THE RELATIONSHIP BETWEEN INFLATION AND UNEMPLOYMENT IN BOTSWANA: ANALYSIS OF THE PHILLIPS CURVE

BY

OMPONYE DAISY GOBHOZA
STUDENT ID: 201001708

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DECLARATION

This dissertation was undertaken from October 2018 to March 2020. I hereby declare that the study has not been done before. The contents of this paper are my original work, except where referenced.

Name: Omponye Daisy Gobhoza

Signature: …….

Date:……

APPROVAL

This dissertation has been examined and approved as meeting the requirements for the partial fulfilment of the Master of Arts Degree in Economics.

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Supervisor **Date**

…….. ……..

Head of Department **Date**

DEDICATION

This work is dedicated to my husband, Malcom, who has been a constant source of support and encouragement during the challenges of graduate school and life. I am truly thankful for having you in my life. To my children; Lone and Lwazi, who have been affected in every way possible by this journey, thank you. My love for you is infinite. God bless you.

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Lastly, a special thanks to my friends who supported me throughout this journey. Your contribution is immeasurable.

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ABBREVIATIONS AND ACRONYMS

ADF: Augmented Dickey-Fuller

ARDL: Autoregressive Distributive Lag

DF-GLS: Dickey-Fuller Generalized Least Square

ECM: Error Correction Model

ECT: Error Correction Term

GDP: Gross Domestic Product

GMM: Generalized Method of Moments

NAIRU: Non-Accelerating Inflation Rate of Unemployment

NKPC: New-Keynesian Phillips Curve

RESET: Regression Specification Error Test

WDI: World Development Indicators

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ABSTRACT

The study conducts a Phillip's curve analysis of the relationship between unemployment and inflation in Botswana. In investigating inflation-unemployment nexus, cointegration is tested using autoregressive distributive (ARDL) bounds testing approach on the yearly data from 1980 to 2017. The paper initially investigates a bivariate regression between inflation and unemployment, where the proxies used are change in price levels and output gap respectively. To make the investigation robust and yield relevant results, control variables are added; real GDP, real exchange rate, nominal interest rates, import prices and lastly broad money supply. Post establishing presence of strong cointegration effects between inflation and unemployment, ARDL coefficient diagnostics for cointegration and long run form are used to find the impact of unemployment and other control variables on inflation. Unemployment is found to not have a significant impact on inflation, failure to identify a significant relationship between inflation and unemployment implies that existing high levels of unemployment has little to do with the current low inflation rate experienced in Botswana. Import prices are found to have a significant impact on inflation. The last interesting finding of the study is that depreciation of the Pula against the Rand leads to inflation while interest rates have no significant impact on inflation. This is then perhaps a call for monetary policy authorities to focus more on the crawling peg between Botswana and its trading partners. To increase employment Authorities should consider lowering the crawling peg (depreciating the pula) against its trading partners. While this may lead to a modest increase in inflation, this will have a significant impact since Botswana is a net importer.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

The purpose of this study is to determine the relationship between inflation and unemployment in Botswana. As inflation rises because of the high economic growth, better job opportunities may be availed to people, implying a low unemployment rate. Stable inflation rate and low unemployment rate are the macroeconomic goals of developing and developed countries. The Phillips Curve can cast light on the problem of steadying inflation or reducing unemployment rate. A country that decides to stabilize inflation anticipates a higher unemployment rate, and should therefore be poised to confront the economic problem. It is critical for policy makers to deal with this matter carefully otherwise a wrong decision on policies may hurt the economy.

Inflation rate and unemployment rate are some of the main indicators in an economy. They are seen to be major indicators of under-development in any country including Botswana. The question of whether it is possible to achieve the two main macroeconomic goals: low inflation and low unemployment in a particular economy at the same time, has remained a hot debate among economists, hence the emergence of the Phillips Curve. Consequently, there are various discussions among researchers to determine the relationship between the two indicators, which has been the core of policy discussion. In 1958, A.W. Phillips of London School of Economics published a paper demonstrating that British wage changes during the previous 95 years were systematically related to the level of unemployment. That relationship later became known as the Phillips Curve. Phillips observed that, a stable curve known as the Phillips Curve can be used to show the tradeoff relationship between inflation and unemployment. This model has been at the heart of many economists because it throws light on the effect of monetary policy in an economy.

The objective of monetary policy in Botswana has been reviewed to maintain price stability by safeguarding low and stable inflation rate over the medium to long term (Masalila & Phetwe, 2001). Thus, with a focus on a single objective, adjustment of monetary policy instruments could be expected to be more effective in controlling inflation. This goal is expected to contribute to the broader national objective of sustainable growth and development through promotion of savings and productive investment. Hence, evaluating policy in respect of the

inflation objective is instructive. It is considered that as monetary policy effectively controls inflation, investment would be promoted since relative price movements would give correct signals to the business firms on how to efficiently and profitably allocate economic resources.

In the context of the Phillips Curve the following questions arise: Does the short run inverse relationship between inflation and unemployment in Botswana exist? Second, does Botswana have a long run tradeoff between inflation and unemployment? Finally, if a tradeoff can be observed, is the relationship stable or does it vary along with the changes in the macroeconomic system? To answer these questions, the quantitative relationships between inflation and unemployment need to be established empirically. Without this empirical evidence, actions of policy makers are likely to either undershoot or exceed the targeted equilibrium level of inflation that would ensure higher employment. As the monetary announcement of an economy has an important influence on both inflation and unemployment, the existing literature has to be reviewed to find out the relation between inflation and unemployment rate in Botswana with special emphasis given on the monetary announcement (inflation objective of 3-6%) over a period of 1980-2017. In order to successfully embark on stabilizing price and raising employment in Botswana, the trade-off between inflation and unemployment should be determined empirically.

Unfortunately for the case of Botswana, there are limited studies that have looked at this trade-off. One related study was done by Sediakgotla (2017) which was aimed at investigating the short run inflation dynamics in Botswana. Policy makers should rely on empirical research that confirms the Phillips Curve phenomenon or otherwise in Botswana or within the SADC region with a similar economic structure. In a nutshell, the inverse relationship between inflation and unemployment are specific to each economy in question. Hence, to effectively capture their trade-offs, economy characteristics need to be accounted for. In light of this, a thorough investigation into the quantitative relationship between inflation rate and unemployment rate using time series data on Botswana would help policy makers understand the actual relationship between inflation rate and unemployment rate. It would assist them in choosing the optimal policy mix between inflation rate and unemployment rate.

1.1 Statement of the Problem

Unemployment and inflation are major determinants of socio-economic welfare in any country. It is therefore crucial to strive for both consistent low and stable prices and low unemployment. The prime objective of the Central Bank's monetary policy is to achieve price stability. It is

defined as a sustainable level of inflation that is within the medium-term objective range of 3 – 6 percent. The policy is also formulated with a view to maintain the stability of the financial system. A low and predictable level of inflation enhances savings mobilization, productive investment and international competitiveness of domestic producers, which, in turn, contribute towards the broader national objective of sustainable economic development (Bank of Botswana, 2018).

However, overall financial stability alone cannot guarantee the achievement of the ultimate macroeconomic objectives by itself (Mboweni, 2000). This is especially true as the country is facing high levels of poverty and unemployment. This has happened despite unrelenting government efforts to diversify the economy and provide employment opportunities. The country has had periods of persistent high unemployment of about 20 per cent for most of the 1990s and early parts of the new millennium (Siphambe, 2007). Unemployment has however started to decline; in 2015/16 it was estimated at 17.7 percent, a decline from 19.5 percent in 2001 (Statistics Botswana, 2013). Even though this was a decline, the unemployment rate is relatively high for a middle-income country with impressive economic performances.

On the other hand, the inflation rates have been maintained at lower rates within the objective range of 3-6%. The empirical question in terms of the Phillips Curve relationship then is: could this be the reason for the persisting high unemployment rates? This study will help determine whether the objective of low and stable inflation is not the major cause of high unemployment the country faces.

The inflation-unemployment tradeoff is, at its heart, a statement about the effects of monetary policy. It is the claim that changes in monetary policy push these two variables in opposite directions (Phililp, 2014). As the monetary announcement of an economy has an important influence on both inflation and unemployment, this paper reviews the existing literature to find out the relation between inflation and unemployment rate in Botswana with special emphasis given on the monetary announcement over a period of 1980-2015. This study not only looks into the tradeoff between inflation and unemployment, but also looks into the impact of the monetary announcement of the adoption of the 3-6% objective range by Bank of Botswana. The study can therefore help the policy makers to come up with realistic policy to manage the country's inflation and unemployment rate with the support by monetary policy.

1.2 Significance of the Study

Although the Phillips Curve has been researched extensively, there is no consensus evidence on the existence of the Phillips Curve trade-off. Therefore, the relationship between inflation and unemployment rates depicted by the Phillips Curve remains critical. As to our knowledge, limited studies have looked at the validity of the Phillips Curve and its suppositions in Botswana. In a more related study, Sediakgotla (2017) estimated the existence of the Phillips Curve using the Generalised Method of Moments (GMM) approach. The results indicated that the Phillips Curve existed in Botswana for the period 2005-2015.

In this study, we explore the existence of the Phillips Curve trade-off using the Augmented Phillips Curve model to see if the Phillips Curve still does exist with this approach. The Augmented Phillips Curve was an improvement of the traditional Phillips Curve as it takes into account the inflationary expectations, the latter could not explain the problem of stagflation. With the different approaches a better analysis can be made about the existence of the Phillips Curve trade-off. The existence of this trade-off is important especially for a developing country like Botswana. The Phillips Curve will help the policy makers to attain better knowledge and understanding to maintain appropriate levels of inflation that will not harm growth and employment. The present study intends to do both the short run and the long run analysis of the Phillips Curve, as well as through conducting the dummy variable analysis; test for the effect of the monetary policy regime switch in 2008, where Bank of Botswana adopted the medium-term inflation objective of 3-6%. The present study thus fills a gap in knowledge and contributes to the literature.

1.3 Objectives of Study

The main objective of the study is to determine the existence of Phillips Curve and examine its nature and stability for Botswana by using time series data for the period 1980-2015.

Specific objectives include:

- To estimate the short run tradeoff between inflation and unemployment (Phillips Curve).
- To estimate the long run relationship between inflation and unemployment over the last 35 years.
- To examine the effects of adoption of the 3-6% inflation objective over time (Monetary Policy regime switch)

- Provide policy recommendations on the basis of empirical results.

1.4 Statement of Hypothesis

As per the objectives, the following hypotheses were developed.

Hypothesis one**:**

H1: There is no short run tradeoff between inflation and unemployment

Hypothesis two:

H2: There is no long run relationship between inflation and unemployment

Hypothesis three:

H3: Monetary Policy regime switch over time has no impact on the relationship between inflation and unemployment.

1.5 Outline of the rest of the study

The rest of the study is organized as follows. The second chapter presents the review of the economy. Chapter Three provides the review of the existing theoretical and empirical literature relevant to this study. Chapter Four gives the methodology used for the analysis. Chapter Five presents the empirical results and analysis. Lastly, Chapter Six presents conclusions, policy implications and recommendations and potential areas of further study.

CHAPTER TWO

REVIEW OF THE ECONOMY

2.0 Introduction

This chapter discusses the monetary policy framework in Botswana, the economic performance, inflation, growth rates and unemployment trends in Botswana.

2.1 Monetary policy framework in Botswana

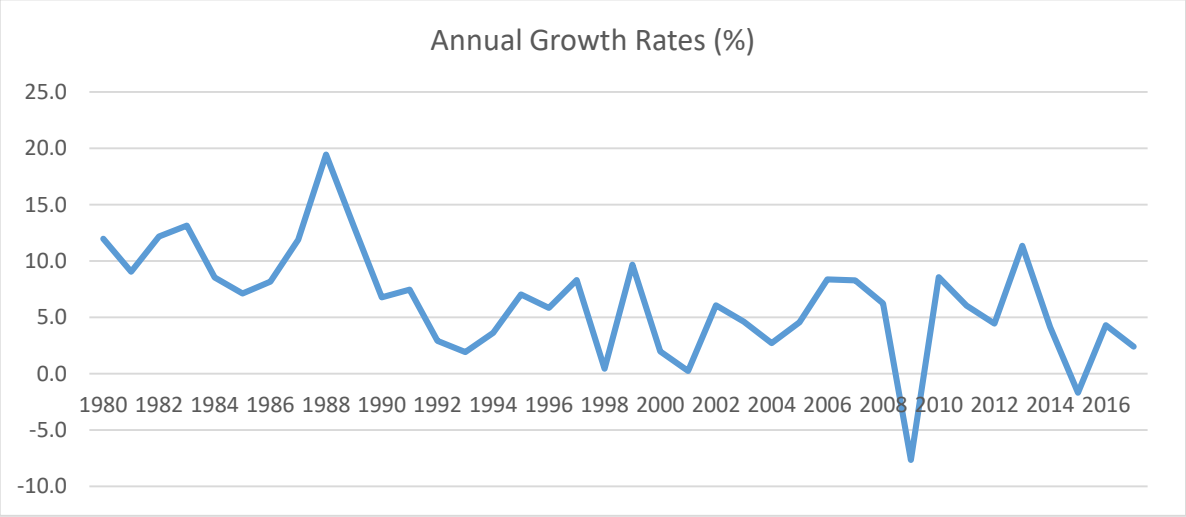
After independence in 1966, Botswana was part of the Rand Monetary Area until 1976 when it attained monetary policy independence through the Central Bank of Botswana and the (Pula). The monetary policy objective in Botswana has been reviewed to maintain price stability by ensuring low and stable rate of inflation over the medium to long term (Masalila & Phetwe, 2001).

The inflation-unemployment tradeoff is a proposition regarding the effects of monetary policy. The inflation targeting objective by the Central Bank is to maintain a medium to long-term inflation rate of 3-6 percent. This monetary policy regime switch in Botswana could have potentially affected the behavior of inflation-unemployment relationship. Botswana had a period of negative real interest rates until 1989 which might have led to reduced savings, credit growth, firms investing in capital-intensive projects and therefore increasing unemployment. In the 1980s, there was a decision to revalue the currency as an anti-inflationary measure, but the decision was later changed as it was not obtaining its objective. The Bank of Botswana was mandated with maintaining price stability since 1998. Botswana's monetary policy underwent an important transformation in 2008 when a forward-looking monetary policy framework was adopted (Sediakgotla, 2017), and the inflation objective was set at 3-6%.

2.2 Botswana's Economic Growth

The relationship between inflation, unemployment and economic growth has long been a fundamental question in economics. Unemployment and inflation have been issues of concern, mainly in developing countries like Botswana. This is because unemployment and inflation are the key macroeconomics indicators and determinants of economic growth and development which is the priority of any economy. Economic growth can be defined as the increase in the inflation- adjusted market value of the goods and services produced by an economy over time. It is conventionally measured as the percentage of increase in real gross domestic product.

Figure 1: Annual Growth Rates (Nominal)



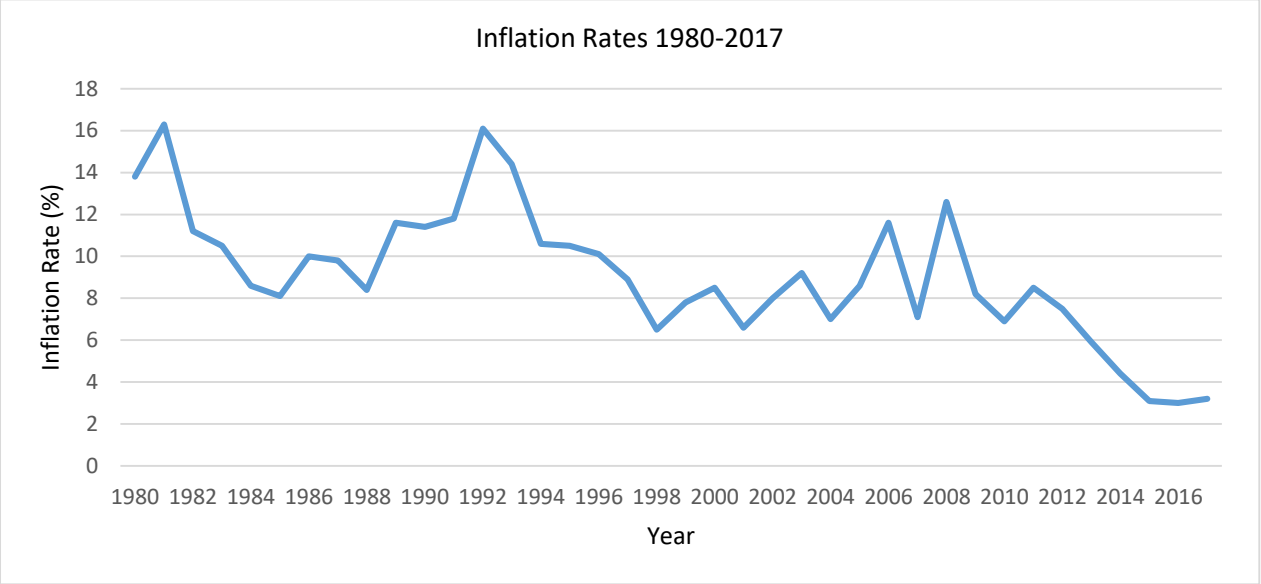
Source: World Development Indicators

From the Graph, despite the observable downward trend, it is evident that Botswana has been experiencing an impressive economic growth over the years. The negative values were hit in 2009 post the 2008 financial crisis.

2.3 Botswana's Inflation Picture

The principal objective of the Bank of Botswana's monetary policy is to attain price stability. It is reflected by a sustainable level of inflation that falls within the medium-term objective range of 3 – 6 percent (Bank of Botswana, 2018).

Figure 2: Annual inflation rates



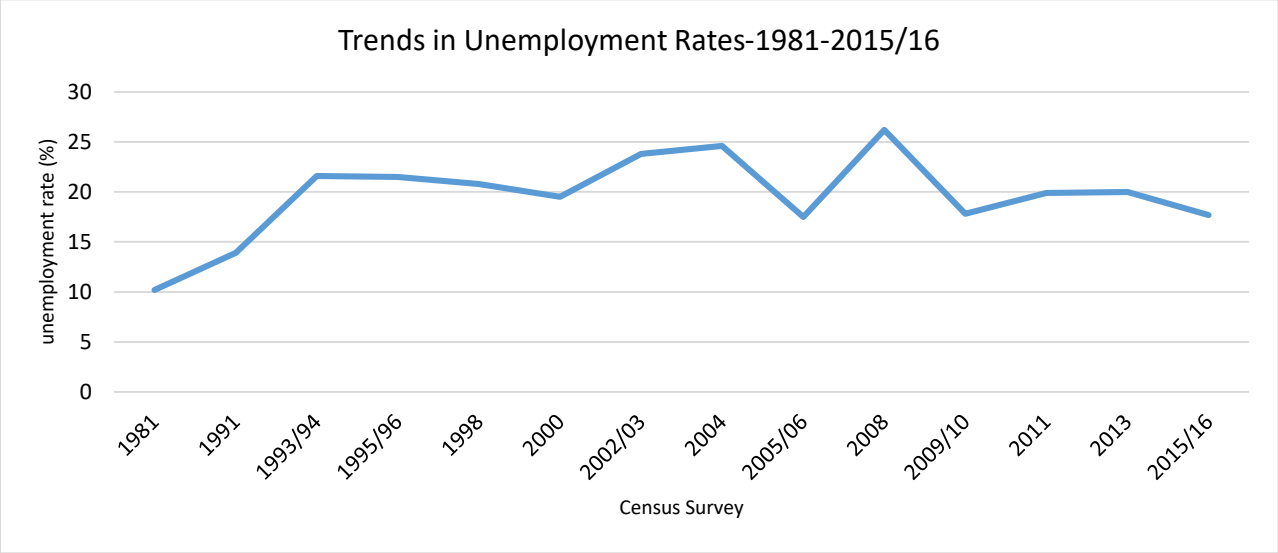
Source: Statistic Botswana and Bank of Botswana

From the Figure above, inflation in Botswana has hardly been within the desired range in the earlier years to the new millennium period. From 2013 to 2017, the inflation rates have been kept within the objective range of 3-6%, with 2015 to 2017 reaching the lower part of the range.

2.4 Trends in Unemployment Rates

Between the 1980s and the current period, unemployment rose from as low as 13 percent in 1981 to high levels of between 17 and 24 percent since the 1990s. As it can be seen from Figure 3, unemployment rate trends from 2001 to 2015/6 show that the highest unemployment rates were estimated from the Botswana Aids Impact Surveys (BAIS III and II) of 2008 and 2004, at 26.2 and 24.6 percent, respectively. Although there is an observable downward trend post the 2008 global financial crisis, the unemployment rate is still considered high. The high unemployment rates may be due to increasing labour force and sluggish job creation in Botswana. Moreover, issues like the skills mismatch may also have played a role.

Figure 3: Trends in unemployment rates- 1981 to 2015/16

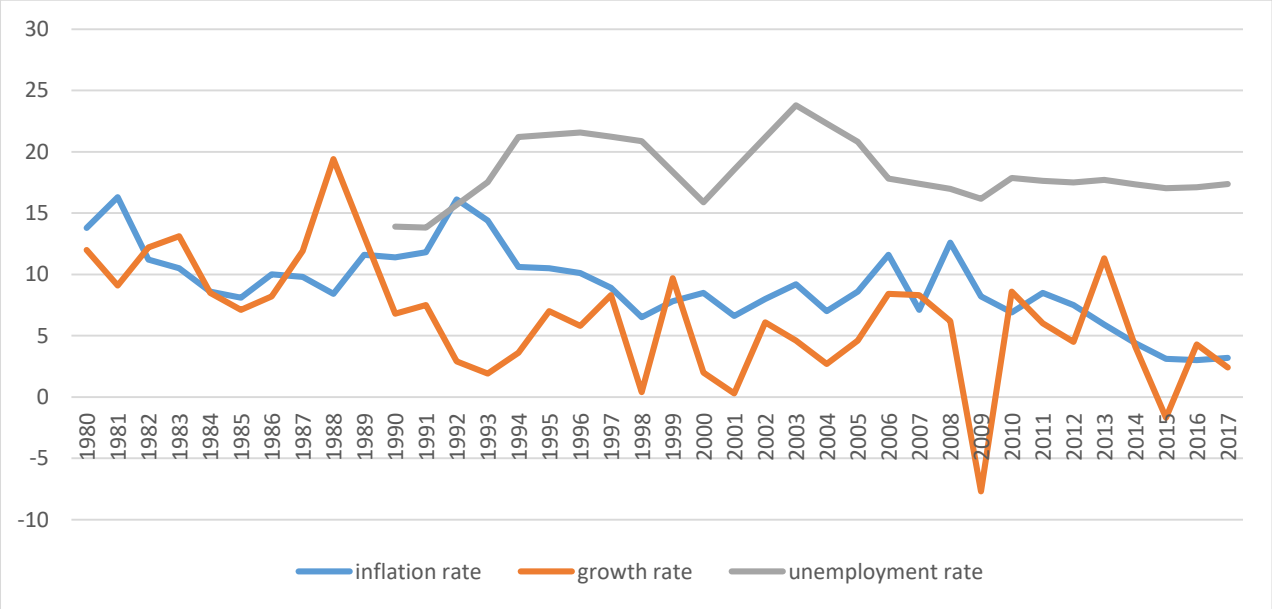


Source: Statistics Botswana

2.5 Inflation, Unemployment and Economic Growth

Unemployment and inflation are the key macroeconomic indicators and determinants of economic growth and development.

Figure 4: Trends in Inflation, Unemployment and Growth rates - 1981 to 2015/16



Source: Statistic Botswana, Bank of Botswana and World development indicators

Figure 4 shows the time series plot of inflation, unemployment and economic growth in Botswana since the 1980s. Due to the limitations in terms of data availability on unemployment, the unemployment rate line starts from 1991. This is only for purposes of giving a picture of the relationship of the three indicators. For data analysis, output gap will be used as a proxy for unemployment. As it can be quickly observed from the figure above, the economic growth is inversely related to the inflation rate. The relationship between growth rate and unemployment is observed to be an inverse relationship, with periods of increase in unemployment coinciding with decrease in economic growth. In general, the economic growth has been impressive despite the general downward trend, the unemployment rates on the other hand are quite high for a growing economy. It can be drawn from this that unemployment is affected by other factors other than a growing economy such as inflation. It could also be as a result of jobless growth that is driven by the capital-intensive mining sector. Nonetheless, a sole visual analysis is not sufficient enough to draw conclusions. The relationships have to be determined empirically.

2.6 Conclusion

The monetary policy objective in Botswana is aimed at maintaining the price stability by ensuring low and stable rate of inflation over the medium to long term. Botswana's monetary policy underwent an important transformation in 2008 when a forward-looking monetary policy framework was adopted and the inflation objective was set at 3-6%. Botswana has been experiencing an impressive economic growth over the years, the inflation rates have lowered over the years, with the achievement of the 3-6% objective range since 2013 to date. However, unemployment rates are still high, the economy has been faced with double digits over the years. Undertaking this study will shed more light in understanding the dynamics between employment, output and inflation, and how policy decisions like inflation targeting might have affected these relationships.

CHAPTER THREE

LITERATURE REVIEW

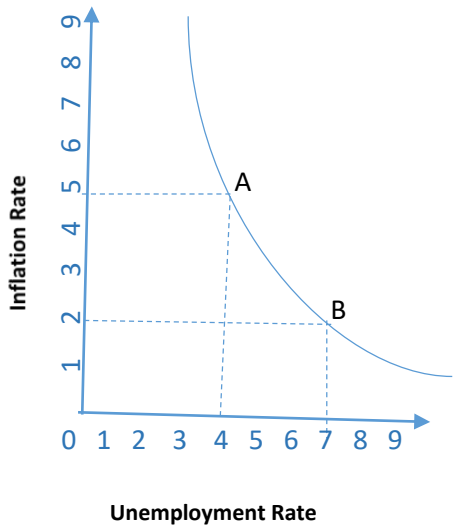
3.0 Introduction

The chapter presents the literature review, there are two sections; section 3.1 which outlines the theoretical underpinnings of the Philips Curve relationship and section 3.2 which present the empirical evidence from other studies regarding the inflation-unemployment relationship.

3.1 Theoretical Literature

The Phillips Curve notion was established by A. W. Phillips who indicated that inflation and unemployment have a stable and inverse relationship. As stated by the theory, high economic growth leads to inflation, which in turn should result in more jobs and reduced unemployment. According to Atkeson and Ohanian (2001) the idea was that, over a long historical period, a lower rate of unemployment (full employment) is associated with higher nominal wage rate. The Phillips Curve is often used to represent a possible trade-off between inflation and unemployment. In view of this, government macroeconomic policies are often presented as trying to achieve full employment and stable with low inflation. One key issue policy makers came across was a risk of increasing inflation in the state of full employment. Thus, there is the question of what level of unemployment ensures stability in price level. In as much as advanced and developing/underdeveloped countries governments seek to ensure full employment for their citizens, then they cannot do away with inflation as depicted by the Phillip's Curve.

Figure 5: Inflation - Unemployment Tradeoff



The figure above shows a simple graphical presentation of the inverse relation between wage inflation and unemployment. The Phillips Curve demonstrates a trade-off between the unemployment rate and the inflation rate; if one is higher, the other must be lower. For example, point B illustrates an unemployment rate of 7% and an inflation rate of 2%. A country aiming at full employment/ reducing unemployment (output) to 4% should expect a 3-percentage point increase in wage inflation.

Although there may be a trade-off between unemployment and inflation in the short run, the same relationship has not been observed in the long run. In 1967 and 1968, Milton Friedman and Edmund Phelps asserted that the Phillips Curve was only applicable in the short-run. Friedman then correctly predicted that in the 1973–75 recession, both inflation and unemployment would increase. The Phillips Curve in the long-run now is a vertical line at the natural rate of unemployment, which implies that inflation rate has no effect on unemployment. In recent years the slope of the Phillips Curve appears to have declined and there has been significant questioning of the usefulness of the Phillips Curve in predicting inflation. Nonetheless, the Phillips Curve remains the conventional framework for inflation forecasts used in central banks (Ferreira & Palma 2015).

However, economic events in the US economy in the 1970s undermined the predictions and recommendations of the Phillips Curve model. Oil shocks resulted in high inflation and, according to the Keynesian model, unemployment was supposed to fall (Govera, 2017). Economists like Milton Friedman and Edmund Phelps later disapproved the Phillips Curve

supposition, stating that the inflation-unemployment tradeoff only occurred in the short-run and that in the long-run, the Phillips Curve is a vertical line thus the introduction of the Natural Rate Hypothesis. Also, studies undertaken by other economists over the years, have in one way or the other challenged the validity of the inflation-unemployment trade-off thesis as postulated by Phillips. Both high inflation rates and high unemployment rates were found to co-exist, giving rise to what has come to be known as stagflation (Kasseh PA, 2018).

In response to this empirical breakdown of the relationship, newer forms of the Phillips Curve were created. These include, among others, the natural rate hypothesis established by Friedman (1968) and Phelps (1967; 1970), and the expectations augmented and New-Keynesian Phillips Curves (NKPC). The NKPC model of inflation was based on an assumption about rational future expectations (Rudd and Whelan, 2005). The NKPC states that inflation is the expectations of future inflations that firms hold today and the excess demand or marginal cost (Hanson, 2017). The model however was criticized for not being able to explain the dynamic effects of monetary policy on inflation and output and the failure to model the dynamic impact of monetary policymaking on the economy (Govera, 2017). This inability of the purely forward-looking NKPC model gave rise to many questions as to what other factors actually contribute to the causes of inflation aside from the NKPC model specification. In light of these shortcomings, the hybrid new Keynesian Phillip's curve was proposed.

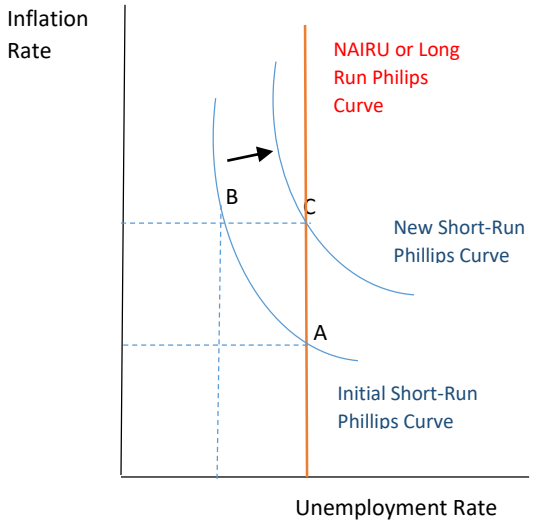
The hybrid NKPC is an extension of the NKPC by Gali & Gertler (1999) built on the purely Forward-looking NKPC. It is a model of inflation that allows a fraction of firms to use a backward– looking rule to set prices while the remaining firms' prices are unchanged. Thus, the unanswered question regarding the role of persistence of inflation in the NKPC model is what the hybrid NKPC manages to capture or represent by incorporating the backward-looking term (inflation lag).

NAIRU and Rational Expectations

In the 1970s, new theories, such as rational expectations and the NAIRU (non-accelerating inflation rate of unemployment) arose to explain how stagflation could occur. The latter theory, also known as the natural rate of unemployment, distinguished between the short-term Phillips Curve and the long-term one. The short-term Phillips Curve looked like a normal Phillips Curve, but shifted in the long run as expectations changed. In the long run, only a single rate of unemployment (the NAIRU or "natural" rate) was consistent with a stable inflation rate. The

long-run Phillips Curve was thus vertical, so there was no trade-off between inflation and unemployment.

Figure 6: The NAIRU



In the figure 6 above, the long-run Phillips Curve is shown by the orange vertical line. The NAIRU theory states that when unemployment is at the rate defined by this line, inflation will be stable. However, in the short-run, policymakers will face an inflation-unemployment trade-off marked by the initial short-run Phillips Curve in the graph. Policymakers can therefore decrease the unemployment rate temporarily, moving from point A to point B through expansionary economic policies. However, according to the NAIRU, exploiting this short-run trade-off will raise inflation expectations, shifting the short-run curve outward to the new short-run Phillips Curve and moving from B to C. Thus, the reduction in unemployment below the natural rate will be temporary, and lead only to higher inflation in the long run.

Since the short-run curve shifts outwards due to the effort to decrease unemployment, the expansionary policy in the long run worsens the inflation-unemployment trade off. That is, it results in more inflation at each short-run unemployment rate. The name NAIRU arises because with actual unemployment below the non-accelerating inflation rate of unemployment, inflation accelerates, whereas with unemployment above it, inflation decelerates. With the actual rate equal to it, inflation is stable. One practical use of this model was to provide an explanation for stagflation, which condemned the traditional Phillips Curve.

Since the rational expectations are informed predictions of future events, they are essentially the same as the predictions of the relevant economic theory (Muth, 1961). This sequentially implied that the short-run period was so short that it was non-existent. Any effort to reduce unemployment below the NAIRU, for example, would straightaway cause inflationary expectations to increase and thus suggest that the policy would be unsuccessful. Unemployment would never depart from the NAIRU except attributable to random and transient mistakes in developing expectations about future inflation rates. In this regard, any deviation of the actual unemployment rate from the NAIRU was a misconception.

One of the implications of a vertical long-run Phillips Curve is that inflation may be non-stationary with multiple long-run rates of inflation (Russell & Banerjee, 2006). The argument that the original Phillips Curve 'broke down' in the late 1960s and early 1970s implies that the expected rate of inflation had changed due to a change in the long-run rate of inflation. Therefore, the 'breakdown' was due to a period where inflation was non-stationary. Consequently, the issue of how rapidly expectations of inflation adjust to changes in the long-run rate of inflation came to be a crucial element of the debate surrounding adaptive and rational expectations. Sala & Karanassou (2009), Islam & Mustafa (2007), Furuoka, et.al (2013), Ikechukwu & Imoh (2015) etc, found evidence of the long run inverse relationship between inflation and unemployment. The direction of the causality in the Phillips Curve relationship remains inconclusive. Thus, whether or not a long-run inflation-unemployment trade-off exists should be left to empirical tests using appropriate tools.

3.2 Empirical Literature

The attainment of price stability largely hinges on a clear understanding of inflation dynamics and appropriate conduct of monetary policy (Sediakgotla, 2017). There have been many empirical studies on whether there exists inflation unemployment trade-off. The results of these empirical studies on Phillips Curve are not consistent. This diversity in empirical results may be because of differences in time frame, used techniques and financial systems (Karahan & Uslu, 2018).

3.2.1 Empirical Evidence on Developed Countries

Islam & Mustafa (2017) using monthly and annual data observed a clear long run trade-off between inflation and the rate of unemployment for Hungary. The study employed the structured cointegration approach and vector error correction model.

Kitov & Kitov (2013) study on inflation, unemployment and labour force dynamics in Japan for the period 1980-2003 used the traditional Phillips Curve approach to make long-term projections of the variables. The study found out that the increase in unemployment resulted in decreasing inflation, confirming the concept of the Phillips Curve in its original form.

Bhattari (2016), carried out a study on the 35 OECD countries on the relationship between inflation and unemployment. Country specific regressions in fixed and random effect panel data models were used and in a panel VAR model for 1990 to 2014. While rates of unemployment varied significantly among these economies, rates of inflation had stabilized at lower rates as a result of inflation targeting policies adopted in these countries during the last two decades. Co-integration and Granger causality tests were used and the results suggested that there was a long run relationship between inflation and unemployment. Of the 28 out of 35 countries, the Phillips Curve phenomena were empirically significant. The results provided econometric evidence on empirical significance of Phillips Curve in 28 out of 35 OECD countries separately and in the panel of 40 advanced economies based on quarterly time series. Country specific supply curves and Okun curves are consistent to the Phillips Curve relations. However, the trade-offs were more significant in countries such as Australia, Denmark, France, Italy, Netherlands, Spain, New Zealand, the UK and the USA. While there was no evidence found in some countries such as Austria, Germany, Israel and Norway and even positive counterintuitive relations were found for Korea, Russian and Slovak Republic.

Sala & Karanassou (2009) established the long run relationship between inflation and unemployment in the USA economy for the period 1960-2005. The study employed structural vector autoregression (SVAR) and generalised method of moments (GMM) models. The study confirmed the existence of the long-run inflation-unemployment trade-off in the USA.

3.2.3 Empirical Evidence on Developing Countries

Tony (2013), normalized cointegration equation showed that unemployment gap has a long-run positive feedback on the changes in inflation rate. This is consistent with Lucas Critique where a policy of inflation would fail to reduce unemployment rate in the long run, because workers would eventually adjust their expectation.

Maduku & Kaseeram (2018) analysed the relationship between inflation targeting monetary policy and unemployment in South Africa. The study found the evidence of the negative long-run relationship between inflation and unemployment. It employed the ARDL method.

Islam et al., (2007) estimated the existence and the stability of the Phillips Curve in the North Cyprus using time series data. The study found that the Phillips Curve existed in both the long run and short run; it employed the ARDL and DOLS approaches.

Okpe, et.al (2015) analyzed the empirical relationship between inflation and unemployment in the Ghanaian economy. Using data for the period of 1990 to 2014, the research employed Co-Integration Regression, Causality, and Correlation and Sensitivity analysis. This was to explain the empirical relationship between inflation and unemployment as well as determine the sensitivity of unemployment to changing inflation levels. The variables used were tax rate, compensation of employees, labour force participation and tertiary school enrollment as indicators of unemployment. The results confirmed a significant but positive relationship between unemployment and inflation in Ghana. This is inconsistent with theory; it implies that low inflation cannot be attained by increasing unemployment. The author attributed this to the errors in inflation data.

Furuoka, et.al (2013) study was aimed at finding out whether the Phillips Curve relationship existed in the Philippines during the period 1980-2010. The study employed the dynamic ordinary least squares (DOLS) method and the Hodrick-Prescott filter. The study found that the Phillips Curve existed in the Philippines for the period under review.

Ikechukwu & Imoh (2015) did a study with the objective to evaluate the short and long run impact of unemployment on inflation in Nigeria. The study used time series data from 1970-2013.The Ordinary Least Square Method (OLS) and Generalized Least Square (GLS) were employed. The theoretical framework for analysis was the Phillip`s Curve model and Koyck`s transformation was used to factor in expectations into the Phillip`s Curve model. The study found evidence of inflation-unemployment tradeoff in both the short run and long run

Govera (2017) studied the relationship between inflation and unemployment in South Africa for the period 1994-2015. The study employed a Hybrid New Keynesian Phillips Curve (HNKPC) and various econometric techniques. The Vector Error Correction Model was derived and estimated to examine both short-run and long-run relationships among the variables. The study found no evidence of the tradeoff between inflation and unemployment.

Anning, et.al (2017) study was aimed at investigating the impact of inflation and unemployment on the economic growth of Iraq and found out that there exists an equilibrium impact between unemployment and inflation, which supports the validity of the Phillips Curve hypothesis. Anning, et.al (2017) study used the VAR approach model.

Singh (2016) estimated the short-run tradeoff between inflation and unemployment for the Indian economy over the period 2009-2015. The findings of the study verified the influential relationship between unemployment and inflation conditions, as well as unemployment and real GDP.

3.2.4 Empirical Evidence from Botswana

There are very few studies on the existence of the Phillip's Curve in Botswana from the list of those published and from any other studies. The more related study was done by Sediakgotla (2017). Sediakgotla (2017) study investigated the short run inflation dynamics in Botswana by way of the hybrid new Keynesian Phillips Curve using quarterly data for the period 2005:1-2015:1. The study employed the Generalised Method of Moments (GMM) approach. The study found that the hybrid Phillips Curve exists for Botswana. Unlike the Sediakgotla (2017) study which only examined the short run relations, this study is examining the long run relationship between inflation and unemployment covering the period 1980 to 2015.

Given the long period, the proposed study examines if there were any effects of regime switch in terms of monetary policy over time, which could have influenced the findings of the Sediakgotla (2017) study. For instance, Karahan (2018) found out that the effect of unemployment on inflation significantly increased after the implementation of inflation targeting regime in 2002 in Turkey. A significant long run relationship between inflation and unemployment can thus be used as a tool to ensure price stability in the long run for the Botswana economy, hence better forecasting.

3.3 Conclusion

From the review of both theoretical and empirical literature it is evident that the results of the studies on Phillips Curve are not consistent. While some found the existence of both the long run and short run Phillips Curves in their studies, some found the tradeoff only in either the long run or short run, while others found no evidence at all. This diversity in empirical results may be because of differences in time frame, used techniques and financial systems (Karahan & Uslu, 2018). The previous study in Botswana, Sediakgotla (2017), identified the Phillips Curve relationship to be existent in the short run. This study is expected to examine the existence of the inflation-unemployment relationship both in the long and short run.

CHAPTER FOUR

EMPIRICAL MODEL SPECIFICATION AND ESTIMATION TECHNIQUES

4.0 Introduction

This chapter explains in detail the research methodology used in this study. It discusses the estimation techniques employed to investigate inflation-unemployment nexus in Botswana. The chapter is segregated into 3 sections, namely, i) empirical model specification, ii) estimation techniques including; different types of unit root test employed in the study which are ADF, PP and DF-GLS tests; ARDL bounds test for cointegration, autoregressive distributed lag (ARDL) Error correction model and lastly iii) diagnostic tests.

4.1 Empirical Model Specification

The empirical literature reviewed provides mixed results on the relationship between unemployment and inflation. Some conclude on the existence of the Phillips Curve trade-off both in the long run and short run, while the other evidence suggests absence of a significant trade-off between unemployment and inflation.

In order to formulate model specification for inflation – unemployment nexus, the study starts by employing the Phillips (1958) argument that unemployment level together with rate of change in unemployment rate explains the change in price levels (inflation). From his analysis Phillips suggested that inflation rates tend to be high when there are low levels of unemployment. On the other hand, high level of unemployment is associated with low inflation rates, thus there exists a negative relationship between the two.

Although several literature including that of (Balaban & Vintu, 2010; Corrado & Holly, 2003) suggest a non-linear relationship between unemployment and inflation, Bhattarai (2016) and Blanchard (2016) in his Policy Brief suggested a linear relationship between inflation and unemployment. The current study follows the latter, and the first bivariate model specification is as follows;

Model 1

$$Inf_t = \beta_1 + \beta_2 Y_t + \beta_3 D + \varepsilon_t \quad (1)$$

Following this bivariate model, this study then follows previous studies by adding other determinants of inflation to set up other four multivariate models, to make the findings robust. The Sediakgotla (2017) study estimated a GMM model with the non-mining output gap, nominal effective exchange rate, M2 and interest rate and found evidence of the short run Phillips Curve trade off. This study follows a modified version of the above approach in that, in addition to establishing the short run relationship of the variables using the GMM, a long run relationship is estimated using the ARDL method. Furthermore, additional variables like real GDP and import prices are included unlike the above noted study. The variables have been found to be significant in determining inflation, according to the literature e.g. Taye (2013) found GDP to have a significant impact on inflation.

The basic model is extended to include other variables that previous studies have found to affect inflation. The variables are included to capture the macroeconomic variables, policies and circumstances peculiar to Botswana. The following models include the above-mentioned control variables and they are specified as follows.

Model 2

$$Inf_t = \beta_1 + \beta_2 y_t + \beta_3 y_t X + \beta_4 D + \varepsilon_t \quad (2)$$

Model 3

$$Inf_t = \beta_1 + \beta_2 y_t + \beta_3 IM + \beta_4 Int + \beta_5 D + \varepsilon_t \quad (3)$$

Model 4

$$Inf_t = \beta_1 + \beta_2 y_t + \beta_3 IM + \beta_4 Int + \beta_5 GDP + \beta_6 D + \varepsilon_t \quad (4)$$

Model 5

$$Inf_t = \beta_1 + \beta_2 y_t + \beta_3 IM + \beta_4 Int + \beta_5 GDP + \beta_6 MS + \beta_7 RER + \beta_7 D + \varepsilon_t \quad (5)$$

Where Inf is inflation rate, y_t is output gap representing unemployment, IM is import prices, Int is interest rates, GDP is real domestic product growth, MS is money supply, RER is real exchange rate and D is the dummy variable accounting for 2009 global financial crisis and monetary policy regime switch. D=0 to capture time before the policy switch and D=1 for capture time after policy switch.

4.1.1 Definition of Variables (The explanatory Variables)

Output Gap (y):

The study used output gap as a proxy for unemployment since there is no time series data on unemployment rate in Botswana. The output gap is calculated as the difference between the actual level of output and its potential. It is estimated using the method proposed by Hodrick and Prescott (1997) (Khalid & Marwan, 2012). Output gap is considered to be a good indicator as it has a significant impact on inflation; a positive output gap commonly spurs inflation in the economy because the cost of goods and labour increase as a result of increased demand. Alternatively, a negative output gap reflects a lack of demand for goods and services in an economy and therefore a fall in wages and prices of goods. Output gap has been chosen as the best proxy for unemployment because the two have been found to be closely related, although not identical, they tend to be used interchangeably. Deviations of unemployment from the NAIRU are associated with deviations of output from its potential level (Jahan & Mahmud, 2013). The economist, Arthur Okun, also discovered a strong empirical relationship between output growth and changes in the unemployment rate, (Owyang, et.al 2013). Output gap is expected to have a positive sign since increases in the gap indicate that the economy is operating above capacity.

Real Gross Domestic Product (GDP):

Taye (2013) results show that economic activity /domestic output has significant impact on the inflation of Botswana. According to Taye (2013), real GDP is an important variable both in the short run and long run; it exerts a negative relationship between inflation and GDP. Microeconomics theory through the Law of Supply and Demand posits that an increase in availability of goods and services is expected to lower prices when demand is unchanged.

Interest Rates (Int):

Another variable that is expected to affect inflation is nominal interest rate, defined as cost of credit. It is expected to have a negative effect on inflation in the sense that higher interest rate affect borrowing, hence negative impact on spending and Aggregate demand.

Import prices (IM):

Import prices are included in the model as a measure of the cost of goods and services bought by local residents from a foreign country which could include either final products destined for final consumption or intermediate products that are further processed or manufactured into final consumable products. The coefficient of import prices is expected to be positive and statistically significant (Madito & Odhiambo, 2018). This is because high import prices result in price hikes in the domestic markets of net importers of commodities.

Broad Money Supply (MS):

The variable broad money supply plays a role in influencing domestic inflation; it is expected to have a positive sign as it is a potential source of inflation (Taye, 2013). Money Supply will increase the price level through an increase in the demand for goods and services in the economy (Alam, Q., 2016; Alam, S., 2016).

Real Exchange Rate (REER):

Another variable that is expected to affect inflation is the real exchange rate. In Arshad & Ali (2016) study, the exchange rate coefficient depicts negative and significant relationship with inflation rate. The exchange rate variable is expected to have a negative sign because the exchange rate is defined such that an increase in the variable represents an appreciation of the Pula. When the Pula appreciates, imported inflation should decline which, in turn, would result in lower domestic inflation.

4.2 Estimation Techniques

4.2.1 Unit Root Testing

A variable is said to be stationary if it is in a state of statistical equilibrium, meaning that the data fluctuates about the mean or constant level. Furthermore, a time series is stationary if its statistical properties do not depend on time. In other words, the time series has constant moments over time. Moments include the mean, covariance, skewness, kurtosis and variance; these are constant over time. A variable is said to be non-stationary if it has time-varying mean or time-varying variance or both (Enders, 2014; Greene, 2012). It is mandatory to check for stationarity of time series variables before estimating a regression model because if time series data is nonstationary, characteristics of that data can only be studied under that particular time period specified in the

study and as a result such model presents forecasting challenges. Nonstationary time series data can also result in spurious regression, even if the sample size is large (Greene, 2012).

One of the key advantages about using ARDL is that it allows dealing with both stationary and non-stationary variables, provided that the order of integration is not more than one. ARDL also ensures more consistent estimates even in small samples (Pesaran et al, 1999). Although unit root testing is not a pre-requisite for ARDL, it is still performed to check if time series employed in this study is suitable for the model since it has allowance for variables that has unit root 1 going downwards. Therefore, this study undertakes 3-unit root tests to investigate the stationarity of variables used, firstly the Augmented Dickey Fuller test, followed by the Philips Peron test and lastly the Dickey-Fuller Generalized Least Squares.

The reason for choosing to run three separate tests is because of the lower power of the various unit root tests. According to Enders (2014) and Koop (2000), some of the tests do not have the power to distinguish between a unit root and a near unit root process. It is likely that such a test will indicate that a series contains a unit root. If a variable is found to have a unit root by ADF, but no unit root by Phillips-Perron, then we can conclude that ADF has low power, hence cannot distinguish between a unit root and a near unit root process. In such a case, the author will declare that variable as stationary (non-unit root process).

4.2.2 Augmented Dickey Fuller Test

Augmented Dickey Fuller (ADF) test was introduced to robust unit root test results produced by the original Dickey-Fuller (DF) test. The basic assumption of the Dickey and Fuller (1981) unit root test is that the error terms are assumed to be independently and identically distributed (*iid*) (Makuria, (2013). The ADF test adjusts the DF test by adding lags of the dependent variable to generate *iid* errors in the model, the ADF regression test is specified as follows:

$$\Delta y_t = \propto + \delta T + \beta y_{t-1} + \sum_{i=1}^{k} \sigma \Delta y_{t-1} + e_t \qquad (6)$$

Where y_t represents time series,Δ is a first difference operator and $\propto$ is a constant. The null hypothesis for this unit root test is such that $H_0: B = 0$, tested against the alternative of stationary process of $H_0: B < 0$.

4.2.3 Philips Peron

The Phillips and Perron (1988) unit root test is the alternative approach that allows for non *iid* errors in the model. This test has become popular in analysis of financial time series for its robustness to general forms of heteroscedasticity. The main difference between PP test and ADF test is how they deal with serial correlation and heteroscedasticity of errors, the test is robust to general forms of heteroscedasticity, also unlike on the ADF test, there is no need for lag specifications. The test regression for PP test is specified as follows

$$\Delta y_t = \beta D_t + \pi y_t + u_t \quad (7)$$

4.2.4 Dickey-Fuller Generalised Least Square (DF-GLS)

DF-GLS test is another form of unit root testing that involves detrending of variables before running ADF regression model. It is its quality of the power in the presence of unknown mean or trend that makes it more preferred than the above two models by most researchers. Nyasha, (2014) explains it to be "an adapted version of the conventional Augmented Dickey-Fuller (ADF) t-test".

4.2.5 Cointegration Test: Autoregressive Distributed Lag (ARDL) Bounds Testing Approach

Before performance of the bounds testing for cointegration, the optimal lag of each of the estimated ARDL regressions is chosen through the minimization of the Schwarz Criterion (SC) information criterion. This study utilises bounds testing approach by Pesaran and Shin (1999), and later extended by Pesaran *et al*. (2001) to examine the cointegration of inflation and unemployment.

ARDL approach comes at the top of the rank when compared to other conventional approaches to cointegration because of its advantages over others. Firstly, unlike other approaches, ARDL approach does not require variables under investigation to be integrated of the same order, thus it works with variables of both order one (I (1)) and order zero (I (0)). ARDL is also convenient since it employs a single reduced form equation instead of estimating long run relationship within a context of a system of equations. Other advantages include the fact that ARDL allows for small samples unlike other models.

The ARDL bounds test as postulated by Pesaran *et al* (2001) consists of the following steps:

Step 1: Estimate the error correction model as follows;

Model 1

$$\Delta inf = \propto_{10} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-1} + \partial_1 inf_{t-1} + \partial_2 Y_{t-1} + U_{1t}$$

Model 2

$$\Delta inf = \propto_{20} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-1} + \partial_1 inf_{t-1} + \partial_2 Y_{t-1} + \partial_3 IM_{t-1} + U_{2t}$$

Model 3

$$\Delta inf = \propto_{30} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-1} + \sum_{i=1}^{n} \beta_{4i} \Delta int_{t-1} + \partial_1 inf_{t-1} + \partial_2 Y_{t-1} + \partial_3 IM_{t-1} + \partial_4 int_{t-1} + U_{3t}$$

Model 4

$$\Delta inf = \propto_{40} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-1} + \sum_{i=1}^{n} \beta_{4i} \Delta int_{t-1} + \sum_{i=1}^{n} \beta_{5i} \Delta gdp_{t-1} + \partial_1 inf_{t-1} + \partial_2 Y_{t-1} + \partial_3 IM_{t-1} + \partial_4 int_{t-1} + \partial_5 gdp_{t-1} + \partial_6 D_{t-1} + U_{4t}$$

Model 5

$$\Delta inf = \propto_{50} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-1} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-1} + \sum_{i=1}^{n} \beta_{4i} \Delta int_{t-1} + \sum_{i=1}^{n} \beta_{5i} \Delta gdp_{t-1} + \sum_{i=1}^{n} \beta_{6i} \Delta MS_{t-1} + \sum_{i=1}^{n} \beta_{7i} \Delta RER_{t-1} + \partial_1 inf_{t-1} + \partial_2 Y_{t-1} + \partial_3 IM_{t-1} + \partial_4 int_{t-1} + \partial_5 gdp_{t-1} + \partial_6 MS_{t-1} + \partial_7 RER_{t-i} + U_{5t}$$

Where Δ denotes first difference operator, n is the lag length; $\propto_j$, j=1, 2, …, 5 are constant terms, $\beta_{1i}, \dots, \beta_{7i}$ and $\partial_1, \dots, \partial_{7i}$ are short run and long run coefficients respectively.

Step 2: Compute the Wald or F-statistics for testing the null hypothesis. For instance, to test for cointegration for model, the Bounds tests the null hypothesis of no cointegration:

H_0: $\partial_1 = \partial_2 = \partial_3 = \partial_4 = \partial_5 = \partial_6 = \partial_7$

Against the alternative hypothesis of cointegration:

H_1: At least one of the ∂'s $\neq 0$

Cointegration effects are evaluated through the use of computed Wald or F-statistic and critical values by Pesaran *et al* (2001). The null hypothesis is rejected if the computed F-statistic than the upper bound of the critical values. If the F-statistic turns out to be less the lower bound of the critical level, the null hypothesis will not be rejected. In other words, the author will fail to reject the null hypothesis. However, should the computed F-statistic take values of the range between lower and upper bound of the critical values, the test is considered to be inconclusive.

If the Bounds test indicates cointegration, then the following Error Correction Models (ECM) in the form of ARDL equations are estimated:

Model 1

$$\Delta inf = \propto_{10} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \emptyset_1 ECT_{t-1} + \pi_1 D + U_{1t}$$

Model 2

$$\Delta inf = \propto_{20} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-i} + \emptyset_2 ECT_{t-1} + \pi_2 D + U_{2t}$$

Model 3

$$\Delta inf = \propto_{30} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta int_{t-i} + \emptyset_3 ECT_{t-1} + \pi_3 D + U_{3t}$$

Model 4

$$\Delta inf = \propto_{40} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta int_{t-i} + \sum_{i=1}^{n} \beta_{5i} \Delta gdp_{t-i} + \emptyset_4 ECT_{t-1} + \pi_4 D + U_{4t}$$

Model 5

$$\Delta inf = \propto_{50} + \sum_{i=1}^{n} \beta_{1i} \Delta inf_{t-i} + \sum_{i=1}^{n} \beta_{2i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{3i} \Delta IM_{t-i} + \sum_{i=1}^{n} \beta_{4i} \Delta int_{t-i} + \sum_{i=1}^{n} \beta_{5i} \Delta gdp_{t-i} + \sum_{i=1}^{n} \beta_{6i} \Delta MS_{t-i} + \sum_{i=1}^{n} \beta_{7i} \Delta RER_{t-i} + \emptyset_5 ECT_{t-1} + \pi_5 D + U_{5t}$$

Again where Δ denotes first difference operator, n is the lag length; $\propto_j$, j=1, 2, …, 5 are constant terms, $\beta_{1i}, \dots, \beta_{7i}$ are short run coefficients; ECT_{t-1} is the error correction term with coefficients

$\emptyset_j, j = 1, 2, \ldots, 5$ represent the speed of adjustment towards the long run equilibrium path subsequent to a shock in the system. Short run coefficients provide analysis of the short run effects of exogenous variables, output gap and control variables on the dependent variable on inflation. The long run relationship is indicated by the error correction term.

4.3 Diagnostic Testing

4.3.1 Normality

This study uses the Jacque- Bera test to check for normality diagnostic. Jack- Bera test is a goodness of fit test that was invented by Jarque and Bera (1987). This test was well accepted around the world by a lot of econometricians and since then it has been playing a very vital role in statistical application to test for normality.

The test statistic formula is shown below;

$$JB = n\left[\frac{s^2}{6} + \frac{k-3^2}{24}\right] \quad (8)$$

Where n is the sample size; s is skewness and k is kurtosis. The Jarque–Bera test statistic follows the chi square distribution with two degrees of freedom (Jarque and Bera 1987). Hypothesis testing for normality is such that the null hypothesis assumes normality of residuals, insignificant p value hinders us from rejecting the null, hence concluding that there is normal distribution of data.

4.3.2 Serial Correlation

This study makes use of the Godfrey LM developed by Breusch (1978) and Godfrey (1978). This test can be explained using two variable model where Y_t is a dependent variable, and x_t is exogenous.

$$Y_t = \beta_1 + \beta_2 X_t + e_t \quad (9)$$

Assuming the error term follows AR(P) such that

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \varepsilon_t \quad (10)$$

Residuals are then explained explanatory variables X_t, and lagged value of residuals themselves, as shown below;

$$\mu_t = \alpha_1 + \alpha_2 X_t + \rho_1 u_{t-1} + \rho_2 u_{t-2} + \cdots + \rho_p u_{t-p} + \varepsilon_t \quad (11)$$

From this auxiliary equation, null hypothesis for the equation can be tested as H_0: $\rho_1 = \rho_2 = \cdots = \rho_\rho$=0, implying there is no serial correlation.

The langrage multiplier for Breush –Godfery test is specified as follows

$$LM = (n-p)R^2 \quad (12)$$

Where R^2 is derived from the auxiliary equation, n is the sample size and p is the number of lags. If the LM statistic exceeds the critical values of chi square at a given level of significance, then the null hypothesis will be rejected.

4.3.3 Ramsey (1969) Regression Specification Error Test

RESET test was developed by Ramsey (1969) to detect omitted variables and incorrect functional form in the linear regression model. Assumption 9, is that the regression model used in the analysis is correctly specified, if the model is not correctly specified, we encounter the problem of model specification error. The RESET test is conducted as follows:

1. Firstly, estimate Y using OLS and predict its values, which is $\hat{Y}$ from the selected model
2. Add the powers of $\hat{Y}$, such as $\hat{Y}^2$ and $\hat{Y}^3$ to the selected model and rerun it again to capture the systematic relationship between the residuals and estimated Y

$$Y = \beta_1 + \beta_2 X_t + \beta_3 \hat{Y}^2{}_t + \beta_4 \hat{Y}^3{}_t + v_t \quad (13)$$

Where v_t is the error term

3. Let R^2 obtained from the first model be R^2(o) and R^2 (1) obtained from the second model, then use the F test equation to find out if the increase in R^2 is statistically significant.

$$F = \frac{\frac{R^2(1) - R^2(0)}{number\ of\ new\ regressors}}{\frac{1-R^2(1)}{n-k}} \quad (14)$$

Where n is number of observations and k is the number of parameters in the new model.

4. If the F value is statistically significant at the chosen level of significance, then it can be concluded that the first model was miss-specified.

4.3.4 Lag Selection Criterion

The optimal lag of each of the estimated ARDL regressions is chosen through the minimization of the Schwarz Criterion(SC) information criterion. All regressions point to an optimal lag of 1 on the dependent variables and 0 lags on the independent variable.

4.4 Conclusion

Empirical models used in the study together with the theories underpinning the models were thoroughly discussed in this chapter. The study makes use of the Autoregressive Distributed Lags model and graphical trend analysis to carry out the aforementioned objectives. The Augmented Dickey Fuller (ADF) test, Dickey-Fuller Generalized Least Square (DF-GLS) and the Phillips-Peron (PP) test are employed to gauge the stationarity of variables. All the models discussed here are used in the next chapter for estimations and interpretation.

CHAPTER FIVE

EMPIRICAL ANALYSIS AND RESULTS

5.0 Introduction

This chapter presents an econometric analysis and empirical findings on Phillip's Curve using Botswana data and methodology discussed in the previous section. This study employs ARDL bounds testing approach to examine the relationship between unemployment and inflation. Output gap is used as a proxy of unemployment due to unavailability of time series data on unemployment in Botswana. There are 5 models presented in this study. The first model is a bivariate investigation between unemployment and inflation. The next 4 models consist of different combination of control variables.

5.1 Summary Statistics, Data Description and Correlation Matrix

Table 1 presents summary statistics of the time series data used in the study. We note that the mean of all variables is within the minimum and maximum values of the respective variables, this to an extent suggests normal distribution of the time series. Jaque-Bera statistics conform to normal distribution of the variables with the sole exception of the dummy variable which is technically not an inflation determinant. We also note the lowest output gap of -11.62% for the year 1993. This implies that we had the highest unemployment rate of all time of the duration of the study in 1993. This corresponds to figure 2 in chapter 3 observations on the graph where we can spot unemployment at its peak. The reported standard deviations indicate high volatility on the variables especially on import prices, followed by money supply.

Table 1: Descriptive Analysis

symbol	Median	Obs.	Mean	min	max	Std. dev	j-b
Inflation	8.60000	38	9.11315	3.000000	16.30000	3.191473	0.227001
Real_gdp	13.26339	38	14.16959	3.830327	30.84274	5.770138	16.39339
Output_gap	0.661865	38	0.449377	-11.62733	9.310623	4.489959	2.157564
Rer	1.003274	38	1.025210	0.820203	1.410751	0.152026	2.805780
Nominal_int_rates	13.51500	38	12.70105	6.880000	24.21000	3.614065	2.899707
Import_value_index	91.83566	38	141.3040	27.21329	401.3468	115.8914	7.155037
Broad MS	28.82533	38	33.82808	19.79454	52.70287	10.69555	3.825026
Dummy	0	38	0.026316	0	1	0.16221	1948.913

Source: Author's computation

The correlation matrix of the variables used in the study is presented in Table 2. Here we note a positive inflation-growth correlation and a negative money supply-inflation correlation which is contrary to economic theory. However, a positive inflation-growth correlation in Botswana has already been established by Mothuti and Phiri (2018). A positive correlation between output gap and inflation conforms to Phillips (1958) theory that there is a negative relationship between inflation and unemployment. Preliminary analysis indicates that high levels of inflation corresponds to high levels of output gap, translating to high levels of unemployment, the event where both unemployment and inflation are high which is referred to as stagflation. Although there is no defined yardstick of correlation that presents collinearity problem, a rule of thumb that is generally accepted is that correlation less than 0.8 indicate that there is no problem of high multicollinearity. It ca then be concluded that all the models in this study will not suffer from high multicollinearity.

Table 2: Correlation Matrix of Variables

Correlation	Inflation	Real_gdp	Output_gap	Rer	Nominal_int_ra	Import_value_index	Broad_ms	dummy
Inflation	1.0000							
Real_gdp	0.2420	1.00000						
Output_gap	0.1040	0.2583	1.000000					
Rer	-0.622	-0.4686	0.03443	1.0000				
Nominal_int_rates	0.2349	-0.2867	0.07744	-0.1003	1.000000			
Import_value_index	-0.578	-0.3294	-0.06777	0.7187	-0.28577	1.000000		
BROAD_MS	-0.447	-0.3770	-0.11844	0.7152	0.063025	0.684994	1.000000	
dummy	0.1826	0.0513	0.1590	0.2053	0.1762	0.2952	0.2212	1.0000

5.3 Unit Root Testing

Although ARDL does not require pre testing, it is vital to ensure that there is no presence of I(2) in the variables as ARDL only works with variables that are integrated of different order, I(0), I(1) or combination of both. Therefore table 3 and 4 show results of unit root tests using ADF, PP and DF-GLS tests to test for unit root at both levels and at first differences, on trend and trend+ intercept to ensure absence of I(2) in variables. Real exchange rate, Nominal interest rates, Import prices and money supply fail to reject the null hypothesis of unit root at levels in all the three tests employed while other variables reject the null hypothesis at levels concluding that inflation, GDP growth and output gap are I(0). At first differences, it is notable that all variables reject the null hypothesis of unit root at first differences, concluding that Real exchange rate, Nominal interest rates, Import prices and money supply are I(1). After performing unit root tests at first differences and being able to reject the null hypothesis for all variables, the study concludes that there is no evidence of I(2), therefore all variables pass to be included in the ARDL estimation.

Table 3: Unit Root Test Results at Levels

Variable	ADF		PP		DF-GLS	
	t-Statistic	Probability	t-Statistic	Probability	t-Statistic	Probability
Inflation	-3.334364	0.0765*	-3.450996	0.0600*	-3.405504	0.0016***
Real GDP	-4.204682	0.0108**	-3.977484	0.0108**	-4.206985	0.0002***
Output_gap	-5.639278	0.0003***	-4.442528	0.0058**	-4.591506	0.0001***
Rer	0.305859	0.7689	-1.622257	0.4574	-2.857683	0.0070***
Int. Rate	-0.641812	0.4322	-0.58423	0.4574	-0.777848	0.4420
IM Prices	-0.151946	0.6241	0.738104	0.8696	-1.680355	0.3244
Broad MS	-0.018408	0.6702	0.089525	0.7050	-2.173255	0.02364**

Source: Author's computation Notes: "***", "**", "*" represent the 1 percent, 5 percent and 10 percent critical levels, respectively

Table 4: Unit Root Test Results at First Difference

Variable	ADF		PP		DF-GLS	
	t-Statistic	Probability	t-Statistic	Probability	t-Statistic	Probability
Inflation	-8.594919	0.0000***	-8.509570	0.0000***	-8.193669	0.0000***
Real GDP	-4.863308	0.0023***	-13.97749	0.0000***	-4.880453	0.0000***
Output_gap	-6.655565	0.0000***	-8.159445	0.0000***	-7.157659	0.0000***
Rer	-6.978947	0.0000***	-9.272641	0.0000***	-6.748438	0.0000***
Int. Rate	-3.625277	0.0424**	-8.719124	0.0000***	-4.085145	0.0003***
IM Prices	-3.262368	0.0246**	-3.262368	0.0246**	-3.307515	0.0022***
Broad MS	-6.849437	0.0000***	-6.897055	0.0000***	-6.858675	0.0000***

Source: Author's computation Notes: "***", "**", "*" represent the 1 percent, 5 percent and 10 percent critical levels, respectively

5.4 Empirical Results

This section reports empirical results from our ARDL model estimates. Regression (1) estimates the bi-variate inflation-unemployment relationship for the data, whereas regressions (2) to (5) are multivariate regressions with equation (2) adding import prices time series as a control variable,

equation (3) adds import prices and interest rates, equation (4) uses import prices, interest rates and GDP whilst equation (5) includes import prices, interest rates, GDP, broad money supply and real exchange rate. Note that a dummy variable corresponding to the 2008-2009 global financial crisis and monetary policy regime switch is included in each of the estimated regressions for control purposes.

We first examine the relationship between inflation and unemployment by performing bounds tests to check cointegration between the variables. Indicated on table 5 is the F statistic for bounce test in all the five models. Bivariate model which consist of the two main variables investigated in the study fails to reject the null hypothesis and therefore conforming to no evidence of cointegration. Models 3 and 4 produces inconclusive results while models 2 and 5 posits strong evidence of cointegration. The study therefore uses model 2 and 5 for inferences.

Table 5: ARDL Bounds Test Results

	Model 1		Model 2		Model 3		Model 4		Model 5	
F-stats	**2.67**		**4.19**		**3.32**		**3.61**		**5.12**	
	L(0)	L(1)	L(0)	L(1)	L(0)	L(1)	L(0)	L(1)	L(0)	L(1)
10%	2.93	3.35	2.20	3.09	2.08	3.41	1.99	3.94	1.92	2.89
5%	3.10	3.87	2.56	3.29	2.39	3.48	2.27	4.18	2.17	3.21
2.5%	3.55	4.38	2.88	3.37	2.71	3.53	2.55	4.61	2.48	3.51
1%	4.13	5.01	3.19	4.07	3.06	4.15	2.88	4.79	2.73	3.90

Source: Author's computation

On table 5, the long-run ARDL estimates on the models 2 and 5 are reported since cointegration has been established on the two models. We note a negative correlation between unemployment and inflation (through a positive correlation between output gap and inflation). However, the relationship in both equations posits to be statistically insignificant. Failure to find evidence of inflation-unemployment tradeoff is similar to Govera (2017) findings on inflation-unemployment nexus in South Africa. Among the remaining control variables; import prices, interest rates, GDP growth, money supply and real exchange rate, only import prices and real exchange rate posit a significant relationship with inflation both in the long run and short run.

A positive relationship between import prices and inflation is evident in all the models; this implies that increase in prices in Botswana's trading partners, specifically sources of Botswana's imports will lead to increase in general price levels in Botswana too. This is in line with the studies of Islam (2013) and Ahmed R (2018) who found a positive relationship between the two. A negative and significant coefficient found on the real exchange rate variable indicates that a real depreciation of the Pula to the South African Rand will lead to increase an in inflation. This finding corresponds to that of the study by Mothuti and Phiri (2018) who found that depreciation of the Pula led to an increase in inflation in Botswana. This is because Botswana will then be buying goods on the international market at an expensive price than before. It also conforms to theory.

Table 6: Long-run estimates

	Model 2	Model 5
Y	0.0027 (0.9743)	0.0836 (0.6647)
IM	0.1797 (0.0215)***	0.2313 (0.0956)*
Int		-0.0018 (0.9962)
GDP		-0.08313 (0.5904)
MS		0.0251 (0.7831)
REER		-14.6117 (0.0591)**
dummy	13.6246 (0.0199)***	10.7784 (0.0044)***

Source: Author's computation

Table 6 presents the short run results of the Philips curve investigation in Botswana. The results are similar to those of the long run. We continue to note a negative but insignificant relationship between unemployment and inflation. This finding is different from Sediakgotla (2017) study which investigated the short run inflation dynamics in Botswana. Sediakgotla (2017) found a short-term negative relationship between unemployment and inflation, thus emphasizing on the importance of setting inflation rate objective and maintaining it.

However, the current study fails to identify a strong relationship between the two implying that monetary policy activity like inflation rate objective plays a minimal role in controlling unemployment and therefore the authorities should consider exploring other sound macroeconomic policies to improve employment. Some of these policies could be through fiscal policy like increasing government expenditure. The difference between findings of this study and Sediakgotla (2017) could arise from the use of different econometric models, and the frequency at which both studies captured data. Sediakgotla (2017) used quarterly data while this study used yearly data.

Just like in the long run analysis, among the remaining control variables, import prices, interest rates, GDP growth, money supply and real exchange rate, only import prices and real exchange rate posit a significant relationship with inflation both in the long run and in the short run.

Note that the dummy variable is an interaction term of the dummy and output gap. Dummy variable analysis is quantitative analysis. Therefore, interpretation is in terms of comparison between the two periods captured by the dummy variable, in this study D=0 captures the period before the policy switch and D=1 captures post policy switch. The results of the dummy variable in both models and both in the long and short run estimates indicate that the policy regime switch significantly altered the trend of inflation but does not significantly explain the trend in unemployment rates. In other words, from 2008 there was a sharp decline in the rate of inflation and an increase in the level of unemployment compared to the period before the policy regime switch. This is also indicated by figure 7. Although the dummy variable suggests that the policy regime switch is significant in explaining the trade-off between inflation and unemployment, the relationship between these two variables remains insignificant. These results suggest that there are other factors beyond the policy switch that explain the high levels of unemployment in Botswana that are not captured in these models.

Table 7: Short-run estimates

	Model 2	Model 5
Y	0.0074 (0.9743)	0.0441 (0.6449)
IM	0.4977 (0.0638)**	0.1929 (0.0848)*
Int		-0.0009 (0.9962)
GDP		-0.0438 (0.5357)
MS		0.0132 (0.7727)
REER		-7.7094 (0.0029)***
dummy	4.9194 (0.000)***	5.6869 (0.0003)***
Ect(-1)	-0.4694 (0.0039)***	-0.5271 (0.0080)

Source: Author's computation

Table 8 contains results of the diagnostic and recursive tests of the models. All the models fail to reject the null hypothesis of all diagnostic tests implying normality, absence of serial correlation, heteroscedasticity and no misspecification with the exception to model 4 which rejects the null hypothesis of no heteroscedasticity. This however does not affect the results of the study as the model is not used for analysis due to failure to pass the bounce test. Lastly the cumulative sum of

recursive residuals (CUSUM) and CUSUM squared tests were conducted to test the stability of the coefficients of the model. The null hypothesis of these tests is that coefficients are stable. Decision rule is to reject the null hypothesis if either of the 5% significance lines is crossed. The test revealed parameter stability

Table 8: Diagnostic tests

	Model 1	Model 2	Model 3	Model 4	Model 5
Nor.	0.2531	0.2123	0.1244	0.1212	0.2334
SC	0.1663	0.1158	0.1011	0.0391	0.1114
Het.	0.5446	0.8349	0.7951	0.0982	0.6956
FF	SS	SS	SS	SS	SS
CUSUM	S	S	S	S	S
CUSUMSQ	S	S	S	S	S

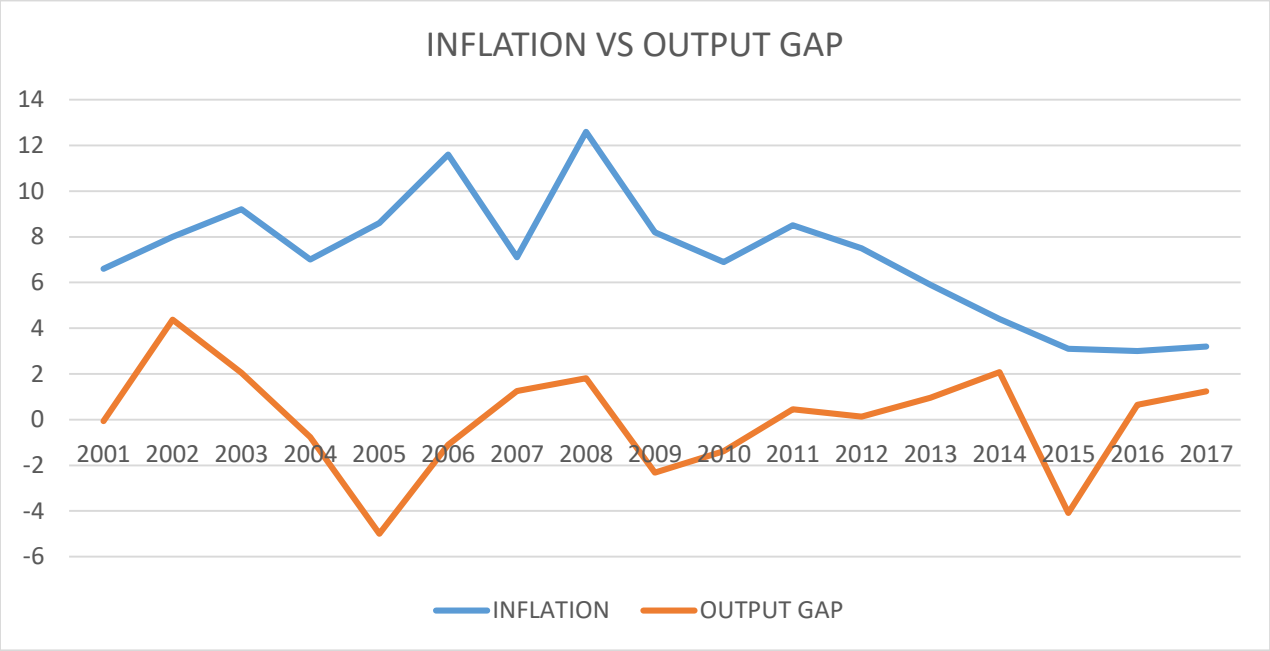
Source: Author's computation

Monetary Policy Regime Switch Effects on Inflation and Unemployment

The graph below illustrates trend in movement of inflation rate and unemployment (proxied by output gap) from 2002 to 2017 to illustrate the impact of introduction of inflation objective of 3 – 6% in 2008 on inflation and unemployment. Despite inflation generally being on a decreasing trend, monetary authorities only started realizing its set objective of 3 to 6 percent in 2013 when inflation was 5.9% and going forward.

Unlike inflation rate, output gap shows a stable trend in the 15 years of observation, that on average the trend is neither increasing nor decreasing. This finding is in line with the above ARDL model finding of no significant relationship between unemployment and inflation, therefore it can be concluded that there is no evidence to support Phillips Curve both in the long and short run in Botswana.

Figure 7: Inflation & Output Gap



Source: Author's computation

The Chow Test

The chow test is a test for structural break in the series. It tests if some or all regression coefficients are different in different sub-sets. The chow test uses the F-statistics, and the null hypothesis is that there is no structural break in the time series. The null hypothesis is rejected if the p-value of the F-statistics is significant at conventional levels. The results of the chow test are presented below;

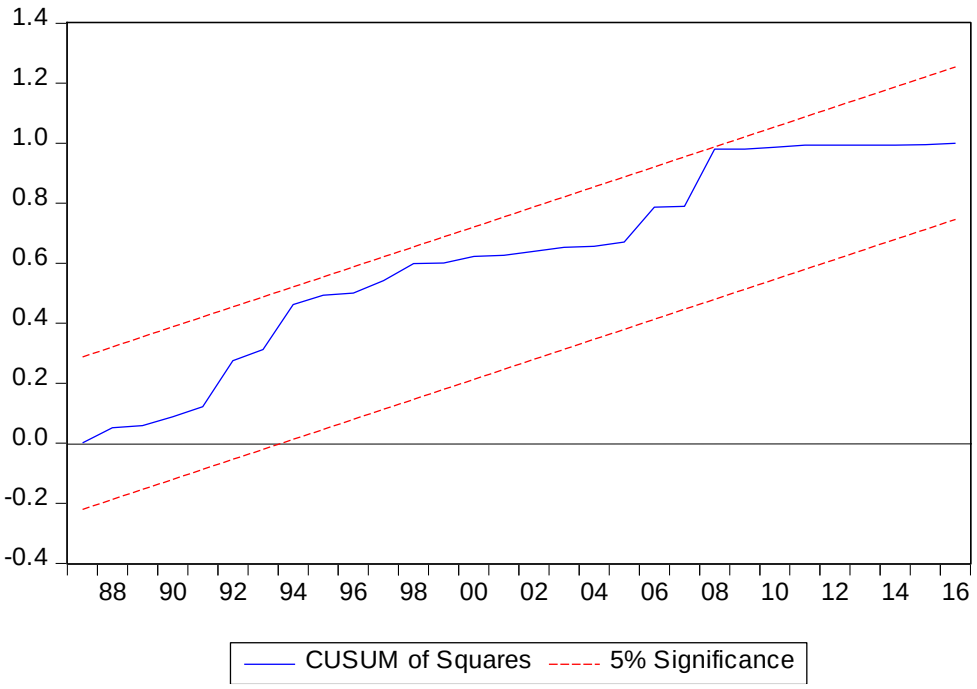
Table 9: Chow Test Results

F-statistic	0.777371	Prob. F(7,23)	0.6125
Log likelihood ratio	7.857266	Prob. Chi-Square(7)	0.3453
Wald Statistic	5.441597	Prob. Chi-Square(7)	0.6062

Source: Author's computation

The results show that there is no structural break in the inflation series. These results imply that the change in inflation due to policy regime switch do not significantly explain the trend in unemployment in Botswana. Furthermore, the results suggest that there are other factors not considered in this model that can better explain the behavior of unemployment during the years of this study. However, the study still includes a dummy variable to capture the effect of the policy switch implemented by the monetary authority of Botswana (Bank of Botswana). The policy switch is that of inflation targeting (3-6%). The CUSUM square also confirmed that there is no structural break, as indicated by the graph below;

Figure 8: Cusum Square Test



Source: *Author's computation*

The implication of these results is that the policy switch that was implemented has had no significant impact on the trend of inflation series. In other words, it is concluded that the regime switch does not significantly explain the high unemployment Botswana is currently facing.

5.5 Conclusion

This chapter attempted to find out the relationship between unemployment and inflation in Botswana. Empirical analysis through linear ARDL model was conducted and it was deduced that there is no significant relationship between the two in the case of Botswana. A further investigation of the impact of monetary policy regime switch on inflation was conducted through a graphical analysis and the chow test. The results indicated that the policy regime switch has no significant impact on unemployment in Botswana. This might be due the nature of unemployment in Botswana which is not responsive to monetary conditions (structural).

CHAPTER SIX

CONCLUSION AND POLICY IMPLICATIONS AND RECOMMENDATIONS

6.0 Introduction

This study examined the relationship between inflation and unemployment in Botswana. An ARDL bound testing approach was used to determine the short run and long run dynamics in both approaches. The study used annual time series data covering the period 1980-2017. Finally, to ensure the robustness of the model, diagnostic tests were carried out.

6.1 Summary of the Study

The question of whether the traditional Phillips Curve relationship holds true remains debatable despite advances in both empirical and theoretical evidence. This study investigated further this phenomenon for the case of Botswana using annual data from 1980 to 2017. To conceptualize this phenomenon, the following objectives were set up in chapter 1 of the study; i) To estimate the short run tradeoff between inflation and unemployment (Phillips Curve); ii) To estimate the long run relationship between inflation and unemployment over the last 35 years; iii) To examine if there were any effects of regime switch in terms of monetary policy over time and to iv) Provide policy recommendations on the basis of empirical results.

In addition to a number of studies that were conducted for both theoretical and empirical underpinnings regarding this nexus, this study used Autoregressive Distributed Lags model and graphical trend analysis to carry out the aforementioned objectives. Prior to running the aforementioned model, Augmented Dickey Fuller (ADF) test, Dickey-Fuller Generalized Least Square (DF-GLS) and the Phillips-Peron (PP) test were employed to gauge the stationarity of variables.

The study first conducted a bivariate model which was aimed at investigating the direct relationship between inflation and unemployment. Post a bivariate relationship investigation the study continued to carry out multivariate regression, adding different variables which according to existing literature have a significant impact on inflation of Botswana. Control variables added includes GDP growth, interest rates, import prices, real exchange rate and broad money supply**.**

6.2 Main Findings and Policy Recommendations

The estimated results show an insignificant relationship between unemployment and inflation in the domestic economy between 1980 and 2017 both in the short and long run, thus, absence of the Philips Curve relationship. Both ARDL and graphical analysis estimation results imply that there is no cointegration between the unemployment and inflation. These findings are in contrast with conclusions made by Phillips and other researchers who found a significant trade-off between unemployment and inflation. One relevant study in Botswana by Sediakgotla (2017) found a negative, significant short run relationship when investigating inflation – unemployment nexus. However recent studies in other developing countries are inconclusive. This means that despite the superiority of Philips Curve theory, it has not been successful in explaining inflation and unemployment dynamics in Botswana and other developing countries like South Africa.

The study also found a positive significant relationship between inflation and import prices (general price level increase in South Africa was used to proxy import prices). This is because South Africa is Botswana's major trading partner and majority of the imports come from South Africa. The positive significant relationship implies that an increase in prices in South Africa will lead to increase in general price level (inflation) in Botswana.

The last interesting finding of the study was a negative relationship that was found between inflation and exchange rate, implying that depreciation of the Pula leads to inflation. This is because a weaker currency will lead us to buying goods from the international market with more money than before. As a result, they will be sold to local consumers at higher prices than before.

It is of great importance for policy makers to take into consideration the nature of association between inflation and unemployment in formulating fiscal and monetary policies. In the case of Botswana, the findings generated doubts as to whether Phillips Curve will be useful for policy guidance. The implication of the study findings is that monetary authorities cannot exploit the Phillips Curve relationship by generating any kind of inflationary pressure on the economy to control unemployment. This is not surprising since unemployment in Botswana is known to be structural- not one that can be solved by expansionary monetary policy. The study therefore recommends authorities to look into alternative ways to spur employment other than the use of inflation objective.

In order to control inflation, monetary policy authorities should focus more on the crawling peg between Botswana and its trading partners to keep inflation at low and stable levels which has been constantly recorded within the inflation objective of 3-6%. Authorities should consider lowering the crawling peg (depreciating the Pula) against its trading partners. This will have a significant impact since Botswana is a net importer. Interest rates have been found to be insignificant to impact inflation. Therefore, the most effective monetary policy tool to influence employment with moderate impact on inflation has been found to be exchange rates by this study.

6.3 Limitations of The Study

Despite the efforts to make this study analytically defensible, it suffers from the problem of insufficient data, as is the case with many other scientific research studies. The study was forced to use output gap as a proxy for unemployment since there was no time series data on unemployment rate in Botswana. The choice of annual data from 1980 to 2017 for empirical investigation was dictated by the availability of macroeconomic data. The study would have otherwise stretched back to an earlier time to ensure a greater sample size. However, the use of ARDL model should have lessened the impact of using a small size sample. Although these limitations could have affected the empirical results and evidence given in this study, it is assumed that their effects are minimal and that they have not significantly influenced the theoretical and empirical findings of this study.

6.4 Further Studies

Future studies could focus more on finding the determinants of unemployment in Botswana, since this study has found out that inflation does not impact unemployment significantly, unlike what empirical and theoretical literature suggests. Future studies should consider expanding the sample size by using monthly/quarterly data in order to yield robust results. Lastly future studies should interrogate exchange rate pass-through to import prices for the Botswana economy.

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APPENDIX

Model 1

ARDL Cointegrating And Long Run Form

Dependent Variable: INFLATION

Selected Model: ARDL(1, 0, 0, 0)

Date: 10/04/19 Time: 10:22

Sample: 1980 2017

Included observations: 36

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OUTPUT_GAP)	0.007410	0.074734	0.210823	0.7936
D(IMPORT_VALUE_INDEX)	0.497695	0.003462	-2.495123	0.0683
D(DUMMY)	4.919369	2.037101	2.852203	0.0000
CointEq(-1)	-0.469493	0.136610	-3.249757	0.0039

Cointeq = INFLATION - (0.0027*OUTPUT_GAP +0.1793*IMPORT_VALUE_I

NDEX + 11.2095*DUMMY + 11.2096)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OUTPUT_GAP	0.002745	0.168176	0.211026	0.9743
IMPORT_VALUE_INDEX	0.179734	0.006831	-2.848383	0.0215
DUMMY	22.2840	6.300382	2.077270	0.00001
C	11.209559	1.201614	9.328749	0.0000

Model 2.

ARDL Cointegrating And Long Run Form

Dependent Variable: INFLATION

Selected Model: ARDL(1, 0, 0, 0, 0, 0, 0, 0)

Date: 10/04/19 Time: 10:39

Sample: 1980 2017

Included observations: 36

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(OUTPUT_GAP)	0.004412	0.082810	0.796940	0.6449
D(IMPORT_VALUE_INDEX)	0.192901	0.004884	-1.409569	0.0848
D(NOMINAL_INT_RATES)	-0.00890	0.130704	-1.136539	0.9996
D(REAL_GDP)	-0.04382	0.078173	-0.858340	0.5357
D(BROAD_MS)	0.013201	0.052241	0.493195	0.7727
D(RER)	-7.709495	4.182502	-1.667287	0.0029
D(DUMMY)	5.686956	2.164210	3.115725	0.0003
CointEq(-1)	-0.527192	0.161680	-3.055768	0.0080

Cointeq = INFLATION - (0.0836*OUTPUT_GAP +0.2313*IMPORT_VALUE_I

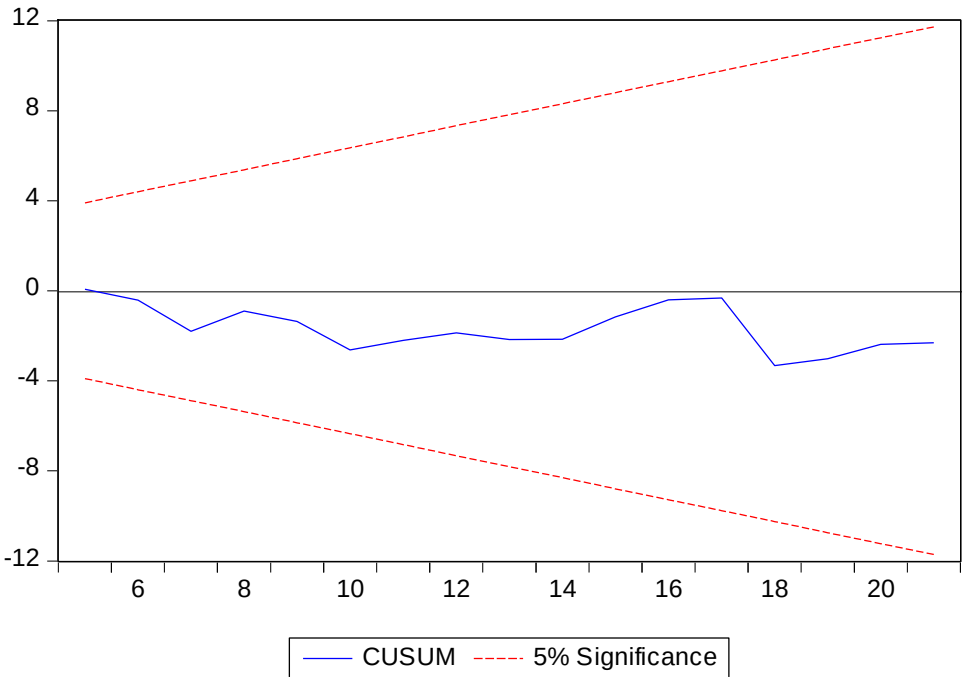
NDEX -0.0018*NOMINAL_INT_RATES -0.0831*REAL_GDP + 0.0251

*BROAD_MS -14.1167*RER + 13.6484*DUMMY + 28.9588)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OUTPUT_GAP	0.083604	0.170016	0.785676	0.6647
IMPORT_VALUE_INDEX	0.231312	0.010920	-1.275950	0.0956
NOMINAL_INT_RATES	-0.0018	0.311829	-0.964225	0.9962
REAL_GDP	-0.08313	0.162391	-0.836330	0.5904
BROAD_MS	0.025102	0.109477	0.476355	0.7831
RER	-14.11661	8.037902	-1.756013	0.0591
DUMMY	10.778432	6.458171	2.113357	0.0440
C	28.958791	10.043499	2.883337	0.0076

CUSUM TEST



CUSUM OF SQUARES