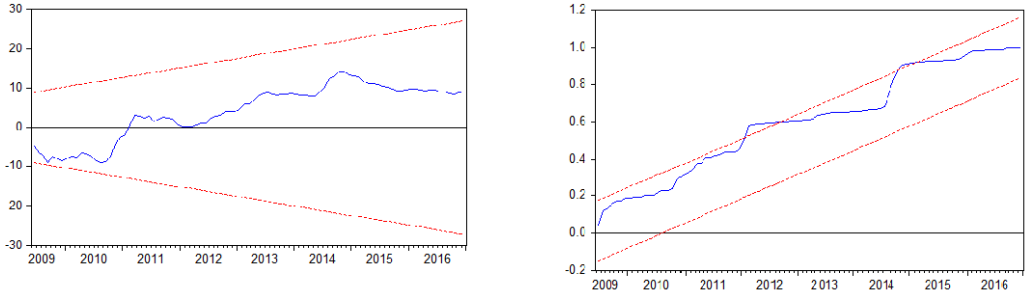
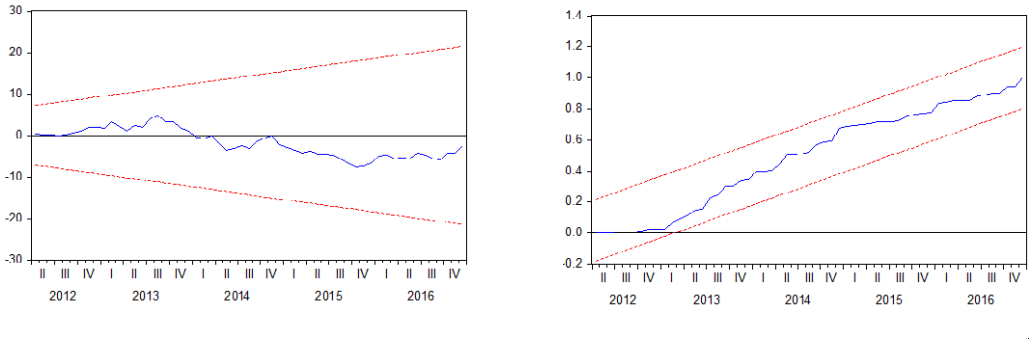


Figure 7: CUSUM and CUSUM of Squares Plot Plot for MI_{sub2} Model



95% level which correspond to 5% significant level with regard to the CUSUM Plot. However, the robustness of the model coefficients is not significant at 5% level as is shown by the CUSUM square test. Nonetheless, the model is acceptable since it is significant at the 10% level. AS for the SI_t model, it

Figure 8: CUSUM and CUSUM of Squares Plot for SI_{sub3} Model



qualifies in both tests as shown in Fig 8. Hence the coefficients of the model are dynamically stable.

4.5 Granger Causality Analysis

Cointegrated variables should be tested their causal relation within the structure of the model Granger (1988). A pairwise Granger Causality test was carried out to identify the exogeneity of each variable in the system in relation to the respective depended variable. The table 13 below shows the results.

In most of the cases it has been found that there is a Granger causality relationship between variables. The interacting relationship between the independent variables has not been evaluated. From Table 13, it can be concluded that there is no a unidimensional relationship noted in the following sets

$$(IF, CPI : CPI \Longrightarrow IF),$$
$$(SI, CPI : SI \Longrightarrow CPI),$$
$$(IF, EX : EX \Longrightarrow IF),$$
$$(IR, IF : IR \Longrightarrow IF), and$$
$$(SI, IF : SI \Longrightarrow IF).$$

The direction of the cause is indicated by the arrow. From the first set, a unidimensional relationship between IF and CPI exists and CPI cause IF and not vice-versa.

Table 13: Granger Causality Tests

Hypothesis	obs	F-Statistic P-value	Conclusion	
IF does not Granger Cause CPI	84	1.36738	0.2075	Accept H_0
CPI does not Granger Cause IF		10.3010	2.E-10	Reject H_0
II does not Granger Cause CPI	84	0.30318	0.9864	Accept H_0
CPI does not Granger Cause II		0.50154	0.9055	Accept H_0
MI does not Granger Cause CPI	84	0.95154	0.5039	Accept H_0
CPI does not Granger Cause MI		0.84973	0.6004	Accept H_0
SI does not Granger Cause CPI	84	2.40615	0.0131	Reject H_0
CPI does not Granger Cause SI		0.53842	0.8807	Accept H_0
IF does not Granger Cause EX	84	0.50306	0.9045	Accept H_0
EX does not Granger Cause IF		2.64430	0.0067	Reject H_0
II does not Granger Cause EX	84	0.60108	0.8325	Accept H_0
EX does not Granger Cause II		0.63411	0.8046	Accept H_0
IR does not Granger Cause SI	84	1.12666	0.3569	Accept H_0
SI does not Granger Cause IR		0.37936	0.9659	Accept H_0
MI does not Granger Cause EX	84	0.41954	0.9498	Accept H_0
EX does not Granger Cause MI		0.69764	0.7472	Accept H_0
SI does not Granger Cause EX	84	0.73709	0.7098	Accept H_0
EX does not Granger Cause SI		1.53858	0.1362	Accept H_0
II does not Granger Cause IF	84	1.37460	0.2039	Accept H_0
IF does not Granger Cause II		0.83111	0.6185	Accept H_0
IR does not Granger Cause IF	84	2.73822	0.0052	Reject H_0
IF does not Granger Cause IR		1.33084	0.2262	Accept H_0
MI does not Granger Cause IF	84	5.42977	4.E-06	Reject H_0
IF does not Granger Cause MI		1.91365	0.0509	Reject H_0
SI does not Granger Cause IF	84	3.13045	0.0017	Reject H_0
IF does not Granger Cause SI		0.37819	0.9663	Accept H_0
IR does not Granger Cause II	84	1.18426	0.3155	Accept H_0
II does not Granger Cause IR		0.15530	0.9994	Accept H_0
MI does not Granger Cause II	84	0.76261	0.6852	Accept H_0
II does not Granger Cause MI		1.13383	0.3516	Accept H_0
SI does not Granger Cause II	84	2.27269	0.0190	Reject H_0
II does not Granger Cause SI		3.48834	0.0006	Reject H_0
MI does not Granger Cause IR	84	1.25660	0.2685	Accept H_0
IR does not Granger Cause MI		0.80507	0.6439	Accept H_0
SI does not Granger Cause MI	84	0.42973	0.9452	Accept H_0
MI does not Granger Cause SI		1.81969	0.0655	Accept H_0

A feedback system is noted on the relationship between MI and IF, such that $MI \Longleftrightarrow IF$ and also between SI and II. This relationship is called bilateral relationship.

4.6 Concluding Remarks

This chapter objectives were to develop models and test their statistically significant. Everything was done in line with the objectives of this thesis. The $ARDL$ models developed are:

$$\Delta II_t = 0.743404II_{t-1} + 3.038029CPI_t - 3.437592EX_t - 1.910376IF_t - 202.7412$$

$$\ldots\ldots(1)$$

$$\Delta MI_t = 0.932525MI_{t-1} - 0.365928MI_{t-2} - 0.203498MI_{t-4} - 3.737774CPI_t$$

$$-6.921120EX_t + 480.9313\ldots\ldots(2)$$

$$\Delta SI_t = 0.981188SI_{t-1} - 0.303014SI_{t-2} + 0.423362SI_{t-3} - 0.486466SI_{t-4} +$$

$$0.393538SI_{t-5} + 1.003731CPI_{t-3} - 2.675778EX_{t-11} + 2.115534EX_{t-12}$$

$$-0.572315IR_t - 0.576945IR_{t-1} - 91.69168\ldots\ldots(3),$$

and the corresponding R^2 for these models are, $R^2_{II_t} = 0.851438$, $R^2_{MI_t} = 0.956402$ and $R^2_{SI_t} = 0.954227$ respectively. Also it important to note that all insignificant coefficients were removed owing to the principle of parsimonious. The high R^2 exhibited in the models implying that most of the variation in the depended variable is being explained by the models.

The succeeding Chapter will be more focused on interpretation of the results of this chapter, striking the similarities and differences with those of other researchers who studied on the similar research like this one. Furthermore, the economic theories behind the findings shall also be used in explaining the findings of this paper and or reasoning behind where they differ. Finally, conclusions on the limitations and further study of this work shall be presented.

5 Discussion of Empirical Results

5.1 Introduction

This chapter shall be focused on the discussion of the results obtained from the preceding chapter and the empirical results obtained by other researchers outlined in the review of related literature. Meaningful conclusions shall be drawn thereof taking into consideration the economic theories behind the issue, what other researchers have obtained, variable mix structure and the prevailing macroeconomic conditions in Zimbabwe. The roadmap shall be:

1. Interpretation of SI results,
2. Interpretation of II results, and finally
3. Interpretation of MI results.

5.2 Discussion and Interpretation of SI results

The long-run relationship of the depended variable SI and independent variables EX and IF, independent variables of my results shows that there is nos long-run relationship. This is shown by insignificant coefficients of the these variables in the model (ref Table 8). Also, there is a positive long-run relationship of SI and CPI and a negative one with IR, as indicated by the positive and negative significant coefficients respectively. These results differs with the results of (Sohail and Zahir(2010), Aamir et al (2011) and Srinivasan (2011)), who noted a long-run relationship between EX and SI. Although their results confirmed a relationship, they differ on the impact of the variable to the SI, in which the former researcher noted a positive impact and however with the later researcher (Srinivasan (2011)). The differing in the results might be as a result of the nature of the EX used. In my analysis I used the 'direct quote exchange rate', while the other researchers used the 'effective exchange rate' . However, on the same variable, my results get along with the findings of Naik (2013) who used the direct quote in his study. This therefore implies that exchange rate (direct quote), does not have a lon-run relationship nature with SI, probably this is because the SI is a composite index of different companies that deals in different currencies and serving different local and international markets, also 'effective exchange

rate' is a composite of different currencies the country is having trading relations with. Hence a better statistics to use than a direct quote. However, my results indicated that there is a short-run casual effect of lagged variables of EX on lag 9 and 10 on SI, this might be due to the recurring effects of macroeconomic variables as they bear a memoryless property nature and also the volatility nature of EX in the short-run which can be of low impact if effective interest rate is used.

On IF, my results contradicts those of (Sirine & Jamel (2016), Dhira Dwijayanti et al (2012), Tajana Barbi & Iva Ondi-Jurki (2011), Ioannidis et al. (2004)) who noted a significant negative relationship between the SI and IF, with exception of Dhira et al, who noted a positive significant relationship one. The results of the mentioned researchers are determined mostly by the monetary policies implemented during the years of their study. Economic theory suggested that, "tightening of the monetary policy raises the rate of interest and this will reduce net profits of firms, reduces bank loans, thus reduces inflation rate and also stock prices, thus leaving less disposable income in the hands of consumers for effective demand of goods and services as well as stock. Thus, it is well established in theory that inflation rate and stock index move in the same direction, such that positive or negative depending on the monetary policy being implement in the fiscal period. This goes back to the Keynesian ideas on the non-neutrality of money a view that contradicts the monetary aspect on the same subject matter. Thus one an conclude that, if there is a positive relationship of SI and IF, there is an expansionary policy being at force and otherwise it is negative. As a practical example, in 2007/8, Zimbabwe was experiencing hyper inflationary periods, the ZSE was considered the best performing stock exchange in the same period. The volumes of trade were exceedingly tremendously and a lot of trading activities were being done. This was solemnly because, investors were losing confidence in the local money and would prefer to hold a claim of an asset of a company than money, hence drive the stock index up and inflation was also going up.

On the same point, Zakaria and Shamsuddin (2012) results indicated that there is no long run relationship between IF and SI but rather short-run. His results (no long-run relationship) are at even with those of this work. However we differ on the short run relationship as my results could not confirm the short-run as well. On the short-run relationship, he pointed that investors on the Stock market are more concerned about profits in the short-

run rather than in the long run, thus make sense due to the high volatility of stock in the short run due to the high volumes of trade. The only possible explanation of my results is no relationship in both short/long run, can best be explained by the prevailing macroeconomic conditions in Zimbabwe. The Central Bank, has no legitimate power to implement any monetary instrument owing to the use of the USD which they do not have control over. This can be easily be noted on the results in Table 6, which shows that the trend of IF and IR, are moving in different direction, with IF taking an downward trend and IR an upward, which is a correct relation. The difficulties comes in if we factor in the SI, under normal circumstances it should be going down with IF if IF is going down or up if otherwise, but with IR the relationship is correct, thus contradicting the existing economic theories. Analogous, the same phenomena happened in Angola after the slump of oil prices on a global market. Without loss of generality, one would expect that the prices of things were supposed to go down as well, but in Angola they do the opposite. This could be probably the fact that Angolian domestic market rely on imports, so slumping of oil prices means less foreign reserves, this therefore would mean that the government will have few disposable reserves to spend on foreign payments, thus they will be force to import less, thus forces of demand and supply take charge because inelastic nature of basic commodities. No matter how prices changes, people still have to eat something, thus when demand exceeds supply, the price will rise to clear off the market, though there will be market imperfections.

The negative long-run and short-run relationship of IR on SI shown in the results of this paper are at even with those of Dhira Dwijayanti et al (2012) (long-run relationship). However, these results contradicts the results of (Zakaria and Shamsuddin (2012) and Naik (2013)) which could not justify the existence of the long-run relationship between the two variables. The similarity of results of this work and those of Dhira Dwijayanti et al (2012), my be due to the variables we used. We have similar variables IR, EX and IF. Also our sample space are small compared to those of (Zakaria and Shamsuddin (2012) and Naik (2013)). Also the variables the latter researchers (Zakaria and Shamsuddin (2012) and Naik (2013)) used (GDP, Inflation, exchange rate, interest rates, money supply), their sample sample was of a monthly data over a period of 13 years, implying 156 observations in their study in comparison with 96 and 60 observations of this study and those of Dhira Dwijayanti et al (2012). However they all used the same methodology

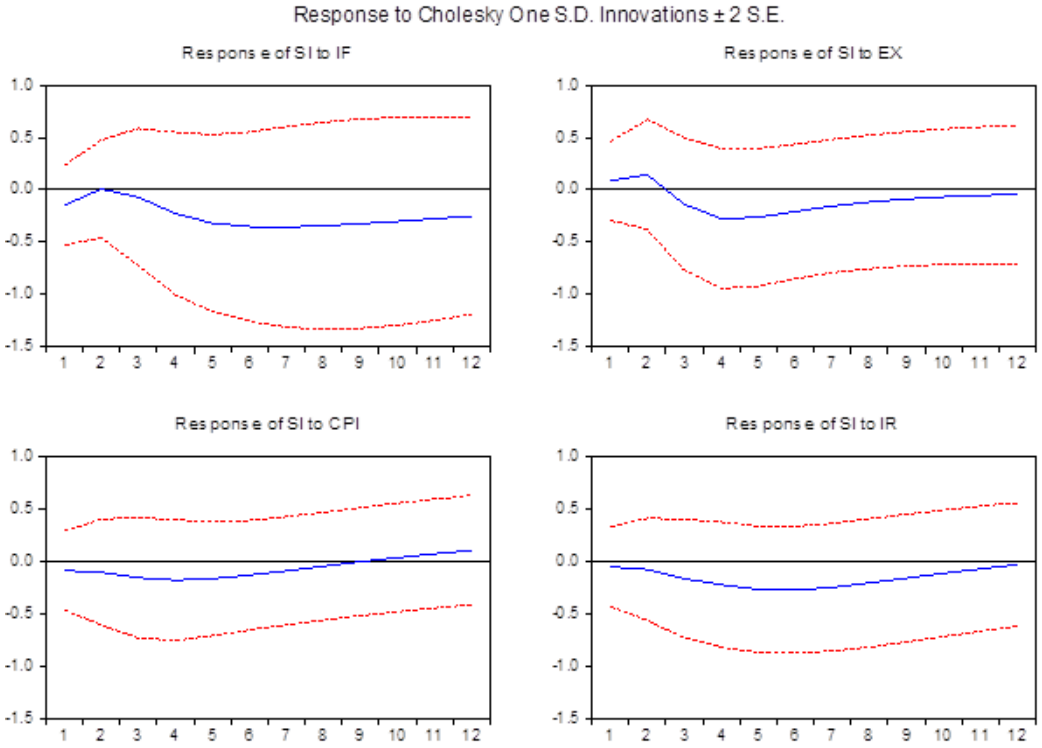
for data analysis, OLS, which is different from the methodology of this research of autoregressive distributed lag models and error correction model. Critically, the research work of (Zakaria and Shamsuddin (2012) and Naik (2013)) may be questionable, since they used CPI as a proxy for GDP, as GDP measures can not be obtained on a monthly basis which is a weakness to their study and which may throw a tilt of grain in favour of this study and that of Dhira Dwijayanti et al (2012).

The positive long-run impacts of the CPI on SI concluded by the results of this paper are the same with with those of (Hussain et al (2011) and Sohail & Zahir (2010)) who noted the same in their study. Contrary there results of Forson and Janrattanagul (2014), noted a long-run negative impact of CPI on SI. But, on the same aspect, our granger causality test confirmed also a unidimensional relationship that runs from the SI to CPI ($SI \longrightarrow CPI$) but not vices versa These results implies that CPI does impact the SI positively in the in the long-run and negatively in the short-run as shown in Table 10. This might be due to the price volatilities in the short-run that may affect the volumes of trade of companies listed and this will easy out in the long run.

The results of the granger causality test of Zakaria and Shamsuddin (2012), indicated that there is no causal link between SI, IR andEX which are indeed the same result of this work. However, a unilateral relationship was found to exist that runs from SI to IF, a relationship which is contrary to the work of Naik (2013). These results contradicts the economic theory in that, SI, does not cause IF literally, it is IF that is deemed to cause SI, probably it is due to the fact that in Zimbabwe we have deflationary conditions, and are left unattended due to the limited power of the Central Bank to implement inflationary polices. The overall relationship of SI and chosen macroeconomics variables are shown in the Impulse Response function diagram below:

A shock of one standard deviation Cholesky from EX and IR on IS revealed to come to equilibrium after 12 months, as shown in figure9 above. Initially, SI comes to equilibrium following a shock from EX in the second month and then have a negative response that will eventually to equilibrium. The negative response for IR is in line with previous empirical result. Also the a shock from IF to SI initially rises and then drops gradually to a value which is gradually decrease to settle on another level slightly lower than the

Figure 9: Response to Cholesky One S.D. Innovations + 2 S.E: Depended Variable SI



initially equilibrium. Lastly, a shock coming from CPI causes the SI to response negatively till the 4th month after which it became to rise sharply and finally settle on a higher positive equilibrium than its initial state. The longer the equilibrium point of a response variable shows after a shock from the independent variable explain the picture of the macroeconomic climate in Zimbabwe. This imply absence of decisive economic policies implemented in the period to correct the anomalies and or ineffectiveness of policies being implemented.

5.3 Discussion and Interpretation of II results

The long-run relationship shown from the empirical studies indicated that only the IR is insignificant in the long-run. And a positive long-run relationship exists with CPI, negative long-run relationship with both EX and IF

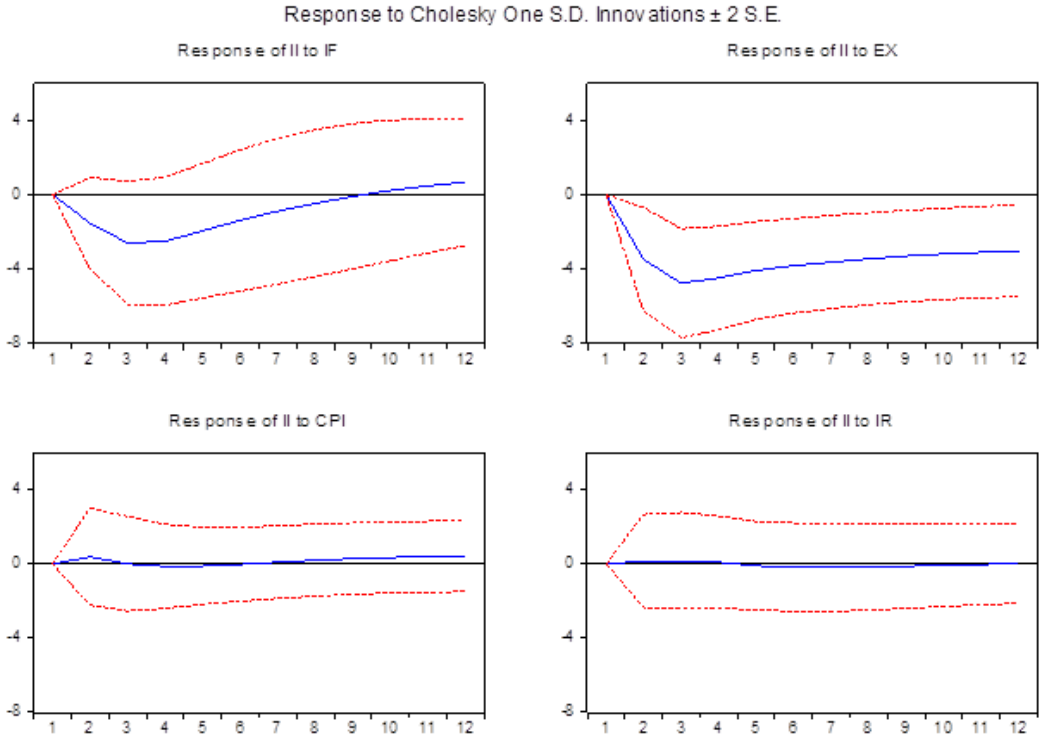
(ref Table 8). The empirical results of this work and the data sample space are almost similar to those of Ahment Ozean (2012) study. In his study, he noted a long-run relationship between the macroeconomics indicators and the industrial index just as was concluded with the analysis of this work. A minor contradictory results is witnessed on the variable IR, which is in his study was a significant long-run component yet in this study it is insignificant. This might be as a result of the different size and nature of dominant trades in Zimbabwe and Turkey. Turkey has no oil fossils which drive the variable IR as the product is worldly connected to different economies and different industries, thus being a significant component.

The work of other researcher like (Malik & Chondhury (2001), Ahmed & Mortaza (2005), Volkan & Ugur Ergun (2014), Korhan Gokmenoglua et al. (2015), Md. Tasnimul Hasan et al (2016)) reveals the same findings of long-run relationship. Although the variable mix of those researchers are somewhat different, in our common variables, the results are the same. The major perplexing results of my findings to those of the researchers above and others not mentioned, is the causality relations of variables. Most researcher have noted a unilateral (Volkan & Ugur Ergun (2014)) and or bilateral(Md. Tasnimul Hasan et al (2016)) relationship that runs from II to CPI, in my results there is no any causality effects between variables. In theory, CPI is heavily related to II and there should be a causality effects on these two variables because one depends on another. The reason for this might be that, in Zimbabwe the CPI index is being constructed from goods that are not domestically produced but imported from SA. This means, what is driving the II is not the means of production of domestic firms, but rather imports from SA.

Furthermore, the empirical results of this study have noted a short and long run between variables which differs from the results of (Volkan & Ugur Ergun (2014) and Md. Tasnimul Hasan et al (2016)) who in their study established a long-run relationship only. They concluded in their work that the long-run relationship was owing to demand pull inflation, something that can not be felt in the short run owing to rigidity nature of wages. On a different note, the state of the economy during which this study covers is marred up with continuously deflationary pressures, an economical situation that results in business incurring loses before they trade, hampers consumption, fuelling deindustrialization, job loses, just to mention but a few. Therefore, these results

maybe consistence with the current situation in Zimbabwe, although more research is needed to establish these to avoid a *'haste generalization fallacy'*. Fig 10 shows the Impulse response function of the results. A shock from EX

Figure 10: Response to Cholesky One S.D. Innovations + 2 S.E: Depended Variable II



and IF on II causes a rapid negative response on the II in the first 3 months after which a steady rise will be noted. A response from IF continues to rise and settle on a positive equilibrium slightly above the initial equilibrium. This is in-line with existing economic theories, deflationary conditions buy back consumption, so a shock from the index, adversely affect the II in the short run and later on easy the effects with time. Contrary to the results from EX shock, which settle down on a negative equilibrium far below the initial equilibrium after 12 months, implying that the EX changes (appreciation) negatively affects the industries in Zimbabwe. A delay in the settling of the shock to equilibrium, is nothing other than absence of economic policies to correct the issue the exchange rates for the benefit of the economy. As for a

shock from CPI and IR, the II responded with positively in the first 2 and 3 months respectively after which it gradually decreases negatively beyond the symmetric line, 0. A shock from CPI lead II continues to rise and settle at the same value it achieve in month 2 after 12 months. However the shock from IR led to a negative equilibrium in the 10th month. This is a reverse of the existing economic theories, on the relationship between interests rate and exchange rate. Under normal circumstances, an appreciation of a currency is normally driven by an increase in IR. When the interest rate in a domestic money market increases, holding all other things constant, the demand of the local currency will increase, pushing the exchange rates upwards as there will be rapid capital influx from investors abroad, investing in domestic money market.

5.4 Discussion and Interpretation of MI results

Like what has been elaborated in Chapter 3, there is no a similar research on the mining index relationship with macroeconomics fundamentals. The following discussion shall be based on researcher's intuition.

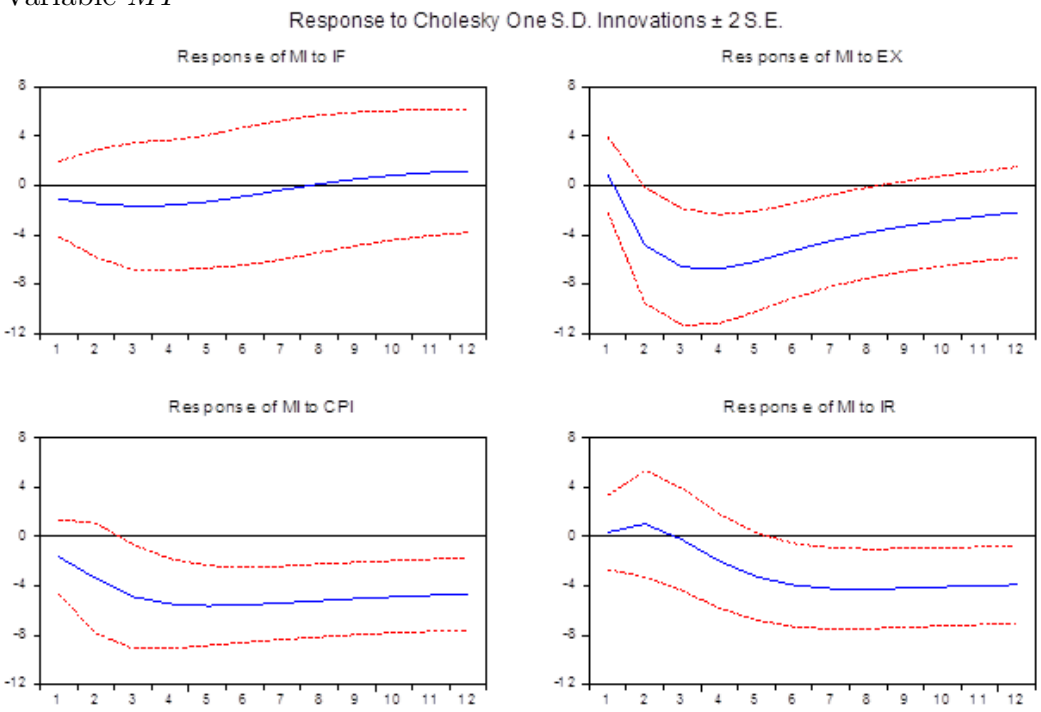
It has been found that there is a negative long-run association between the MI and CPI and EX. Indeed the relationship with EX is justifiable in economic theory since exchange rates either affect the mining industry in a positive way or negative way. If the currency of a given country is depreciating against main trading currencies a positive long-run relationship is expected otherwise a negative one. In my case, a negative relationship was expected owing to the appreciation of the USD in the period which has scaled down the mining industry in Zimbabwe.

The relationship is not so easy to explain on CPI, under normal circumstances, the CPI and IM should be moving in the same direction. For example, a boom in mining industry has a positive impact on CPI and vice-versa. Meaning, the two series should be moving together in the same direction, negative or positive. CPI and MI. The results of the model are in line with existing economic theories but contradict the earlier results that has been spelt out on the descriptive part of the data. MI and CPI, the converge in the market of goods and services of households, under performance of the mining sector will results in the loss of jobs to the people in

the industry which will shrink the effective demand on the goods and service market, eventually affects the CPI negatively. This might be due to the proportion (6.5%) of mining companies that are listed on the ZSE. There are only 4 companies listed on the ZSE, therefore, it is a possibility that their impact may not be felt on the goods market as they may represent a minor proportion of workforce in the industry in the country. The results could be different if the mining companies listed account for a significant proportion on the ZSE.

IF and IR indices, has found to have an insignificant long-run effect on MI although their coefficients are negative. In theory, these variables affects the MI industry heavily, both in the short and long-run since the mining industry is a high capital intensive business. The Fig 11 show the shows the Impulse response function of the results. The shock from CPI, EX and IR,

Figure 11: Response to Cholesky One S.D. Innovations + 2 S.E: Depended Variable MI



affects the MI index negatively. The shock will equilibrates after 12 months

at on a value lower than the initial one. Taking the IR index into consideration, a shock from it initially raises the MI in the first month and falls gradually to settle on a negative value in the 12th month. Also, a shock from IF, initially drop the IM till the forth month after which it began to rise and settle on a higher equilibrium value in the 12th month. The relationship between these variables seems to be self adjusting, from negative to positive, a see-saw relationship pivoted at a neutral point (0 axis). The Granger causality test confirms that by showing a bilateral relationship, such that, $MI \Longleftrightarrow IF$. So it is IF cause MI, and MI cause IF. This relationship is justifiable in the sense that, if the mining sector booms, this will cause inflationary pressure on the market of goods and services as employees in the mining industry quest for wage increases, which will in-turn induced consumption. In 2007/08 when diamonds were discovered in Zimbabwe, goods were overpriced since people had a lot of the USD from illegal diamond mining. For example, a crate of eggs was been sold for $12, one room apartment in a high density area was costing $80 to $150, and in low density more than $250, cars, houses, almost everything was being overpriced. Personally, I do not believe that we were actually experiencing deflationary periods but I am with the idea that things were overpriced by then, so with the passage of time, the market self adjust to proper prices, hence the cutting down of wages, prices of almost everything going down, and so forth.

The shock that is being exerted by the EX index, indicates that MI is adversely affected by the EX. Mining sector heavily depends on EX since a bulky of mining products are normally for international consumption. The appreciation of the USD, had made Zimbabwean goods to be expensive to our trading partner SA, thus affecting the mining operations in the period as shown by the negative long-run coefficient of EX and also by the impulse response function diagram.

5.5 Concluding Remarks

This chapter concludes all the interpretation of the results obtained in the preceding chapter. Most of the results obtained in Chapter 4 were worked out in accordance to the objectives of this work. Subsequently, this Chapter laid down all the necessary conclusions that can be drawn from the results in according to other researchers results, existing economic theory and the Zim-

babwean situation presently. Also, in cases there is no any decisive economic interpretation and or limited research on the particular issue, the author concluded the phenomena based on his intuition taking into consideration of the parameters of the framework in which the study is being conducted in. It can be noted that more research on the same issue is needed in different countries with the similar and or near similar conditions like those that are prevailing in Zimbabwe to conclude the behaviour of macroeconomics indices with capital market indices. Although some results were in line with other researchers, but further research is needed. It is apparent in some similar research work of other authors, the macroeconomic environment is stable yet in Zimbabwe it is not stable, because of the following:

i) Absence of Money supply aggregates (inactive Central Bank),

ii) High unemployment rate,

iii) High levels of de-industrialization,

iv) Uncontrolled deflationary rate,

v) High trade deficit,

vi) Little to no investor confidence in the financial system,

vii) Bad political institution which shun away foreign direct investments, etc.

The above reasons made this research more unique and contributed greatly in the literature. Unlike other researcher, money supply was one of the most used variable since it has a direct impact on all capital market indices and macroeconomic fundamentals.
Some researcher have used consumer price index as a proxy for inflation and or gross domestic product (GDP), citing the fact that the former can be used as inflation since it represents the purchasing power of the local currency and or GDP since GDP figures are available on a yearly bases. This study used both variables independently and in all cases there was found no multicollinearity problems. One might think that these variables may cause the above mentioned problem but this study proved it otherwise.
The results of this thesis may not be applicable in a healthy economy like those in Europe or even stable economies like South

Africa. They might be applicable in countries with similar socio-political and economic conditions which are in this case difficult to have. Which in this case are too extreme and takes time to fix.

The following chapter shall present the conclusion of the whole work, recommendation and the possibility of future research work needed to justify some of the findings explained.

6 Summary and Final Conclusion

The objectives of this thesis were met and it can be concluded that there is indeed significant long-run relationship between capital markets indices and macroeconomic variables in Zimbabwe. Although the macroeconomic environment is hostile some variables did not deviate from the results of other researchers. The Granger causality tests conducted are the main results that goes in a reverse direction from other researchers. For example, some researcher have noticed a bilateral causality effects between the stock index and the interest rate, but this research shows no causality effects between these two variables. Fama (1981), laid down the fundamentals of the relationship between these two indices and other researchers confirmed that after Fama (1981).

The appreciation of the USD since 2009 against the southern African Rand has had many negative impact in the both macroeconomic environment and capital market environment. Small sized business were not adversely affected as they embrace the arbitrage of fist kind by buying less in SA and sell dear in Zimbabwe. However on the medium to large business they were affected negatively in the sense that they suffered internal competition from small business who were getting things at a cheaper price and at the same time not paying tax. Even if the medium to large business would have embrace the arbitrage opportunities from SA, they were still going to have intense competition to the small business who were bringing things in the country without paying import duty.

On the same aspect, Zimbabwe is one of the countries with the worst revenue collecting system. Thus, the shrinking of the industries (which pays tax) and the sky-rocketing of small informal traders (which does not pay tax), have thrown the in a bad government deficit. This has affected many sectors in the country as many civil servants could not get their salaries in time. This has been show by the slumping down of the consumer price index in the years 2011-2016.

Also, looking the SI critically it is easy to note that there is no much activities that are taking place. The number of listed companies on ZSE have reduced by 30% and 25% in the periods 2007-2013 and 2013-2016 respectively. However, if you take the SI series into consideration, one would note

that it is exhibiting an upward trend (ref Table 6), but in actual fact one would expect it to have a downward trend owing to the statistics of de-listing of other companies. This suggest that, the companies who were de-listed, had an insignificant contribution to the SI and there are top drivers of the SI. This offers a gap of research in determining the main companies driving the ZSE using advanced statistical methods like the "Principal Component analysis."

The fact that Zimbabwe has no an active Central Bank is affecting many operations in the country as there are no policies being implemented to correct the macroeconomic movement for the benefit of the country's economic objectives. On my point of view, the economic planners made a mistake in adopting the USD as the nations currency in 2009. The USD is a strong currency in which almost all countries in the world make international transactions with it-Hence, Zimbabwe is just but a small nation to withstand the shocks of the volatilities of the USD on the International platform. The situations we are experiencing could have been quiet different if there was a formal agreement between Zimbabwe and the Federal Reserve on the usage of the USD in Zimbabwe. In which the Federal Reserve will promise to chip in as a lender of last resort in Zimbabwean Financial System. Now, there is high levels of liquidity crunch, in which people queue for cash for days, some they even sleep at the doors of Banks. The RBZ issued some Bonds notes in-order to stimulate domestic demand. This has not being received by almost the majority of Zimbabwe as they fear that the 2007/8 hyperinflation situation will come back again.

Gresham's law states that, "Bad money drives out good", Bond vs USD. Many speculators and economic analysts in Zimbabwe expected that the USD shall completely disappear after the advent of the Bonds notes. As an individual I also analysed the situation mathematically in an attempt to estimate the time that will lapse after which the USD would disappear or be in lower levels that can be felt by everyone in the country. My results vary based on some situations and assumptions I consider. The following are my theoretical calculations. My time start at $t = 0$, the time when the RBZ introduced the Bonds notes. Thus let B_0-Bonds injected in the system at $t = 0$, U_0-amount of USD at $t = 0$ when Bond were introduced, $\frac{dU_i}{dt}-$ the

rate at which the USD is entering the system at any given time t, $\frac{dU_{out}}{dt}-$ the rate at which the USD are leaving the system at any given time t, and $Z(U_t, B_t)-$ be the function representing the quantity of money in circulation at time t, and its derivative, shows the change of money in circulation at any given time. Hence the total money in the Zimbabwean monetary system at any given time t is given by:

$$Z(U_t, B_t) = U_0 + B_0 + (\frac{dU_i}{dt} - \frac{dU_{out}}{dt}) \ldots\ldots\ldots\ldots\ldots\ldots (1),$$

For simplicity sake, let me denote the term $\eta_{U_t}(t) = \frac{dU_i}{dt} - \frac{dU_{out}}{dt}$ From equation (1), I realized that for Gresham's law to fully take place there are three situations to consider for analysis, the RBZ reaction towards the situation determines the outcome, which are:

1. $\eta_{U_t}(t) = 0$,
2. $\eta_{U_t}(t) > 0$, and
3. $\eta_{U_t}(t) < 0$,

If $\eta_{U_t}(t) = 0$, it means the rate at which the USD are leaving and entering the country balance, such that $\frac{dU_i}{dt} = \frac{dU_{out}}{dt}$. The current cash crises will persists as it is today. Gresham law my not take place in the short-run because if the households and firms decides to hold the USD, they will eventually use it because the supply of bonds will be fixed and not enough for total nation's transaction at any given moment. However if the RBZ decides to print more bonds to easy the liquidity crunch, thus Gresham law will take charge in the very short-run.
If $\eta_{U_t}(t) > 0$, it means that there is a positive net inflows of the USD, such that $\frac{dU_i}{dt} > \frac{dU_{out}}{dt}$. This will be a favourable situation for Zimbabwe as more cash is being injected into the system than the one leaving. This scenario is the one we are mostly likely to experience this season due to the opening of tobacco sales floors. Tobacco is one of the major foreign currency earners in Zimbabwe. Thus, all the variables like SI, II, CPI and IR will be affected positively. However this situation may not last forever since Zimbabwe is a consuming country, such that, buying goods and other services from abroad

and no local people who are investing in the local companies. If the industry has been fixed, then the situation may persists in the long-run but not very long-run in the event if we continue using the USD. Thus in the very long-run we ended up in either of these two states, $\eta_{U_t}(t) = 0$, and $\eta_{U_t}(t) < 0$. Also Gresham law will take effect in the short-run based on the stance of the Central Bank.
A very dangerous situation will be when $\eta_{U_t}(t) < 0$,. This means that the rate at which the USD is leaving the monetary system is more than the rate at which it is coming, such that, $\frac{dU_i}{dt} < \frac{dU_{out}}{dt}$. This situation will be very unfavourable to Zimbabwe. The RBZ will be in this case be forced to issue more Bonds notes to easy the liquidity crunch, lets say they decided to issue them at a rate proportional to the amount of Bonds that are in circulation, such that $\frac{dB_t}{dt}_i = kB_0$, for $k \in (0, 1]$. Then the equation in (1) will become:

$$Z(U_t, B_t) = U_0 + B_0 + (\frac{dU_i}{dt} - \frac{dU_{out}}{dt}) + \frac{dB_i}{dt} \dots\dots\dots\dots\dots\dots (2),$$

If $\frac{dB_i}{dt}$ is being introduced, then the Gresham law will take place in the very short run. This will also led to the mushrooming of the black market exchange rate of Bond and USD. When Bonds first introduced, they were deemed to be at par with the USD, under this scenario, the market will correctly price the value of Bonds in relation to the USD. If Gresham law takes effect, then the injection of Bonds will be of a permanent nature, and inflation pressures will accelerate due to pseudo demand which will be as a result of market imperfections. Since the official rate of Bond: USD will be 1:1, yet on black market it may be 10 Bond: 1 USD (suppose). Under this situation, the CPI index will be driven upwards due to frictional demand, but the SI will go down due to shrinkage of the supply side, de-industrialization.

$\frac{dB_t}{dt}$ will be a constant (kB_0), but if the RBZ continues to issues Bonds which is highly probable, then it will be a differential variable, and advanced calculus and the methods partial derivatives integration will be used to solve equation (2) to determine the actual time that elapses before which Gresham law take charge. Also note that the above models excluded withdrawal of money in the system both the USD and Bond due to other factors like, fire, water, etc. (assumptions). Everything that was been presented in this work,

comes back to the state of the Zimbabwean economy. In most cases when my results differs from others, the researchers would have included the money supply aggregates (M_1, M_2, etc) as one of their independent variables. Thus, absence of the monetary aggregates are the main factors that are contributing to the variations of my results with those of others. In conclusion, if things remains like this in Zimbabwe, Gresham law will take effect in whatever case and what differs is the time it will fully manifest.

Like what has been said earlier, the merit and consistence of these results needs further research in countries with almost similar macroeconomic environment. They might not be that identical but almost similar. Personally, I suggest a panel study of a similar research taking countries with troubled economies and an ineffective monetary Policy like Greece, Venezuela, Ukraine, Brazil, Yemen, Pakistan, South Sudan, and other African nations. Up until that, the conclusions of this thesis will be handled with reservation. Venezuela political history, rise of Hugo Chavez, is a perfect replica of what happened in Zimbabwe. A person who have studied and analysed the rise of Robert Mugabe and Hugo Chavez, and how the polices of indigenization and land reform programs destroyed a once strong economy, one would think that these leaders communicated about polices they implemented. The polices are identical, presently Venezuela is in trouble with hyperinflation, maybe soon or latter they will dollarize their economy just like what happened in Zimbabwe. After that, fixing the economy will be a far-fetched task that may quest even issues of a regime change. Macroeconomics variables and Stock market indices are directly related to the political atmosphere of a respective country. In conclusion, good institutional development is an Indispensable condition for a healthy economy.

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