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Hitting the Target: An Analysis of Inflation Targeting Policies

Elin Roslund (25030) and Victoria Benckert (25151)

Abstract

Acknowledging that world inflation reached its highest levels in decades in 2022, this paper investigates how the adoption of an inflation targeting regime has affected the inflation level and the inflation variability for a sample of five advanced economies from 1980 until the end of 2020. This paper discusses the implications of inflation targets in relation to the relative output growth across inflation targeting and non-inflation targeting economies to further contribute to the debate about its efficacy. The study is conducted using the Generalized Synthetic Control Method. With this approach, we allow for a relaxation of the parallel trends assumption, account for multiple treated units, and construct a synthetic control group to mitigate the self-selection bias. The findings provide no statistically significant effects of inflation targets on the inflation rate or inflation variability. A shortcoming of the estimation is that the model failed to construct a sufficient synthetic control, which poses concerns of bias in the estimated treatment effects. The findings related to output growth suggest that inflation targets may hamper the flexibility of central banks, and that the instrument rule may be too vague to be an operational guideline for monetary policy. We argue that whilst inflation targeting may be useful to anchor expectations, its capacity to influence macroeconomic outcomes is subject to the intricate nature of the transmission mechanism, making its impact uncertain.

Keywords: Inflation Target, Inflation, Generalized Synthetic Control Method, Output Growth, Discretion, Taylor Rule, Transmission Mechanism

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Discussants: Felix Ling & Karin Oldsjö

Examiner: Johanna Wallenius

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1. Introduction

Spurred by the cumulative effects of the past three years of adverse shocks, most notably the COVID-19 pandemic and Russia's invasion of Ukraine, world inflation reached its highest levels in decades of 8.8 percent in 2022. In order to bring back inflation to their targets and keep inflation expectations anchored, the majority of central banks around the world have been raising interest rates since 2021, both at a faster pace, and in a more synchronous manner than in the global monetary tightening episode just before the Global Financial Crisis. Even so, inflation rates have remained at about double their pre-2021 levels on average, far above the target among almost all inflation targeting countries. Additionally, the rapid rise in interest rates and anticipated slowing of economic activity has contributed to stress in the financial system, leaving the global economy to be highly uncertain. Moving forward, many economies are likely to experience slower growth in 2023, and the road back to price stability could be long, despite the sharp increases in interest rates. Over the medium term, the prospects for growth are claimed to be dimmer than they have been in decades (IMF, 2023).

It has long been argued that the achievement of price stability was considered a major contribution of monetary policy to economic growth (Debelle et al., 1998). In fact, it has been claimed that the conduct of monetary policy has changed dramatically, with an increased focus on achieving price stability (Schmitt-Grohé and Urbine, 2010). The reason being that high inflation rates are associated with poor macroeconomic performance, which are deemed harmful to households, firms, and the broader economy (Frankel, 2010). During periods of high inflation, there is thus a general consensus that monetary policy authorities should strive to bring inflation back to a sustainable level.

It was argued by Ball (2010) that during the past quarter century, two developments in monetary policy stand out, whereby the spread of inflation targeting is one of them. As of this year, the IMF (2023) reported that 72 countries are inflation targeters, which constitutes a dramatic increase from 2021, where the IMF (2021) reported that 45 countries were inflation targeters (IMF, 2021).

In light of this development, the conduct of discretionary monetary policy versus reliance on policy rules has, once again, become highly relevant. On the one hand, Prescott and Kydland (1977), and Taylor (1993), contend that monetary policy decisions based on discretion are inconsistent and unreliable, providing support for the idea that policymakers should rely on predictable rules to enhance the effectiveness of monetary policy. On the other hand, Fischer (1990) claims that the strongest argument for discretion is that it leaves policymakers the flexibility to respond rapidly to contingencies which are not foreseen or describable in the potential rule. Related to inflation targeting, proponents argue that this policy anchors inflation expectations, making it easier to stabilize the economy (King, 2005). Contrary, opponents suggest that inflation targets stabilize inflation at the expense of more volatile output (Kohn, 2005). Further, proponents argue that inflation targets increase the accountability of policymakers and the monetary authority (Bernanke et al., 1999), while some skeptics argue that inflation targets reduce accountability (Friedman, 2004).

Given the increase in the number of inflation targeters, and the intense debate regarding discretion versus policy rules, the importance of understanding the implications of inflation targeting becomes crucial.

The extensive literature on the macroeconomic effects of inflation targeting support varying results, which to a great extent depends on the sample of countries studied. For advanced economies, the effect of inflation targeting is found to be weak or non-existent (Lin and Ye, 2007; Ball and Sheridan; 2005), whilst the effect on developing- and emerging market economies is stronger (Gonçalves and Salles, 2008; Lin and Ye, 2009; Mendonça and de Guimarães e Souza, 2010; Alpanda and Honig, 2014; Ouyang and Rajan, 2019; Vega and Winkelried, 2005). Furthermore, the management of expectation is deemed fundamental to ensure effective monetary policy (Svensson, 2010). The literature on expectations provides relatively robust empirical evidence that an explicit numerical target for inflation anchors and stabilizes inflation expectations (Batini and Laxton, 2007; Gürkaynak, et al., 2007, 2006; Johnson, 2002; Levin, et al. 2004; Ravenna, 2008).

Since results from previous literature appear to be sensitive to the sample of countries studied, this motivates further research on a novel sample of countries which substantiate these previous findings. Second, the debate regarding discretion versus policy rules, as well as proponents and opponents of inflation targeting, argues for the relative benefits and drawbacks of inflation targeting, and a proposed trade off between keeping low inflation rates and promoting economic growth. Since many previous studies inadvertently omit discussions on the importance of the relationship between inflation, inflation targets, and output growth, this motivates further research which substantiates these debates.

In this paper, we answer the following research questions: (1) Has the adoption of an inflation target led to lower inflation for the sample of inflation targeting economies during the period of interest? and (2) Has the adoption of an inflation target led to lower inflation variability for the sample of inflation targeting economies during the period of interest?

We exploit a balanced annual country-level panel dataset containing both developed and developing countries that spans 41 years, from 1980 until the end of 2020. The sample consists of 5 treatment units and 16 control units. The treatment units are inflation targeting countries and the control units are non-inflation targeting countries.

The study is conducted by estimating the average treatment effect on the treated (ATT), using the Generalized Synthetic Control Method (GSCM). The GSCM is considered a suitable methodology due to several aspects. First, since the decision to adopt an inflation target is dependent on economic and institutional characteristics within countries, there exists endogeneity in our data. Hence, adopting an inflation target is a non-random treatment, which the GSCM accounts for by constructing a synthetic control group that resembles the treated units' pretreatment characteristics. Thus, the method reduces bias that can arise from endogeneity. Second, in our cross-country study, there exists heterogeneity across inflation targeters and non-inflation targets in their prior levels of inflation and inflation variability. By adopting the GSCM, this allows for differences in pretreatment trends since heterogeneous effects at the country level are modeled using latent factors (Xu, 2017). Third, the GSCM can accommodate multiple treated units through factor augmented models (Xu, 2017), and for our cross-country study on inflation targeting countries, this prerequisite becomes essential.

Moreover, we integrate a discussion of the development of output growth, comparing the averages across inflation targeting, and non-inflation targeting countries in the pretreatment and posttreatment periods.

Taken together, this paper contributes to the economic literature in several ways. First, this paper substantiates previous research through testing the effect of inflation targeting on a

novel sample of countries, during a new period of interest. Second, by integrating a discussion on output growth across the treatment and control group in the pretreatment and posttreatment periods, this paper contributes with insights into the debate concerning the proposed trade-off between keeping low inflation rates and promoting economic growth. Third, by utilizing the GSCM, this paper takes a novel approach in evaluating the effects of inflation targets.

In short, we find no evidence that inflation targeting has a statistically significant effect on reducing inflation rates or inflation variability. We suspect that the primary reason for insignificance is the fact that the treated and control units did not share common support in factor loadings, subsequently causing the GSCM to fail in its construction of a sufficient synthetic control group. In turn, there is risk that the estimated ATT is invalid. For our research, this could be due to a fairly small sample size, insufficient model specification, or that noise in the data is created as shocks to the economy accumulate over time. For further research, we thus recommend increasing the number of pretreatment periods, as well as the number of units in the control group.

With regards to the debate on discretion versus policy rules, as well as the Taylor rule, we find that the average output growth was higher for the non-inflation targeting countries in both the pretreatment and posttreatment period. More importantly, the inflation targeting countries experienced a reduction in their average output growth rate in the posttreatment period, while this was not the case for the non-inflation targeting countries. In spite of not being able to isolate the cause of the enlarged gap, a few concerns related to the debate are raised. It is possible that the increased gap is an indication that an inflation targeting policy is somewhat inflexible, which would limit policymakers' ability to reach the inflation targeting objectives and simultaneously stabilize the real economy.

Regarding implications for monetary policy, we conclude that, on one hand, inflation targets may be useful in terms of anchoring expectations of the private sector. Thereby, it is possible that inflation targets prevent inflation from spiraling out of control. On the other hand, it may be challenging for monetary authorities to ensure stable, positive output growth while adhering to an inflation targeting policy. Thus, we contend that central banks should carefully evaluate the efficacy of an inflation target in relation to the macroeconomic circumstances. Lastly, we acknowledge that the conduct of effective monetary policy is complex due to the transmission mechanism. In essence, regardless of any monetary policy decisions, these only have indirect control over the macroeconomic outcomes.

The rest of this paper is organized as follows: In section 2, a detailed overview of previous literature and our research development is presented. In section 3, the background of inflation targeting and the motivation of its adoption are reviewed. Following, section 4 presents the main elements of inflation targeting, as well as associated theories and debates related to the purpose of this paper. Further, section 5 presents and argues for the methodology and its assumptions, the data and sample, variables, and the model specification. The results from the statistical inferences are presented and subsequently interpreted in section 6. In section 7, the results are discussed in relation to previous literature and theories. In addition, section 7 also includes a deliberation on the internal validity, together with the limitations and sources of errors in our study. Finally, in section 8, the paper concludes with a summary of the main findings and recommendations for future research.

2. Literature Review and Research Development

This section begins with a review of the existing literature on the macroeconomic effects of inflation targeting, emphasizing the differences across developed and developing economies, as well as the research methodologies used in the studies. The latter is important because of the risk that there is endogeneity in the data, which is associated with the self-selection bias in the decision to adopt an inflation targeting framework, as well as the heterogeneity across inflation targeting- and non-inflation targeting countries. Further, it is important because this paper adopts a novel methodology within this field of research. Later, the literature on the effects of inflation targeting on inflation expectations is presented. As previously stated, this is of relevance since managing private sector expectations is crucial to the effectiveness of monetary policy (Svensson, 2010).

2.1. The Macroeconomic Effects of Inflation Targeting

Early empirical work on the macroeconomic effects of inflation targeting provided some support for the view that inflation targeting improves macroeconomic performance (Bernanke et al., 1999; Mishkin, 1999; Corbo et al., 2001; Neumann and von Hagen, 2002; Truman, 2003). However, these studies have received criticism for their limited sample sizes, which Svensson (2010) argued could undermine the reliability and external validity of the findings.

For the literature on advanced economies, the effect of inflation targeting is to a large extent weak, or non-existent. For instance, Lin and Ye (2007) found that inflation targets have no impact on the inflation rate or its variability when using a sample of 22 industrial economies over the period 1985 to 1999. Similarly, Ball and Sheridan (2005) found no evidence that inflation targeting has a significant impact on reducing inflation levels or inflation variability in a study on developed countries. Rather, they argue that improvements in inflation or its variability was due to that these countries had higher inflation at the time of introduction, and that the development was instead caused by other systematic macro factors. On the contrary, Mishkin and Schmidt-Hebbel (2007) find evidence that inflation targets play a significant role in helping industrial countries achieve lower inflation and bring it closer to the target level in the long run.

Furthermore, literature on both developed and developing economies, largely confirms the above findings, suggesting that the effect of inflation targeting is insignificant or weak for developed economies, and stronger for developing and emerging market economies. To begin with, Gonçalves and Salles (2008) extended the analysis by Ball and Sheridan (2005) to also include developing economies. Their findings suggest that the inflation target regime was sufficient in attaining lower inflation rates and variability in the targeting economies. As highlighted by Gonçalves and Salles (2008), this conclusion seemed to make sense because central banks in advanced economies are likely to have higher levels of credibility and expertise than those in emerging market economies, and are subject to smaller shocks. In turn, these advantages may allow policymakers in developed economies to stabilize the economy without an explicit nominal anchor, while emerging market economies need the discipline of inflation targeting. Further, numerous papers find similar results. Lin and Ye (2009) found that inflation target regimes have a large effect on decreasing the level of inflation, as well as its variability in their sample of 52 developing economies for the period of 1985 to 2005. Mendonça and de

Guimarães e Souza (2010) found that inflation targeting regimes reduce inflation rates in developing economies, but not in developed economies for their sample of 180 countries for the period of 1990 to 2007. Alpanda and Honig (2014) also show how inflation target regimes do not have a significant impact on inflation levels in developed countries and have only a small effect in developing economies for their sample of 66 countries in between 1980 and 2006. Ouyang and Rajan (2019) found similar and novel results in their sample of 46 countries over the period of 1980 and 2015. They found that the inflation target frameworks appear to reduce inflation rates in developing economies, while it reduces inflation variability only when controls are made for levels of financial market development. Lastly, Vega and Winkelried (2005) suggest that inflation targeting facilitates reducing inflation levels and inflation variability, but find no support in reducing inflation persistence.[1]

Furthermore, Brito and Bystedt (2010) extended the analysis of the effects of inflation targets, to also include output growth, for a sample of 46 economies over the period of 1980 to 2006. When using instrumental variable estimation to control for the endogeneity of the inflation target framework, they find support that lower inflation was due to conscious decisions to lower their inflation level, rather than the inflation target framework itself. Regardless, although their findings suggest that inflation targets do not play a significant role in reduced inflation rates, they argue that it was possibly detrimental to output growth.

Since there is a risk of endogeneity in the data, which is associated with the self-selection bias in the decision to adopt an inflation target, careful consideration must be taken to address this concern.

With regards to previous literature, the extent to which the authors account for endogeneity varies. On the one hand, Neumann and von Hagen (2002), and Ball and Sheridan (2005) used a conventional difference-in-differences approach, which accounts for the adoption of an inflation target as random. Consequently, these papers may be criticized as they risk having systemic differences between the treatment and control groups, resulting in biased and unreliable outcomes. On the other hand, several studies have adopted alternative methodologies to account for the endogeneity across countries. Lin and Ye (2007, 2009) and Mendonça and de Guimarães e Souza (2010) adopt a propensity score matching methodology to accommodate for the probability that an economy's decision to implement an inflation target framework may be non-random. Further, Alpanda and Honig (2014) and Ouyang and Rajan (2019) performed a study estimating a dynamic panel estimator to control for time-varying effects and country fixed effects. Lastly, Brito and Bystedt (2010) developed a dynamic panel estimator, and utilized instrumental variable estimation to control for the endogeneity of the inflation target framework.

2.2. The Effects of Inflation Targeting on Inflation Expectations

Since it has been argued by Svensson (2010) that managing private sector expectations is crucial to the effectiveness of monetary policy, the effects of inflation targeting on inflation expectations is of high relevance for our study. There is relatively robust empirical evidence that an explicit numerical target for inflation, anchors and stabilizes inflation expectations (Batini and Laxton, 2007; Gürkaynak, et al., 2006, 2007; Johnson, 2002; Levin et al., 2004; Ravenna, 2008). In particular, Gürkaynak et al. (2006) conducted a comparative analysis of daily bond yield data

[1] Inflation persistence refers to the tendency of inflation to persist at a certain level.

in the United Kingdom and Sweden, both inflation targeters, and the United States, a non-inflation targeter at that time. Their findings indicate that a well-known and credible inflation target can help to anchor the private sector's long-term inflation expectations. Specifically, they found that the sensitivity of forward inflation compensation to economic news was significantly high in the United States, while the United Kingdom exhibited a similar level of sensitivity before the Bank of England gained independence in 1997, but showed a striking absence of such sensitivity afterward. Sweden, on the contrary, displayed insensitivity to economic news over the entire data period. Furthermore, the International Monetary Fund (2008) noted that inflation targeting has been more effective in anchoring inflation expectations in emerging market economies than alternative monetary policy frameworks after the 2007 oil and food price shocks.

2.3. Research Motivation and Contributions to Literature

This section summarizes the previous literature on the effects of inflation targets, identifies the research gaps, and formulates the research aims. Following, the contributions of this paper are presented.

To begin with, findings of previous literature can be summarized in some key aspects. First, the estimated effect of inflation targeting varies to a great extent, whereby much of the variation is explained by which sample of countries is examined. Second, a considerable amount of work on advanced economies, although not all, confirm that the effect of inflation targeting on macroeconomic variables is weak or inconsistent. In contrast, papers which examine emerging and developing economies report significant benefits of an inflation targeting framework. Lastly, although significant effects on other macroeconomic variables such as employment have been established, many inadvertently omit discussions on the importance of the relationship between inflation, inflation targets, and output growth.

When taking into account these findings, there are two aspects which motivate further research. First, since the results appear to be sensitive to the sample of countries studied, this motivates further research on a novel set of countries which provides insights into the external validity of previous findings. Second, the traditional hypothesis of monetary policy states that monetary expansion and inflation elicit higher output and employment, provided the expansion is an acceleration from the past or a departure from expectations (Frankel, 2010). Further, the debate regarding discretion versus policy rule of monetary policy, as well as proponents and opponents of inflation targeting, argues for the relative benefits and drawbacks of inflation targeting, and proposes a trade off between keeping low inflation rates and promoting economic growth. Hence, since many previous studies inadvertently omit discussions on the importance of the relationship between inflation, inflation targets, and output growth, this motivates further research which may substantiate these debates.

With regards to the aforementioned research gaps, the aims of this paper become twofold. First, this paper aims to investigate whether the sample of inflation targeters have been successful in reducing their inflation rates, and have experienced lower inflation variability due to the adoption of an inflation target. Second, this study then aims to discuss the effectiveness of inflation targeting by taking into account the relative differences in output growth across the sample of inflation targeters and non-inflation targeters, before and after the implementation of an inflation target.

This paper contributes to the economic literature in several ways. Firstly, as emphasized, previous results appear to be sensitive to the sample of countries studied. Thus, this paper substantiates previous research by testing the effect of inflation targeting on a novel sample of countries, during a new period of interest which contains the accumulated effects of additional shocks to the world economy. Secondly, by integrating a discussion on output growth across the treatment and control group in the pretreatment and posttreatment periods, this paper contributes with insights into the debate concerning the proposed trade-off between keeping low inflation rates and promoting economic growth. Thirdly, to account for the endogeneity, heterogeneity, and for multiple treated units, this study is conducted using the Generalized Synthetic Control Method proposed by Xu (2017). By using this method, this paper takes a novel approach in evaluating the effects of inflation targets. With this approach, we allow for a relaxation of the parallel trends assumption in the treatment and control group required in a conventional difference-in-differences model, while still estimating the average treatment effect on the treatment.

3. Background

This section provides an overview of the history of inflation targeting adoption, alternative monetary policy strategies, and the motivations of introducing inflation targeting to begin with.

3.1. The History of Inflation Targeting Adoption

Inflation targeting was initially introduced in New Zealand in 1990, which had, along with most of the OECD countries, experienced high and volatile inflation during the 1970s and the early 1980s. Following the inception of the inflation targeting framework, numerous small and medium-sized advanced economies, including Canada, United Kingdom, Australia and Sweden adopted the strategy in the early 1990s (Svensson, 2010). Although inflation targeting was predominately implemented by advanced economies during the 1990s, numerous developing and emerging market economies joined shortly thereafter. In contrast to the peak inflation in industrialized countries, inflation in the median emerging market country culminated around 1990, about 10 years after. Following this period of high inflation, and unsuccessful attempts of stabilizing the economy, numerous developing and emerging market economies switched to an inflation targeting monetary policy as well. To mention a few, Brazil, Chile, Colombia, and Mexico switched from exchange rate targets to an inflation target in 1999, and the Czech Republic, Hungary, and Poland switched around the same time (Frankel, 2010). Ultimately, although inflation targets were predominantly implemented in advanced economies during the 1990s, the majority of inflation targeters were emerging market and developing countries by 2010 (Svensson, 2010). Moreover, it is claimed that no country has abandoned inflation targeting once implemented, apart from when joining the Euro area (Svensson, 2010). In 2021, the IMF (2021) reported that 45 of the world's countries were inflation targeters, whilst, as of this year, 72 countries were reported to adhere to an inflation target framework (IMF, 2023). This continued momentum to adopt inflation targeting, suggests further importance to understand its impact.

Svensson (2010) highlights two alternative monetary policy strategies that were common prior to inflation targeting. Through recognizing the implications of these strategies, and the critique directed toward them in terms of stabilizing the economy, the initial motivation to introduce an inflation target can be understood. By shearing light on how inflation targeting differs from these alternative monetary policy strategies, it facilitates the understanding of the treatment effect.

The first alternative to inflation targeting is the targeting of a monetary aggregate. This strategy suggests that the central bank has an explicit target for the growth of the money supply (Svensson, 2010). Versions of this policy have been practiced in several countries, including the United States during 1979-1982, as well as Germany and Switzerland during the 1980s and 1990s. Today, however, most central banks in advanced and emerging market economies pay little attention to monetary aggregates (Ball, 2010). This change is claimed to be driven by the fact that practical experience has consistently shown that the relationship between money growth and inflation is too unstable and unreliable to provide successful inflation stabilization (Svensson, 2010).

The second alternative to inflation targeting is an exchange rate targeting regime. Many small- and medium sized economies have attempted to utilize this policy in the form of a fixed

exchange rate. In practice, this monetary policy strategy implies that a country fixes their exchange rate relative to a center country with an independent monetary policy. Today, many of the countries who once utilized this strategy have committed to inflation targeting instead, whereby exchange rates are kept flexible. The motivation of switching policies is based on the fact that fixed exchange rates have become less viable and successful in stabilizing inflation. This is claimed to be driven by several factors, including increased international capital flows which adds to the complexity of defending misaligned fixed exchange rates (Svensson, 2010).

When taking into account some of the critique directed toward alternative monetary policy strategies in their ability to stabilize the economy, we better understand the motivations of introducing inflation targeting . The adoption of inflation targets was claimed to be driven by two primary factors (Debelle et al., 1998). First, the achievement of price stability was considered a major contribution of monetary policy to economic growth. Second, practical experience had demonstrated that short-term monetary policy decisions aimed at achieving other objectives such as higher employment or output, might conflict with price stability. Consequently, intermediate targets for inflation stability, including the aforementioned monetary policy strategies, were increasingly viewed as suboptimal, and came under considerable criticism for their inadequate focus on promoting economic growth. By prioritizing inflation targeting as the primary goal of monetary policy, the issue of economic growth was believed to be resolved (Debelle et al., 1998).

4. Theoretical Framework

This section explains the main elements of inflation targeting, as well as associated theories and debates related to the purpose of this paper. Together, these constitute the theoretical framework.

4.1. An Institutional Commitment to a Numerical Target

To begin with, inflation targeting involves the public announcement of a numerical inflation target, with an institutional commitment by the monetary authority to achieve this target (IMF, 2021).

The inflation target for advanced economies is typically set at an annual rate of consumer price index (CPI) of 2 percent, or in the form of a range, such as 1 to 3 percent. For emerging markets- and developing countries, the target levels of inflation are typically a few percentage points higher than 2 percent (Svensson, 2010). In fact, popular arguments against setting inflation targets at zero or negative, is that with zero or negative rates of inflation, the risk of hitting the zero lower bound of nominal interest rates would severely restrict the central bank's ability to conduct a successful stabilization policy (Schmitt-Grohé and Urbine, 2010).

According to Gaspar et al. (2010), inflation targeting anchors the private sector's expectations of inflation, which is widely acknowledged both in theory and in practice to be important for the conduct of effective monetary policy. In essence, the fear is that when inflation expectations become unanchored, they become fixed to the actual inflation or deflation, making it very costly to re-establish price stability. Further, it is claimed that when expectations are not rational, the gains from anchoring inflation and inflation expectations increase significantly (Gaspar et al., 2010). Whilst rational expectations have been the standard to assume in modern macroeconomics, this strong assumption has been claimed to be unrealistic. The reason being that it not only requires that agents are extremely knowledgeable, but also that they have the ability to navigate through the uncertainty they have to face. Instead, Gaspar et al. (2010) highlight adaptive learning as a more reasonable assumption of how agents form expectations. In this case, agents have limited knowledge of the economy, but beliefs are updated as information accumulates. Adaptive learning may be seen as a minimal departure from rational expectations in an environment of pervasive structural change. In practice, empirical evidence has shown that adaptive learning models are able to reproduce features of empirically observed inflation expectations. Regardless of precisely how much inflation expectations deviate from the rational assumption, the main intuition is that any deviation from rational expectations increases the potential for instability in the economy. In turn, the importance of anchoring inflation expectations is strengthened (Gaspar et al., 2010).

For the purpose of this paper, the importance of inflation expectations for the conduct of effective monetary policy adds to the complexity of studying the effects of inflation targets on macroeconomic outcomes. Hence, consideration of the indirect control of monetary policy decisions through expectations needs to be accounted for when discussing the results.

4.2. Monetary Policy Decisions Based on Forecasts

Svensson (2010) emphasizes the central role of forecasts associated with inflation targeting. This has been called forecast targeting, and implies that decisions are made based on forecasts, conditional on that decisions made are accurate to stabilize inflation around the inflation target, and that the real economy stabilizes around a normal level. The criticality of forecast targeting stems from the fact that the impact of monetary policy decisions on the economy imposes time lags. Thus, it has been argued that monetary policy is more effective when it is guided by forecasts (Svensson, 2010).

Monetary policy decisions based on forecast targeting are complex due to the uncertainty of how the decisions impact the economy, as well as the true state of the economy (Svensson, 2010). To provide further understanding of these complexities, the below sections elaborate on these two aspects.

To begin with, central banks implement monetary policy by setting the value of some instrument over which it exerts direct control. For most central banks, including those who are inflation targeters, this has meant setting a short-term interest rate (Friedman and Kuttner, 2010). Furthermore, the process in which these monetary policies impact inflation and the real economy, such as the consumption and employment rate, is through the macroeconomic transmission mechanism (Sveriges Riksbank, 2018). Notably, however, monetary policy is claimed to have a limited impact on the real economy in the long run (Hopkins et al., 2009). The complexity of the transmission mechanism is not only associated with long, variable, and uncertain time lags, but also with the various channels and layers which determine the outcome of monetary policy decisions, making the central bank's control over these outcomes indirect. The European Central Bank (2016) provides an explanation of the main transmission channels of monetary policy decisions. To begin with, given the monopoly of central banks to issue money to the private sector, they are able to determine the policy interest rate. Following, changes in the policy interest rate have an impact on various channels in which the inflation rate is affected. These channels include: banks and money-market interest rates, expectations, asset prices, saving and investment decisions, supply of credit, aggregate demand and prices, and the supply of bank loans. Notably, shocks to the real economy and fiscal policy that are beyond the control of central banks, also affect the level of inflation. In sum, due to the transmission mechanism, the central banks only exert indirect control of the outcome on macroeconomic variables.

Moreover, there is significant uncertainty about the true state of the economy which adds to the complexity of conducting effective monetary policy (Svensson, 2010). This is because central banks need to approximate the future development of important exogenous variables to guide their decisions. Further, indicators may provide conflicting information on developments in the economy, and appropriate weight on different information must be made. Additionally, many forward-looking indicator variables depend on private-sector expectations, which adds to the complexity of effective monetary policy conduct.

In connection to our study, the complexity of the transmission mechanism, and the uncertainty about the state of the economy, provides understanding that monetary policy decisions may not reach their intended outcome. This could be due to its various channels of impact, shocks that are beyond the control of central banks, as well as reliance on assumptions for decision making. In turn, this indicates that studying monetary policies is a complex field of

research in which the above phenomena helps understand whether or not monetary policies achieve their intended outcomes.

4.3. Transparency and Accountability of Central Banks

Moreover, Svensson (2010) emphasizes that another important characteristic associated with inflation targeting is a high degree of transparency and accountability of central banks. In practice, it is thus normal that inflation targeting central banks publish regular monetary policy reports, and even, in some cases, provide information on likely future policy decisions. As previously touched upon, this is driven by the insight that the conduct of effective monetary policy, to a large extent, relies on anchoring the private sector's expectations (Svensson, 2010).

The fact that inflation targeting is associated with transparent and accountable central banks, may partly be explained by arguments in the long-lived discussion on discretion versus policy rules.[2] To begin with, Prescott and Kydland (1977) contend that monetary policy decisions based on discretion are inconsistent and unreliable, whereas decisions based on simple, transparent, and predictable rules enhance the effectiveness in guiding macroeconomic outcomes. The authors demonstrate that optimal plans, predicted on discretionary policy, are not perceived credible due to the risk that policymakers manipulate them for political purposes. In contrast, the authors show how simple rules are deemed more credible due to it being more transparent and predictable. In essence, the fact that inflation targeting is associated with transparent and accountable central banks is not only a natural consequence of following a rule, but it also displays a strength in conducting effective monetary policy according to the aforementioned argument.

4.4. Inflation Targeting as a Flexible Strategy

Svensson (2010) claims that inflation targeting is to be considered a flexible strategy in practice. The reason is that inflation targeting central banks often do not only aim at stabilizing inflation around the target, but also put some weight on stabilizing the real economy (Svensson, 2010). The intuition of strict versus flexible inflation targeting can be explained by its respective implications for monetary policy (Frankel, 2010). In the presence of a supply shock, and under strict inflation targeting, monetary policy must be tightened to a degree at which the entire burden of the fall in nominal GDP is borne by real GDP. In contrast, flexible targeting would imply that the monetary authorities would allow part of the temporary shock to show up as an increase in inflation. In turn, inflation targeting countries include implicit or explicit measures of controlling other target variables such as the output gap and resource utilization (Svensson, 2010).

If inflation targeting is flexible, this would allow policymakers to be adaptive, which in turn, would render these arguments for discretionary policy to become obsolete. In fact, Fischer (1990) claims that the strongest argument for discretion, rather than rules for monetary policy, is that it leaves policymakers the flexibility to respond rapidly to contingencies which are not foreseen or describable in the potential rule.

[2] Discretionary policy refers to a monetary policy that is determined by policymakers judgment and discretion, rather than being predetermined by a set of pre-established rules or targets.

In light of the debate of discretion versus policy rules, Taylor (1993) argued that policymakers should rely more on policy rules rather than on discretionary policy, which he believed had led to inconsistent and unpredictable policy decisions. Furthermore, Taylor derived the Taylor rule equation that relates the central bank's target interest rate to the deviation of inflation from its target rate and the output gap (Taylor, 1993). The Taylor rule relates to the traditional hypothesis of monetary policy, which is that monetary expansion and inflation elicit higher output and employment, provided the expansion is an acceleration from the past or a departure from expectations (Frankel, 2010). Notably, however, at high rates of inflation this relationship breaks down, and the detrimental effects of price instability on growth dominate, perhaps via a disruption of the usefulness of price signals for the allocation of output. In turn, inflation targeting proponents favor flexible inflation targeting, often in the form of the Taylor rule, which does indeed call for the central bank to share the pain between inflation and output (Frankel, 2010).

More specifically, the Taylor rule suggests that when inflation increases (decreases) above the target rate, or if the output gap becomes positive (negative), then the central bank should increase (decrease) its interest rate (Taylor, 1993). In terms of the relative weights assigned to inflation and output gap, it was argued that these should be based on their relative importance in the economy. For instance, if inflation is seen as a more significant concern, the central bank may choose to assign a higher weight to the inflation variable in the Taylor rule equation. Also, Taylor acknowledges that the appropriate weights may vary over time, depending on changes in the structure of the economy or other factors. In essence, Taylor argued that this rule was a simple and transparent framework for setting monetary policy, that would allow for a balance in anchoring expectations and promoting macroeconomic stability (Taylor, 1993).

Moreover, the Taylor rule has been subject to some criticism, particularly with regards to its simplicity and its assumption that the output gap can be measured accurately. For instance, Svensson (2003) argues that such a simple instrument rule is too vague to be an operational guideline for monetary policy, not least because it does not provide any recommendations for when deviations from the rules are appropriate. Regardless, the intuition related to the traditional hypothesis of the tradeoff between economic stability and growth, poses relevance for our research in determining the effectiveness of inflation targeting.

5. Empirical Method

This section describes and motivates the methodology adopted to pursue the aims of this paper, provides details on the data and sample included in the analysis, and specifies the model.

5.1. Generalized Synthetic Control Method

To measure the impact of an inflation target in a cross-country study is complex because of the non-randomness associated with the decision of adopting an inflation target. Thus, there is a risk of self-selection bias in the estimation, also causing concerns of endogeneity in the data. Further, cross-country differences in the trajectories of the inflation level and the inflation variability, as well as other country-specific factors may lead to a risk of heterogeneity in the data, which requires consideration. To mitigate these estimation difficulties and to enable us to extract the causal effect of inflation targets on the inflation targeting countries, we adopt the Generalized Synthetic Control Method (GSCM) proposed by Xu (2017). This model unifies the synthetic control method (SCM), proposed by (Abadie et al., 2010), with the linear fixed effects model proposed by Bai (2009).

While the GSCM was inspired by the SCM, their estimation strategies differ. Abadie et al., (2010) uses a convex combination of several control units to estimate the counterfactuals, whilst Xu (2017) uses the interactive fixed effects (IFE) model to estimate the causal effect of the treatment by comparing the observed outcome of the treated unit to the counterfactual outcome of the synthetic control group. Also, the SCM only allows for a synthetic control unit for one single treated unit, while the GSCM extends this method in order for it to be applicable to several treated units.

Regardless of these differences, the intuition behind the GSCM is similar to that of the SCM. In essence, both methods can be used to construct synthetic control units by re-weighting observations from the pool of control units. Among other characteristics, the re-weighting is based on the pretreatment pathway of the outcome. The GSCM then compares the treatment unit to a weighted control-pool which, on average, has a similar pretreatment outcome trajectory. Moreover, by predicting the counterfactual outcome for the treated observations, heterogeneous treatment effects over time are flexibly identified. The counterfactuals then serve as control units in identifying the treatment effect and resemble the behavior of treated units if they had not been exposed to the treatment (Xu, 2017).

5.1.1. Modeling Assumptions

As Xu (2017) asserts, the GSCM requires different identification assumptions compared to the traditional SCM.

To begin with, it assumes a specific functional form whereby the data-generating process of the outcome variable must take a linear form. The functional form assumption requires that both the treated- and control units are affected by the same set of factors, and that the number of these factors remain fixed over the observed time period. See section 5.2.3. Model Specification for further details applied to our research.

Another important assumption of the GSCM is strict exogeneity. This means that the error term is independent of the treatment assigned, covariates, factors or factor loadings of any

unit at any given time. Concretely, the GSCM precludes the possibility of endogeneity through estimating an IFE model using only the control group data to obtain the factors and factor loadings, by minimizing the mean squared error of the predicted treated outcome in pretreatment period. Subsequently, by controlling for the factors and factor loadings, the GSCM estimation alleviates the concern of the endogeneity associated with a non-random treatment. Following, a counterfactual scenario is created, in which the treated unit did not receive the intervention and estimates the causal effect of the intervention by comparing the posttreatment outcome to what would have been the outcome if the unit had not received the intervention. Thus, the GSCM can reduce bias that arise from endogeneity. Notably, however, the validity of the ATT is thus dependent on the quality of the estimated factors and factor loadings.

Moreover, the GSCM requires assumptions which are common for standard panel data models, including weak serial dependence of the error terms, regularity of conditions, cross-sectionally independent and homoscedastic errors (Xu, 2017).

5.1.2. Methodology Motivation

For the purpose of this paper, the GSCM is preferred over alternative methodologies due to three aspects.

First, there may exist endogeneity in the data since the decision to adopt an inflation target is dependent on economic and institutional characteristics within countries. Hence, the adoption of an inflation target is a non-random treatment, which the GSCM accounts for by constructing a synthetic control group that resembles the treated units' pretreatment characteristics. Notably, Xu (2017) states that the assumption of strict exogeneity is arguably weaker for the GSCM than the strict exogeneity assumption required by fixed effects models when decomposable time-varying confounders are at present.[3]

Second, the GSCM allows for differences in pretreatment trends by using latent factors, which model heterogeneous effects at the country level of common time trends (Xu, 2017). As was previously mentioned, there is significant heterogeneity between adopters and non-adopters in their trajectories of inflation and inflation variability, which makes this condition suitable. Compared to the difference-in-differences (DID) method, which assumes parallel pretreatment trends in the outcome variable, the GSCM model is thus preferred since this condition is unlikely to hold in this study. Consequently, through utilizing the GSCM, we aim to produce valid causal estimates by sufficiently accommodating these differences.

Third, in contrast to the traditional SCM, the GSCM can accommodate multiple treated units through factor augmented models (Xu, 2017). For our cross-country study on inflation targeting countries, this prerequisite becomes essential.

5.1.3. Caveats of The Generalized Synthetic Control Method

Two caveats of the GSCM are emphasized by Xu (2017). The first is concerned with insufficient data, whereby a small amount of pretreatment periods ($T_0 < 10$) or few units in the control group ($N_{co} < 40$) can lead to imprecise estimates. The main intuition for this

[3] Confounders are said to be decomposable time-varying confounders if they can be decomposed into two different parts: the effect of a common trend or a series of common shocks, and the individual-specific effect that varies across individuals.

caveat is that the quality of the constructed synthetic control group depends on how closely it corresponds to the treated units' covariates and outcome. Consequently, this requires a sizable pretreatment period and high ratio of control units. Xu (2017) contends that the risk of bias in the estimates is seemingly low when the treatment units comprise approximately one fifth of the total number of units in the sample.

The second caveat suggests that excessive extrapolations based on imprecisely estimated factors and factor loadings can lead to erroneous results. The intuition for this caveat is that the synthetic matching method may fail to construct a synthetic control unit, if the treated and control units do not share common support in factor loadings.

For clarity, we explain in section 5.2. Data and Model specification how the data selection accounts for the first caveat. Additionally, Appendix B exhibits and explains the estimated factors and factor loadings. The implications of these are further elaborated on in section 7.1. Sources of Error and Internal Validity.

5.2. Data and Model Specification

5.2.1. Research Sample

We exploit a balanced annual country-level panel dataset containing both developed and developing countries that spans 41 years, from 1980 until the end of 2020. We select this sizable time span to fortify that the dataset has a sufficient number of pretreatment periods $(T_0 \geq 10)$, as suggested by Xu (2017). This number of pretreatment periods accounts for gradual effects of the treatment (Xu, 2017). With this time span, we aim to substantiate previous literature with a novel period of interest that contains the accumulated effects of additional shocks to the world economy.

To begin with, all data on the outcome variables and observed covariates for the sample countries is gathered from the IMF World Economic Outlook (2023) and the World Bank Database (2021).

The selection of sample countries is guided by several aspects. First, we select the number of treatment units in accordance with the recommendation from Xu (2017). Hence, the treatment units comprise approximately one fifth of the total number of units in the sample. Second, the selection is guided by accessibility to reliable and comparable data which can be retrieved from the IMF World Economic Outlook (2023) and the World Bank Database (2021). Third, the selection accounts for a somewhat comparable treatment and control group, whereby significant outliers in terms of observed covariates are excluded. This is to ensure the quality of the synthetic control group, as well as to minimize the risk of biased estimates.

The countries included in the treatment group are New Zealand, Canada, Australia, the United Kingdom, and Sweden. These countries are all developed economies, and with regards to prior literature, we thereby expect the effect of an inflation target on the inflation rate and its variability to be weak or non-existent. Yet, this must not be the case due to our novel period of interest. Furthermore, the decision on which countries to include in the treatment group is guided by somewhat similar times of adopting an inflation target. In turn, the included countries are among the first to follow the strategy. Moreover, the exclusion of countries who adopted an inflation target around the same time, is due to significant outliers in terms of inflation levels or

other observed covariates which raises concerns of biased estimates.[4] Table 1 exhibits the sample of treatment countries, the timing of inflation target adoption, as well as the target level of inflation at time of adoption.

Moreover, the control group consists of 16 non-inflation targeting, developing and developed, countries. These countries are never exposed to the treatment during the observed period and include Algeria, Barbados, Denmark, Egypt, El Salvador, Honduras, Hong Kong, Iran, Jordan, Malaysia, Mauritius, Morocco, Panama, Switzerland, Trinidad and Tobago, and Tunisia. To ensure the quality of the constructed synthetic control group, the selection excludes countries with significant outliers, and accounts for data availability. Notably, in cases where $N_{co} < 40$, Xu (2017), suggests parametric bootstraps rather than non-parametric bootstraps, whereby the GSCM is claimed to produce valid uncertainty estimates regardless of a relatively small sample.

Figure 1 visualizes the treatment status of each unit in the sample. It shows that the observed period begins in 1980, with the earliest adoption of an inflation target being in 1990. This implies that $T_0 \geq 10$, which according to the GSCM, is suggested to ensure validity of the cross-validation scheme

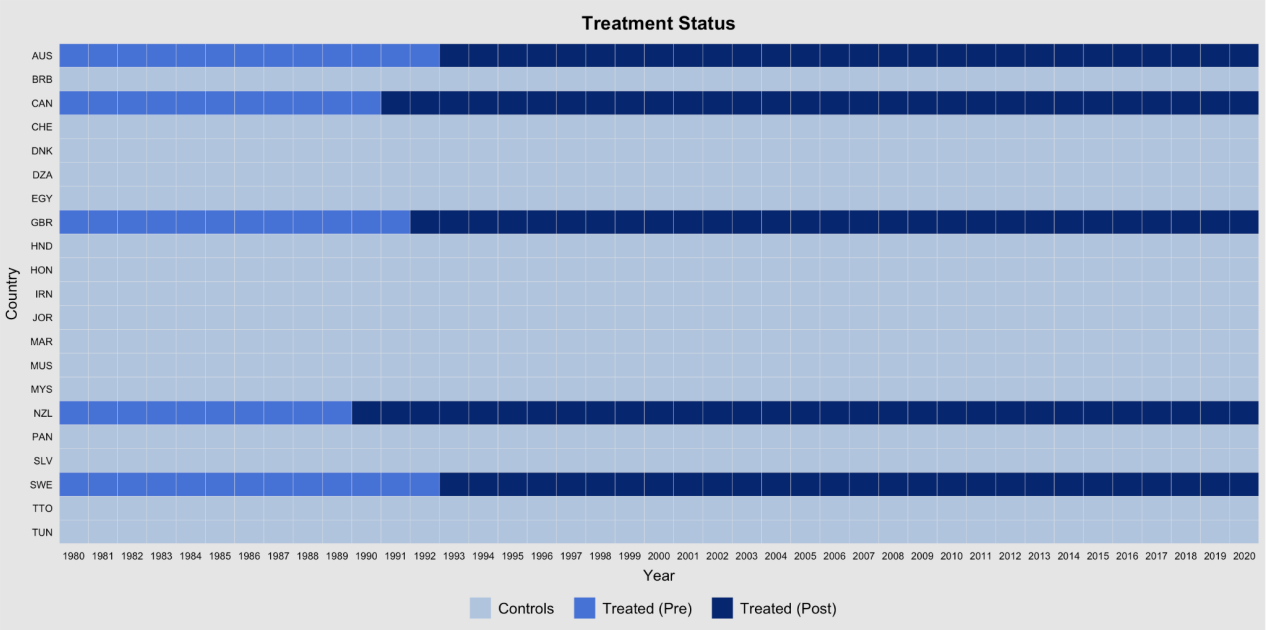
[4] For instance, Israel adopted an inflation target during the same time period, but experienced significantly high rates of inflation during the observed period and was in turn excluded from the sample.

Table 1. Starting Dates for Inflation Targeting and Inflation Target Level

Country	Targeting rate (as of 2021)	Adoption Date
New Zealand	1-3%	1990
Canada	2% (1-3%)	1991
United Kingdom	2%	1992
Australia	2-3%	1993
Sweden	2% (1-3%)	1993

Note: Information on inflation target levels and year of adoption, is extracted from the International Monetary Fund World Economic Outlook (2023).

Figure 1. Treatment Status



Note: Figure 1 visualizes the sample of the treatment and control units marked in different colors. The lightest blue depicts the control group units, while the two darkest colors represent the treatment group units before and after the implementation of an inflation target, respectively. No square is white, indicating that the panel is balanced. The visualization is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

5.2.2. Variables

For the first research question, the dependent variable is the annual percentage change in the consumer price index (CPI), retrieved from the International Monetary Fund World Economic Outlook (2023). For the second research question, inflation variability is construed as the standard deviation from a three-year moving average of inflation. This measure of inflation variability has been previously used in literature on inflation targeting, (see for instance Lin and Ye, 2009).

As an indicator of inflation targeting countries, we generate a binary variable from a list of targeting economies highlighted by the Annual Report on Exchange Arrangements and Exchange Restrictions from IMF (2021). According to the report, a country is classified as an inflation targeter if: (a) there is a public announcement of a numerical point or bandwidth target, (b) an institutional commitment by the monetary authority to the target, normally over a medium-term period, (c) targeters' monetary authorities increase their transparency through communication with the population about their objectives and increased accountability to meet the targets, and (d) monetary policy decisions are generally guided by the divergence of the estimated future inflation from the announced target. This classification provides a framework for inflation targeting countries and whereby the criterias ensure comparability for the purpose of our research.

A parsimonious set of covariates are selected for the statistical inferences. All covariates are retrieved from the World Bank and the International Monetary Fund. These are: GDP deflator, volume of imports, volume of exports, unemployment rate, broad money growth, and current account balance. We use previous literature on inflation and inflation variability to guide the selection of covariates. First, we use GDP deflator and current account balance since they are argued by Calderón and Schmidt-Hebbel (2008) to be potential determinants of inflation. Furthermore, some covariates are chosen since they have been used in previous studies which evaluate the effect of inflation targets on inflation and its variability. Broad money growth and trade volumes were used as confounders by Lin and Ye (2009). Lastly, Ball and Sheridan (2005) discussed the importance of integrating the rate of unemployment when studying inflation. Table 2 exhibits all of the included covariates, including their respective definition and source. Table 3 exhibits the summary statistics of the inflation rate, inflation variability and the included covariates.

Table 2. Variable Description

Variable	Definition	Source
Inflation Rate	The annual percentage change in the consumer price index	IMF World Economic Outlook
Inflation Variability	Standard deviation of a 3 year moving average of the inflation rate	IMF World Economic Outlook
Inflation Target	Dummy variable taking on the value 1 if a country has adopted an inflation target and 0 otherwise	IMF Annual Report on Exchange Arrangements and Exchange Restrictions
GDP Deflator	The money price of all new, domestically produced, final goods and services in a country in a year, relative to the real value of them	IMF World Economic Outlook
Volume of Imports	The aggregate change in the quantities of total imports whose characteristics are unchanged	IMF World Economic Outlook & World Bank
Volume of Exports	The aggregate change in the quantities of total exports whose characteristics are unchanged	IMF World Economic Outlook & World Bank
Unemployment Rate	The number of unemployed people as a percentage of the labor force	IMF World Economic Outlook
Broad Money Growth	The amount of money circulating in an economy as a percentage of GDP	IMF World Economic Outlook
Current Account Balance	Government current account balance as a percentage of GDP	IMF World Economic Outlook

Note: Information on variables is extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

Table 3. Summary Statistics

	Mean	Median	SD	Min	Max
Inflation	6.01	3.95	6.65	-9.16	49.32
Inflation Variability	2.17	1.29	2.50	0.03	17.19
GDP Deflator	73.59	72.21	44.48	0.14	291.50
Volume of Imports	4.03	4.42	10.39	-44.22	46.62
Volume of Exports	3.84	3.85	10.71	-69.88	135.47
Unemployment Rate	8.90	7.77	5.05	0.19	29.50
Broad Money Growth	11.47	9.90	10.96	-43.74	125.03
Current Account Balance	-0.77	-2.09	6.29	-17.50	38.30

Note: The summary statistics is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

5.2.3. Model Specification

Given the assumptions of the GSCM, we formulate the models for the analyses in accordance with Xu (2017).

Suppose that INF_{it} and $INFVAR_{it}$ is the inflation rate and inflation variability, respectively, of country i at time t. Let τ and c represent the sets of treatment group, and the control group, respectively. It is assumed that country i in group τ, adopts an inflation target at $T_{0,i}$.

Following the first assumption, the INF_{it} and $INFVAR_{it}$ are given by the following equations:

$$INF_{it} = \delta_{it} D_{it} + X'_{it}\beta + \lambda'_i f_t + \varepsilon_{it} \quad (1)$$

$$INFVAR_{it} = \delta_{it} D_{it} + X'_{it}\beta + \lambda'_i f_t + \varepsilon_{it} \quad (2)$$

where D_{it} is the dummy variable for the adoption of an inflation target. $D_{it} = 1$ if country i has adopted an inflation target during the period $T(T \geq T_0)$; otherwise $D_{it} = 0$. δ_{it} is the parameter of interest, representing the effect of heterogeneous policy treatment of country i in the period t. X_{it} is a $(k \times 1)$ vector of observed covariates, $\beta = [\beta_1, ..., \beta_k]'$ is a $(k \times 1)$ vector of unknown parameters, $f_t = [f_{1t}, ..., f_{rt}]'$ is an $(r \times 1)$ vector of unobserved common factors, $\lambda_i = [\lambda_{i1}, ..., \lambda_{ir}]'$ is an $(r \times 1)$ vector of unknown factor loadings. Lastly, ε_{it} has has zero mean and represent the unobserved idiosyncratic shocks for country i at time t.

The factors (f) can be interpreted as common time-dependent shocks affecting all units and the factor loadings (λ) as the differential effects these impacts have on them. In the context of our research, the factors are common time trends and the factor loadings are unobservable country characteristics that differentially affect our outcome variables. Since factor loadings can be similar for different clusters of units, these interactions capture differential impacts at the country level, or higher levels of aggregation of common time trends.

Through the assumption of functional form, the average treatment effect on the treated (ATT) of an inflation target during period T is given by the following equations:

$$ATT_{t,t>T_0} = \frac{1}{N_t} \sum_{i \in T} \left[INF_{it}(1) - INF_{it}(0) \right] = \frac{1}{N_t} \sum_{i \in T} \delta_{it} \quad (3)$$

$$ATT_{t,t>T_0} = \frac{1}{N_t} \sum_{i \in T} \left[INFVAR_{it}(1) - INFVAR_{it}(0) \right] = \frac{1}{N_t} \sum_{i \in T} \delta_{it} \quad (4)$$

where $INF_{it}(1)$ and $INF_{it}(0)$ in equation (3) represent the potential inflation of country i if an inflation target is introduced in period t and if an inflation target is not introduced in period t, respectively. Correspondingly, $INFVAR_{it}(1)$ and $INFVAR_{it}(0)$ in equation (4) represent the potential inflation variability of country i if an inflation target is introduced in period t and if an inflation target is not introduced in period t, respectively.

6. Results

In this section, we present the results of our analysis aimed at answering the following research questions: (1) Has the adoption of an inflation target led to lower inflation for the sample of inflation targeting economies during the period of interest? and (2) Has the adoption of an inflation target led to lower inflation variability for the sample of inflation targeting economies during the period of interest?

As previously stated, the first step in the GSCM was to estimate the factors and factor loadings. These findings provide insight into the underlying structure of the data and form the foundation for the subsequent analyses presented in this section. As explained in Appendix B, the cross-validation scheme identified three and two factors for the first and the second research question, respectively. Appendix B illustrates the respective overlaps of the treatment and control groups, as well as the implications of the estimated factors and factor loadings. Both the former and the latter are critical factors for the validity of the ATT, and will therefore be elaborated on further in the discussion.

6.1. The Effect of an Inflation Target on the Inflation Rate

For the first inference, we utilize the GSCM to explain the effects of adopting an inflation target on the inflation rate. Included in the inference are the covariates related to the inflation rate and the latent factors were controlled for through the interaction fixed effect, $\lambda'_i f_t$.

As summarized in Table 4, the estimated ATT coefficient is -3.578. This indicates that the adoption of an inflation target is associated with a decrease in the inflation rate by 3.578 percentage points on average for the treated units in the sample, holding other factors constant. However, the p-value of 0.389 suggests that this result is statistically insignificant at the 95 percent confidence level.

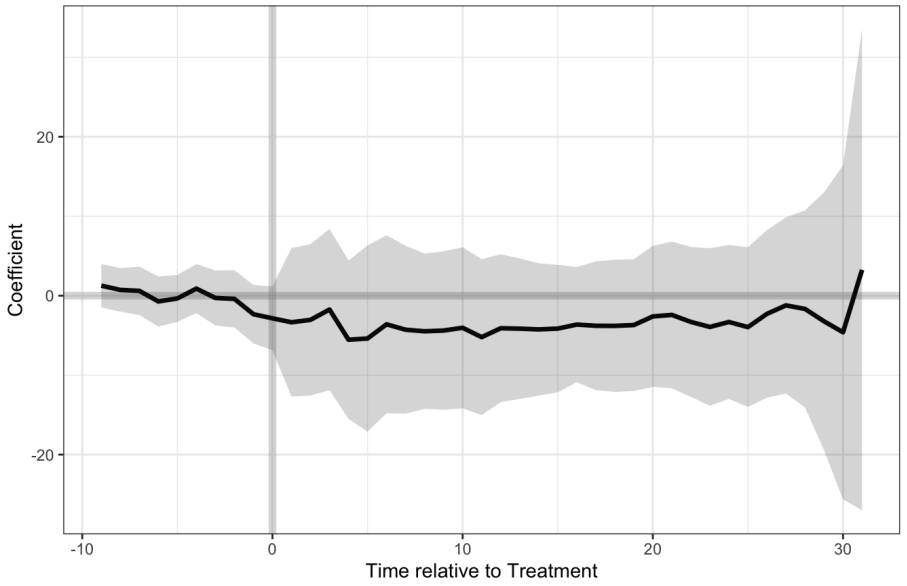
Table 4. Average Treatment Effect on the Treated

	Estimate	S.E.	CI.lower	CI.upper	p.value
ATT.avg	-3.578	4.15	-11.712	4.556	0.389

Note: The estimation is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

Figure 2 exhibits the ATT of introducing an inflation target on the inflation rate. As can be visually interpreted, the ATT displays a slight downward sloping trend starting prior to the introduction of treatment. This suggests that the negative impact on the inflation rate is not necessarily due to the adoption of an inflation target. For the rest of the observed period, the ATT takes on a negative value, except for a slight increase near the end where it intersects with zero. Moreover, Figure 2 exhibits an expanding confidence interval primarily toward the end of the observed period. Further, the confidence interval includes a zero effect during the whole observed period, hence, we cannot conclude a statistically significant effect at the 95 percent confidence level.

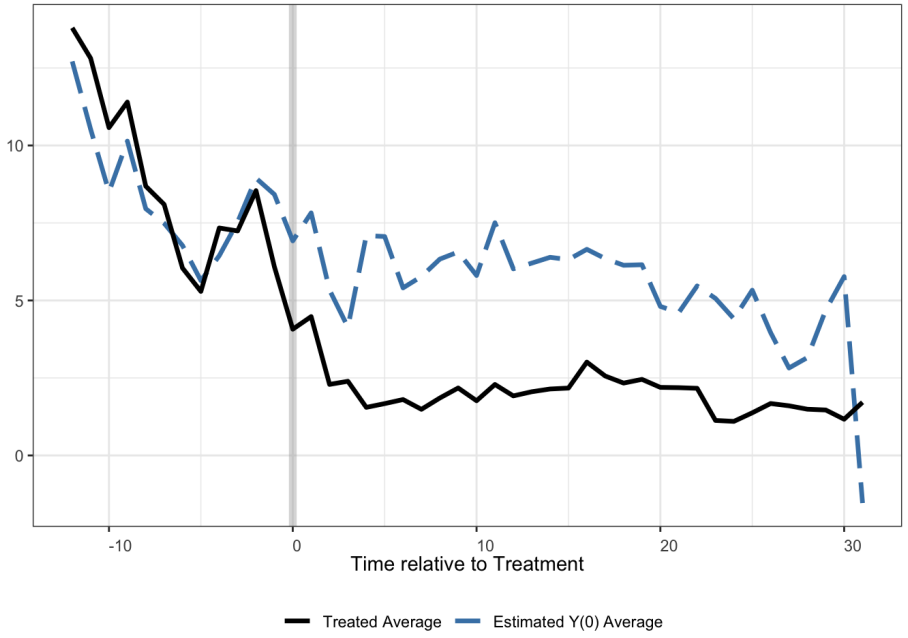
Figure 2. Average Treatment Effect on the Treated



Note: In Figure 2, the vertical axis represents the estimated coefficient of the ATT, the horizontal axis represents the relative time before and after the adoption of inflation targeting, the solid black line represents the ATT over time, the gray area represents the 95 percent confidence interval of the ATT. The area to the right of the gray vertical line displays the posttreatment period. The estimation is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

As can be seen in Figure 3, the treated average and estimated counterfactuals follow similar trends prior to the treatment. This is used as a diagnostic check to visually conclude the fit of the estimated counterfactual to the treatment group. In turn, the seemingly good overlap of the two lines provides confidence that the data of the control group fitted relatively well with that of the treatment group. After the adoption of inflation targeting, the treated average displays a rather low, stable average of inflation rate compared to the estimated counterfactual almost for the full duration of the postreatment period. However, the estimated counterfactual displays a sharp decrease by the end of the observed period, with an average inflation rate below that of the treated average. In sum, Figure 3 supports that the average inflation rate of the treated countries was notably lower and less volatile than its average composite value during the majority of the posttreatment period.

Figure 3. Average Inflation Rate of the Treated With Plotted Counterfactuals



Note: In Figure 3, the vertical axis represents the inflation rate, the horizontal axis represents the relative time before and after the adoption of inflation targeting, the solid black line represents the average inflation rate of the treatment group, the dashed blue line represents the estimated average of the inflation rate of the treatment group. The area to the right of the gray vertical line displays the posttreatment period. The estimation is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

6.2. The Effect of an Inflation Target on the Inflation Variability

For the second inference, we utilize the GSCM to explain the effect of the adoption of an inflation target on inflation variability. Included in the inference are the same covariates and latent factors which were controlled for by the interaction fixed effect, $\lambda'_i f_t$.

As summarized in Table 5, the estimated ATT coefficient is -1.1. This indicates that the adoption of an inflation target is associated with a decrease in the inflation variability by 1.1 percentage points on average for the treated units in the sample, holding other factors constant. However, the p-value of 0.186 suggests that this result is statistically insignificant at the 95 percent confidence level.

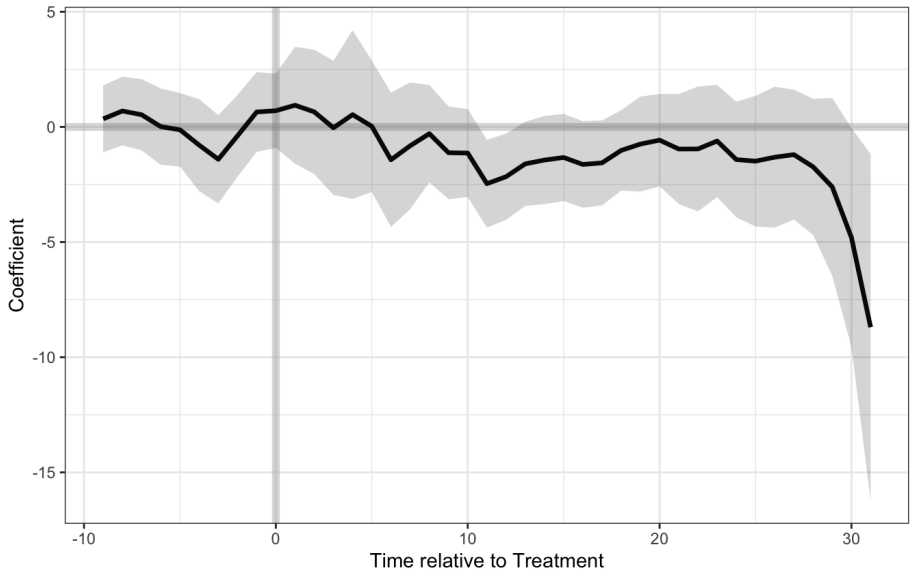
Table 5. Average Treatment Effect on the Treated

	Estimate	S.E.	CI.lower	CI.upper	p.value
ATT.avg	-1.1	0.833	-2.732	0.532	0.186

Note: The estimation is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

Figure 4 exhibits the ATT of introducing an inflation target on the inflation variability. As can be visually inspected, the ATT displays a slight negative trend approximately 3 years after the treatment. The coefficient of the slope takes on negative values starting 5 years after the treatment and displays a rather stable level until a sharp decrease by the end of the observed period. The negative coefficient supports that inflation targeting has lowered the inflation variability, however since the confidence interval includes a zero effect for almost the full duration of the observed period, we find no statistically significant support at the 95 percent confidence level.

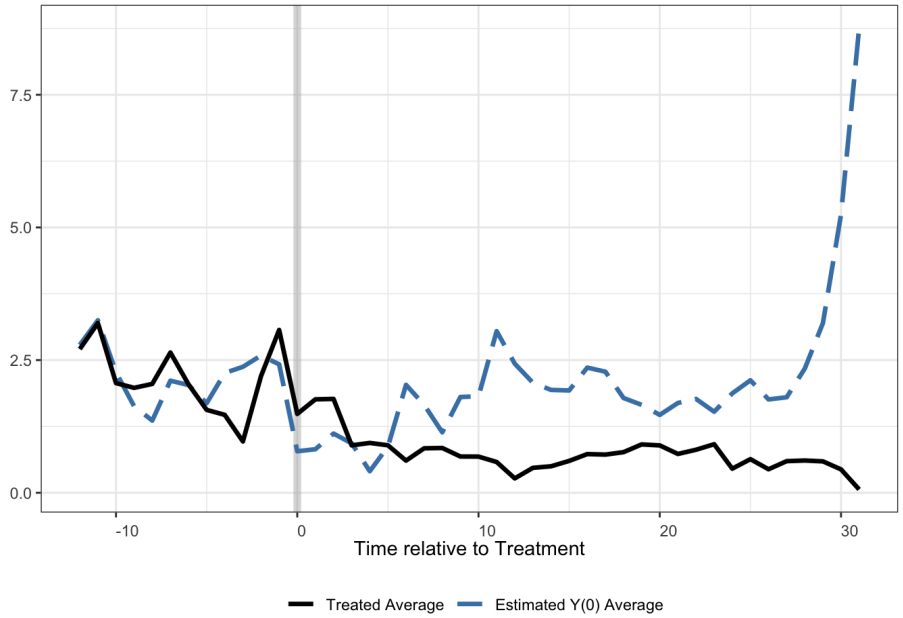
Figure 4. Average Treatment Effect on the Treated



Note: In Figure 4, the vertical axis represents the estimated coefficient of the ATT, the horizontal axis represents the relative time before and after the adoption of inflation targeting, the solid black line represents the ATT over time, the gray area represents the 95 percent confidence interval of the ATT. The area to the right of the gray vertical line displays the posttreatment period. The estimation is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

In Figure 5, the treated average and estimated counterfactuals do not exhibit substantial overlap in the pretreatment period, suggesting that the fit of the data is poor. In the beginning of the posttreatment period, the average of both the treated and estimated counterfactuals experience a decrease in inflation variability. Following, the treated units experienced lower average inflation variability compared to the estimated counterfactuals for the whole observed period. Also, the slope of the estimated counterfactual displays a sharp increase toward the end of the observed period.

Figure 5. Average Inflation Variability of the Treated With Plotted Counterfactuals



Note: In Figure 5, the vertical axis represents the inflation variability, the horizontal axis represents the relative time before and after the adoption of inflation targeting, the solid black line represents the average inflation variability of the treatment group, the dashed blue line represents the estimated average of the inflation variability of the treatment group. The area to the right of the gray vertical line displays the posttreatment period. The estimation is based on data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).

7. Discussion

The first aim of this paper was to investigate whether the sample of inflation targeters have been successful in reducing their inflation rates, and have experienced lower inflation variability due to the adoption of an inflation target. This was done utilizing the GSCM for a sample of 21 economies, during the period from 1980 to the end of 2020. Based on the results from our analysis, we find no statistically significant support that inflation targeting has been effective in reducing inflation rates or inflation variability for the inflation targeting countries. There are several possibilities as to why our findings are statistically insignificant. Hence, the internal validity and sources of error will be elaborated on in the subsequent subsection.

The second aim of this paper was to discuss the effectiveness of inflation targeting by taking into account the relative differences in output growth across the sample of inflation targeting and non-inflation targeting countries, before and after the implementation of an inflation target. Hence, the section proceeds with a discussion on the relative output growth across inflation targeting- and non-inflation targeting countries in relation to the Taylor rule and debate regarding discretion versus policy rules.

The section concludes with a discussion on the implication for monetary policy.

7.1. Sources of Error and Internal Validity

This section discusses the plausible sources of error and internal validity of the estimation.

Our primary concern of the inferences is associated with a failure of constructing a synthetic control group. Considering that the GSCM is based on a cross-validation approach to estimate the potential impact factors and factor loadings in order for the data of the treatment group to be better fitted, it is problematic if the treated and control units do not share common support in factor loadings. If this is the case, the synthetic matching method may fail to construct a sufficient synthetic control unit. For our analysis, the estimated factors and factor loadings show low significance (Appendix B). In essence, the analysis suffers from the caveat of excessive extrapolations based on imprecisely estimated factors and factor loadings which can lead to erroneous results.

To better understand the failure of constructing a sufficient synthetic control, we raise a few concerns in relation to the diagnostic checks posed by Xu (2017). Although the GSCM was utilized since it can account for heterogeneity across the treatment and control group, the estimation may have failed to accommodate these differences. Xu (2017) suggests plotting the raw data of the treated and control outcomes, as well as the imputed counterfactuals to check whether these are within reasonable intervals. For the raw data, the plots exhibit higher average levels of inflation and inflation variability for the control group during the whole observed period (see Appendix A). This shows systematic differences across the treatment and control groups, which the GSCM could, evidently, not account for. For the imputed counterfactuals, it was visually interpreted as sufficient overlap in Figure 3, but not in Figure 5. This indicates that the data from the control group fitted reasonably well with that from the treatment group for the first inference, but not for the second inference. In turn, whilst the average inflation rate of the

estimated counterfactual in the first inference was within reasonable intervals, the average inflation variability of the estimated counterfactuals for the second inference, was not.[5]

Lastly, since the failure to construct a sufficient control unit may lead to biased estimates, we raise a few concerns regarding the estimated ATT in both regressions. To begin with, Xu (2017) recommends increasing the number of pretreatment periods and the number of units in the control group to strengthen the precision of the estimated factors and factor loadings. For our analysis, we might thus suspect that the number of pretreatment periods, and the number of control units, are sources of errors due to them being too small. If the sample size or number of pretreatment periods are small, there may, consequently, not be sufficient evidence to prove that an inflation target has a considerable effect on inflation or its variability. Hence, the statistical power becomes rather low. Furthermore, the expanding confidence intervals toward the end of the observed period could be the consequence of several factors. Not only could this be due to a small sample size, but it may also suggest that there is some degree of heteroscedasticity in the data that was not sufficiently accommodated for in our models. Further, it is plausible to assume that, over time, shocks to an economy accumulate, which creates more noise in the estimation. In turn, this may explain why the confidence intervals expand toward the end of the observed period.

7.2. Output Growth

As previously discussed, inflation targeting proponents favor flexible inflation targeting, often in the form of the Taylor rule. This entails that central banks share the pain of shocks between inflation and output (Frankel, 2010). As argued by Talor (1993), this rule would allow for a balance in anchoring expectations and promote economic growth by assigning adequate weight to inflation or the output depending on their relative importance to the prevailing economic conditions. Related to our research, committing to an inflation target indicates that an economy is putting higher weight on stabilizing inflation, relative to promoting growth. According to the Taylor Rule, we would thus expect that inflation is stabilized, while the output growth is decreased. Taking into account the flexibility of inflation targeting, the weight put on inflation should not be detrimental to growth.

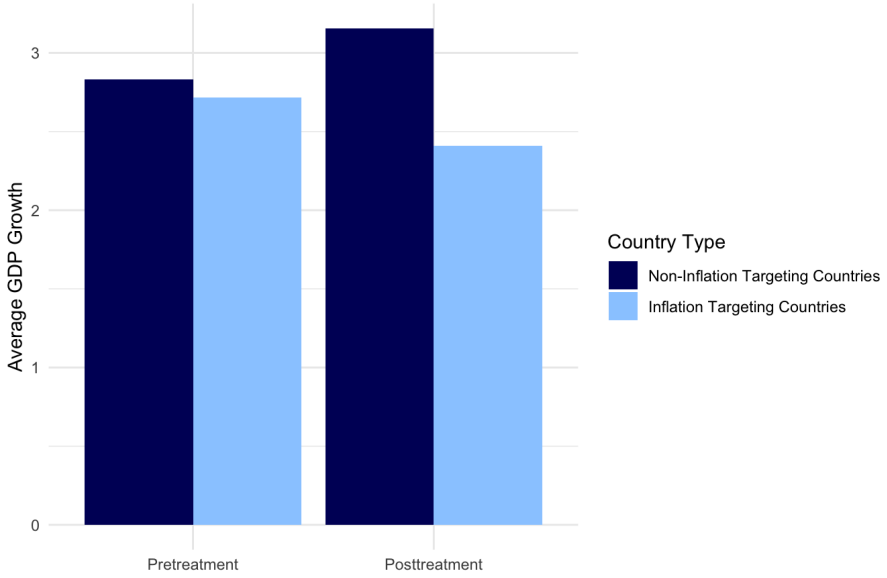
Related to output growth, the non-inflation targeting countries experienced higher average GDP growth compared to the inflation targeting countries in both the pre-treatment and posttreatment period, as visualized in Figure 6. As can be observed, this gap increased from the pretreatment, to the posttreatment period, suggesting that the non-inflation targeting countries experienced higher average GDP growth compared to the inflation targeting countries. On the one hand, this might indicate that the pursuit of inflation stabilization may potentially have negative consequences for economic growth. On the other hand, this might be explained by other factors which are not controlled for. For instance, it could be due to differences in the development levels of the inflation targeting and the non-inflation targeting countries. As already stated, the inflation targeting countries are all developed economies, whilst the treatment group comprises both developed and developing economies. Related to the Taylor rule, developing countries are often further from their full potential output, in terms of, for instance,

[5] The summary statistics is used as a benchmark to check whether the estimated counterfactuals are within reasonable intervals.

industrialization, infrastructure, and technological advancement. In turn, according to the Taylor rule, this means that monetary policy authorities in these economies should put more weight on promoting GDP growth compared to stabilizing inflation at a low level.

Despite not being able to isolate the effects of inflation targets on GDP growth, we are able to voice a few concerns. First, if the extended gap in GDP growth is due to the implementation of an inflation target, there is little support for that an inflation target policy is flexible in practice. Also, it is thus reasonable to assume that an inflation target, at least in some aspects, limits the ability of policymakers to make decisions based on their assessment of the current macroeconomic circumstances, and thus, cannot take actions which would cause inflation to deviate from the target level. This would confirm the claim by Fischer (1990), meaning that discretion leaves policymakers flexibility, and it would also support the criticism posed by Svensson (2003), that such a simple instrument rule is too vague to be an operational guideline for monetary policy. This is not least because it does not provide any recommendations for when deviations from the rules are appropriate. In fact, if central banks would make decisions that make inflation deviate too much from the target, the rule and monetary policy authorities would lose their credibility, as argued by Prescott and Kydland (1977).

Figure 6. Average GDP Growth Pre-and Post Inflation Targeting



Note: Data on GDP growth is extracted from the World Bank Open Data (2023). Figure 6 displays the average GDP growth for the sample of countries in the control group and treatment group. The dark blue bar represents the average GDP growth for the non-inflation targeting countries. The light blue bar represents the average GDP growth for the inflation targeting countries. The average GDP growth is displayed for the pretreatment period to the left in the figure, and the posttreatment period is displayed to the right in the figure.

7.3. Implications for Monetary Policy

While the results were inconclusive, there are some general remarks that can be made in connection to prior literature and the debate regarding the value and effectiveness of inflation targets.

To begin with, despite the absence of a statistically significant ATT in the inferences, it is crucial to expound upon the possible economic implications of our findings. We would expect the coefficients of the ATT for both regressions to be negative. The reason for this is not least because inflation targets show robust evidence to anchor inflation expectations. Moreover, although previous literature is conflicted about the significance of inflation targets, there is, to our knowledge, no previous study that has found inflation targets to increase the inflation rate or its variability. This claim remains consistent with the raw data trends plotted in Appendix A.

Moreover, several papers show support that inflation targeting is effective for macroeconomic performance for developing countries, but show little to no support for effectiveness in developed countries (Lin and Ye, 2007; Lin and Ye, 2009; Guimarães e Souza, 2010; Alpanda and Honig, 2014; Ball and Sheridan, 2005; Gonçalves and Salles, 2008). As explained by Gonçalves and Salles (2008), this conclusion seemed to make sense because central banks in advanced economies are likely to have higher levels of credibility and expertise than those in emerging market economies. Further, developed economies are subject to smaller shocks than developing- and emerging market economies. In turn, these advantages may allow policymakers in developed economies to stabilize the economy without an explicit nominal anchor, while emerging market economies need the discipline of inflation targeting (Gonçalves and Salles, 2008). Relating this to our analysis, the insignificant effect could be the consequence of the sample of treated countries being developed. In essence, despite the absence of statistically significant effects, the economic implications of our results are in line with previous literature, showing little to no support of inflation targeting effectiveness in developed economies. Correspondingly, limitations are posed with regards to how the results and implications can be generalized to countries of different advancements. Consequently, since the effect of inflation targeting is ambiguous depending on the economy, caution should be taken when claiming its effectiveness.

Related to the debate on the effectiveness of inflation targeting, proponents argue that the implementation of an inflation target can serve as a valuable tool for guiding monetary policy decisions, perhaps especially in mitigating the potential risk of policy mistakes that could lead to substantial fluctuations in inflation rates. Furthermore, when the monetary authority sets a clear target for inflation, policymakers could be empowered to avoid the potential pitfalls of reacting excessively to short-term inflationary movements and instead concentrate on accomplishing their long-term objective of maintaining price stability. Contrary, as discussed in the previous subsection, it may be difficult for monetary authorities to ensure stable and positive economic growth while adhering to an inflation target policy. Hence, central banks would need to evaluate the efficacy of an inflation target in relation to the prevailing macroeconomic circumstances.

Lastly, it is essential to acknowledge that central banks do not exert direct control over outcomes of macroeconomic variables, such as inflation and GDP, due to the transmission mechanism. Consequently, the conduct of effective monetary policy is subject to various factors that have the potential to either weaken or amplify its impact. Thus, while monetary policy frameworks such as inflation targeting can serve as a valuable tool to anchor expectations and

provide guidance in policy-making, their capacity to influence macroeconomic outcomes is subject to the intricate and uncertain nature of the transmission mechanism.

8. Conclusion

This paper explores the effects of adopting an inflation targeting policy for 5 developed countries during the period 1980 to the end of 2020. The effects are estimated on the inflation rate and the inflation variability by using the Generalized Synthetic Control Method. This methodology was adopted since it can accommodate for endogeneity, heterogeneity, and multiple treated units.

We find no evidence that inflation targets have had a significant effect on the studied sample and provide rationale for these results. One plausible explanation is that the inflation targeters are advanced economies and in line with previous literature, inflation targets have little to no support for effectiveness in these countries. A probable reason for this, is that the central banks in these economies have enough credibility to anchor the private sector's expectations regardless of the increased accountability associated with the introduction of an inflation target. Moreover, another plausible explanation is that central banks only have indirect control of the outcome on macroeconomic variables due to its function via the transmission mechanism. Hence, the objectives inflation targets might not reach its intended outcome due to this reason. Regardless, neither our, nor previous research provide support for that inflation target should have been harmful to macroeconomic performance.

The estimation suffers from several caveats which pose concerns for biased estimates. Primarily, since the factors and factor loadings did not show common support for the treatment and control group, this causes concerns of insufficiently constructed counterfactuals. Thus, the estimated ATT in both regressions may suffer from bias.

The discussion on relative output growth across the inflation targeters and non-inflation targeters, argued for a few concerns with regards to the relatively higher output growth of the non-targeting economies in the posttreatment period. Most importantly, if the extended gap in GDP growth in the posttreatment period was due to the implementation of an inflation target, there is little support for that an inflation target policy is flexible in practice. This would confirm the rationale provided by Fischer (1990) that policy rules hamper the flexibility of policymakers. It would also support the criticism posed by Svensson (2003), that a simple instrument rule, such as inflation targeting, is too vague to be an operational guideline for monetary policy. Not least since it does not provide any recommendations for when deviations from the rules are appropriate.

Regarding implications for monetary policy, we conclude that, on one hand, inflation targets may be useful in terms of anchoring expectations of the private sector. Thereby, it is possible that inflation targets prevent inflation from spiraling out of control. On the other hand, it may be challenging for monetary authorities to ensure stable, positive output growth while adhering to an inflation targeting policy. Thus, we contend that central banks should carefully evaluate the efficacy of an inflation target in relation to the macroeconomic circumstances. Lastly, we acknowledge that the conduct of effective monetary policy is complex due to the transmission mechanism. In essence, regardless of any monetary policy decisions, these only have indirect control over the macroeconomic outcomes.

This paper contributes to the economic literature in several ways. Firstly, this paper substantiates previous research through testing the effect of inflation targeting on a novel sample of countries, during a new period of interest. Secondly, by integrating a discussion on output

growth across the treatment and control group in the pretreatment and posttreatment periods, this paper contributes with insights into the debate concerning the proposed trade-off between keeping low inflation rates and promoting economic growth. Thirdly, by utilizing the Generalized Synthetic Control Method, this paper takes a novel approach in evaluating the effects of inflation targets. Although our models suffered from a caveat using this method, we provide recommendations for further research to improve its performance. In particular, increasing the number of pretreatment periods and the number of control units is recommended.

Lastly, we acknowledge two aspects which pose relevance for further studies. First, as was shown in Figure 2 to Figure 5, the estimated effect of inflation targets exhibited significant changes toward the end of the observed period. In fact, the current world economy has experienced the highest inflation rates in decades spurred by the cumulative effects of the past three years of adverse shocks, most notably the COVID-19 pandemic, and Russia's invasion of Ukraine. Hence, an important topic for further research is the performance of inflation targeting during and after these recent shocks. Second, as argued by the IMF (2023), debates about the appropriate level of inflation target may reemerge following the latest years' shocks, as countries weigh the social cost of higher inflation against the constraint of ineffective stabilization due to the effective lower bound. Hence, studies on the appropriate level of inflation targets are relevant to substantiate these debates.

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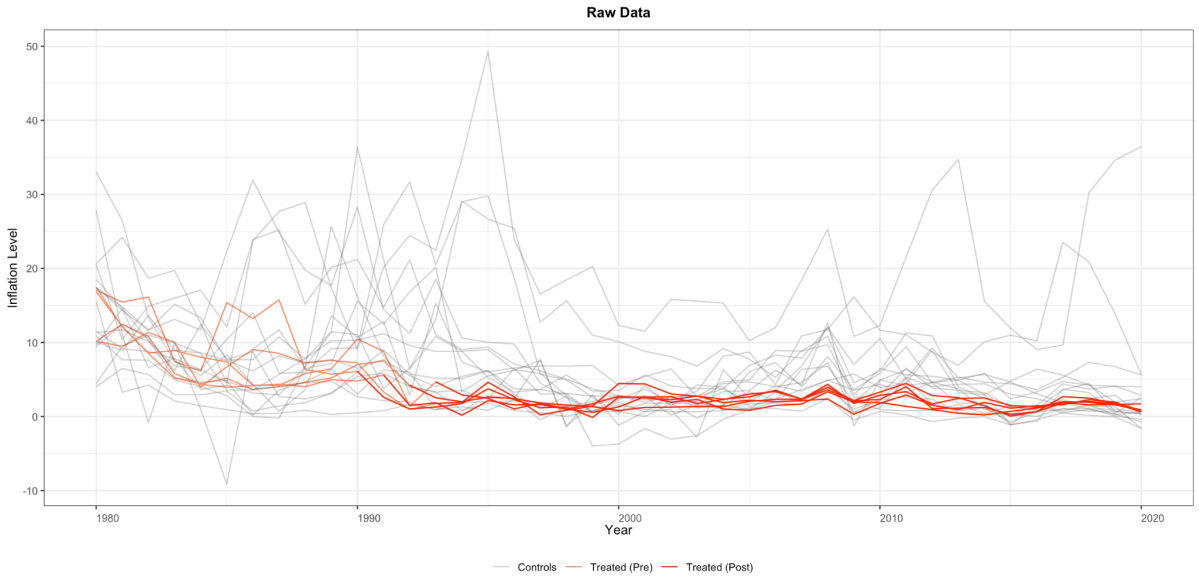
10. Appendices

Appendix A: Raw Data Trends in Inflation Rate and Inflation Variability

To better understand trends in the inflation rate and inflation variability across our sample countries, we summarize the raw data trends in Figure A. The orange lines show the trends of the treated countries before the introduction of an inflation target, and the red lines show the same countries after they adopted an inflation target. The gray lines show the inflation of countries in the control group. For both (a) and (b), the average level of inflation rate and inflation variability is less for the sample of treated countries compared to the control group. As can be seen from Figure A (a), from 1980 to 2020, the sample of treated units display values at a maximum of roughly 15 percent and at minimum of roughly 0 percent. Visually from this Figure, the average inflation rate for the treated units seems to be lesser after the introduction of an inflation target. For the control group, the maximum value of inflation rate is approximately 50 percent at one point in time, with minimum values below 0 percent.

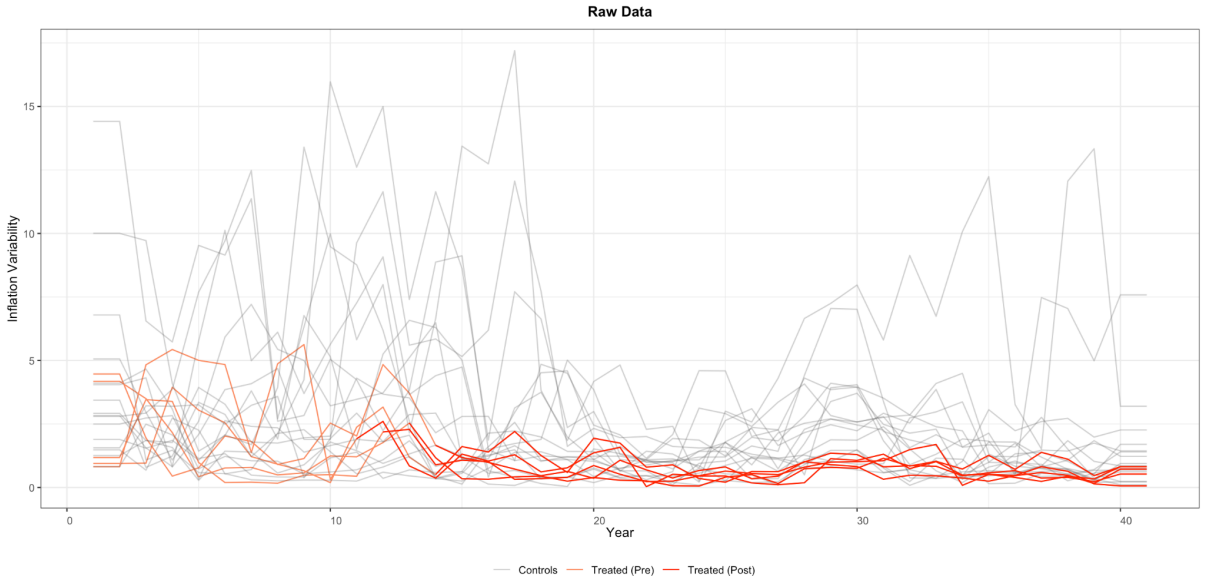
Moreover, Figure A (b) displays similar trends showing how the variability for the control countries is on average higher than the treated units for the total duration of the inspected period. For the treatment units, these display values at a maximum of roughly 5 and minimum close to zero. Similar to the inflation rate, a visual interpretation suggests that the inflation variability has decreased since the introduction of inflation targets. For the control group, the maximum value of inflation variability is roughly 17 percent, with minimal values close to zero.

Figure A. Raw Data of Inflation Rate and Inflation Variability



(a) Inflation Rate

Note: Data on the inflation rate in Figure A (a) is extracted from the International Monetary Fund World Economic Outlook (2023).



(b) Inflation Variability

Note: Data on the inflation rate in Figure A (b) is extracted from the International Monetary Fund World Economic Outlook (2023).

Appendix B: Estimation of Potential Impact Factors by the GSCM

As proposed by Xu (2017), the GSCM is based on a cross-validation approach to estimate the potential impact factors (time-varying coefficients) and factor loadings (unit specific intercepts) so that the data of the treatment group can be better fitted. Notably, it is pointed out that the potential impact factors estimated by the GSCM may not be directly explainable as they are linear transformations of realistic influencing factors. Regardless, these are the estimated impact factors, which covers a wide range of unobserved heterogeneities across the control and treatment group, captured by the interaction fixed effect $\lambda'_i f_t$.

This section first presents the outcome of the cross-validation scheme, and then discusses the implications for the subsequent analysis which estimates the ATT based on this.

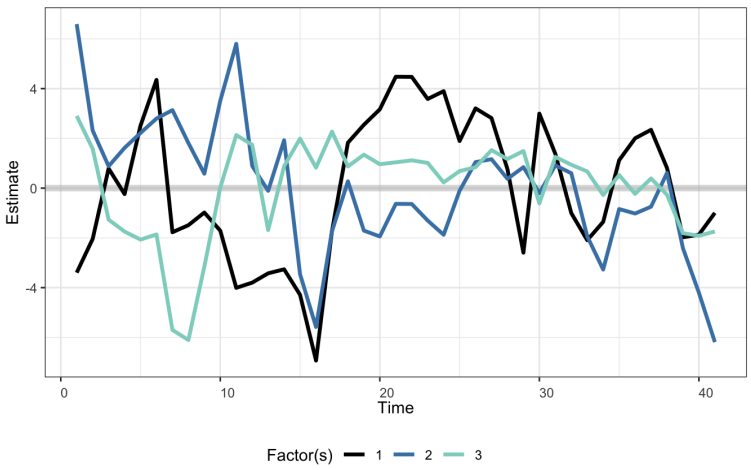
For research question 1, the cross validation scheme estimated three potential impact factors plotted in Figure B (a). For research question 2, the cross validation scheme estimated two potential impact factors plotted in Figure B (b). The horizontal axis in Figure B, represents the year starting from 1980, and the vertical axis displays the importance of the factor (estimated according to the square root of its corresponding eigenvalue to demonstrate their relative importance).

Figure C shows the factor loading of the potential impact factors. The red shows the factor loading of the influence of the potential factors on the control group and the green shows the factor loading of the influence of the impact factors on the treatment group. Figure C (b)

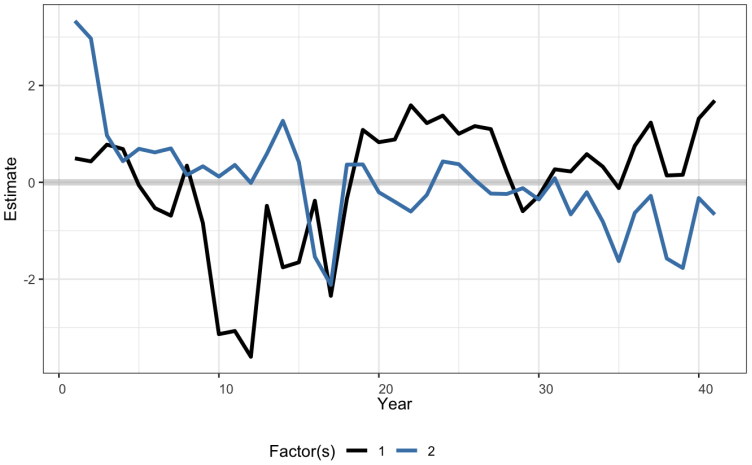
also displays the correlation coefficients of the factors. Looking at Figure C(a), it becomes clear that the overlap is highly existent for factors two and three, however poor for factor one. Regardless, none of the factors are significant. Figure C(b) exhibits little overlap in factor loadings for both factors, however shows a significant correlation. The poor overlap and insignificance of factor loadings, poses concerns for our subsequent analyses as explained below.

Making causal claims based on the GSCM is heavily based on the outcome of the factors and factor loadings, as the main contribution of the GSCM original paper was to employ a latent factor approach to address causal inference problems. According to Xu (2017), synthetic matching methods may fail to construct a synthetic control unit if the treated and control units do not share common support in factor loadings. In turn, this means that excessive extrapolations based on imprecisely estimated factors and factor loadings can lead to erroneous results. Relating this to our analysis, this causes concerns that the estimator failed to construct a synthetic control group, and thereby, that the estimated effect of inflation targets is unreliable due to this reason.

Figure B. Latent Factors Estimated By the GSCM

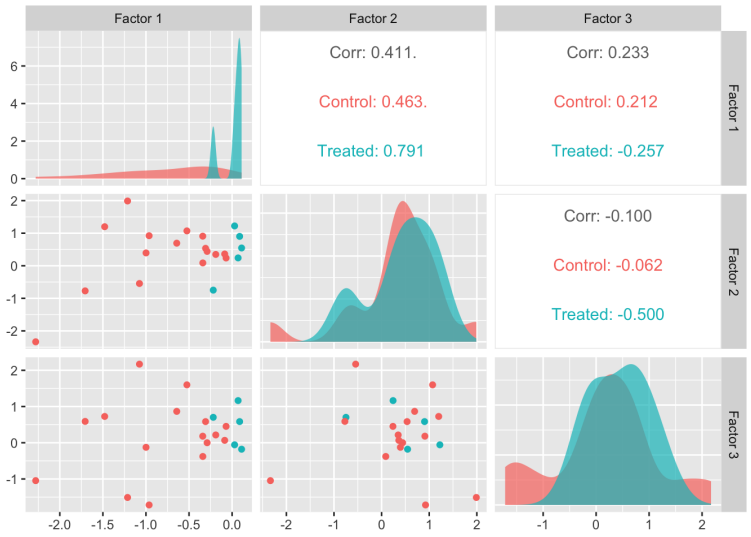


(a) Latent Factor for Research Question 1

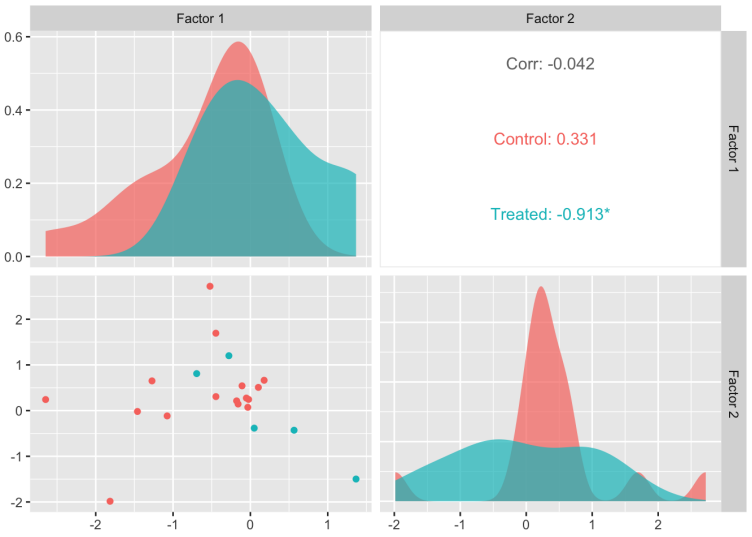


(b) Latent Factors for Research Question 2

Figure C. Factors Loadings Estimated By the GSCM



(a) Factor Loading for Research Question 1



(b) Factor Loadings for Research Question 2

Note: Analysis is based on the data extracted from the International Monetary Fund World Economic Outlook (2023) and the World Bank Open Data (2023).