THE EFFECTIVENESS OF INFLATION TARGETING SINCE 1990: ACROSS-COUNTRY COMPARATIVE ANALYSIS

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DEDICATION

To my esteemed spouse, mother, and siblings, who have consistently demonstrated unwavering love and exceptional support throughout my life.

ABSTRACT

This thesis examined how Inflation Target (IT) countries have performed in terms of managing inflation and inflation volatility. The thesis also conducted a comparative analysis of inflation between inflation targets and non-inflation targets countries. A sample of 48 IT and non-IT countries and annual observations from the period 1990 to 2022 were employed. For the empirical analysis, the probit model was used to estimate the probability of inflation falling within the target band. The results suggest the lower and upper limit of the inflation rate in IT is crucial in maintaining inflation within its target band combined with a policy interest rate. The probit regression model also suggests that Sub-Saharan African countries that use Inflation Targeting on average are more likely to fall outside their inflation target band relative to the omitted zone of Oceania though not significant. Europe, Asia, and North and Central American regions were not significantly different from the Oceania zone. South American countries have a higher probability relative to Oceania of approximately 0.13 and this is the only statistically significant regional result.

The empirical evidence from the volatility regression model suggests that implementing IT in countries lowers inflation volatility compared to those without IT adoption. The dummy coefficient of the IT target suggests that volatility, measured by the standard deviation of the historical inflation rate, is 28% lower for countries that use IT and is statistically significant.

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TABLE OF CONTENT

Contents

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

1.0 Background

The act of managing monetary policy in this world has evolved over time since World War II. Many countries have transitioned from one monetary policy framework to another over the period. The sole aim of these transitions in these countries was to hold key macroeconomic indicators that saw a major decline. Cottarelli and Giannini (1997) identified nine basic monetary frameworks, based on announced policy rules, from a longitudinal sample of the principal monetary frameworks of 100 countries. These monetary management frameworks have moved from non-discretionary to a degree of increasing discretion up until 1994 when about 36 percent of countries had completely adopted a discretionary framework. Of these nine monetary frameworks a few of them stand out.

Developed and developing countries have long used monetary regimes based on exchange rate targeting in the form of a fixed rate. This regime experienced significant success as a means of reducing inflation. For example, according to Barth (2002), Argentina was able to lower its annual inflation rate from more than 1000 percent in 1989 to 3.3 percent by 1995. However, this was not without its challenges. Countries that have adopted this monetary management framework were not able to respond to domestic shocks. For example, the inability of the European exchange rate mechanism (ERM) to respond to domestic shocks led to the United Kingdom opting out of the ERM in 1992 just two years after joining, primarily to be able to adapt monetary policy to its domestic circumstances.

Several countries adopted monetary targeting in the 1970s. This monetary management framework was successful, particularly in Germany and Switzerland. They used a flexible approach to monetary

targeting. A key component of the monetary policies in both nations was the determined focus on notifying the public about their monetary policy to enhance transparency and openness. They experienced satisfactory outcomes even though they did not consistently meet their intermediate monetary targets. The story was however different in countries such as the United States, the United Kingdom, and Canada. These countries were unsuccessful at using this method to control money growth and inflation. Mishkin (1998) argued that none of these countries pursued this policy seriously. By the early 1990s, all three countries had opted out of the monetary targeting although they had reduced their dependence since the early 1980s. They realized the relationship between the growth in monetary aggregates and inflation and nominal income had become highly unstable.

However, it was not until the early 1990s that policymakers realized that it was better for central banks to mainly focus on controlling inflation rather than other macroeconomic aggregates. To mitigate the detrimental effects of inflation and to respond to the instability of the velocity of money, many countries adopted an inflation target (IT) as their monetary management framework. In 1990, New Zealand became the first country to adopt this monetary management framework with several other countries such as Australia, Canada, Finland, Spain, Sweden, and the United Kingdom following shortly after. All the inflation-targeting countries have chosen to target the inflation rate rather than the price level. The target range of inflation currently ranges from a midpoint of 1.5 percent a year in New Zealand to a midpoint of 2 percent in Canada, with somewhat higher levels for other countries.

An instructive example of IT is Canada. In the Canadian case, the IT policy was adopted in 1991 by the Bank of Canada with a target range of 1-3% with the midpoint of 2% being the primary target. The Bank also sets an operational band around the target of ±1% around the 2% target to allow for short-term fluctuations in inflation. The Bank of Canada uses the Consumer Price Index (CPI) as its

primary measure of inflation, but it also tracks other measures such as the core inflation rate, which excludes volatile items such as food and energy prices. The Bank collects data on prices from a variety of sources, including surveys of retailers and online prices. The Bank of Canada conducts monetary policy by adjusting its key policy rate, the overnight interest rate, which is currently 5% (May 2024), to achieve the inflation target. Once the Governing Council decides on the overnight rate target, the Bank of Canada (BoC) implements monetary policy by conducting open market operations if it decides to change the overnight rate target. The novelty of the system is that banks know that the BoC will undertake these actions to affect their daily reserves and thus reverse any change of the overnight rate from its target, therefore, they do not undertake actions with their reserves that would significantly move the overnight rate.

The BoC Governing Council meets eight times each year on preannounced dates to set the overnight interest rate target, considering economic and financial developments at home and abroad. If inflation is expected to be above the target range in the near future, the Bank may increase the overnight target rate and raise short and medium-term interest rates to slow down spending and borrowing, tempering aggregate demand. If inflation is expected to be below the target range, the Bank may lower interest rates to stimulate spending and borrowing. The BoC communicates its monetary policy decisions and forecasts to the public through various channels, including press releases, speeches, and publications. The Bank also conducts regular reviews of its monetary policy framework to ensure that it remains effective and relevant in a changing economic and financial environment.

Given the detrimental welfare costs of inflation, there is a need to manage inflation and make it reasonably stable so that inflation expectations are accurate. Most central banks tend to use an IT monetary policy framework to mitigate the negative effects of inflation.

A look at a cross-country comparative result suggests that the adoption of IT tends to reduce inflation. Gonçalves & Salles (2008) investigated emerging markets in 36 developing countries across different regions, of which 13 were inflation targeting. The results revealed there was a greater decrease in inflation among the IT countries. Ayres, Belasen, & Kutan (2014) focused on developing countries across six regions. They assessed the impact of IT on inflation after its adoption and found significant regional variation in developing countries in the sample. Middle Eastern and North African and Southern and Eastern European nations lowered their inflation rates substantially along with Latin American and Caribbean nations whereas the Asian, Sub-Saharan African, and Oceanic nations saw a rise in inflation. With regards to inflation volatility, Creel & Hubert (2015) and De Mendonca & De Souza (2012) found that IT stabilizes inflation at an acceptable rate and lowers inflation volatility. Lin & Ye (2007) and Ardakani, Kishor, and Song (2018) found no significant impact of IT in reducing inflation and inflation variability. These results are at odds with each other, although their research methodologies differ. This thesis seeks to improve on these papers by investigating the effectiveness of IT in countries that have explicitly adopted IT and a cross-country comparison. Also, the volatility of inflation between IT and non-IT countries. This will be done using a longer time series and a sample size across all countries from the region of the world.

1.1 Statement of Problem

IT has been adopted by many central banks to bring about the prospects of low and stable inflation. The question is how successful have the central banks been in managing inflation within the target band? This question is important due to the adverse consequences of inflation on individuals, businesses, and governments (that can include political upheaval). The goal of maintaining a stable

and low inflation rate is one that every country should wish to achieve. Low and stable inflation provides a conducive economic environment that supports sustainable growth, fosters financial confidence, and promotes financial stability. The adoption of IT provides a proven framework to address these economic goals. The effectiveness of IT is what this study seeks to measure. Has the adoption of IT yielded moderate and stable inflation rates, or is it just a fallacy that is postulated by IT economists? Inflation targeting is not without its critics who point out that a real output growth target could be preferable (Benchimal and Fourcans 2019). The effectiveness of IT has been widely debated with Frankel (2012) arguing that it is ineffective in responding to asset price bubbles and supply shocks. Additionally, there is no economic formula for what an optimal target rate should be (Reichlin and Baldwin 2013). This study aims to assess the effectiveness of IT using empirical evidence. In addition, it will consider a cross-country comparison and investigate the factors explaining why some countries have fared better than others.

1.2 Objectives of the Study

The main objectives of this study are to evaluate how IT countries have performed in terms of managing inflation and inflation volatility. For a comprehensive analysis, the study will also investigate and compare IT and non-IT countries across different regions of the world. The study will investigate how some variables such as broad money growth, trade openness, interest rates, government debt, and the inflation target affect inflation and inflation volatility over the period 1990 to 2022.

Finally, the study will provide valuable insights into what factors must be focused to ensure the effectiveness of this monetary management framework and provide recommendations to policymakers and stakeholders on managing inflation and inflation volatility.

1.3 Research Questions

Following the objectives of the study, the study aims to estimate the following vital research questions:

1. What has been the ease of maintaining inflation within the target band across regions as measured by the frequency of occurrences of the inflation rate falling inside the target band?
2. In comparison to non-IT countries across economic regions, how volatile is inflation in IT countries as measured by the variance of the inflation rate around the target rate?
3. What has been the performance of IT countries in managing inflation when compared across regions?

1.4 Justification and Significance of Study

High inflation rates are often associated with negative economic consequences, such as reduced purchasing power for households, reduced investment due to the difficulty in writing contracts for the delivery of goods and services, lenders realizing a lower real interest rate when inflation is unexpectedly decreased, reduced international competitiveness, and potential political upheaval. Low and stable inflation rates can provide a stable environment for economic activity, which can be conducive to economic growth. The adoption of inflation targeting (IT) by central banks has been driven by a desire to improve the effectiveness of monetary policy in controlling inflation rates, volatility and reducing the economic and social costs of inflation. Therefore, it is imperative to examine the factors that contribute to the effectiveness of this monetary policy framework.

This study is significant because it will contribute to the existing literature on IT effectiveness in managing inflation and inflation volatility by providing empirical evidence from various countries across different regions. This will provide useful insights and recommendations for policymakers on how to manage inflation. Finally, the study will address the gap in the current literature by expanding on the number of IT countries and data range.

1.5 Structure of the Thesis

The rest of the thesis consists of five chapters. Chapter two provides an overview of inflation targeting since 1990. Chapter three reviews relevant theoretical and empirical literature on inflation targeting, inflation volatility, and central bank independence. Chapter four describes the research methodology and data used in the analysis. Chapter five presents and discusses the main findings of the study. Chapter six summarizes the results and conclusions of the study and offers policy recommendations.

CHAPTER TWO: OVERVIEW OF INFLATION AND INFLATION TARGETING

2.0 Introduction

Every nation around the globe aims to be prosperous. Each puts measures in place to achieve this goal. In most cases, the fundamental macroeconomic indicators are the best measures of prosperity in such countries. Economic growth, employment, inflation, and the balance of trade are important indicators of a country's position in the global economy. These are useful in grouping countries into categories of development and prosperity. In essence, they become a yardstick to indicate where they stand on the global stage. Governments and institutions all seek to achieve positive outcomes with these measures – strong and stable economic growth, low unemployment, low inflation, and a positive balance of trade.

Admittedly, it is unlikely for any country to experience positive results from all four macroeconomic aggregates. Nations, as much as they try, cannot attain the goal of achieving all the indicators moving in the best direction. For example, when a country experiences high economic growth, it typically leads to increased employment. Workers tend to be in demand, and businesses are more likely to hire new workers to meet increasing demand. This could result in higher cost-push inflation. As businesses increase production and expand their operations, costs often rise, which can lead to increased prices and higher inflation.

Alternatively, economic growth can lead to an improved balance of trade through expanded production and capacity to produce exports. The potential cost of higher economic growth is upward inflation pressure, the latter being a consistent increase in the price level over time. This can become particularly acute if current output is beyond potential output and economic growth is being encouraged by an expansionary monetary policy.

Over the years, there has been an ongoing intellectual discourse within the economic community regarding the precise definition of inflation. The Austrian school views inflation as an increase in the money supply, particularly when it is not matched by an increase in the demand for money. The result is a decrease in the purchasing power of the monetary unit. The Keynesians view inflation as the general rise in prices that erodes the purchasing power of money. The New Keynesian school shares a similar definition emphasizing the role of nominal rigidities, such as sticky prices and wages, in explaining why changes in aggregate demand can lead to inflation. The Monetarists define inflation as a sustained increase in the general price level of goods and services in an economy, linking inflation to changes in the growth rate of the money supply that exceeds the growth rate of real output. For this study, inflation is defined as a persistent increase in the general prices of goods and services over a period, usually one year, measured by the growth rate of the consumer price index. This is based on the common definition used by central banks. The limitation in measuring inflation using CPI arises when the basket of goods is not updated frequently. Consumer tastes and preferences evolve, and it does take a while before they are captured in the basket. The CPI basket does not immediately reflect the introduction of new products in the market. This delay may result in the CPI not accurately representing current consumption patterns until it is updated to include new items. Central bank behavior is the key focus of this study, particularly how effective inflation targeting (IT) is in controlling inflation which is important for central banks around the world because of the economic and social consequences of inflation.

Nevertheless, Ambler (2024) argues that though monetary aggregates play no role in monetary policy analysis, in some extreme cases like Covid-19 money contains information about the evolution of inflation that is dangerous to ignore. He exercises caution in interpreting this

information because the velocity of circulation of money is endogenous to expectations about the permeance of monetary shocks.

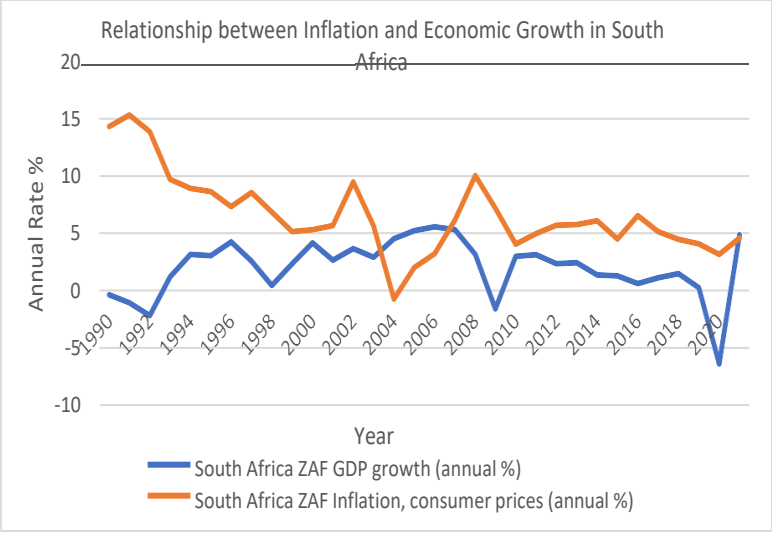
Many countries have had to weigh the benefits of higher economic growth and employment with higher inflation. At least in the short run, the Phillips curve suggests that lower unemployment comes at the cost of higher inflation. To many central banks, inflation is the overriding concern since using monetary policy (discretionary money growth or interest rate intervention) to affect other macroeconomic factors (unemployment, real growth, etc.) has proven ineffective. In the case of economic growth and inflation, there are more consistent findings that inflation depresses real growth.

Tenzin (2019), Saidu and Muhammad (2018), and Munyeka (2014), among others, have all established that inflation depresses real growth in their studies across different economic regions and regimes. Figure 2.1 considers the case of South Africa where the behavior of economic growth is normally inversely associated with the rate of inflation. The country experienced a better economic growth rate as the rate of inflation was decreasing from 1990, but experienced a decline in growth in 1998, even though there was a decrease in inflation. The year 1999 witnessed the return to an inverse association. The overall association is negative with a correlation coefficient of -0.3323. This suggests a relatively weak negative correlation between real GDP growth and inflation based on consumer prices.

In Figure 2.2, there is evidence of an inverse association between real economic growth and inflation in India. In most cases, when inflation is above 10%, there is a significant decline in economic growth. An example is the year 1991, but in subsequent years when inflation falls below 10%, we

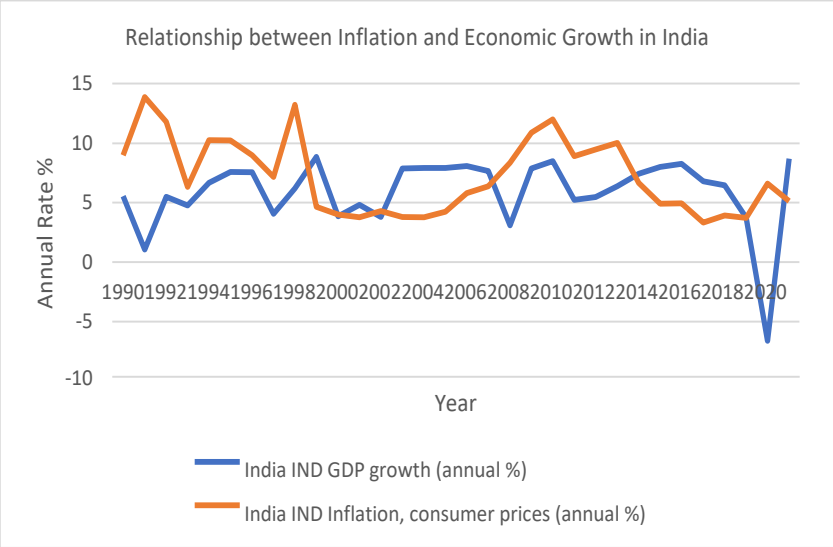
experienced an improvement in economic growth. The correlation coefficient of -0.0986 indicates a weak negative correlation between real GDP growth and inflation.

Figure 2.1



Source: World Development Indicators, World Bank

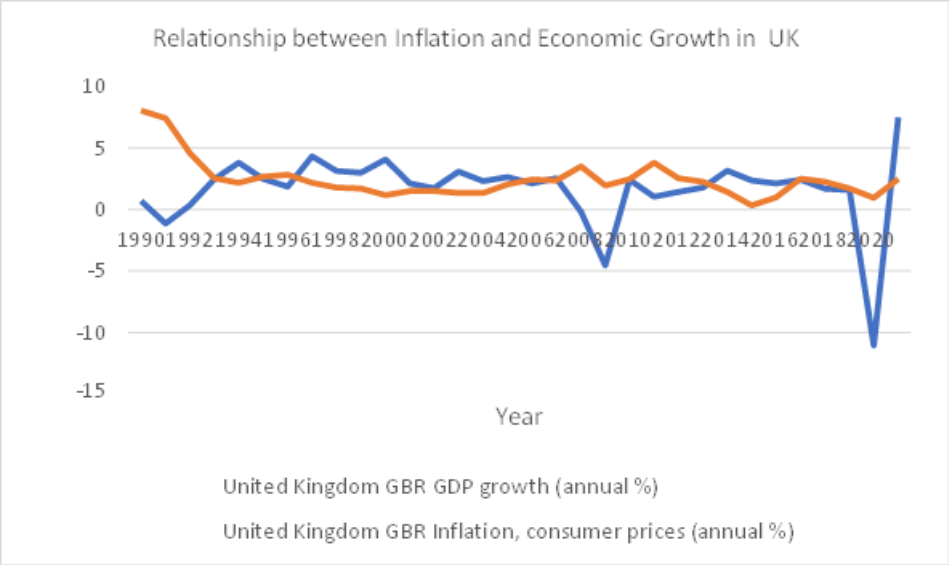
Figure 2.2



Source: World Development Indicators, World Bank

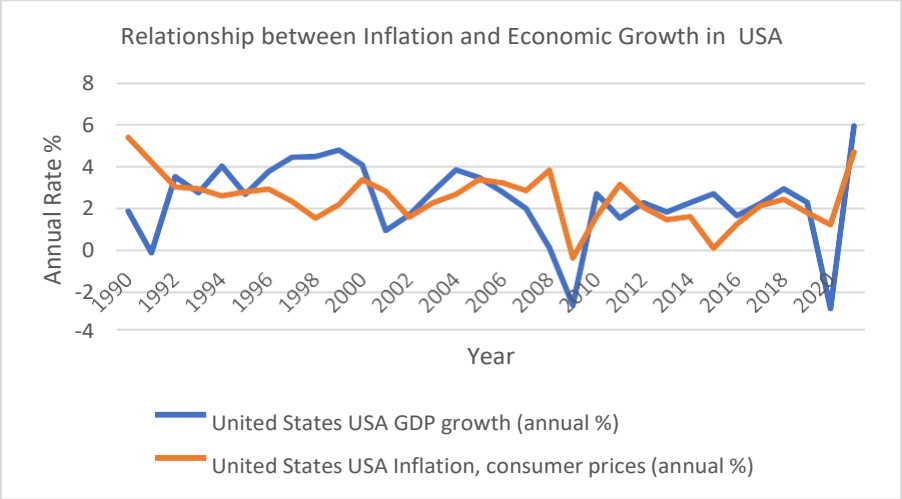
Figures 2.3 and 2.4 depict real economic growth and the inflation rate for the United Kingdom and the United States, respectively. The correlation coefficient for the United Kingdom is - 0.10139974, while that for the United States is 0.31143014. The United Kingdom follows the same weakly negative association predicted by the Phillips curve. The positive association for the United States suggests that inflation expectations adjust very quickly to changes in aggregate demand, more so than in the other countries mentioned. This could be due to greater transparency by the Federal Reserve regarding its monetary policy stance or greater adherence to a monetary rule.

Figure 2.3



Source: World Development Indicators. World Bank

Figure 2.4



Source: World Development Indicators, World Bank

2.1 Inflation Targeting

The adoption of inflation targeting (IT) by central banks has been driven by a desire to improve the effectiveness of monetary policy in controlling inflation rates and reducing the economic and social costs of inflation. IT has been implemented in many countries, including developed and emerging economies, and has become a popular monetary policy framework in many regions of the world.

Under IT, a central bank announces a target inflation rate, typically halfway between the upper and lower bounds of no more than 1% from the target inflation rate. For example, The Bank of Canada has maintained an inflation target of 2% since 1991 with a target range of 1% to 3%. The central bank then uses different monetary policy tools to close the disparity between the actual inflation rate and its target. Central banks rely on a channel/corridor system for very short-term interest rates to manage inflation but can use other tools if inflation falls outside the target band. The Reserve Bank of New Zealand became the first central bank to adopt the IT regime in 1989 with a target of 2%, followed by Canada in 1991. Most of the adopters of this monetary management framework have not reverted to using discretionary monetary policy due to how successful IT has been in achieving low and stable inflation.

A total of 72 countries have adopted, either implicitly or explicitly, inflation targeting as of 2023[1]. Among those countries, Argentina has recorded the highest annual inflation rate at 98.6%, while Switzerland has recorded the lowest rate at 2.4% as of April 2023[2]. Table 2.1 shows a list of some countries and their target inflation rate. The interesting feature to note is that every country in Table

[1] http://www.centralbanknews.info/p/inflation-targets.html. Accessed on June 6, 2023.

[2] https://www.imf.org/external/datamapper/PCPIPCH@WEO/WEOWORLD/VEN

2.1 experienced an inflation rate exceeding the upper bound of its target range in 2022, largely due to the highly expansionary monetary policies used in response to the Covid-19 shutdown of economies. Central banks have managed to bring inflation rates down since 2022, some but not many, back within their target ranges.

Table 1: Selected Countries Inflation Target and Inflation Rate as at 2022

COUNTRY	LOWER LIMIT TARGET	UPPER LIMIT TARGET	INFLATION RATE
	%	%	%
Albania	2	4	6.7
Australia	2	3	6.6
Brazil	2.25	5.25	9.3
Canada	1	3	6.8
Costa Rica	2	4	8.3
Ghana	6	10	31.3
Hungary	2	4	14.6
India	2	6	6.7
Japan	2	2	2.5
Mexico	2	4	7.9
New Zealand	1	3	7.2
Norway	2	2	5.8
Peru	1	3	8.3
South Korea	2	2	5.1
South Africa	3	6	7.0
United Kingdom	2	2	7.9
USA	2	2	8.0

Source: 1. http://www.centralbanknews.info/p/inflation-targets.html , 2.World Development Indicators, World Bank

2.1.1 Theoretical Foundations of Inflation Targeting

There is a fundamental guideline that follows the general principle in the adoption of IT. Central banks implement explicit inflation targeting by establishing a tool that makes the inflation target and forecasted inflation as similar as possible. Svensson (1997) interprets inflation targeting as a targeting rule that specifies a target variable and target level to minimize a loss function.

$$L_t = \frac{1}{2}(\pi_t - \pi^*)^2 + \lambda(y_t - y^*)^2 \quad (2.1)$$

The optimal inflation rate π^* and a zero-output gap $y_t = y^*$ are the target variables. In Canada's case, the λ weight attached to the output gap is zero, however, that is not the case for some other countries. The loss function is minimized by using an interest rate policy tool. Typically, this is added to the model by specifying the Phillips curve equation.

$$\pi_t = \pi_o + \alpha(y_t - y^*) \quad (2.2)$$

The term π_0 is the inflation rate that exists with a zero-output gap. Any increase in output beyond the full employment output results in higher inflation according to the parameter α. Equation (2.2) is now substituted into equation (2.1) for π_t below.

$$L_t = \frac{1}{2}(\pi_o + \alpha(y_t - y^*) - \pi^*)^2 + \lambda(y_t - y^*)^2 \quad (2.3)$$

Equation (2.3) allows only combinations of the inflation rate and output that lie on a Phillips curve. Equation (2.3) is differentiated with respect to y_t and the resulting first-order condition in equation (2.4) below gives the theoretical relationship between the output gap and the inflation gap.

$$\frac{dL_t}{dy_t} = (\pi_o + \alpha(y_t - y^*) - \pi^*)\alpha + 2\lambda(y_t + y^*)\frac{dL_t}{dy_t}$$

$= \alpha\pi_o + \alpha^2(y_t + y^*) - \alpha\pi^* + 2\lambda(y_t - y^*)$

$\frac{dl_t}{dy_t} = \alpha^2(y_t - y^*) + 2\lambda(y_t - y^*) + \alpha\pi_o - \alpha\pi^*$

$\frac{dL_t}{dy_t} = \alpha^2 + 2\lambda(y_t - y^*) + \alpha(\pi_o - \pi^*)$

$\alpha^2 + 2\lambda(y_t + y^*) = -\alpha(\pi_o - \pi^*)$

$(y_t - y^*) = -\frac{\alpha}{\alpha^2+2\lambda}(\pi_o - \pi^*)$ (2.4)

2.1.2 Interest Rate Rule or Taylor Rule

To close the model, we need to introduce the policy tool into (2.4), the short-term interest rate i_o. This is set by the central bank as a relation to the deviation of the current inflation deviation from its target. This is done by the central bank setting the real interest rate, ro, indirectly through the determination of the nominal short-term interest rate directly, the interest rate the bank can control.

The IS equation constitutes the effects of the real interest rate on real output:

$y_t = A - ar_o$ (2.5)

The stabilizing interest rate r_s, is the interest rate that produces equilibrium output at potential output, defined by:

$y^* = A - ar_s$ (2.6)

By subtracting equation (2.6) from equation (2.5) we get the IS equation in output gap form as:

$$y_t - y^* = -a(r_o - r_s) \tag{2.7}$$

Substitute equation (2.7) into equation (2.4)

$$(r_0 - r_s) = -\frac{\alpha}{\alpha^2+2\lambda}(\pi_o - \pi^*) \tag{2.8}$$

Simplifying and solving for r_o, we have

$$r_o = r_s + \frac{\alpha}{\alpha^2+2\lambda}(\pi_o - \pi^*) \tag{2.9}$$

However, the central bank does not target the real interest rate, rather it targets the nominal interest rate, so we add the inflation rate to both sides of the equation.[3]

$$r_o + \pi_o = r_s + \pi_o + \frac{\alpha}{\alpha^2+2\lambda}(\pi_o - \pi^*) \tag{2.10}$$

By applying the Fisher equation, $i_o \approx r_o + \pi_o$, we have

$$i_o = (r_s + \pi_o) + \frac{\alpha}{\alpha^2+2\lambda}(\pi_o - \pi^*) \tag{2.11}$$

Equation (2.11) is the interest rate rule or the Taylor rule. It states that the target for the short-term nominal interest rate is a positive function of the nominal interest rate at potential output, $r_s + \pi_o$, and the gap between the inflation rate and the target inflation rate. The Taylor rule as stated in (2.11) is quite aggressive towards inflation. A 1 percentage point increase in the observed inflation rate

[3] This could be the current inflation rate or a forecast of the inflation rate in the near future.

results in an increase in the target nominal interest rate equal to $1 + \frac{\alpha}{\alpha^2+2\lambda} > 1$ percentage point. The larger (steeper) the slope of the IS curve (a), the less of an interest rate increase is necessary to maintain output at potential output in the face of a given inflation rate. The rule then becomes less aggressive towards inflation. If a greater weight is attached to maintaining potential output (λ) than the inflation target, the rule is also less aggressive towards inflation. Central banks generally use this sort of rule when determining their nominal interest rate targets, although its application may not be consistent over time.

A fact worthy of note to the Austrian and Monetarist schools of inflation is that the rate of money growth, nor the money supply, does not appear in the Taylor rule in (2.11). This is by design and not a shortcoming of the model. The loss function in (2.1) is only a function of the deviation of the inflation rate from its optimal level and the deviation of output from the full employment level. The nominal interest rate in (2.11) is used to minimize these deviations without any consideration for the rate of money growth or the stock of money. That is, monetary aggregates will adjust passively to achieve the inflation and output targets without concern for their values. It has been observed that since the adoption of IT in many countries, the connection between inflation and money growth has become weak at best, only becoming significant with very high money growth (Borio, Hoffman and Zakrajsek 2023). Nevertheless, the long-run association between money growth and inflation could still hold. The IT model only suggests that the rate of money growth is not a policy tool.

The two factors of aggregate demand and inflation expectations are used to evaluate the efficiency of this monetary policy framework. In the aggregate demand channel, monetary policy affects aggregate demand and then inflation by the effect of nominal interest rates on investment spending and the trade balance (from exchange rate adjustments through interest rate parity) while being

constrained by the Phillips curve. The Phillips curve suggests that there is a trade-off between inflation and unemployment, with greater inflation rates being linked to lower unemployment rates (and output greater than potential output) and vice versa. According to the Phillips curve, monetary policy can be used in the short run to influence the level of economic aggregate demand to affect the trade-off between inflation and unemployment. In the expectations channel, monetary policy affects inflation by anchoring inflation expectations. Inflation expectations are an important determinant of actual inflation because they influence the behavior of economic agents. By anchoring inflation expectations, monetary policy can influence the behavior of economic agents and prevent inflation from spiraling out of control by establishing the Phillips curve at a rate of inflation that is time-consistent with potential output. Time-consistency refers to a situation where a policy that is optimal at one point in time remains optimal at all future points in time. In other words, a policy is time-consistent if it is optimal today and follows the same pattern in the future given that its conditions are known today. The Taylor rule is time-consistent if it is credible and there is no incentive to deviate from it in the future. This can help to keep actual inflation rates low and stable. Inflation targeting is one monetary policy framework that relies heavily on the expectations channel to achieve its objectives. Under inflation targeting, central banks set an explicit target for inflation and communicate this target to the public.

The central bank's commitment to achieving the inflation target is intended to anchor inflation expectations and prevent inflation from deviating from the target. The effectiveness of the expectations channel depends on the credibility of the central bank's commitment to the inflation target. If the central bank is perceived as credible, households, firms, and financial markets are more likely to believe that the central bank will take the necessary actions to achieve the inflation target. This, in turn, can lead to greater confidence in the central bank's ability to control inflation and

anchor inflation expectations.

However, if the central bank's commitment to IT is perceived as not credible, households, firms, and financial markets may not believe that the central bank will take the necessary actions to achieve the inflation target. In this case, the inflation target is not time-consistent. This can lead to a loss of confidence in the central bank's ability to control inflation and anchor inflation expectations. In such cases, the expectations channel may be less effective in influencing actual inflation rates.

Inflation Target is not always the best monetary policy in controlling inflation especially when using a Taylor rule. There are various shortcomings that central banks and economists face when applying the Taylor rule. In a recent article from The Economist, several shortcomings were enumerated. The neutral rate of interest and potential output are two oversimplified assumptions that underpin the Taylor rule. These presumptions can result in policy mistakes and are frequently difficult to assess with accuracy. Since the economy is complicated and vulnerable to several uncontrollable circumstances, these presumptions may not be accurate.

The effects of monetary policy changes can take time to fully influence the economy. Taylor's rules, which are backward-looking and respond to current conditions, may not fully capture the forward-looking nature of policy decisions. A more forward-looking approach that considers inflation forecasts could potentially provide a better guide for policy decisions. The accuracy of inflation forecasting can be a significant challenge. Inflation expectations may change rapidly based on new information, making it difficult to predict future inflation rates.

If inflation forecasts are inaccurate, it can lead to misguided policy decisions. This is the major drawback of inflation forecasts. Recent inflation predictions have been unreliable. This unreliability may make it less likely for policymakers to rely on inflation estimates when making choices. Finally,

Taylor's rules often depend on market expectations of future inflation rates. However, these expectations themselves can be influenced by predicted monetary policy actions. This circularity can complicate the decision-making process and lead to feedback loops.

2.1.3 Inflation Targeting and the Overnight Market

Central banks use a channel/corridor system to implement their monetary policy that involves setting a target for the overnight interest rate and then allowing the rate to fluctuate within a specified range. The overnight rate is the interest rate at which banks lend or borrow funds overnight from each other. The channel/corridor system consists of the overnight rate and two other key interest rates. The Bank Rate is the overnight interest rate the central banks will charge a bank that borrows funds to shore up its reserves held at the central bank. This acts as the upper bound or ceiling for the overnight rate since there is no need for banks to borrow from each other at a rate above the Bank Rate. The Deposit Rate is the overnight interest rate paid on excess reserve banks hold with the central banks. Banks will not hold excess reserves with each other at a rate lower than the Deposit Rate, so it acts as the lower bound or floor for the overnight rate. The lower bound rate is always the bank rate less than say 0.50% in Canada. These two bounds act as the overnight rate's target range.

An instructive example of how a channel/corridor system is implemented is the Bank of Canada (BoC). In Figure 2.5, the demand for reserves is downward sloping since the quantity of reserves held increases as borrowing costs decline. The demand curve becomes completely elastic as the Deposit Rate since a bank will not hold excess reserves with any other bank at a rate below the Deposit Rate. The supply of reserves held is vertical at the level of non-borrowed reserves (NBR) targeted by the BoC. The BoC understands that banks face an opportunity cost to hold reserves, thus

the level of NBR is set rather low but maintained to bring about the overnight rate target. Banks may borrow all they wish at the Bank Rate thus the reserve supply curve is completely elastic.

Initially, the equilibrium overnight interest rate is at its target i^*_{or} in Figure 2.5. The demand for reserves faces an unexpected increase, perhaps due to consumers demanding more cash in the holiday season. This shifts the demand curve to the right to R^{d1}, intercepting the flat portion of the supply curve and establishing a new equilibrium at the bank rate i_b. Reserves will continue to increase, matching the increase in reserve demand. The overnight rate will not move above the Bank Rate, however the BoC would prefer the overnight rate be maintained at i^*_{or} to meet its inflation target. It can use a Special Purchase and Resale Agreement (SPRA) to reduce undesired upward pressure on the overnight interest rate. The BoC purchases a high-quality (Government of Canada T-Bill) from a bank and deposits the purchase funds in the bank's reserve account, satisfying its excess demand for reserves at the target overnight rate. The bank purchases the securities back the next day at a price lower than the contracted sale price the previous day, the difference equates to the overnight rate target in yield. Typically shifts in reserve demand are short-lived, however, the BoC maintains longer-term SPRA facilities up to one month in maturity.

Alternatively, if there is an unexpected decline in the demand for reserves, the demand curve shifts to the left to R^{d2}. This intercepts the flat portion of the supply curve and establishes a new equilibrium at the Deposit Rate. No matter how far left the demand shifts, it will stay at the deposit rate. Rather than see the overnight rate drop to the Deposit Rate, the BoC can offer a Sale and Repurchase Agreements (SRA) to reduce undesired downward pressure on the overnight interest rate. The BoC purchases sell a high-quality security to a bank and reduce the bank's reserve account by the necessary amount of the sale, alleviating the excess supply of reserves. The transaction is reversed the next day with the BoC purchasing the security back at a price higher than the sale price, the

effective yield equaling the target overnight rate.

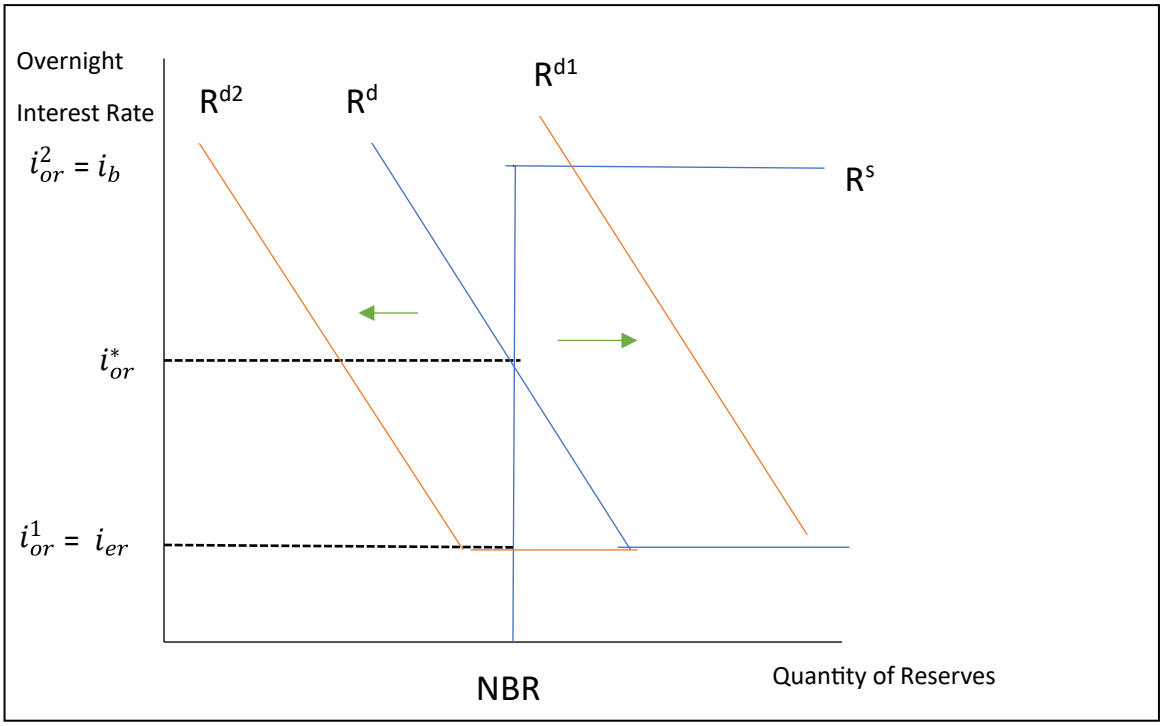
The BoC can increase the overnight rate target in the expectation of higher future inflation. It can do this eight times per year on pre-announced dates to make their policy move transparent and avoid a volatile reaction from financial markets. This also raises the Bank Rate and the Deposit Rate by an equal amount. This makes borrowing more expensive when short and medium-term interest rates follow (through an arbitrage process), which can help to reduce spending and inflationary pressures in the economy. This is represented by a vertical shift of the reserve supply curve and the reserve demand curve in Figure 2.5. The effect of the announcement increases the Bank Rate, shifting the vertical supply curve. The only required action by the BoC is to guarantee that funds are available to borrow at the higher Bank Rate. The vertical shift in the completely elastic portion of the reserve demand curve is also achieved by the BoC guarantee to pay the higher Deposit Rate on non-borrowed reserves. The increase in the equilibrium overnight rate is achieved when banks increase their demand for non-borrowed reserves to reduce the likelihood of paying the higher Bank Rate on borrowed reserves (not shown in Figure 2.5), shifting the demand curve for non-borrowed reserves to the right. The BoC uses its short-term and long-term lending facilities(SPRA, SRA, and others) to facilitate reaching the newly announced overnight rate target, if necessary.

Conversely, when the BoC seeks to lower the overnight rate, it lowers the Bank Rate and the Deposit Rate by an equal amount. This makes borrowing cheaper, which can stimulate spending and economic activity. The effect in Figure 2.5 is just the opposite of an increase in the overnight rate. The model suggests an important point that will be revisited later in the paper. The levels of borrowed and non-borrowed reserves move passively to bring about an equilibrium overnight rate that is equal to the overnight rate target. Changes in total reserves (borrowed plus non-borrowed) result in changes in the M1 money supply through a money multiplier process, hence the money

stock (or its growth rate) will change with expected inflation. However, the connection is not clear since the money multiplier is not stable.[4]

Figure 2.5

How Bank of Canada Achieves Overnight Target



[4] The money multiplier in its simplest form is given by $m = \frac{1+c}{c+r}$ where c is the currency to deposits ratio and r is the reserves to deposits ratio. The M1 money stock is computed by multiplying the monetary base (currency + reserves) by the money multiplier.

2.2 Volatility and Central bank independence in IT

High but stable inflation is not particularly costly if it is predictable. Excessive volatility results in uncertain expectations that hamper the ability of consumers, firms, and governments to enter into medium and long-term commitments. Volatility in inflation in IT could occur due to unexpected changes in exogenous factors such as global commodity prices, exchange rates, or international economic conditions. In some cases, they occur because of a response from the central bank and changes in expectations. Inflation volatility has been kept moderately stable in most IT frameworks. Vega and Winkelried (2005) found that the level and volatility of inflation have been reduced in countries that have adopted IT. Aguir (2014) and Cornand & M'baye (2018) found that IT regimes result in low and stable inflation, reduce the volatility of inflation, and interest rates, and improve macroeconomic performance.

The importance of IT in volatility serves as a good precursor for inflation to be kept within the target bonds. The central bank considers many factors to set the inflation target bands. As of 2022, Liberia had the highest target band (6.50% and 10.50%)[5]. Keeping inflation in the single digit is the best cause of action hence why most central banks keep their target bands in the single digits.

A key important feature of the success of IT is the independence of the central bank. When the central bank is credible, transparent, and trusted, it plays a vital role in the adoption and success of IT. A clear framework for monetary policy is provided by central bank independence and explicit inflation objective, reducing uncertainty, and improving the efficiency of the policy transmission from the short-term interest rate target to the inflation rate.

[5] http://www.centralbanknews.info/p/inflation-targets.html

Central bank independence also promotes public confidence in the competence of the central bank to keep inflation under control, which anchors inflation expectations and promotes long-term macroeconomic stability. Arnone and Romelli (2013), Jacome and Vazquez (2008), and Garriga and Rodriguez (2020) found that highly independent central banks tend to have a low inflation rate.

In conclusion, this chapter has emphasized the critical importance of comprehending the fundamental principles and operations of inflation targeting. These elements serve as the foundation for the monetary management framework employed by most central banks to mitigate the adverse effects of inflation.

CHAPTER THREE: LITERATURE REVIEW

3.0 Introduction

This chapter briefly reviews the relevant literature on inflation targets. The chapter is divided into two sections: theoretical literature review and empirical literature review. The theoretical literature review focuses on some of the theories and workings surrounding inflation targets, while the empirical literature review focuses on empirical studies surrounding inflation targets and non-inflation targets studies, inflation volatility, central bank independence, and cross-country comparison of IT performance.

3.1 Theoretical Literature Review

The underpinning concept in IT is that inflation must be the only target rather than other agents. This attempt is not without its challenges. Kydland and Prescott's (1977) proposition highlights the temptation faced by policymakers to utilize the short-term Phillips curve, which characterizes the trade-off between inflation and output. This suggests that monetary authorities may opt for expansionary measures, aiming to elevate output beyond its potential level through unanticipated inflation. However, such strategies, once foreseen by private agents, would merely escalate the average inflation rate without effectively influencing output. This results in what is termed as inflation bias.

Notably, Svensson (1995) advocated for inflation targeting as a strategy to reduce inflation and counteract the inherent bias toward inflation in discretionary policy frameworks. When we correctly choose the inflation target it offsets the bias so that the average inflation matches the social preference.

The key role of the central bank cannot be over-emphasized. One major attribute of a central bank in IT is credibility. This arises mostly when the central bank is inconsistent with the average and expected inflation exceeds the actual inflation target announced. The players or agents in the economy lose trust with the central bank. To avoid this, Green (1996) postulated that the credibility and enforceability of a central bank can be restored by prioritizing inflation control and abandoning attempts to stabilize output. However, this singular focus may not align with societal preferences, as it can lead to increased output variability.

Woodford (2003) and Goodfriend and King (1997), demonstrate that establishing a robust nominal anchor is a critical component of effective monetary policy. The compelling evidence on inflation expectations strongly supports the adoption of inflation targeting. However, Calvo and Mishkin (2003) argued that an inflation target by itself is not capable of establishing a strong nominal anchor if the government pursues irresponsible fiscal policy or inadequate prudential supervision of the financial system, which might then be prone to financial blow-ups.

The target range set by central banks is mostly ideal though some argue that a point is better as in the case of Japan (2%). The sense of a range to many especially the public communicates uncertainty in the inflation process and that the central bank's control of inflation is imperfect. Nevertheless, the theory supports this notion. Mishkin & Westelius (2005) found that the implementation of target ranges has proven to be an effective strategy in addressing the time-inconsistency issue. These ranges offer incentives that closely align monetary policy with optimal policy, effectively eliminating the potential for time inconsistency.

3.2 Empirical Literature Review

The empirical literature on inflation targeting has produced mixed results regarding its effectiveness. Several studies have found that inflation targeting has been successful in achieving low and stable inflation rates. Creel & Hubert (2015) estimated how inflation targeting is successful in reducing inflation and inflation variability. Using three alternative econometric models: a structural break model, a time-varying parameter model with stochastic volatility, and a Markov-switching VAR model, they test whether inflation targeting leads to a favorable response in inflation and concluded that inflation targeting has not led to a stronger response to inflation in the reaction function (rule) of the monetary authority. This suggests that inflation targeting which aims to anchor inflation expectations through increased credibility and responsibility, may allow a central bank to stabilize inflation without taking drastic measures in response to changes in inflation.

Propensity Score Matching is a statistical technique used in observational studies to reduce the potential bias caused by differences in the observed characteristics of treatment and control groups. De Mendonça and De Souza (2012) using this methodology suggested that the adoption of inflation targeting is the best monetary policy for developing economies since it lowers inflation volatility and can even bring inflation down to levels that are considered acceptable internationally. This was investigated on a sample of 180 countries for the period from 1990 to 2007, where the sample is split into two sets of countries (advanced and developing). In summary, the empirical findings concluded that adopting inflation targeting is beneficial for nations that need to increase their credibility in the management of monetary policy.

Wu 2004 & Genc, and Lee, Rodriguez, & Lutz (2007) also compared countries before and after the adoption of inflation targeting and found a positive association between inflation targeting and low

and stable inflation. Vega and Winkelried (2005) estimated the effects of the adoption of inflation targeting on inflation dynamics using a wide control group of 23 countries. They performed propensity score matching to find suitable counterfactuals to use inflation targeting. They found that inflation targeting has helped to reduce the level and volatility of inflation in the countries that adopted it. They also found that inflation targeting has reduced the persistence of inflation in developing countries. Given that inflation targeting is understood to be flexible, the reduction in persistence is likely to be the effect of the anchoring of expectations to a defined nominal level.

Lin & Ye (2009) considered the positive impact that inflation targeting has on low and stable inflation in developing countries. They evaluated the treatment effect of inflation targeting in thirteen developing countries that had adopted IT by the end of 2004. Using a variety of propensity score matching methods, they showed that, on average, inflation targeting has large and significant effects on lowering both inflation and inflation variability in those countries. However, the effectiveness of inflation targeting in lowering inflation is found to be quite mixed. Certain key characteristics such as the government's fiscal position, the central bank's desire to limit the movements of the exchange rate, its willingness to meet the preconditions of the policy adoption, and the time length since the policy adoption, determined the effectiveness of the inflation targeting.

In other studies, it was found that there is no meaningful evidence of the impact of inflation targeting on reducing inflation and inflation volatility. Lin & Ye (2007) found no significant impact of inflation targeting in reducing the variability of expected inflation. Evaluating the treatment effect of inflation targeting in seven industrial countries that adopted this policy in the 1990s, the authors

concluded that inflation targeting had no significant effects on either inflation or inflation variability in these seven countries[6] using a variety of propensity scores.

Ardakani, Kishor, and Song (2018) estimated the treatment effect of inflation targeting on macroeconomic variables (GDP growth, money growth, inflation, exchange regime, central bank assets, and credit deposit) using a semiparametric single index method by considering the model misspecification of parametric propensity scores. Among all the approaches for estimating propensity scores, the semiparametric single index model provides a consistent and asymptotically more efficient estimator due to the following reasons: (1) it allows estimating the conditional mean under less strict conditions on the functional form and error distribution and (2) the parameters can be estimated without being subject to the curse of dimensionality because the index model includes the linear-in-parameter specification (Ichimura and Todd, 2007). Their results also suggested no significant difference in the inflation level and inflation volatility between inflation targeters and non-targeters after the adoption of inflation targeting. The paper utilized a data set of 98 countries for the period from 1990 to 2013 on an annual basis – 27 countries are inflation targeters (treated group) and 71 countries are non-targeters (control group). They also found that inflation targeting reduced the sacrifice ratio[7] and interest rate volatility in the developed economies and that it enhanced fiscal discipline in both the industrial and developing countries.

Johnson (2002) found that an inflation-targeting regime does not reduce the variability of expected inflation. Using panel data from 11 countries from 1984 to 2000, changes in the behavior of *expected* inflation in the five targeting countries were measured in a panel that includes six non-targeting

[6] Seven countries—Australia, Canada, Finland, New Zealand, Spain, Sweden, and the United Kingdom

[7] Sacrifice ratio refers to the amount of economic output that is lost when a country or region reduces its inflation rate by one percentage point. In other words, it measures the short-term costs of reducing inflation, often through contractionary monetary policy.

countries: France, Germany, Italy, the Netherlands, Japan, and the United States. The level of expected inflation in targeting countries falls after the announcement of targets with controls for country effects, year effects, ongoing inflation reduction, and the business cycle. Neither the variability of expected inflation nor the average absolute forecast error falls after the announcement of targets with controls for the level and variability of past inflation. Both targeting and non-targeting countries experienced unexpected disinflation.

Central bank independence and inflation targeting are closely related, as the credibility of an inflation targeting regime depends on the independence of the central bank. When the central bank is independent, it implements monetary policy without political interference, enhancing its credibility and effectiveness in achieving the inflation target. Since the late 1980s, central bank independence—allowing central banks to manage monetary instruments without influence from politics—has been the major institutional strategy for battling inflation. This has sparked a wave of reforms at central banks all over the world (Goodfriend, 2007).

Studies have shown that central bank independence is strongly associated with low and stable inflation. Arnone and Romelli (2013) show this relationship is sensitive to the method by which central bank independence indices are constructed. By performing unit root tests with structural breaks to verify if the implementation of central bank reforms represents a structural break for the inflation rate dynamics, and implementing a panel data analysis, they found evidence that legislative reforms that modify the degree of independence of a central bank have a strong impact on the inflation rate dynamics. Moreover, underlying the importance of employing dynamic central bank independence indices, they confirm the negative relationship between the latter and inflation for a sample of 10 OECD countries.

A similar result of central bank independence on inflation was found in Latin America. In a sample of 24 Latin and Caribbean countries from 1985 to 2002, Jacome and Vazquez (2008), using panel regressions, concluded that there is a negative association between CBI and inflation. This result holds for three alternative measures of legal central bank independence, as well as for a measure of effective CBI, after controlling for international inflation, banking crises, and exchange rate regimes.

For developing countries, Garriga & Rodriguez (2020) concluded that higher central bank independence is associated with lower inflation. By using a novel dataset of 118 developing countries between 1980 and 2013 this study examined the effect of legal central bank independence on inflation in developing countries. This effect on inflation is stronger the more democratic a country is, but it is also present in non-democratic countries. The results were robust to different specifications and methodologies. Furthermore, they suggested that all dimensions included in the measurement of central bank independence (objectives, personnel, policy, and financial independence) contributed to reducing inflation.

The literature on comparative studies on IT has been quite limited. The few that done a good job are Gonçalves & Salles (2008) and Ayres, Belasen, & Kutan (2014). Gonçalves & Salles (2008) investigated emerging markets in 36 developing countries across the different regions, of which 13 were IT targets. These developing IT target countries were selected from Europe, Asia, Sub-Saharan Africa, Latin America, and North America. Using a difference-in-difference, they found that compared to non-targeters, developing countries across the regions adopting the IT regime not only experienced greater drops in inflation but also in growth volatility, thus corroborating the view that the regime's "constrained flexibility" to deal with adverse shocks delivered concrete welfare gains.

Ayres, Belasen, & Kutan (2014) focused on developing countries across six regions. They accessed the impact of IT on inflation after its adoption. They found significant regional variation in developing countries in the sample. Middle Eastern and North African and Southern and Eastern European nations can lower their inflation rates substantially along with Latin American and Caribbean nations whereas the Asian, Sub-Saharan African, and Oceanic nations saw a rise in inflation. focused on developing countries across six regions. They accessed the impact of IT on inflation after its adoption. They found significant regional variation in developing countries in the sample after running an OLS regression. Middle Eastern and North African and Southern and Eastern European nations can lower their inflation rates substantially along with Latin American and Caribbean nations whereas the Asian, Sub-Saharan African, and Oceanic nations saw a rise in inflation.

From the studies discussed above it is very evident of the limited empirical review on comparative studies. Though most studies have looked at the effectiveness of inflation targets between IT countries and non-IT countries and the associated results, only a few have done a cross-country comparison from different regions. The closest seems to be Ayres, Belasen, & Kutan (2014) who investigated the impact of IT after its adoption. The limitation of this study is that it focused on 13 developing IT countries across six regions and the data spanned from 1991: Q1–2010: Q2.

This study contributes to the existing literature by expanding the sample size, including all countries that have explicitly adopted IT, and the data spans from 1990 to 2022. The effectiveness of IT on inflation and inflation volatility among these IT countries will be accessed and possibly find reasons why some regions perform better than others.

CHAPTER FOUR: DATA DESCRIPTION AND METHODOLOGY

The data set for this study will consist of annual data for 48 countries for the period from 1990 to 2022. Data is obtained from the World Bank's World Development Indicators (WDI) and the International Monetary Fund's International Financial Statistics (IFS). When data was not available for a country from the IMF, data was obtained from the country's Ministry of Finance and their central bank. Among our full sample, 15 countries are from Europe, 7 countries are from Asia, 3 countries are from Sub-Sahara Africa, 5 countries are from South America, 6 countries are from North and Central America and 2 countries are from Oceania. All these countries as of 2022 had explicitly adopted IT. Some countries were not included because their sample from the period of adoption was too short, for example, Argentina. The remaining 10 countries were randomly selected from non-IT countries across all the regions to compare the variability of inflation between IT adopters and non-IT countries. By carefully selecting these countries, the research ensures a diverse representation across different regions, thereby enhancing the robustness and generalizability of the findings. This deliberate choice allows for a meaningful comparison between IT and non-IT countries, shedding light on the broader dynamics of inflation variability.

Different countries adopted IT in different years and for some countries, the necessary data was not available for a continuous time series. The result is an unbalanced panel composed of 710 observations for each variable to appear in the models to be estimated. Unbalanced panels are easily managed using econometric software.

Our goal is two-fold. First, we examine the frequency to which countries that have adopted IT are staying within their target band given shocks to a set of economic variables that could move them outside their target band and identify any regional differences in inflation targeting policy. To do

this, we estimate a probit model. Second, we estimate the extent to which IT countries have reduced the volatility of inflation compared to non-IT countries. This is very imperative because minimizing the variability within the target bond is part of the welfare function in (2.1). We estimate a log-linear regression model to do this.

The probit model is a statistical method used to model binary or categorical dependent variables in situations where the dependent variable is a binary outcome (Rahul, 2024). The probit model isa type of generalized linear model (GLM) that assumes the underlying relationship between the independent variables and the probability of the binary outcome follows a cumulative normal distribution.

Mathematically, the probit model can be expressed as:

$$P(y = 1) = \emptyset(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + e) \quad (4.1)$$

Where:

- P (y = 1) is the probability of the dependent variable Y taking the value 1 (success or one category of the binary outcome). In our case, y = 1 if the inflation rate falls inside of the target band in a specific time period, y = 0 otherwise.
- $\emptyset$ is the cumulative distribution function (CDF) of the standard normal distribution.
- β_0, β_1, β_2, ... , β_k are the slope coefficients of the independent variables X_1, X_2, ..., X_k, respectively.

The probit model estimates the slope coefficients using maximum likelihood estimation, which is a common statistical technique for estimating parameters in probabilistic models. The independent variables serve two functions in (4.1). First, they hold constant characteristics that differentiate the

state of the economies in the sample. For instance, countries that experience high levels of government debt or are not open to trade could sustain higher inflation rates, regardless of the use of a policy interest rate to target inflation. Second, if IT is effective these independent variables should not significantly affect the probability that the inflation rate falls within the target range, hence their slope coefficients will not be statistically significant. The purpose is to suggest economic variables that put pressure on the inflation rate and the ability of the central bank to use IT tools to manage it. This could be particularly true for external shocks, such as the terms of trade, the real exchange rate, and general inflation in the rest of the world that are not specifically targeted by the central bank (and likely cannot be).

To estimate the ease by which countries that have adopted IT stay within the target band, we propose to estimate the probit model below.

$$P(y_{it} = 1) = \beta_o + \beta_1 \pi_{it}^{TUL} + \beta_2 \pi_{it}^{TlL} + \beta_3 Mg_{it} + \beta_4 Mg_{it-1} + \beta_5 Gd_{it} + \beta_6 Gd_{it-1} + \beta_7 Tt_{it} + \beta_8 Tt_{it-1} + \beta_9 Ir_{it} + \beta_{10} Ir_{it-1} + \Sigma_{t=1}^{5} \gamma_i D_i + \varepsilon_{it} \quad (4.2)$$

Where;

t = 1, 2, 3, ….., 33 (time period is from 1990 – 2022)

i = the country

y_{it} = 1 if the inflation rate falls inside of the target band

π_{it}^{TUL} = inflation target upper limit for country i at time t

π_{it}^{TLL} = inflation target lower limit for country i at time t

Mg_{it} = broad money growth rate of country i at time t

Mg_{it-1} = lag of broad money growth rate of country i at time t

Gd_{it} = central government debt to GDP ratio of country i at time t

Gd_{it-1} = lag of central government debt to GDP ratio of country i at time t

Ir_{it} = policy rate (short-term interest rate or treasury bill rate) of country *i* at time *t*

Ir_{it-1} = lag of policy rate (short-term interest rate or treasury bill rate) i at time t

Tt_{it} = trade openness of country *i* at time *t*

Tt_{it-1} = lag of trade openness of country *i* at time *t*

$\Sigma_{t=1}^{5}\gamma_i D_i$ = dummy variable for each region with an attached coefficient

ε_{it} = error term

These independent variables are related to the determination of how countries cope within the target band. A change or sudden trigger in these variables may have a positive or negative impact on inflation that moves it outside the target band. The likely potential estimation problems that may arise from this model include the endogeneity of one or more independent variables with the error term, multicollinearity, and heteroscedasticity (both in cross-section form and in ARCH (Engle (1983) form).[8] In addition, the probit model does not consider the magnitude of the deviation of the inflation rate from the target band.

Since not all the countries adopted IT in the same year, the data will be an unbalanced panel. This is common as countries adopted IT leading in different years producing different timeframes. Also, entities might have irregular time intervals between observations, resulting in different time spans for each entity.

To model the volatility or variability of inflation, we utilize an OLS model regressing the natural log of the standard deviation of the inflation rate from the target inflation rate on broad money growth, central government debt, trade openness inflation, and a dummy variable for IT countries

[8] Heteroskedasticity is a violation of the least squares assumption that the variance of the error term is constant between cross-section units. In this case, the least squares slope estimator is not efficient.

(1 if IT Target country, 0 otherwise). The model is specified as:

$$ln\sigma(\pi_{it}) = \alpha_0 + \beta_1 Mg_{it} + \beta_2 Gd_{it} + \beta_3 Tt_{it} + \beta_4 \pi_{it} + \beta_5 IT_{it} + e_{it} \quad (4.3)$$

Where;

t = 1, 2, 3, …..,48 (time period is from 1990 – 2022)

i = the country

$\sigma(\pi_{it})$ = standard deviation of inflation rate of country i at time t in log

Mg_{it} = broad money growth for country i at time t

Gd_{it} = central government debt as %GDP of country i at time t

Tt_{it} = trade openness of country i at time t

IT_t = represents dummy of IT countries {1 if IT Target countries, 0 otherwise}

π_{it} = inflation rate of country i at time t

e_{it} = error term

This specification is based on the Calderón and Kubota (2018) estimation technique to explain the volatility of the real exchange rate (RER) for a sample of OECD countries, with the addition of a dummy variable to capture IT and non-IT countries.

The natural log of the standard deviation of inflation is used since the distribution of the sample standard deviations for the 48 countries is quite skewed. Explanation of the choice of the independent variables is necessary. Money growth is an important long-run determinant of inflation even under inflation targeting. According to Hossain & Arwatchanakarn (2017), there is a causal long-run relationship between money growth and inflation in the case of Thailand under inflation targeting.

Higher money growth rates may initially boost economic activity, but they can also cause inflation volatility if not accompanied by adequate monetary policy measures and macroeconomic stability. To maintain price stability and reduce long-term inflation volatility, central banks frequently evaluate and adapt their policy stance in reaction to variations in broad money growth.

The impact of government debt on the money supply and fiscal policy can affect inflation. When a government borrows money to pay for its expenditures by selling treasury bills to the private sector, the economy's money supply shrinks. However, selling treasury bills to the central bank increases the money supply. A heavily indebted government could be inclined to monetize the debt (sell treasuries to the central bank or print money), which might make inflation even worse. Inflation can result from a considerable increase in the money supply without a corresponding rise in the output of goods and services.

Trade openness is measured as exports plus imports divided by GDP, indicating the total trade as a percentage of GDP (Ardakani, Kishor, and Song (2018)). Trade openness increases the degree of competition among producers in the home country, diminishing their ability to profit by increasing prices. However, if a country’s terms of trade improve (export prices increase relative to import prices) with higher trade openness, the result is higher export earnings and potentially more income for the economy. This increased income may result in higher domestic demand. If there is not an equal rise in supply to go along with the higher domestic demand caused by this higher income, inflationary pressures may ensue.

The inflation targeting dummy variable estimates the variability of inflation in IT countries compared to non-IT countries. Holding other factors constant, if we find a significant negative coefficient on the dummy, it suggests that countries that have adopted IT have a lower volatility of inflation. Inflation is included as an independent variable because countries with higher average

inflation rates tend to have greater inflation volatility.

By estimating the regression model in (4.3), the explained portion of the variability of inflation is estimated. The regression when run for the 48 countries will ascertain whether IT or non-IT countries control volatility better, if any, and a possible explanation for this occurrence. The coefficient of the dummy inflation target will suggest whether countries that have adopted IT have controlled the variability of inflation better than those that have not adopted IT.

The central bank independence (CBI) is of great importance as the literature in the previous chapter has suggested a negative relationship with inflation. Unfortunately, there are no time-series observations available for CBI, only very infrequent values for specific years. In this paper, CBI is measured using fixed effects. This is on the assumption central bank independence is fixed over time but differs between countries. Any measure of central bank independence will then just be the same number in each year of the sample, but the number could differ across countries. The fixed effects will then just add a country-specific constant to the intercept of the regression equation.

CHAPTER FIVE: EMPIRICAL RESULTS AND INTERPRETATION

5.1 Correlation Matrix

The correlation matrix of the variables used for this thesis is shown in Table 2. This was used to check the presence of multicollinearity. From the results, most of the variables have seemingly lower correlation coefficients. The ones between the variable and the lag of it are expected to be higher but of no concern.

Table 2: Results of Correlation Coefficient Matrix

	π_t	GD_{it}	GD_{it-1}	Tt_{it}	Tt_{it-1}	Ir_{it}	Ir_{it-1}	Mg_{it}	Mg_{it-1}
π_t	1.000	0.0313	0.0097	-0.1137	-0.0892	-0.0928	-0.0197	0.0117	-0.0330
GD_{it}		1.000	0.7408	-0.0356	-0.0417	-0.1876	-0.1525	-0.1471	-0.1697
GD_{it-1}			1.0000	-0.0181	-0.0283	-0.1816	-0.1860	-0.1475	-0.1456
Tt_{it}				1.0000	0.9795	-0.2490	-0.2705	-0.0658	-0.0572
Tt_{it-1}					1.0000	-0.2434	-0.2562	-0.0705	-0.0598
Ir_{it}						1.0000	0.8837	0.2884	0.3160
Ir_{it-1}							1.0000	0.2447	0.2807
Mg_{it}								1.0000	0.2419
Mg_{it-1}									1.0000

5.2 Probit Model Results for Target Band

The model in (4.2) was estimated to assess the probability of the inflation rate falling inside of the target band for countries that use IT. An unbalanced panel data ranging from 1990 to 2022 for 38 IT countries was employed. The sample has a total of 710 observations. The focus was to estimate how the four main independent variables (broad money growth, central government debt, trade openness, and interest rate) affect the ease with which these IT countries remain inside the target zone

using the policy interest rate as the monetary tool. One-year lags for these independent variables were included because it takes a year or more for changes in these variables to affect the inflation rate.

The estimated coefficient of each variable is not the marginal effect on the probability of staying within the target zone but the change in the latent variable associated with a one-unit change in the independent variable, holding all other variables constant. The marginal effects are shown in the last column of Table 3 and are evaluated at the mean values of the independent variables. The investigation of a cross-country comparison to assess which region performs better in managing to stay within the target band was conducted using a dummy variable for the regions, excluding one (Oceania in this case because of its effectiveness in managing inflation). Table 3 presents the summary of the results of the probit model.

Table 3: Summary of Probit Estimates for Inflation on the Target Band.

Dependent Variable: Inflation within target band = 1

Variables	Coefficients	Standard Errors	Slope
Constant	−0.2271	0.2623	
Upper Limit	0.3336	0.0901	0.1331***
Lower Limit	−0.2807	0.0913	−0.1120***
Broad Money Growth	0.0043	0.0056	0.0017
Lag Broad Money Growth	−0.0028	0.0054	−0.0011
Central Gov't Debt	−0.00007	0.0018	-0.00003
Lag of Central Gov't Debt	−0.0001	0.0018	-0.00005
Trade Openness	−0.0246	0.0085	−0.0098***
Lag of Trade Openness	0.0180	0.0086	0.0072**
Interest Rate	−0.1091	0.0269	−0.0435***
Lag of Interest Rate	0.0414	0.0242	0.0165*
Asia	0.0485	0.1859	0.0194
Europe	0.2448	0.1635	0.0973
Africa	0.0181	0.2813	0.0072
North & Central America	0.1964	0.1650	0.0780
South America	0.3335	0.1739	0.1316*

No. Observation 710

*, **, and *** represent 10%, 5%, and 1% level of significance Oceania was the omitted continent for the continent dummy variables. Number of cases 'correctly predicted' = 432 (60.8%)

5.2.1 Analysis of Probit Results

The upper limit and the lower limit of the inflation target band have coefficients with opposite signs, and both are statistically significant at the 1% significance level. Holding constant the upper limit for inflation, an increase in the lower limit reduces the width of the target band and results in a drop in inflation, hence the negative coefficient. If there is an increase in the lower limit by one point (5% to 6% for example), there will be a drop in the probability of falling within the target zone by about 0.11. Holding constant the lower limit, an increase in the upper limit for inflation widens the target band, allowing inflation to drift up and fall above the target band, hence the positive coefficient. If there is an increase in the upper limit by one point, there will be an increase in the probability of about 0.13 of falling within the target zone. Both coefficients are close in absolute value suggesting that moving the upper and lower limits to maintain a constant width of the target zone is independent of the actual inflation rate (since the inflation rate is held constant).[9]

Broad money growth has a coefficient with a positive sign but is not statistically significant. This is the case because of the theory of the mechanism of IT explained in the previous section. The main policy tool in this monetary policy framework is the short-term interest rate. Money growth may have a positive association with moving the inflation rate inside the inflation target in the long run according to commonly accepted belief by the Monetarist but is not important in the short run in this model. From the results in Table 3, if broad money growth increases by 10%, there will be a 0.017 increase in the probability that it will fall within the target zone, although it is not statistically significant.

The central government debt to GDP ratio has a negative coefficient and is not statistically

[9] A test of this restriction is not available in the probit model as the distribution for the test is complex.

significant. The option of central banks printing money as a means of financing debt causes inflationary pressures. If the debt to GDP ratio increases by 10%, there is a likelihood that there will be a drop in the probability of approximately 0.0003 of falling within the inflation target band. This suggests that the influence of central government debt is small and not significant.

Trade openness and the one-year lagged trade openness have a negative and a positive coefficient respectively, statistically significant at the 1% and 5% significance levels respectively. This is broadly consistent with our expectations. The coefficient values are close in absolute value, suggesting no association with the probability of falling in the target zone in the long run. The lack of any long-run association between government debt, trade openness, or money growth is positive evidence for the effectiveness of IT in insulating inflation from shocks to these variables.

The interest rate and the one-year lagged interest rate have a negative and positive coefficient respectively, statistically significant at the 1% and 10% significance levels respectively. When the interest rate increases by 1 point, then the probability of inflation falling within the target band is reduced. After a year from the lag, an increase in the interest rate by 1 point increases the probability of inflation falling within the target band. This is counterintuitive but that is the case. If inflation goes up, leading to a probability of it falling outside the target band, the central banks respond by raising interest rates (which shows as a negative coefficient) in the most current year. After a year, due to the bank raising interest rate inflation is perhaps brought within the target band so it leads to a positive coefficient. Hence the probability that inflation falls within the target band increases.

Inspection of the cross-country dummy variables suggests that the probability of Sub-Sahara Africa falling within the target band increases by about 0.0072 relative to the omitted region of Oceania. The largest coefficient is South America which has a higher probability than Oceania of approximately 0.13 and is the only statistically significant continental result. Asia, Europe, and

North and Central America have a higher probability of 0.0194, 0.078, and 0.0973, none of which is statistically significant. Holding the other variables constant, the results suggest that the nations of South America that use inflation targeting tend to have a much higher probability of falling within their inflation target bands with Sub-Sahara having a lower probability of falling within the target band though not significant. This is perhaps not surprising given their poor records of controlling inflation and eventually resorting to excessive monetary growth.

5.2.2 ARCH Test

The autoregressive conditional heteroskedasticity (ARCH) model is a statistical model for time series data. It is used to detect the presence of heteroskedasticity in time series data. It looks for periods of time when large or small residuals are clustered together, indicating that the variance of the error term is not constant. This is one of the potential estimation problems that was likely to occur given the time series structure of the sample data for the model in (4.2). To conduct the ARCH test, follow these steps;

$H_o: No\ ARCH\ exist$

$H_o: ARCH\ exist$

- Step 1: Estimate the probit model.
- Step 2: Calculate the errors or residuals from the probit model and square them.
- Step 3: Estimate a second regression model with the squared residuals as the dependent variable and lags of the squared residuals as the independent variables. In this model, we chose to use 4 lagged values.
- Step 4: The F-test is the ARCH test.

Since the F-test F(4, 38) = 0.400201 is less than 0.05, we fail to reject H_o. Hence the series of the residuals exhibits no ARCH effects

5.3 OLS Results for the Volatility of Inflation

To test for a significant difference between the volatility of inflation between IT and non-IT countries, equation (4.3) was estimated using OLS. The data employed were the standard deviation of the inflation rate and the averages for the 48 IT and non-IT countries (Appendix 1) of the independent variables from 1990 to 2022 sample period. The sample has a total of 48 observations. Table 4 below presents the summary of the results.

Table 4: Summary Results for OLS Estimate of (4.3)
Dependent Variable: Log of Standard Deviation of inflation

Variables	Coefficient
Constant	0.7076**
	(0.2677)
Broad Money Growth	−0.0135
	(0.0087)
Central Government Debt (%GDP)	−0.0024
	(0.0017)
Trade Openness	0.0008
	(0.0011)
Dummy of IT Target	−0.2801**
	(0.1362)
Inflation	0.1600***
	(0.0185)
R-squared	0.704039
Adjusted R-Squared	0.668805
No. Observation	48

Standard errors are reported in parentheses. **. *** indicates significance at the 5% and 1% level, respectively

The coefficient of broad money growth is negative. A percentage change in broad money growth leads to a 1.35% decrease in the standard deviation of the inflation rate holding all other factors constant. However, it is not statistically significant based on a t-statistic of -1.552. From the theoretical model of inflation targeting, money growth passively adjusts to achieve the inflation target that uses the interest rate tool in (3.11). The theoretical model predicts no short-run association between money growth and inflation or inflation volatility. This is confirmed by the empirical result. The negative coefficient is somewhat perplexing, implying that, on its face value, higher money growth reduces inflation volatility.

The coefficient for the central government debt to GDP ratio is negative but not statistically significant. One of the ways a central government can finance its debts is by printing money which increases money growth if done consistently. A percentage change in the debt-to-GDP ratio decreases the volatility of inflation by 0.24% holding all other factors constant. The negative coefficient could be explained by the fact that most countries that have adopted IT have higher debt-to-GDP ratios, for example, Japan (263.9% in 2022), and the United States (116.69% in 2022). These countries do not engage in financing government debt by monetary expansion; hence the negative coefficient is simply a result of the sample, and its explanation lies outside of the model here.

Trade openness has a positive coefficient that does not coincide with our expectations. The more open the economy is to trade and the fewer government regulations, the less volatile inflation should be as the country is more insulated from foreign shocks that could affect domestic inflation (Samimi, Ghaderi, Hosseinzadeh, & Nademi, (2012) and Chhabra & Alam (2020)). A percentage change in trade openness results in about a 0.08% increase in the volatility of inflation holding all other factors constant. Fortunately, it is statistically insignificant based on a t-statistic of 0.727.

Countries that have a high rate of inflation tend to have higher volatility as there is simply more room for the inflation rate to vary. From the result, inflation meets this expectation. The coefficient suggests that when there is a unit increase in the inflation rate, the volatility of inflation increases by about 16% holding all other factors constant. This is statistically significant at the 1%significance level. We suspect that this result is greatly influenced by the non-IT countries that tend to have higher inflation rates and volatilities than the IT countries.

One of the major aims of this study was to measure the volatility of inflation between IT countries and non-IT countries. From the literature review in Chapter 3, the results from previous studies were mixed. Some studies found that inflation volatility was low and stable among IT countries compared to non-IT countries, whereas in other cases there was no significant difference. In this study, a dummy variable equal to one for IT countries and 0 if it is non-IT countries was used to test this hypothesis. From the results, holding all other factors constant, it appears that countries with an IT policy have a lower volatility of inflation, on average by about 28% compared to non-IT countries holding all other factors constant. This result is statistically significant at the 5% significance level. This meets the expectation of the dummy variable coefficient being negative and statistically significant.

The adjusted R-squared is used to measure the goodness of fit of the model in (4.3). Its value is 0.668805, meaning that about 67% of the variation in the log of the standard deviation of the inflation rate is explained by this model.

5.3.1 Test for Heteroscedasticity Using White Test

Heteroscedasticity occurs in regression analysis when the variability of the errors (residuals) is not constant across all levels of the independent variables. In other words, the spread or dispersion of

the residuals or errors varies with the values of the independent variables. This goes against the OLS assumption of homoscedasticity, which states that the variance of the errors is constant. When this occurs, the OLS slope estimator is not efficient (although still unbiased), and any inference made on the standard errors could be incorrect. This is one of the potential estimation problems that was likely to occur given the cross-section structure of the sample data for the model in (4.3). If heteroscedasticity is found, a corrected vector of robust standard errors can be computed using a heteroscedasticity consistent covariance matrix estimator (White 1980).[10] The presence of heteroscedasticity was tested using the White test. Though there exist several tests for heteroscedasticity, the White test was chosen because of its ability to test for linear and non-linear forms of heteroscedasticity. The test was conducted by following these steps:

H_o: *No Heteroscedasticity exists*

H_A: *Heteroscedasticity exists*

- Step 1: Estimate the regression model with OLS (Appendix 2)
- Step 2: Calculate the errors or residuals (uhats)
- Step 3: Estimate a second regression model with the squared of the uhats as the dependent variable regressed on the independent variables, the squares of the independent variables (excluding the dummy), and the interactions (cross-products) of the independent variables.

$$(uhat)^2 = \alpha_c + \beta_1 Mg_{it} + \beta_2 Gd_{it} + \beta_3 Tt_{it} + \beta_4 IT_{it} + \beta_5 \pi_{it} + \beta_6 Mg_{it}^2 + \beta_7 Gd_{it}^2 + \beta_8 Tt_{it}^2 + \beta_9 \pi_{it}^2 + \beta_{10} Mg_{it} Gd_{it} + \ldots + \beta_{19} IT_{it} \pi_{it} + e_{it} \quad (5.1)$$

[10] Technically, the heteroscedasticity consistent covariance matrix estimator is given in matrix form by $(X'X)^{-1}X'\Omega^{-1}X(X'X)^{-1}$ where Ω is a matrix with elements on the main diagonal that are estimates of the error variance obtained from an initial OLS regression. The resulting matrix multiplication gives a single vector of standard errors for the coefficients

- Step 4: From the regression results (Appendix 3), obtain the R-squared which is 0.431064 in our case.
- Compare n(R-squared) to a critical value given by $\chi^2_{0.05,19}$ in our case where n is the sample size.

From the White test results, since 48(0.431064) = 20.691093 < 30.144, we fail to reject H_o. Hence there is no presence of heteroscedasticity in the model and the OLS results in Table 5.3 can be deemed reliable.

CHAPTER SIX: CONCLUDING REMARKS

Inflation targeting has played a vital role in the macroeconomics literature in the last three decades and more specifically among many central banks across the globe as a major monetary policy framework to control inflation. It is not surprising that its effectiveness has been tested with different data and methods from developed to emerging market countries. Many of the empirical research papers cited in this study have focused on comparing the success of IT policy between IT countries and non-IT countries in reducing or managing inflation. In this study, we utilize the probit model to measure the ability of IT countries in a cross-country comparison on their effectiveness in managing inflation. This thesis seeks to add to the limited literature on cross-country comparison. This was conducted by looking at the probability of them staying within the target band by employing a larger sample and data from 1990 to 2022.

Furthermore, the volatility of inflation in IT and non-IT countries was investigated to assess which among them can reduce the volatility of inflation. Again, other variables that are thought to be associated with inflation volatility are held constant and a dummy variable is used to distinguish between countries that use an IT policy and those that do not.

The results from the probit model suggest that the lower and upper limit of the inflation rate in IT is crucial in maintaining inflation within its target band combined with a policy interest rate. As one would expect, the lower and upper limits both had opposite but statistically significant coefficients. This combination of factors plays a key role in the effectiveness of IT. This is consistent with the theoretical model of inflation policy. An increase in the policy interest rate is an important tool to maintain inflation within the target band based on its negative and statistically significant coefficient. This suggests that changes in the policy interest rate are an effective means to mitigate

inflation from falling within the target band.

The probit regression model also suggests that Sub-Saharan African countries that use Inflation Targeting on average are more likely to fall outside their inflation target band relative to the omitted zone of Oceania though not significant. Europe, Asia, and North and Central American regions were not significantly different from the Oceania zone. South American countries have a higher probability relative to Oceania of approximately 0.13 and this is the only statistically significant regional result.

Generally, the empirical evidence from the volatility regression model suggests that IT, when employed in countries, tends to lower the volatility of inflation compared to those that do not adopt IT. The dummy coefficient of the IT target suggests that volatility, measured by the standard deviation of the inflation rate, is 28% lower for countries that use IT and is statistically significant. The assertion is supported by and consistent with some of the existing literature where inflation volatility was low and stable among IT countries (De Mendonça and De Souza (2012) and Vega and Winkelried (2005)). Their studies differ in the data and methodology, as we used a longer time series and a different measure of volatility (the natural log of the standard deviation of inflation).

The coefficients for money growth are not statistically significant in both models, implying that the Austrian and Monetarist schools' emphasis on the relationship between inflation and money growth does not appear to hold in the short run when inflation targeting (IT) is used as the monetary policy framework. This finding is consistent with the theoretical model of inflation targeting, which does not contain money growth as a key variable. Instead, the channel-corridor model in Figure 2.5 depicts the money stock as a passive adjuster, rather than a driver of inflation, This finding calls into question the central tenets of Austrian and Monetarist theories, which hold that money expansion and inflation are inextricably linked. The absence of a statistical significance between these

variables under an IT regime suggests that the transmission mechanism described by these schools may not be the major driver of inflation in the short run.

The research has revealed significant insights and implications. Based on the analysis and discussion of key findings, the following policy implications are proposed. Policymakers who have adopted IT should focus on the target band as it is crucial in managing inflation. Countries can set a more optimistic target band and utilize interest rates to effectively manage inflation. Adopting an IT framework is the most effective way to minimize the impact of inflation volatility. Countries aiming to achieve this should consider implementing this monetary management framework.

In concluding the study, it is imperative to acknowledge certain limitations that have surfaced, particularly concerning the volatility regression. One notable constraint stems from the constrained sample size, primarily due to the limited availability of data across countries. A larger sample size is inherently desirable as it enhances the robustness and reliability of the findings. However, the scarcity of data, especially regarding countries that have adopted IT and those that have not, posed a challenge in this regard.

Furthermore, the second model encountered a particular limitation pertaining to the distribution of countries adopting IT across continents. Notably, the continent of Sub-Sahara Africa featured only three countries with explicit IT adoption It is crucial to exercise prudence when applying these findings to regions that are not adequately represented in the dataset.

Additionally, while the study delved into the examination of inflation volatility, certain influential factors were not fully explored due to the scope limitations. Factors such as external shocks stemming from changes in global commodity prices, variations in credit availability, and dynamics in asset prices are known to exert considerable influence on inflation volatility. Future research

endeavors could delve deeper into the impact of these factors on inflation volatility within the context of IT frameworks.

Moreover, the role of exchange rate dynamics in influencing the ease with which IT frameworks adhere to the target band warrants further investigation. While exchange rates were acknowledged as potential influencers of inflation dynamics, their explicit examination was beyond the scope of this study. Exploring the relationship between exchange rate dynamics and the effectiveness of IT in maintaining price stability could offer valuable insights into the policy transmission mechanisms underpinning IT frameworks.

Lastly, a notable avenue for future research lies in comparing countries that have adopted IT implicitly versus explicitly. While this study predominantly focused on countries with explicit IT frameworks, examining potential differences in inflation control effectiveness between implicit and explicit IT adopters could offer nuanced perspectives on the efficacy of different approaches to inflation targeting.

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Appendix 1: Inflation Targeting Countries and Non-Inflation Targeting Countries

INFLATION TARGETING COUNTRIES		NON INFLATION TARGETING COUNTRIES
Albania	Japan	Algeria
Armenia	Kazakhstan	Bolivia
Australia	South Korea	Cote d'Ivoire
Brazil	Mexico	Ecuador
Canada	New Zealand	France
Chile	Norway	Italy
Colombia	Peru	Germany
Costa Rica	Philippines	North Macedonia
Czech Republic	Poland	Malaysia
Dominica Republic	Russia	Singapore
Georgia	Serbia	
Ghana	South Africa	
Guatemala	Sweden	
Hungry	Thailand	
Iceland	Uganda	
India	United Kingdom	
Indonesia	United States of America	
Israel		

Appendix 2: GRETL RESULTS FOR OLS

Model 1: OLS, using observations 1-48
Dependent variable: l_STD

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.707589	0.267737	2.643	0.0115	**
Broadmoneygrowthannual	−0.0134591	0.00871418	−1.545	0.1300	
CGDtotalofGDP	−0.00240220	0.00165121	−1.455	0.1532	
TradeOpeness	0.000772526	0.00109298	0.7068	0.4836	
ITTarget	−0.280152	0.136293	−2.056	0.0461	**
Inflation	0.159781	0.0184874	8.643	<0.0001	***

Mean dependent var	0.967005	S.D. dependent var	0.605222
Sum squared resid	5.095203	S.E. of regression	0.348302
R-squared	0.704039	Adjusted R-squared	0.668805
F(5, 42)	19.98211	P-value(F)	3.78e-10
Log-likelihood	−14.27941	Akaike criterion	40.55882
Schwarz criterion	51.78603	Hannan-Quinn	44.80160

Appendix 3: White Test Heteroscedasticity

White's test for heteroskedasticity
OLS, using observations 1-48
Dependent variable: uhat^2

	coefficient	std. error	t-ratio	p-value
const	0.863462	0.706857	1.222	0.2321
Broadmoneygrowth~	−0.0660567	0.0721663	−0.9153	0.3678
CGDtotalofGDP	−0.00472916	0.00747671	−0.6325	0.5322
TradeOpeness	−0.00249411	0.00553114	−0.4509	0.6555
ITTarget	−0.291772	0.443875	−0.6573	0.5163
Inflation	0.00471673	0.0907223	0.05199	0.9589
sq_Broadmoneygro~	−0.000268385	0.000770181	−0.3485	0.7301
X2_X3	0.000713871	0.000623907	1.144	0.2622
X2_X4	0.000350759	0.000504202	0.6957	0.4924
X2_X5	0.00213688	0.0227071	0.09411	0.9257
X2_X6	0.00104392	0.00184578	0.5656	0.5762
sq_CGDtotalofGDP	3.23863e-06	2.35791e-05	0.1374	0.8917
X3_X4	−2.90003e-05	2.94922e-05	−0.9833	0.3339
X3_X5	0.00139659	0.00366201	0.3814	0.7058
X3_X6	−0.000503646	0.000827828	−0.6084	0.5478
sq_TradeOpeness	3.28105e-06	1.18881e-05	0.2760	0.7846
X4_X5	−0.000394999	0.00254338	−0.1553	0.8777
X4_X6	0.000143886	0.000799343	0.1800	0.8584
X5_X6	0.0119204	0.0405072	0.2943	0.7707
sq_Inflation	−0.000665451	0.00290611	−0.2290	0.8205

Unadjusted R-squared = 0.431064

Test statistic: TR^2 = 20.691093,
with p-value = P(Chi-square(19) > 20.691093) = 0.354118

Appendix 4: Gretl Results for Probit Model without Unit Dummies of Countries

Model 1: Probit, using 710 observations
Dependent variable: Inflation
Standard errors based on Hessian

	Coefficient	*Std. Error*	*z*	*Slope**
const	−0.227056	0.262322	−0.8656	
UpperLimit	0.333616	0.0900658	3.704	0.133093
LowerLimit	−0.280689	0.0913143	−3.074	−0.111979
Broadmoneygrowthannual	0.00431265	0.00569367	0.7574	0.00172049
Broadmoneygrowthannual_1	−0.00280856	0.00537579	−0.5224	−0.00112045
CGDtotalofGDP	−6.90232e-05	0.00177375	−0.03891	−2.75362e-05
CGDtotalofGDP_1	−0.000113847	0.00178816	−0.06367	−4.54182e-05
TradeOpeness	−0.0246401	0.00853223	−2.888	−0.00982994
TradeOpeness_1	0.0180405	0.00862606	2.091	0.00719710
Interestrate	−0.109056	0.0269213	−4.051	−0.0435070
Interestrate_1	0.0413709	0.0242818	1.704	0.0165046
Asia	0.0485393	0.185936	0.2611	0.0193587
Europe	0.244822	0.163522	1.497	0.0973665
Africa	0.0180892	0.281306	0.06430	0.00721609
NorthAmerica	0.196418	0.165037	1.190	0.0780375
SouthAmerica	0.333451	0.173920	1.917	0.131559

Mean dependent var	0.502817	S.D. dependent var	0.500345
McFadden R-squared	0.059347	Adjusted R-squared	0.026835
Log-likelihood	−462.9173	Akaike criterion	957.8347
Schwarz criterion	1030.879	Hannan-Quinn	986.0520

*Evaluated at the mean
Number of cases 'correctly predicted' = 432 (60.8%)
f(beta'x) at mean of independent vars = 0.500
Likelihood ratio test: Chi-square(15) = 58.4118 [0.0000]
Test for normality of residual -
 Null hypothesis: error is normally distributed
 Test statistic: Chi-square(2) = 7.57809
 with p-value = 0.0226172

Appendix 5: Gretl Results for Probit Model with Unit Dummies of Countries

Model 2: Probit, using 710 observations
Dependent variable: Inflation
Standard errors based on Hessian

	Coefficient	*Std. Error*	*z*	*Slope**
const	−3.97468	3957.09	−0.001004	
UpperLimit	0.441883	0.194437	2.273	0.176274
LowerLimit	−0.373681	0.196404	−1.903	−0.149067
Broadmoneygrowthannual	0.00492165	0.00620855	0.7927	0.00196333
Broadmoneygrowthannual_1	−0.00170119	0.00582132	−0.2922	−0.000678634
CGDtotalofGDP	−0.00184568	0.00204707	−0.9016	−0.000736269
CGDtotalofGDP_1	−0.00197654	0.00203024	−0.9736	−0.000788472
TradeOpeness	−0.0180058	0.00950123	−1.895	−0.00718280
TradeOpeness_1	0.0135921	0.00913263	1.488	0.00542209
Interestrate	−0.111507	0.0289568	−3.851	−0.0444818
Interestrate_1	0.0544417	0.0260761	2.088	0.0217177
Asia	5.85603	3957.08	0.001480	0.793832
Europe	4.81801	3957.09	0.001218	0.960409
Africa	2.82586	3957.09	0.0007141	0.574392
NorthAmerica	4.06821	3957.09	0.001028	0.731714
SouthAmerica	3.65943	3957.09	0.0009248	0.727717
du_1	−1.32536	0.474633	−2.792	−0.410864
du_2	−1.74121	0.532923	−3.267	−0.467754
du_3	3.50258	3957.09	0.0008851	0.561007
du_4	−0.140424	0.505234	−0.2779	−0.0558091
du_5	0.158197	0.559029	0.2830	0.0629301
du_6	0.0260620	0.412094	0.06324	0.0103969
du_7	0.497098	0.432628	1.149	0.191652
du_8	−3.79930	3957.09	−0.0009601	−0.529447
du_9	−1.03681	0.626437	−1.655	−0.354160
du_10	−0.460330	0.642459	−0.7165	−0.177157
du_11	3.07025	3957.09	0.0007759	0.525652
du_12	0.389589	0.658006	0.5921	0.152127
du_13	−0.245340	0.630589	−0.3891	−0.0968354
du_14	−1.09486	0.724121	−1.512	−0.366916
du_15	−0.936437	0.489737	−1.912	−0.327739
du_16	−2.60892	5596.16	−0.0004662	−0.500943
du_17	−2.28736	5596.16	−0.0004087	−0.504845
du_18	3.10809	3957.09	0.0007854	0.546720
du_19	−1.96655	5596.16	−0.0003514	−0.479957
du_20	−1.51518	0.693171	−2.186	−0.436073
du_21	−2.58562	5596.16	−0.0004620	−0.524213
du_22	−1.64599	0.654397	−2.515	−0.462343
du_23	−1.00421	0.665246	−1.510	−0.343001

du_24	4.13434	3957.09	0.001045	0.576091
du_25	−1.06516	0.455283	−2.340	−0.360007
du_26	−0.147880	0.695887	−0.2125	−0.0587387
du_28	−2.00071	5596.16	−0.0003575	−0.492651
du_29	−1.36259	0.470742	−2.895	−0.421701
du_30	−1.70859	0.499542	−3.420	−0.465175
du_31	−1.46008	0.618488	−2.361	−0.428624
du_32	−1.63022	0.603918	−2.699	−0.455820
du_33	0.622181	0.526286	1.182	0.235151
du_34	−1.23858	0.430099	−2.880	−0.400423
du_35	−2.54817	5596.16	−0.0004553	−0.520338

Mean dependent var	0.502817	S.D. dependent var	0.500345
McFadden R-squared	0.121058	Adjusted R-squared	0.019457
Log-likelihood	−432.5479	Akaike criterion	965.0957
Schwarz criterion	1193.359	Hannan-Quinn	1053.275

*Evaluated at the mean
Number of cases 'correctly predicted' = 477 (67.2%)
f(beta'x) at mean of independent vars = 0.500
Likelihood ratio test: Chi-square(49) = 119.151 [0.0000]

Test for normality of residual -
Null hypothesis: error is normally distributed
Test statistic: Chi-square(2) = 2.01631
with p-value = 0.364891

Appendix 6: ARCH Test from Gretl

Model 2: Pooled OLS, using 558 observations
Included 38 cross-sectional units
Time-series length: minimum 3, maximum 27
Dependent variable: usq1
Robust (HAC) standard errors

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.572155	0.0696940	8.210	<0.0001	***
usq1_1	−0.000705813	0.0471253	−0.01498	0.9881	
usq1_2	0.0477512	0.0557961	0.8558	0.3976	
usq1_3	0.0394092	0.0464805	0.8479	0.4020	
usq1_4	−0.0148957	0.0448246	−0.3323	0.7415	

Mean dependent var	0.616299	S.D. dependent var	0.343734
Sum squared resid	65.56789	S.E. of regression	0.344336
R-squared	0.003699	Adjusted R-squared	-0.003507
F(4, 37)	0.400201	P-value(F)	0.807211
Log-likelihood	−194.3526	Akaike criterion	398.7051
Schwarz criterion	420.3269	Hannan-Quinn	407.1492
rho	0.002349	Durbin-Watson	1.794677