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Inflation targeting: a comparative analysis between point, range and point with range inflation targeting

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2021
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Inflation Targeting: A comparative analysis between Point, Range and Point with Range inflation targeting



A Research Report presented in partial fulfilment of the degree of Master of Commerce – CCA02

Research Paper code: ECON7008A,

School of Economics and Finance,

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Word count: 11596

Date: 03 September 2021

Declaration

I, Siphiwe Jeanette Masikane, hereby declare that the compilation of this research is my own individual work and that it has not been submitted anywhere else. I have taken every reasonable step to acknowledge the contributions and efforts made by others by referencing the source of that literature. This thesis was compiled under the capable supervision of Professor Jannie Rossouw of the University of the Witwatersrand.

Acknowledgements

To my family, thank you for the patience and support. With love.

Abstract

This research analyses the performance of three types of inflation targeting, i.e., point targeting, range targeting and point with range targeting. Inflation targeting countries are grouped according to their target type (Treatment group) and compared against non-targeting countries (Control group). The difference and difference model (DID) is used to compute the statistical analyses and to assess performance in respect of average inflation and inflation volatility. The result shows a significant decrease in the average inflation rate in targeting and non-targeting countries. The regressed average inflation rate reduced more under point targeting than under range and point with range targeting. An assessment of inflation volatility finds that the magnitude of the change in volatility is significantly higher in range targeting than in point and point with range targeting. The implications of these results show that countries which plan to introduce inflation targeting for the first time should opt for point targeting from a perspective of reducing inflation and anchoring expectations. On the other hand, countries which aim for low overall inflation volatility should opt for range targeting from a perspective of range flexibility and fostering credibility.

Keywords: Inflation target types, inflation targeting, range target, point target, point with range target.

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1 Introduction

In the past three decades many developed and developing countries across the globe followed New Zealand's footsteps and adopted the well-known Inflation Targeting ("IT") monetary policy framework (Abo-Zaid & Tuzemen, 2012). According to the Central Bank News website (Central Bank, 2021), to date over 40 countries have adopted an explicit IT framework. The primary objective of IT monetary policy is to ensure a stable and low inflation rate, which is predominately measured through low average inflation and inflation volatility (De Mendonça & De Guimarães e Souza, 2012).

Inflation rates in general and inflation volatility have reduced significantly over the years for many countries, especially when comparing pre- and post-IT policy frameworks. There are several empirical research papers which supports the effectiveness of IT in lowering inflation and inflation volatility, such as Lin & Ye (2009); Mishkin & Schmidt-Hebbel (2007); Neuman & von Hagen (2002); Pétursson (2004); Svensson (2010); Vega & Winkelried (2005). There are other contrasting findings such as a paper by Ardakani, Kishor, and Song (2018), which find that IT has made no significant impact in reducing either the volatility nor the inflation rate, albeit these papers do not provide a counter argument against IT either

Working on the premise that IT has contributed to reducing the inflation rate in line with the trends across the world and the knowledge that the formulation of inflation targets differs by countries, it is not clear if any specific target type has contributed significantly to reducing inflation in comparison to other target types. Most of the past research papers have focused on evaluating the success of IT by either comparing between the inflation targeters and non-targeters and/or assessing effects of IT against other monetary regimes.

To our knowledge, none of these papers have taken the analyses a step further by investigating which IT target type yields better economic outcomes, with any comparison to non-IT countries. Accordingly, the gap identified in the literature is that no paper has distinguished between countries which have opted for point, range or point with range targeting to establish which target type offers better economic outcomes.

In this research, we distinguish between point, range and point with range IT and include the non-targeting countries to benchmark our results. Table A1 in the Appendices summarises all the countries that have adopted IT, segmented according to their target types, and includes a list of

selected non-targeting countries. We evaluate the effects of IT according to each target type and we measure this using two indicators, i.e., the average inflation rate and inflation volatility in the initial and final periods of our evaluation, output is excluded from this analysis. We use the difference in difference (DID) model to compute our statistical analyses. The DID looks at comparing effects of treatment group against control group which is a fitting model for our estimation of IT by target type.

Our contribution to this research goes beyond the previous studies in two ways. First, we distinguish between three inflation targeters: point, range and point with range targeting to examine which target choice provides better economic outcomes, measured by average inflation rate and inflation volatility. Secondly, we use a comprehensive updated dataset of inflation targeters covering 39 countries, against 15 non-targeting for period 1991 to 2017 (26 years). Our country sample list comprises a mixture of Eastern European, African, Asian, and Latin American countries, including all the OECD countries that have adopted IT. In this group of IT countries, eight are grouped as point targeters, five countries are grouped as range targeting and twenty-six as point with range targeters. For purposes of comparison, fifteen countries are grouped as non-targeting countries.

The research questions we aim to answer are two-fold. Firstly, which target type has yielded superior economic outcomes since the adoption of IT? Secondly, how do the inflation target choices influence the prevailing inflation rate conditions? The answers to these questions would yield empirical results which will provide policy makers such as governments and central banks with information on which target type provides superior results amongst the IT targets spectrum. This aspect confirms the significance of this study.

Our results show that average inflation has reduced significantly across all target types when comparing the initial and final periods of our evaluation of IT. However, we also note that the rate of inflation declined in non-IT countries as well. These results are consistent with various other empirical papers on the reduction of inflation since the first adoption of IT. The results of the regressed average inflation show that point targeting provides a much higher reduction of inflation rate at -2.41 percentage points and is significant at 5%, in comparison to the reduction with range targeting of -1.83 percentage points, (insignificant) and point with range targeting reduction of -2.19 percentage points (significant at 1%). Therefore, point targeting shows better results in a

process of reducing inflation rate in comparison to point with range and range targeting. The results of regressed inflation volatility show a reduction of -1.80 percentage point (significant at 1%) for point targeting, -2.04 percentage point (significant at 5%) for range targeting and -1,50 percentage point (significant at 1%) for point with range targeting. Therefore, the magnitude of decrease in volatility is higher under range targeting in comparison to point and point with range targeting.

The structure of this research looks as follows: The second chapter provides a comprehensive literature review and is split into two subsections. The first section reviews the theoretical background of IT and provides a detailed discussion on the IT target types. The second section focuses on past empirical papers relating to an assessment of the macroeconomic performance of IT. The methodology is presented in chapter three, in which the approach of this study is described in detail. This includes the criteria for sample selection of countries, data analyses, as well as the methodology and model specification used. Chapter four naturally follows as the results section, and an in-depth discussion is provided on our main economic indicator assessed, which is the average inflation and inflation volatility. Lastly, chapter five provides a conclusion to this study.

2 Literature Review

This section is divided into two subsections. The first section describes the background of IT and provides a detailed discussion on the three target types. The second subsection provides empirical evidence on the previous studies of IT and the various methods used to assess the performance thereof.

2.1 Theoretical background of IT

IT as a monetary policy framework was introduced as a response mechanism to curb high inflation rates. During 1970s and the 1980s, industrialised economies experienced high inflation and as a result, the inflation targeting approach emerged as an appropriate policy to tackle high inflation (Walsh, 2009). New Zealand was the first country to adopt an explicit inflation targeting framework in 1990 and thereafter many developed and developing countries followed suit (Walsh, 2009). South Africa announced the adoption of an inflation-targeting monetary policy framework in 2000, for first achievement in 2002, given the inevitable monetary policy implementation lag (Rossouw, 2008).

It has now been over 30 years since the first adoption of inflation targeting in New Zealand and to date more than 40 emerging and industrial economies have adopted IT (Niedźwiedzińska, 2018). Thus far no country has dropped IT for other monetary policy framework (Niedźwiedzińska, 2018). This suggests that central banks are comfortable with the performance of the IT framework.

IT as a monetary policy is defined using the following five fundamentals. Firstly, IT involves the announcements of an explicit numeric inflation target to the public. Secondly, it is a commitment to price stability as a main objective for the central bank. Thirdly, it entails ensuring high transparency by communicating to the public on the policy plans and policy decisions. Fourthly, the policy framework includes an all-encompassing policy approach with a clear mandate to ensure low inflation. Fifthly and lastly, it provides enhanced accountability for the central bank to achieve its inflation targeting goals (Mishkin, 2001).

From the above five fundamentals of IT, an important aspect of this research is the announcement of a numeric inflation target to the public. This numeric target could be either be a range, point or point with range target. Each country differs in their approach to inflation targets and the choice on which target type and the level or range of the target to announce is informed by various factors. Beechy & Österholm (2018) claim that the rationale for choosing any target type is guided by the respective country's views on inflation expectations, the stabilisation preference as well as some political considerations.

The question, however, is which target type has yielded superior economic outcomes since the adoption of IT? There are various theoretical debates on the economic impact of each target type and the following subsections describe the theory of inflation targets.

2.2 Theory of inflation targets

The IT numeric target types are defined as follows. According to the Riksbank (2017), (i) point targeting is defined as targeting a single numerical value. For example, the United Kingdom has set its point target as 2 percent. (ii) Range targeting refers to two numerical values, that is an upper and lower limit value. For example, South Africa has set its target range between 3 percent to 6 percent. (iii) Point with range targeting is defined as targeting a point with a tolerance level or range around it, built to cater for any shocks from the reference point. For example, Chile has set its point with range numerical target as 3 percent (+ or – 1 percentage point on either side of the reference point).

In this research, we describe three numerical inflation target types, whilst other papers describe four. The recent paper by Niedźwiedzińska (2018), describes four target types, which are point, range, point with range and point with a tolerance level. The difference between the classifications of our targets and the that of Niedźwiedzińska (2018) is that we have combined the point with range and what is termed point with tolerance level target type as one target type, given the similarities.

Moreover, it is essential to indicate that the three main target choices referred to in this research does not represent a comprehensive list of targets under IT regime. There are some target choices which are excluded from this analysis as some countries have opted not to pick from a specific, point, range, or point with range target, but rather use a target that is below or close to a certain point. For example, the Euro area and Vietnam has an inflation target of less than 2 percent and 4 percent, respectively. Thus, for the purposes of this analyses we have excluded those countries and areas, so that we focus on countries that have either selected a point, range or point with range target.

There are opposing views on the effects of each of the types of inflation targeting on the economic outcomes. We therefore review the theoretical arguments for and against each target type.

2.2.1 Arguments for and against range targeting with respect to IT

There are various contrasting views on the effects of a range targeting approach. To begin with, according to Castelnuovo, Nicoletti-Altimari, and Rodriguez-Palenzuela (2003), the announcement of a range target signals to the public that there are uncertainties with inflation forecasts and that controlling inflation has its challenges. In other words, it allows the central bank to provide a realistic view of the challenges, instead of creating a false impression that monetary policy will always keep inflation under control and at a specific level.

There are consequences for those who deviates from inflation targets. Some IT countries have a standard practice that if the actual inflation rate deviates from target for a substantial period, open letters of explanation should be provided by the respective central banks. These letters provide reasons for the deviation from targets, affirm the commitment to the targets, provide inflation outlook and remedial action to bring back inflation to target (Niedźwiedzińska, 2018). For instance, countries such as New Zealand and Canada were frequently deviating from their point targets and this resulted in their central banks having to provide regular letters of explanation for

not meeting their targets, and they subsequently changed their targets to include a tolerance range to cater for uncertainties (Mishkin, 2001).

In addition, range targets are flexible targeting methods. However, some authors view this flexibility as an advantage and some view it as a disadvantage. Albagli & Schmidt-Hebbel (2004) and Castelnuovo et al. (2003) argue that the advantages of a flexible targeting approach such as a range, is that it offers the central bank the ability to apply adjustments in the events of shocks in the inflation and output in the conduct of monetary policy, which is normally a challenge under point targeting. In contrast, Peter, Roger and Heenan (2006) claim that although range targets provide flexibility, this may not be an advantage as there are concerns about the magnitude of the range. A highly flexible range may provide monetary policy with room to apply discretion, and this may erode the public's trust in the targeting framework. Therefore, the relevant authorities in inflation-targeting countries must concern themselves with setting targets within appropriate margins.

Furthermore, another advantage of range targeting is that it could resolve the time inconsistency problems, although this is also applicable to other target types. Time inconsistency problems occur when the monetary policy authorities pursue a temporary problem, such as output and employment, which may impact the long-term outlook and results of inflation (Cornand & M'Baye, 2016). Thus, Mishkin & Westelius (2008) postulate that range targeting can deter large inflation fluctuation caused by time inconsistency problem and the wider the range target the better it is able to absorb the large fluctuations.

Moreover, there are other differing views on whether a range target should have a mid-point target. Beechey & Österholm (2018) and Peter et al. (2006) argue that some countries have not defined a midpoint of a range target and suggest that when a range is not committed to a midpoint, it becomes ineffective in anchoring inflation expectations. In addition, this notion holds true especially for countries who have a wider range target such as Uruguay. For example, Uruguay's range target is set between 3% and 7%. Consequently, without a midpoint, the disparities between the inflation rate at the top versus bottom may impact inflation expectation further in the long run. On the contrary, Svensson (2014) says that whether a range target has a midpoint or not, it does not really matter, as the central bank will always aim for a midpoint of the range in any case. To illustrate, over the last 18 months or two years, the South African Reserve Bank focuses on the midpoint of

the range (Kganyago, 2019). Rather than South Africa targeting a range between 3% to 6%, the central bank has now defined their midpoint as 4.5%, to anchor expectation at 4.5% as opposed to 6% (Kganyago, 2019).

Lastly, a successful inflation targeting policy requires high levels of credibility. That is, the public should trust that the central bank will achieve its set targets. In the event of low credibility, Beechey & Österholm (2018) state that the public will lose trust in the targets and distort inflation expectations. There are opposing opinions on how credibility is impacted within a range target method. Cornand & M'Baye (2016) argue that in the event of a range target being missed, the public will lose trust in the range target and the inflation targeting policy. This is because the public assesses the deviation of a range target harshly, thereby impacting credibility.

On the other hand, Beechey & Österholm (2018) and Mishkin & Westelius (2008) suggest that the notion of a range target being missed is a fallacy, as the inflation rate is more likely to be within as opposed to outside the range. This will probably intensify the credibility in the range target. Besides, economic agents are far more concerned whether the target is "within" or "outside" the range and are far less concerned about the extent of the deviation from the central point, in the event it is stipulated.

The arguments provided above intensify the debate on the advantages and disadvantages of a range target with no clear position on the real effects thereof. Another signal which can be used to gauge the true sentiments of range targeting by central banks, would be to use the recent data on the number of countries which have opted for range targeting. Over the years, the numbers of countries which have opted for range targeting has changed, with fewer countries (five in this study) opting for range targeting. This suggest that the central banks have less confidence in the range target's ability to improve economic performance.

2.2.2 Arguments for and against point targets with respect to IT

According to Beechey & Österholm (2018), point targets are regarded as a superior target method in comparison to range targets. In this research study, eight countries are depicted as point targeting, versus five countries which are range targeting, suggesting that more countries prefer point targeting to range targeting. Castelnuovo et al. (2003) state that a point target have stronger signaling properties when announced (as its more precise) and are also seen to be great at anchoring

expectation and easy to communicate to the public, when compared to range targeting (Castelnuovo et al., 2003).

The arguments against the point target suggests that if the inflation rate deviates from targets temporarily, this may have severe consequences for the credibility of the targets. To the contrary, as already stated above, the range target allows for such deviation (Cornand & M'Baye, 2016). Furthermore, the occurrence of significant volatility affecting inflation expectations during low credibility for point targets may affect the functioning of the monetary policy. Without credibility and well-anchored expectations, the monetary policy approach will not succeed (Cunningham et al., 2010). Therefore, the choice between a range and a point target reflects the trade-offs between the two target types and is interconnected with the monetary policy framework.

Accordingly, central banks do not have to choose between either a range or a point targeting method. The central banks could simply combine the two methods to address the shortcomings of either target type. When the central banks combine the two-target type, they have what we call the point with range target method.

2.2.3 Arguments for and against the point with range target with respect to IT

The most prevalent inflation target type is point with range targeting. There are 26 countries that are depicted under point with range targeting in this research. A point with range target is motivated by the realisation that a point-only target may be difficult to attain and thus a range/tolerance around the point is introduced. Therefore, this may be viewed as hybrid model of point and range targets. The argument supporting this hybrid model is that a point-only target may result in a loss of public confidence in the event of fluctuations, thus the point with range targets incorporate a tolerance range to cater for eventuality of such shocks and anchors the confidence levels (Apel & Claussen, 2017). Moreover, the wider the tolerance range around the point, the more uncertainty it signals to the public (Apel & Claussen, 2017).

According to Peter et al. (2006), point with range targets ensure high levels of credibility. However, deviations from the tolerance range may erode public confidence and credibility. A contrasting view by Riksbank (2017) states that economic agents are aware that the inflation targets may not be met and that deviations will occur from time to time. It is further stated that targets may fall outside the tolerance range, but may not affect credibility of IT. Besides, volatility

is a common part of the monetary policy and so the tolerance range is unnecessary as point only targets should be sufficient (Tetlow, 2008).

With the point with range targeting method, central banks are discouraged from using the range to change the point target as this may cause unfavorable inflation expectations and impact negatively the anchoring of inflation expectations (Ehrmann, 2015). Without anchored inflation expectations, the variations will cause major macroeconomic imbalances (Peter et al., 2006). Hence, the formulation of point with range target covers the medium- and long-term objective of IT, wherein inflation and anchoring of expectation are met (Peter et al., 2006)

To sum up, the above literature provides a comprehensive analysis of the various advantages and disadvantages of each inflation target type. From this analysis, no clear preference for any type of inflation target emerges, while it is also unclear which target choice provides better economic outcomes. We note that majority of the IT countries have opted for point with range targeting. We therefore hypothese that point with range targets provide better economic outcomes in comparison to range or point-only targets. As such it is necessary to perform an empirical assessment to show which target choice has produced better economic results as measured by average inflation and inflation volatility since the adoption of IT.

2.3 Empirical findings of other researchers

The gap identified in the existing empirical literature is the lack of in-depth evaluation of the economic impact of point, range and point with range inflation targets, and a comparison of these results. The closest to a similar assessment is a recent paper by Beechey & Österholm (2018), where they explore the choice of point or range target in a stylised economy, wherein agents learn about the inflation generating process. In this model, the preferred target type is driven by the inflation-output stabilisation preference set by the central bank. They find that a range or band target is associated with higher variability of inflation and lower variability of output gap compared to a point target. Therefore, if the preference is for strong output stabilisation, range or band inflation targets are favored. In terms of inflation stabilisation, a point target outperforms range or band target.

Other authors who have performed a similar assessment are Cornand & M'Baye (2016), Their approach was to conduct a laboratory experiment with human subjects to assess the rationale of adopting a range/band versus a point IT regime. Using the standard New Keynesian model, they

assess the macroeconomic performance of both IT regimes in relation to their strength and shocks of the economy. They find that when an economy is experiencing small shocks, the average level of inflation and volatility are significantly lower in a range/band regime, while output and interest rates and volatility are significantly lower in point targeting regime with a tolerance band. Yet, when the economy is experiencing large shocks, choosing between range/band or point is irrelevant because both regimes lead to comparable performances.

The above empirical papers only focused on analysing the inflation targeting regime by means of point versus range targeting and have not included the point with range target, which is dominant in recent years. Their analyses were based on stylised and laboratory experiments to assess the impact of each target regime and as such no historic data has been used to assess the actual impact of the performance of these IT regimes. Therefore, these papers lacked a comprehensive study of the IT performance of each targeting regime. Given the three decades of IT, there is enough data to run a regression based on the three target types.

The primary assessment of the effectiveness of the IT regime is notedly based on the examination of the level of inflation and inflation volatility. Our approach in this study follows a similar empirical analyses method. There are various research papers that have analysed the effectiveness of IT focusing on the inflation rate and inflation volatility and these authors often present opposing views on the effects of IT thereof. For example, a paper by Wu (2004) investigated a sample of 22 OECD countries which were divided into two groups of IT adopters and non-adopters for the period 1985-2002. They used the "difference in difference statistical estimation method" DID to assess changes between the two groups. Their results from this empirical methodology show that those countries which are participating IT monetary policy have significantly reduced their inflation rate. Similarly, Gonçalves & Salles (2008) studied a sample of 36 emerging market countries, of which 13 were identified as IT, while the remaining 23 countries that have adopted other monetary regimes. The evaluation period was from 1980 to 2004. The results show that emerging counties registered a reduction in average inflation compared to non-targeting countries.

In addition, the paper by Pétursson (2004) estimated a panel model using seemingly unrelated regressions (SUR) with fixed effects for a sample of six IT countries. The effects of IT were found to be statistically significant in that the study revealed that inflation targeting results decrease

inflation by more than 3 percentage points, even after taking into consideration global trends and business cycles.

Other authors such as Vega & Winkelried (2005) have also investigated the effect of IT by evaluating countries that have adopted IT as treatment group against a control group of non-targeting countries, using a propensity score matching method. They find that IT has assisted in reducing inflation rate and inflation variability in the countries that adopted IT. Moreover, Neuman & von Hagen (2002) find that IT was a useful strategy to reduce inflation rate and inflation volatility. Their results collaborate the conclusion that IT was a useful framework for communication the monetary policy which aims at reducing inflation rates.

Some authors provide contrary evidence on the effects of IT on economic outcomes. For example, Willard (2012) provides a view which suggests that IT has a small insignificant impact on inflation. These results were obtained by running several identification approaches such as panel fixed effects as well as instrumental variables to estimate the effects of IT for a sample developed countries.

Brito & Bystedt (2010) provide estimates for Latin American countries which adopted IT regimes. They find that with IT adoption, these economies have experienced a decrease in the level of inflation variability and the sensitivity of projected to actual inflation. Similarly, Thornton (2016) provides an alternative view, suggesting that the adoption of IT in developing countries did not assist in reducing inflation and stabilizing growth variability compared to other monetary regimes such as a pegged exchange rate regime.

Most recently a paper by Ardakani et al. (2018) estimates the treatment effects of IT on macroeconomic variables using single index method, taking into account the model misspecification of parametric propensity scores. Their results also indicate that there's no significant impact in inflation variability and inflation rate between IT and non-IT after adoption of IT. Further, the evidence show that IT has reduced the sacrifice ratio and interest rate variability in emerging economies and that it also enhances fiscal discipline in both developed and developing economies.

Our research builds on the existing literature by analysing the economic outcomes in terms of average inflation and inflation volatility and using difference and difference (DID) model as per

authors Ball & Sheridan (2004) for our estimates. However, we add a new dimension by clustering countries according to their target type. That aspect is point, range, and point with range targeting and evaluate the economic outcome to determine which target type yielded the best economic results.

3 Methodology

In this section**,** we explain in detail the approach used in this study. The method used follows research methodology applied by Gonçalves & Salles (2008) and Thornton (2016). The difference in difference (DID) estimator is used to compare results between point, range and point with range targeting (treatment group) against non-targeting countries (control group). The economic indicator assessed are average inflation and inflation volatility to measure the effectiveness of IT by target type versus non targeting countries. We also provide an overview of the selection criteria for countries used, data, variable used and model specification.

3.1 Selection of countries

We assess major developing and developed countries across regions, including OECD countries. We first select two groups, the IT group (treatment group) and the non-IT group (control group). Secondly, we further cluster the IT countries according to their target types that is; point, range, and point with range targeting. We obtain our list of inflation targeting countries and their respective target types from the central bank's website, similar to the approach used by Riksbank (2017). We reference this list against the, website of IMF database (IMF, 2021) to define the adoption date for all IT countries. Countries with no official IT adoption date, even after checking their respective central banks websites are regarded as non-IT countries. It is important to note that there are various lists of IT countries available, some are outdated, and some are not comprehensive enough for this study. We therefore use the central banks' and the IMF database, as they provide comprehensive recently updated IT countries.

From the list of identified IT countries, we exclude countries which experienced inflation over 50% since 1991 (Turkey, Ukraine, Serbia, Romania, Belarus, Azerbaijan, Argentina, and Kazakhstan). Countries with high inflation may distort our results, for example, if there's a disproportionate number of IT countries with hyperinflation in the past, this will cause a significant decrease in inflation in the final period, essentially distorting the impact of IT pre and post evaluation period. In addition, it is also important to note that in some instances, we only eliminate

the hyperinflation years and not all data from a given country. It is simply not feasible to remove all instances, as various countries experienced hyperinflation at some point. If we remove all countries that at some point experience hyperinflation, it would be necessary to remove more than 50% of our data set. The same approach of eliminating hyperinflation countries to stabilise the research model was adopted by Gonçalves & Salles (2008) and Thornton (2016). Furthermore, IT countries with no inflation data for the period under evaluation were also excluded (Georgia and Argentina).

We are left with 39 inflation targeting countries which are listed on Table 1, of which 8 are classified as point, 5 are classified as range targeting and 26 are cl0061ssified as point with range

Table 1: Inflation targeters

No	IT Countries	Adoption date	Target	Target type
1	Switzerland	2000	2.00%	Point targeting
2	United Kingdom	1992	2.00%	Point targeting
3	Iceland	2001	2.50%	Point targeting
4	Japan	2013	2.00%	Point targeting
5	Malawi	2012	5.00%	Point targeting
6	Norway	2001	2.50	Point targeting
7	Russian Federation	2015	4.00%	Point targeting
8	Sweden	1995	2.00%	Point targeting
1	Australia	1993	2.00% – 3.00%	Range targeting
2	Botswana	2006	3.00% - 6.00%	Range targeting
3	Eswatini	2000	3.00% - 7.00%	Range targeting
4	Uruguay	2007	3.00% - 7.00%	Range targeting
5	South Africa	2000	3.00% - 6.00%	Range targeting
1	Albania	2009	3.00% +/-1%	Point with range targeting
2	Armenia	2006	4.00% +/-1.5%	Point with range targeting
3	Bangladesh	2003	6.00% +/-1.0%	Point with range targeting

4	Brazil	1999	4.50% +/-1.50%	Point with range targeting
5	Canada	1991	2.00% +/-1.0%	Point with range targeting
6	Chile	1990	2.00% +/-1.0%	Point with range targeting
7	Colombia	1999	3.00% +/-1.0%	Point with range targeting
8	Czech Republic	1998	2.00% +/-1.0%	Point with range targeting
9	Dominican Republic	2012	4.00% +/-1%	Point with range targeting
10	Ghana	2007	8.00% +/-2.0%	Point with range targeting
11	Guatemala	2005	4.00% +/-1.0%	Point with range targeting
12	Hungary	2001	3.00% +/-1.0%	Point with range targeting
13	Indonesia	2005	4.00% +/-1.0%	Point with range targeting
14	India	2015	4.00% +/-2.0%	Point with range targeting
15	Israel	1997	3.00% +/-1.0%	Point with range targeting
16	Kenya	2014	5.00% +/-2.50%	Point with range targeting
17	Moldova	2010	5.00% +/-1.5%	Point with range targeting
18	Mexico	2001	3.00% +/-1.0%	Point with range targeting
19	Mongolia	2012	8.00% +/-2%	Point with range targeting
20	New Zealand	1989	2.00% +/-1.0%	Point with range targeting
21	Peru	2001	2.00% +/-1%	Point with range targeting
22	Philippines	2002	3.00% +/- 1.0	Point with range targeting
23	Poland	1998	2.50% +/-1.0%	Point with range targeting
24	Paraguay	2011	4.00% +/-2.0%	Point with range targeting
25	Thailand	2000	2.50% +/-1.5%	Point with range targeting
26	Uganda	2011	5.00% +/-2.0%	Point with range targeting

Source: central banks website, www.centralbanknews.info and IMF, www.imf.org

We select our non-targeting countries from previous study by Thornton (2016) as our control group. A sample of 15 countries with no "official IT adoption date" are selected from this list. The criteria for selecting the non-targeting group on the (Thornton, 2016) list was to ensure a fair balance of representative across developing and developed countries, much like the treatment

group. The reason for using the (Thornton, 2016) is because it consists of a much broader list of non-targeting countries.

It is important to note that whilst some countries do not consider themselves as IT, their execution of monetary of policy framework has some similarities with IT framework, as these countries recognise the need for strategic change with respect to communication and transparency (Reid, 2009).

Table 2 presents our sample of non-IT countries.

Table 2: Non- Targeting Countries

No	Countries
1	Gambia, The
2	Kyrgyz Republic
3	Nepal
4	Pakistan
5	Tonga
6	Tanzania
7	United States
8	Vietnam
9	Samoa
10	Zambia
11	Jamaica
12	Sri Lanka
13	Nigeria
14	Egypt
15	Honduras

Source: Thornton (2016) & Central Bank Websites

3.2 Evaluation period

Following the selection of the countries under observation, the next step is to determine the period under evaluation. The sample periods selected include a pre and post implementation of IT regime assessment. We consider the period starting 1991 to 2017 as our evaluation period of study. The main reason we choose this period of study is that the adoption of IT activity started early in the 1990s by most countries. For example, Canada, United Kingdom and Australia commenced with inflation targeting regimes in 1991, 1992 and 1993, respectively. Furthermore, the research runs to 2017 (end date), as not all countries had updated their inflation data for 2018 and 2019 at the time of extracting this information. For robust analyses we consider two periods. We define the end of the initial period and the start of the final period. To define the end of the initial period, we take the average of our policy evaluation period so that our initial period runs from 1991 to 2003 and our final period runs from 2005 to 2017. This implies that 2014 represents the average year of adoption in our data across IT and non-targeting countries.

Table 3: Evaluation period

Countries	IT & Non-IT	Initial Period	Final Period
Inflation Targeters	Point targeting countries	1991 to 2003 (12 years)	2005 to 2017 (12 years)
	Range countries	1991 to 2003 (12 years)	2005 to 2017 (12 years)
	Point with Range countries	1991 to 2003 (12 years)	2005 to 2017 (12 years)
Non-Targeters	Non-Targeting countries	1991 to 2003 (12 years)	2005 to 2017 (12 years)
Average Adoption year		2004	

Source: Own compilation

3.3 Approach

Our interest in this research is to distinguish between countries which have opted for range, point, and point with range targeting (treatment group) in order to investigate which, target type provides superior economic results. These results are compared against the non-targeting countries (control group). The main economic indicators under assessment are average inflation and inflation volatility.

We aim to answer two questions, Firstly, which target type has yielded superior economic outcomes since the adoption if IT? Secondly, how do the inflation target choices influence the prevailing inflation rate conditions.?

We employ a difference in difference (DID) model as our estimator, similar to Gonçalves & Salles (2008) and (Thornton, 2016). The DID model has been used in various empirical studies to evaluate the performance of IT. These studies include papers by (Gonçalves & Salles, 2008) and (Thornton, 2016) to name a few. According to Lechner (2014), the DID model is a research method designed to estimate the casual effects. It is mainly popular in examining policy effects or changes in empirical economics studies. It is an attractive model choice when evaluating two or more groups and comparing two periods, mainly pre and post treatment evaluations. Thus, the DID model is a fitting estimation model for our research study in evaluating the effects of IT strategy.

An important caveat to highlight is that it is not enough to check only if the observed changes of economic variables between two periods were bigger for those who opted inflation targeting. The reasons for this emphasise is that if the initial inflation was higher within a group, a more significant reduction in the level of this variable may signal mean reversion and not necessary a direct contribution of IT regime. Therefore, to control for this, we add the initial value of the dependent variable as a right-hand side regressor and therefore run our DID model is based on the following model specifications:

Model (1)

$$\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \varepsilon \quad \ldots\ldots\ldots\

α represents the difference in difference coefficient and γ the constant which is also defined as the control group

We run the regressions starting from initial period of 1991 to 2003 and the final period running from 2005 to 2017. If the final period versus the initial period officially recorded a reduced inflation rate, then the results should reflect as negative and show a significant coefficient.

Model (2)

$$\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_6 D_6 + \varepsilon \quad \text{..... (2)}$$

Model 2, we want to test our results for inflation targeters against non-targeters to ascertain our overall results on the effects of IT. Therefore, we remove the distinction between point, range and point with range targeting. We combine inflation targeting countries into one (point, range and point with range targeting combined into one IT targeting countries) and assess against the control group (non-IT targeters). We provide a new model specification and introduce another dummy variable 6, where dummy variable 6 is equal to 1 if countries have adopted IT and 0 if otherwise.

Model (3)

$$\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_2 D_2 + \beta_4 D_4 + \varepsilon \quad \text{..... ..... (3)}$$

Model 3, a point with range targeting method is a hybrid regime with a combination of a range and a point target. In model 3, we collapse the distinction between range, point and point with range targeting. We restructure the model and combine point and point with range targeting into one group and compare this against range targeting. This results in two target types groups instead of the initial three – The new point (combined with point with range) compared against the range only targeting as well as the non-targeters. We have a new dummy variable 4, where if the variable is equal to 1 then countries are point and point with range targeting combined and 0 otherwise. Dummy variable 2 represent the range targeting and if 1 the country is range targeting and 0 otherwise.

Model (4)

$$\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_1 D_1 + \beta_5 D_5 + \varepsilon \quad \text{..... (4)}$$

Model 4, we follow similar approach to model 3, however this time we collapse the three-target type regime and combined point with range and range targeters as one group. This is new group is compared against point targeters. We produce a new dummy variable 5, where if D_5 is equal to 1 then the countries are (point with range and range targeting combined) and 0 if otherwise. D_1 is the dummy variable equal to 1 if countries are point targeting or 0 if otherwise. In the same way, all the models are measured against the non-targeting group as well.

3.4 Variable and descriptions

Our data was collected from the world development index (WDI) database and we use annual inflation data from the World Bank to calculate these economic outcomes (WorldBank, 2021). Data consists of fifty-four countries under observation, of which eight are grouped under point targeting, five are grouped under range targeting, twenty-six are grouped under point with range targeting and fifteen are grouped under non inflation targeters (as control group). We choose average inflation and inflation volatility to measure economic performance. With regards to measuring the success of IT, some may argue that the appropriate assessment would be to test the frequency in which countries hit or miss the target. Whilst this is an appropriate benchmarking assessment, it does not provide a holistic perspective. As an example, the paper by Corbo et al., (2002), show that the deviation of IT from the target is in general small and thus, following this route of analyses will provide a narrow perspective of success of IT with respects to each target type.

Another example is the fact that some countries may exclude some goods and services, to be specific, goods and services which are prone to high volatility from their index used for targeting purposes. More exclusions from the inflation rate specification used for targeting purposes make it easier for the central bank to achieve its inflation targets. A narrow specification of the index used for targeting purposes with many exclusions (for instance administered prices, food and fuel) will therefore support the achievement of a single inflation point or a narrow range, while a broad specification with little or no exclusion will support the achievement of a broader inflation-target range (Rossouw, 2008). This aspect is not considered in this research but is identified as a matter for future research.

Therefore, Pétursson (2004) argues that in line with the IT mandate of providing a credible anchor of monetary policies over time, it is best to measure the success of inflation by assessing how IT

has managed to effectively reduce inflation rate and inflation volatility. Our assessments are in line with this mandate and presented according to average inflation and inflation volatility.

Table 4 Presents the variables and description assessed in this study.

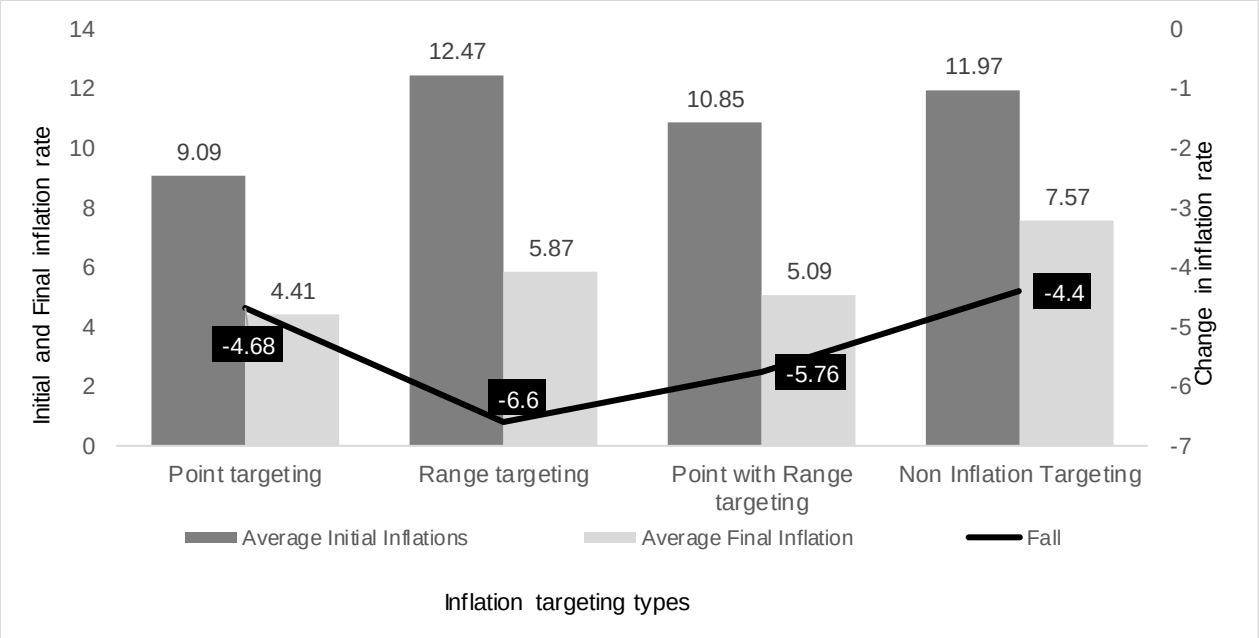
Table 4: Economic Variables	
Economic Variables	**Descriptions**
Inflation, Consumer prices (annual %)	Inflation measured by Consumer Price Index - CPI (annual %), reflects the annual percentage change in cost to average consumer of acquiring a basket of goods and services (Year on Year). This is obtained from the World Bank database.
IT Dummy	Dummy variable is used to indicate whether a specific country is under a target type or not. The dummy variable has a value of 1 when is defined for specific target choice and 0 when started otherwise.

To measure inflation volatility, we use the standard deviation of the sample set of data under each inflation target types. For the standard deviation to be a valid measure of volatility, the mean of the data should not change during the observation window, as we calculate deviation around the mean.

4 Results and Discussion

In this section, we present the main results and analyses thereof, i.e., the comparative analyses between point, range and point with range targeting compared against a control group (non-inflation targeting countries). Our estimates are based on two economic indicators, namely average inflation, and inflation volatility.

4.1 Average Inflation



Source: Own compilation from table A1, appendices

Figure 1: Inflation and change in Inflation

Figure 1 shows the average inflation rate in the initial and final periods for respective IT regimes (point, range and point with range) and the non-targeting group. The graph depicts that average inflation rates fell sharply across all target types, but also in non-targeting countries. However, comparatively speaking, average inflation fell more in IT countries than in non-targeting countries. Average inflation for range targeting (-6.6) fell by a higher magnitude compared to other target types. Then followed by point with range targeting with a decrease of -5.76. There's a similarity in change for point targeting of -4.68 and non-targeting -4.4, albeit with a small difference.

Although we have cleaned up the data and removed instances where countries recorded inflation over 50% per annum, there are still outlier countries with high inflation in the different categories that have influenced the results. These countries are Malawi and Russia under point targeting, Uruguay under range targeting and a few in the point with range targeting, for instance Poland, Ghana, and Moldova.

Moreover, comparing the initial and final average inflation for the targeting type groups against the non-targeting group shows that inflation rates have generally declined since the adoption of IT, especially under the targeting regime of point, range and point with range targeting. However,

by just using averages, we cannot determine if IT was the direct contributor for the reduced inflation. We therefore ran a regression to assess the results are as per Table 5.

Table 5
Average Inflation Regressions

Model 1: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.741 (0.000)	-17.20
α	4.47 (0.000)	5.34
β_1	-2.41 (0.037)	-2.15
β_2	-1.83 (0.173)	-1.38
β_3	-2.19 (0.011)	-2.65
R^2	0.86	
Model 2: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_6 D_6 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.739 (0.000)	17.57
α	4.450 (0.000)	5.42
β_6	-2.19 (0.006)	-2.87
R^2	0.86	
Model 3: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_2 D_2 + \beta_4 D_4 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.740 (0.000)	-17.40
α	4.46 (0.000)	5.39
β_2	-1.82(0.168)	-1.40
β_4	-2.24(0.006)	-2.85
R^2	0.86	
Model 4: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_1 D_1 + \beta_5 D_5 + \varepsilon_i$		
	Coefficients	t-stat
γ	-.740 (0.000)	-17.37
α	4.46 (0.000)	5.38
β_1	-2.41 (0.035)	-2.16
β_5	-2.13 (0.010)	-2.68
R^2	0.86	

The parameters are estimated using the white heteroskedasticity -consistent standard errors

Model 1 regression contains 3 dummy variables, where D_1 = Point targeting, D_2 = Range targeting, D_3 = Point with range targeting and γ = constant (non- targeters). D_1 (point targeting) shows that inflation has fallen by -2.41 percentage points and is significant at 5%. This implies that IT has contributed to a reduction in inflation by -2.41 percentage points. D_2, (range targeting) reflects that inflation has reduced by -1.83 percentage points but results are insignificant. D_3 (Point with

range targeting) results show that inflation has fallen by -2.19 percentage points and is significant at 1% significant level. The causal effect of inflation for point and point with range targeting is significant and implies that these two target types caused inflation to drop. However, comparatively speaking, point targeters results show a much higher magnitude of inflation reduction than is the case with of point with range targeters. On the other hand, the results for range targeting are insignificant. Therefore, we can deduce that point targeters have experienced a more significant reduction inflation than the other target types. The results for non-targeters show that inflation has also reduced by -0.741 percentage points and are also significant.

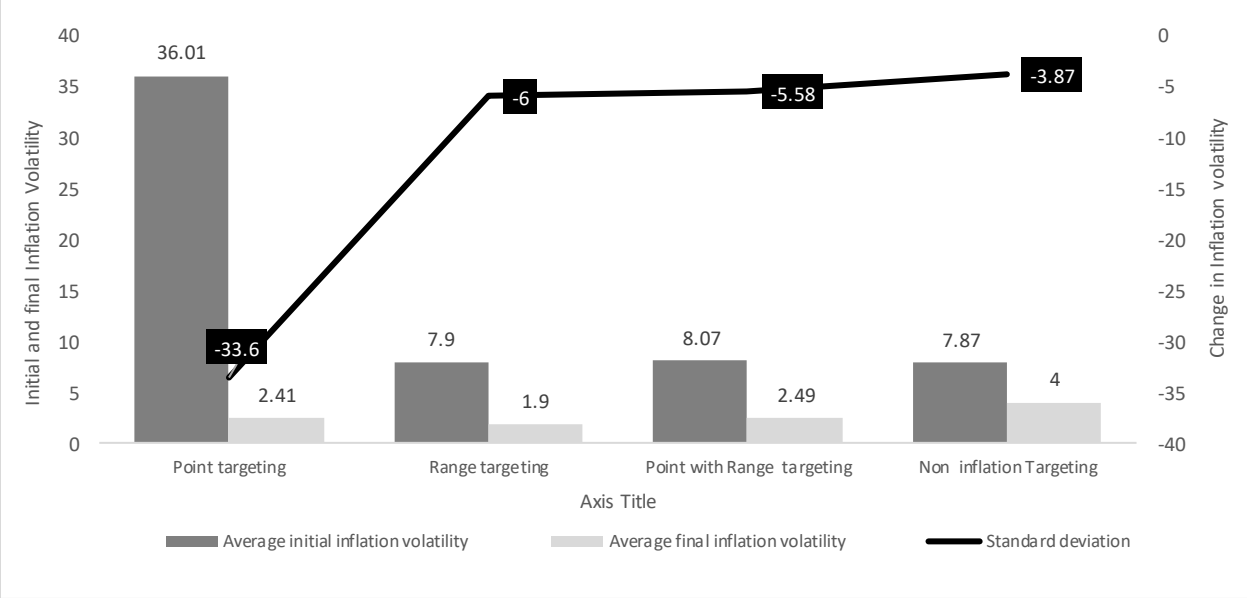
Model 2 regression results show a comparison of targeting versus non targeting countries after we combine all the inflation targeting countries into one. We did not distinguish between point, range and point with range targeting. The results show that inflation targeting has reduced the inflation rate by -2.19 percentage points and is significant at 1% significant level. Compared with non-targeters, results show that inflation reduced by -0.739 percentage points and is significant. These results are consistent with the findings by Gonçalves & Salles (2008) and Thornton (2016) that IT countries reduced inflation significantly.

In **Model 3** we restructure the model and combine point and point with range targeting as one group and compare against range targeting. The dummy variable is then changed to $\boldsymbol{D_4}$ to represent the combination of point and point with range. $\boldsymbol{D_2}$ as previously mapped represents the range targeting method. The results show that in the case of $\boldsymbol{D_2}$ (range targeting), inflation reduced by -1.82 percentage points and are insignificant. In comparison, with $\boldsymbol{D_4}$ (point with range and point targeting), inflation has fallen by -2.24 percentage points and are significant. This means that combined targets for point and point with range provide superior results than range targeting.

In **Model 4**, like the approach in model 3, we redefine the variables and combine point with range and range targeting and compare this against point targeting. We define the point with range and range targeting as $\boldsymbol{D_5}$ in the model and $\boldsymbol{D_1}$ represents the point targeting as original defined. The result in $\boldsymbol{D_1}$ shows that inflation reduced by -2.41 percentage points and are significant at 5% significant level. The results in $\boldsymbol{D_5}$ also show that inflation reduced by -2.13 percentage points and are significant at 1% significant level. The comparison between the two shows that the magnitude of decrease in inflation is higher in point targeters than point with range and range targeters. The

results for the non-targeters remain the same across all models at -0.740 percentage points and are significant.

4.2 Inflation Volatility



Source: Own compilation from table 2, appendices
Figure 2:Inflation volatility and change in inflation volatility

Figure 2 depicts the initial volatility and final inflation volatility per target type. That is point, range, and point with range targeting against the control group (non-targeting countries) using standard deviations. The negative sign across all target types and non-IT shows that volatility has reduced significantly when comparing the initial and final period of evaluation. We observe that point targeting reduced inflation volatility by -33.6 percentage point, the highest reduction when compared to range target with a reduction of -6 percentage point and point with range with a reduction of -5.58 percentage point. The changes in the non-targeting countries are low at -3.86 percentage point. This suggest that point targeting has contributed significantly to stabilising inflation. This results are in line with the paper by Beechey & Österholm (2018), were they also found that point targets outperforms inflation targeting ranges in the stabilisation of inflation

Table 6
Inflation volatility regressions

Model 1: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.992 (0.000)	-150.36
α	3.933 (0.000)	9.46
β_1	-1.80 (0.016)	-2.49
β_2	-2.09 (0.014)	-2.54
β_3	-1.50 (0.005)	-2.91
R^2	0.998	
Model 2: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_6 D_6 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.992 (0.000)	-158.80
α	3.938 (0.000)	9.60
β_6	-1.639 (0.001)	-3.41
R^2	0.998	
Model 3: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_2 D_2 + \beta_4 D_4 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.992 (0.000)	157.77
α	3.940 (0.000)	9.55
β_2	-2.09 (0.014)	-2.56
β_4	-1.571 (0.002)	-3.19
R^2	0.998	
Model 4: $\pi_i - \pi_f = \gamma + \alpha\pi_i + \beta_1 D_1 + \beta_5 D_5 + \varepsilon_i$		
	Coefficients	**t-stat**
γ	-.992 (0.000)	-151.02
α	3.933 (0.000)	9.50
β_1	-1.80 (0.016)	-2.50
β_5	-1.60 (0.002)	-3.20
R^2	0.998	

The parameters are estimated using the white heteroskedasticity-consistent standard errors

Model 1 regression contains 3 dummy variables, where D_1= Point targeting, D_2= Range targeting, D_3=Point with range targeting and γ = constant (non- targeters). D_1 (point targeting) shows that inflation volatility has fallen by -1.80 percentage points and is significant at 1%. D_2, (range targeting) reflects that inflation volatility has reduced by -2.04 percentage points and results are significant at 1% level. D_3 (Point with range targeting) results show that inflation volatility has fallen by -1.50 percentage points and is significant at 1% significant level. Inflation volatility has reduced significantly across all target types including the non-IT countries. However, the magnitude of decrease in inflation volatility is significantly higher in range targeting in comparison to point and point targeting. The results for non-targeters show that inflation has also reduced by -0.99 percentage point and but are significant.

Model 2 regression results show a comparison of targeting versus non targeting countries after we combine all the inflation targeting countries into one. We did not distinguish between point, range and point with range targeting. The results show that inflation volatility reduced by -1.63 percentage points and is significant at 1% significant level. Compared with non-targeters, results show that inflation reduced by -0.99 percentage points and is significant.

In **Model 3** we restructure the model and combine point and point with range targeting as one group and compare against range targeting. The dummy variable is then changed to $\boldsymbol{D_4}$ to represent the combination of point and point with range. $\boldsymbol{D_2}$ as previously mapped represent the range targeting. The results show that $\boldsymbol{D_2}$ (range targeting), inflation volatility reduced by -2.09 percentage points and are significant. In comparison with $\boldsymbol{D_4}$ (point with range and point targeting) that inflation has fallen by -1.57 percentage points and are significant. This means that combined targets for point and point with range provides superior results than range targeting.

In **Model 4,** like the approach in model 3, we redefine the variables and combine point with range and range targeting and compare this against point targeting. We define the point with range and range targeting as $\boldsymbol{D_5}$ in the model and $\boldsymbol{D_1}$ represents the point targeting as original defined. The result in $\boldsymbol{D_1}$ show that inflation reduced by -1.80 percentage points and are significant at 5% significant level. The results in $\boldsymbol{D_5}$ also show that inflation reduced by -1.60 percentage points and are significant at 1% significant level. The comparison between the two shows that the magnitude of decrease in inflation is higher in point targeters than point with range and range targeters. The results for the non-targeters remain the same across all models at -0.99 percentage points and are significant.

5 Conclusion

We aimed to answer two questions in this study, i.e., (i) which target type yields superior economic outcomes since the adoption if IT? and (ii) how do the inflation target choices influence the prevailing inflation rate conditions? The difference in difference model was used to answer these questions.

The method applied for this study was to group IT countries according to their target types, that is point targeting, range targeting, and point with range targeting, and compare these against non-targeting countries. We assessed two economic variables, namely average inflation, and inflation volatility. The result from this study shows that economic performances are influenced by IT even when segmented by target type. We note a significant decrease in average inflation rate in targeting and non-targeting countries. When comparing by target type, the main results for regressed average inflation show that point targeting has reduced inflation rate by a higher magnitude (significant) when compared to range (insignificant) and point with range targeting (significant). The results for non-targeting are also significant, albeit the reduction is lower in magnitude relative to IT countries.

Other results from models which were redefined and re-arranged are as follows: We combined point and point with range into one group, and this new group was compared against range targeting. The results for the grouped point with range and range targeting reduced by a higher magnitude and are significant. In comparison, the results for range targeting were insignificant. On the other hand, we regrouped the model and combined point with range and range targeting together and compared this against point targeters. The results for both point targeters and the grouped (point with range and range targeting) are significant, however point targeters fell by a higher magnitude in comparison to point with range and range targeting.

This conclusion shows that countries planning to introduce inflation targeting for the first time should opt for point targeting from the perspective of reducing inflation and anchoring inflation expectations.

The overall inflation volatility has also decreased significantly across targeting and non-targeting countries. The main results by target type show that range targeting has reduced inflation volatility by a higher magnitude (significant), when compared to point (significant) and point with range targeting (significant).

Other results from model which were re-arranged are as follows: We restructured the model and combined point and point with range together and compared this against range targeters. The results for both groups are significant, although range targeters reduced by a higher magnitude in comparison to point and point with range targeters. On the flip side, we rearranged the model again and combined point with range and range targeters and compared this against point targeters. The results are also significant for both estimates, however, point targeters fell by a higher magnitude in comparison to point with range and range targeters.

This conclusion shows that countries aiming for low inflation volatility, should opt for range targeting, from a perspective of the range flexibility and fostering credibility as inflation outcomes will always fall within target range.

It is important to note that point with range results for both inflation rate and inflation volatility shows a relatively high change and are significant, but the results are not superior in either of the two economic variables being assessed when compared to range and point targeting. We, therefore, reject the hypotheses that point with range targeting provides superior economic results.

Furthermore, we do not find a target type that provide superior results for both average inflation reduction and inflation volatility. We therefore summarize that point targeting is far more effective in reducing the inflation rate and that range targeting is far more effective in reducing inflation volatility. Point with range targeting is more effective in reducing both (inflation rate and inflation volatility), but at a lesser magnitude when compared to the other two target types.

We further conclude that the choice for a target type should be driven by the respective country's current economic environment and what the countries are aiming to achieve with respect to either the reduction of the inflation rate or of inflation volatility. In this choice, it should be borne in mind that there are also other economic objectives such as economic growth and unemployment which could be of importance in the choice of a target.

The study could be expanded in future research with a focus on the specification of the inflation rate used for targeting purposes. This will show whether the inflation specification (narrow or wide) used for targeting purposes in conjunction with the inflation target, impacts any reduction in the rate of inflation, inflation volatility, both aspects or neither.

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7 Appendices

Table A1: Inflation and change in inflation

Country	Target	Adoption year	Initial Inflation	Final Inflation	Change
PT			*1991 – 2003*	*2005 – 2017*	
Switzerland	2.00%	2000	1.67	0.29	-1.38
United Kingdom	2.00%	1992	2.59	2.23	-0.36
Iceland	2.50%	2001	3.52	5.07	1.55
Japan	2.00%	2013	0.49	0.25	-0.24
Malawi	5.00%	2012	28.84	15.15	-13.69
Norway	2.50	2001	2.32	2.05	-0.27
Russian Federation	4.00%	2015	30.95	9.10	-21.85
Sweden	2.00%	1995	2.30	1.11	-1.19
Average		2004			
RT					
Australia	2.00% – 3.00%	1993	2.48	2.48	-0.00
Botswana	3.00% - 6.00%	2006	9.92	6.95	-2.96
Eswatini	3.00% - 7.00%	2000	9.21	6.78	-2.43
Uruguay	3.00% - 7.00%	2007	32.20	7.61	-24.6
South Africa	3.00% - 6.00%	2000	8.521	5.523	-3.00
Average		2004			
PRT					
Albania	3.00% +/-1%	2009	10.87	2.39	-8.48
Armenia	4.00% +/-1.5%	2006	6.26	3.90	2.36
Bangladesh	6.00% +/-1.0%	2003	4.92	7.30	2.38
Brazil	4.50% +/-1.50%	1999	8.47	5.85	-2.62
Canada	2.00% +/-1.0%	1991	2.11	1.71	-0.40
Chile	2.00% +/-1.0%	1990	8.02	3.42	-4.60
Colombia	3.00% +/-1.0%	1999	17.15	4.35	12.80
Czech Republic	2.00% +/-1.0%	1998	7.63	2.04	-5.59
Dominican Republic	4.00% +/-1%	2012	11.66	4.77	-6.89
Ghana	8.00% +/-2.0%	2007	26.03	13.32	-12.70
Guatemala	4.00% +/-1.0%	2005	10.26	5.27	-4.98
Hungary	3.00% +/-1.0%	2001	17.14	3.40	-13.73
Indonesia	4.00% +/-1.0%	2005	13.19	6.60	-6.59
India	4.00% +/-2.0%	2015	7.88	7.41	-0.46
Israel	3.00% +/-1.0%	1997	7.98	1.59	-6.38
Kenya	5.00% +/-2.50%	2014	14.15	10.06	-4.08
Moldova	5.00% +/-1.5%	2010	18.91	7.83	-11.07

Mexico	3.00% +/-1.0%	2001	15.6	4.08	-11.52
Mongolia	8.00% +/-2%	2012	13.81	10.01	-3.79
New Zealand	2.00% +/-1.0%	1990	1.90	2.11	0.21
Peru	2.00% +/-1%	2001	11.13	2.97	-8.16
Philippines	3.00% +/- 1.0	2002	7.26	3.84	-3.43
Poland	2.50% +/-1.0%	1998	17.94	1.98	-15.95
Paraguay	4.00% +/-2.0%	2011	12.89	5.56	-7.33
Thailand	2.50% +/-1.5%	2000	3.80	2.31	-1.48
Uganda	5.00% +/-2.0%	2011	5.14	8.05	2.91
Average		2004			
NT					
Gambia, The	-	-	5.62	5.31	-0.31
Kyrgyz Republic	-	-	16.7	7.93	-8.77
Nepal	-	-	7.84	7.90	0.05
Pakistan	-	-	7.8	9.17	1.34
Tonga	-	-	5.49	4.28	-1.20
Tanzania	-	-	16.67	8.21	-8.46
United States	-	-	2.66	2.03	-0.64
Vietnam	-	-	3.14	8.43	5.29
Samoa	-	-	3.5	3.15	-0.36
Zambia	-	-	27.19	10.36	-16.83
Jamaica	-	-	22.18	9.19	-12.98
Sri Lanka	-	-	9.78	8.43	-1.35
Nigeria	-	-	27.05	11.47	-15.58
Egypt, Arab Rep.	-	-	7.71	11.81	4.09
Honduras	-	-	16.16	5.84	-10.32

Source: central banks website, www.centralbanknews.info and IMF, www.imf.

Table A2: Inflation volatility and change in inflation volatility

Country	Target	Adoption year	Initial Inflation	Final Inflation	Change
PT			*1991 – 2003*	*2005 – 2017*	
Switzerland	2.00%	2000	1.69	0.95	-0.74
United Kingdom	2.00%	1992	1.71	0.93	-0.79
Iceland	2.50%	2001	1.88	3.60	1.72
Japan	2.00%	2013	1.22	1.01	-0.21
Malawi	5.00%	2012	19.69	7.17	-12.52
Norway	2.50	2001	0.67	0.90	0.23
Russian Federation	4.00%	2015	258.69	3.51	-255.18
Sweden	2.00%	1995	2.49	1.22	-1.27
Average		2004			
RT					
Australia	2.00% – 3.00%	1993	1.43	0.88	-0.55
Botswana	3.00% - 6.00%	2006	2.84	3.08	0.24
Eswatini	3.00% - 7.00%	2000	2.81	2.24	-0.57
Uruguay	3.00% - 7.00%	2007	29.3	1.34	-27.96
South Africa	3.00% - 6.00%	2000	3.14	1.96	-1.18
Average		2004			
PRT					
Albania	3.00% +/-1%	2009	11.29	0.73	-10.56
Armenia	4.00% +/-1.5%	2006	6.96	3.06	-3.9
Bangladesh	6.00% +/-1.0%	2003	2.51	1.72	-0.78
Brazil	4.50% +/-1.50%	1999	4.47	1.73	-2.74
Canada	2.00% +/-1.0%	1991	1.27	0.67	-0.59
Chile	2.00% +/-1.0%	1990	5.83	2.03	-3.79
Colombia	3.00% +/-1.0%	1999	7.99	1.67	-6.32
Czech Republic	2.00% +/-1.0%	1998	5.62	1.60	-4.02
Dominican Republic	4.00% +/-1%	2012	12.25	2.93	-9.31
Ghana	8.00% +/-2.0%	2007	14.00	3.74	-10.26
Guatemala	4.00% +/-1.0%	2005	7.21	2.68	-4.53
Hungary	3.00% +/-1.0%	2001	9.25	2.48	-6.76
Indonesia	4.00% +/-1.0%	2005	14.16	2.91	-11.25
India	4.00% +/-2.0%	2015	3.72	2.87	-0.84
Israel	3.00% +/-1.0%	1997	5.38	1.61	-3.77
Kenya	5.00% +/-2.50%	2014	12.95	5.73	-7.21
Moldova	5.00% +/-1.5%	2010	12.27	3.92	-8.34
Mexico	3.00% +/-1.0%	2001	10.28	0.94	-9.34

Mongolia	8.00% +/-2%	2012	16.44	6.54	-9.90
New Zealand	2.00% +/-1.0%	1990	0.99	1.22	0.23
Peru	2.00% +/-1%	2001	14.06	1.14	-12.92
Philippines	3.00% +/- 1.0	2002	4.32	2.06	-2.25
Poland	2.50% +/-1.0%	1998	14.85	1.74	-13.11
Paraguay	4.00% +/-2.0%	2011	5.47	2.68	-2.79
Thailand	2.50% +/-1.5%	2000	2.41	2.07	-0.34
Uganda	5.00% +/-2.0%	2011	3.67	4.18	0.51
Average		2004			
NT					
Gambia, The	-	-	4.63	1.51	-3.11
Kyrgyz Republic	-	-	13.25	6.36	-6.89
Nepal	-	-	4.63	2.49	-2.13
Pakistan	-	-	3.85	4.85	1.00
Tonga	-	-	3.89	3.44	-0.45
Tanzania	-	-	10.33	3.48	-6.85
United States	-	-	0.72	1.26	0.54
Vietnam	-	-	2.95	6.12	3.16
Samoa	-	-	4.49	3.29	-1.20
Zambia	-	-	7.24	4.09	-3.15
Jamaica	-	-	21.34	5.17	-16.17
Sri Lanka	-	-	3.24	5.57	2.32
Nigeria	-	-	22.92	3.69	-19.22
Egypt, Arab Rep.	-	-	5.77	6.23	0.46
Honduras	-	-	8.77	2.32	-6.44

Source: central banks website, www.centralbanknews.info and IMF, www.imf.org