Grinnell College - ECN-286-01 Econometrics

Observing Inflation Targeting Policy Effects on Inflation Rates

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Abstract

This paper employs a difference-in-difference regression model to analyze the effects of inflation targeting policy, using interest rates as the independent variable and inflation rates as the dependent variable. Simplifying the model to focus on interest rates and GDP (% annual growth) as primary drivers of inflation fluctuations, we control for GDP and address policy implementation through a diff-in-diff approach. Utilizing aggregate data from the International Monetary Fund and World Bank, covering 10 countries from 1991 to 2010, with five countries adopting inflation targeting in 2001 (treatment group) and five not implementing the policy (control group), our two-way fixed effects regression model addresses endogeneity. Results indicate that transitioning from no inflation targeting to policy implementation associates a 1.0 percentage point interest rate increase with an estimated 0.9246 percentage point decrease in inflation. We advocate for the adoption of inflation targeting, emphasizing its potential benefits for monetary policy across countries.

Keywords: Inflation Targeting, Monetary Policy, Interest Rates, Inflation Rate
JEL: E52

1. Introduction

In recent years, the concept of inflation targeting has ignited considerable interest within the community of central bankers and monetary economists. As of 2021, fifty-five countries have adopted this policy with the aims of keeping prices low and the economy stable. There have been many studies that suggest similar messages that in countries which have adopted inflation targeting, there is evidence of its success in the transparency of monetary policy decisions and reducing inflation rates. Importantly, these achievements have been realized without adverse effects on economic output. So what is inflation targeting – and does it really work in practice?

Inflation targeting is a monetary policy framework where a central bank sets a specific, transparent target for the rate of inflation and utilizes various policy tools to achieve and maintain that target (Jahan 2023, 1). Inflation targeting grounds monetary policy and provides transparency to the public about macroeconomic decisions. The United States first adopted inflation targeting in 2012 when the Federal Reserve publicly announced the 2% inflation rate target. Since then, the Fed has used various monetary policy tools (raising the interest rate) to keep the inflation rate as close to that target as possible for stable prices in the economy.

We see the effects of inflation targeting policy currently in the United States that started in early March 2022 as contractionary monetary policy, where the US Federal Reserve executed many interest rate hikes as a result of high inflation at just above 10%. The current inflation rate is 3.2%, still over the Fed's target. Inflation targeting is of major importance for the foundation for the current monetary policy, During the Federal Open Market Committee (FOMC) Jerome Powell will almost certainly say something along the lines of "My colleagues and I are gratified by this progress but expect that the process of getting inflation sustainably down to 2 percent has a long way to go (Powell 2023, 1)" when addressing the economy. This policy is key in keeping

inflation low, which in turn encourages and promotes employment, investments, economic growth, and an overall healthy economy. The Federal Reserve is strong in setting the 2% target a priority which guides the monetary policy actions they choose to execute. As the US has some convincing evidence for the policy being effective, we along with many macroeconomists wonder if this framework is beneficial to an economy that could potentially serve other countries around the globe. The research question we composed is - *What impact does inflation targeting policy have on inflation rates and the stabilization of a country's economy?* In this paper, we set out to answer this question by estimating the causal effects of the inflation targeting policy framework on the inflation rate.

To address our research question, we created panel aggregate data from the International Monetary Fund (IMF data, 2023) and World Bank Data (The World Bank, 1960) to use for analysis. The data set includes panel data on 10 countries during the years 1991-2010. Five of the countries implemented inflation targeting in the year 2001 (treatment group) and five of them never implemented the policy at all (control group) which will be discussed in more detail in a later section. Having panel data allows us to utilize a Difference-in-Difference (DiD) model to estimate the effects of inflation targeting policy (raising interest rates) on the inflation rate. To better address endogeneity, we used two-way country and year fixed effects in our primary model to control for unexplained differences in the inflation rate associated with each country across the years. In our quest for causality, we look to estimate accurate and unbiased coefficients from our model. To best do this we need to meet the Gauss Markov Assumptions. In addition, we need to meet the four DiD model assumptions to give us confidence that the change between treated and untreated units is due to the policy. Thus, making it possible to analyze the

potential policy effect of inflation targeting policy through interest rates on the inflation rate with greater confidence.

The existing body of literature on the effects of inflation targeting encompasses a broad range of studies that investigate the relationship between inflation targeting policies and inflation outcomes within an economy. (Mishkin and Posen 1998) examined the experiences of various countries including New Zealand, Canada and the United Kingdom, which were the first three countries to implement inflation targeting. Their study found that countries which targeted inflation maintained a low rate of inflation, promoted economic growth, and showed no evidence of undesirable effects on the economy in the long run. While these results are similar to what we have found, instead of looking at individual country case studies, we examined aggregate data for multiple countries for overall trends to generalize to the globe.

Our results suggest that we have evidence to believe that the implementation of inflation targeting policy has advantages in lowering the inflation rate and stabilizing an economy. In our study, we found that when a country goes from not having inflation targeting to implementing the policy, a one percentage point increase in the interest rate (monetary policy action) is associated with an estimated 0.9246 percentage point decrease in the inflation rate holding all else constant. This is the most important coefficient in our results because it represents the "treatment effect" and captures the difference in slopes between the treatment and control group after the policy implementation. Although this coefficient was not statistically significant at any level, it does present economic significance in the real world. We have evidence that inflation targeting has many advantages as a framework for monetary policy and suggest that every country should consider implementing it.

The rest of this paper is structured as follows. The 2nd part describes past literature and discussion. The 3rd part discusses the data and variables we use in our econometric analysis. The 4th part describes our modeling approach, justification, and econometric models. The 5th part analyzes our results with interpretations of economic and statistical significance. The 6th part discusses the limitations and future ideas of our research. Lastly, the 7th part concludes our paper with overall findings and discussion regarding our research question.

2. Literature Review

As mentioned above, there has been a great abundance of past literature and research on the importance of low inflation and inflation targeting policy effects since its establishment in 1990. For example, Ben Bernanke and Fredric Mishkin's paper called *Inflation Targeting: A New Framework for Monetary Policy?*, explores how inflation targeting can provide a clear and transparent framework for monetary policy, helping to anchor inflation expectations and promote economic stability (Bernanke and Mishkin 1997, 114). They mention that inflation targeting incentivizes the central bank to restrict short-term opportunistic behavior. Consequently, targeting is a helpful tool in stabilizing the economy short-term, as it sets a restrictive economic goal for a country. This study is similar to ours as it observes the impact of inflation targeting on emerging countries; in future literature, we hope to determine what allows targeting to be an effective policy for certain countries.

We expanded on past literature by looking at aggregate data of countries that we could generalize to the globe instead of specific case studies. In *Inflation Targeting in Emerging Market Studies*, Mishkin looks at individual case studies in which inflation targeting provides advantages and/or disadvantages. As a policy, inflation targeting serves as a great monetary

policy on a short-term scope to provide transparency on the government's focus towards battling high inflation (Mishkin 2000, 2). Mishkin also notes several critical disadvantages, the most notable being that there are "long lags from the monetary policy instruments to the inflation outcome" (Mishkin 2000, 4). This confirms previous literature written by Milton Friedman in 1961, who observes a lag between one to two years (Friedman 1961, 3-4). This reaffirms our usage of a larger time window to better observe the impacts of inflation targeting.

Our paper adds to the literature by observing the impact of inflation targeting over a larger window, which can facilitate a better understanding of the long-term impacts of inflation targeting policies. By utilizing a Difference-in-Difference approach, we take advantage of comparative analysis, which allows us to isolate the impact of inflation targeting, which improves the credibility of our model. Our study has contributed to this literature by providing a different approach by using a Difference-in-Difference design and increasing our time window to ten years bidirectionally – a total of twenty years. This extended window allows us to observe the long-term impacts of inflation targeting, which is updated between one and two years, depending on the country. Future renditions of inflation targeting research should attempt to discount targeting goals to better observe the direct impacts of inflation targeting on inflation rates.

In summary, our research supports past literature in arguing that inflation targeting policy is impactful in lowering inflation and stabilizing a country's economy. While there are pros and cons to inflation targeting, we believe that inflation targeting has many advantages as a framework for monetary policy and suggest that most countries should consider implementation. No country has implemented it and decided to reverse the policy, and thus it appears to be

effective. Our primary goal is to determine the effectiveness of the inflation targeting framework for monetary policy.

3. Data

The empirical framework of this study is dependent on country-level data, which has been accessed from two primary sources. Data in regards to the interest rate and inflation rates per country were sourced from the International Monetary Fund (IMF). Gross Domestic Product (GDP) growth rate per country was sourced from World Bank Data (WBD). Inflation rate, interest rate, and GDP growth rate were utilized in the form of annual percentage change, which will be helpful when observing the impacts of inflation targeting. Inflation rate will be utilized as our dependent variable, which will allow us to observe the impacts of inflation targeting as a monetary policy on inflation rate. Interest rate and GDP growth rate are used as control variables within our model.

Since we are planning to observe the impacts of inflation targeting on inflation rates – and several countries have and haven't implemented it – the methodology used will be a Difference-in-Difference model, which incorporates several dummy variables: Treatment, After, and Treatment x After. Treatment is dependent on whether the country observation has utilized inflation targeting, in which they would be in the treatment group (and hence 1). Conversely, country observations that don't utilize inflation targeting would be in the control group, and be assigned the value of 0. In a similar manner, the After variable is dependent on whether the observation year is before or during/after 2001. In the instance the observation year is prior to 2001 – meaning 2000 and below – the observation is assigned a value of 0 for the dummy After.

Consequently, if the observation year is from 2001 onward then we assign a value of 1. This is irrelevant to whether or not the observed country implements inflation targeting.

The interaction effect is derived by multiplying the dummy variables Treatment and After. The interaction variable has a result of 1 for countries within the treatment group from the year 2001 onward (in which inflation targeting is utilized), and 0 otherwise. This signifies the simultaneity of implementation of inflation targeting within a country and the time-centric post-2001 period, which allows us to compare countries that did and didn't implement inflation targeting.

Within our data, we selected and compared ten total countries: five that implemented inflation targeting (our treatment group), and five that did not (control group). The five countries selected within the treatment group were intentionally selected, as they implemented inflation targeting specifically during the 2001 calendar year; they were: 1) South Korea, 2) Mexico, 3) Norway, 4) Iceland, and 5) Hungary. This distinction allowed us to use a Difference-in-Difference model. The five countries selected within the control group were randomly selected, and were: 1) China, 2) Ecuador, 3) Romania, 4) Singapore, and 5) Switzerland. While we did attempt to maintain the Gauss-Markov assumption of randomness, several countries selected within the control have uncontrolled news and influencing factors to their inflation rate. This caused their inflation rates to decrease significantly, which we will discuss. We will now observe the impacts of our random selection of control countries within our summary statistic discussion.

Table 1 provides our summary statistics. We observe abnormal variation within the inflation rate. To further analyze this, we turn to *Figure 1* to observe the scatterplot of inflation rates over time for our control group countries. This allows us to observe outliers within our data

in terms of our dependent variable inflation rate. We find that Ecuador and Romania have incredibly high inflation rates during the early 1990s, which significantly dropped from 2001 onwards. Ecuador's variation can primarily be explained by their transition from sucre to the United States Dollar (USD), in which we will find a steady decline for their inflation rate from 2001 onwards, dropping to a consistent range of 5 to 10 percent (Index Mundi 2019). In a similar manner, Romania performed the same, with inflation rates upwards of 200 percent slowly declining up until 2001. This can be explained by the transference of Romania from a communist regime to a democracy in 1991. We will continue to discuss the impacts of high variation amongst our control countries throughout the paper, as this may have skewed our results. In future versions we will look to incorporate more control and treatment countries to provide a more realistic view of the impact of inflation targeting on inflation rates. This is confirmed within *Figure 2* and *Figure 3*, which visualize the mean inflation rate over time for both treatment and control groups, respectively. We find steady declines in both with significant drops in the control group; as stated above, this is primarily caused by Romania and Ecuador inflation rates. Both the treatment and control groups find steady declines in inflation rate from 2001 onwards with the exception of 2008 and 2009, which can be explained by the Housing Crisis. In regards to the interest rate and GDP, we find summary statistics to be relatively stable and as expected. The summary statistics for the year variable is also as expected.

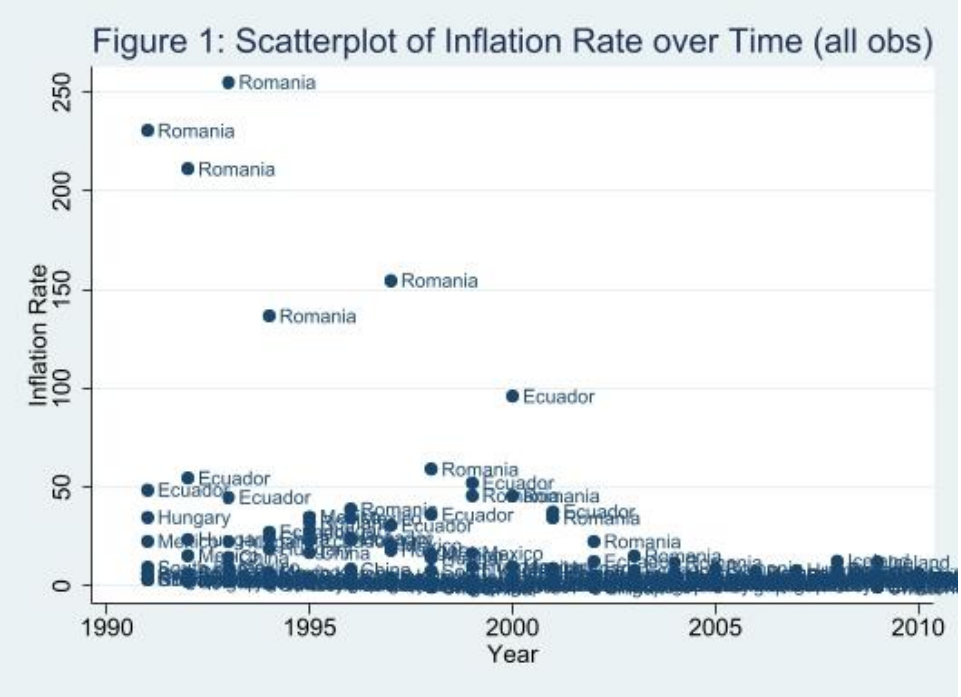
The dummy variables Treatment and After have expected means of 0.5, as half the countries utilize inflation targeting and the other half do not. Similarly, we intentionally centered our data to the year 2001, which allows our After variable to have an identical expected mean. The standard deviations, minimum, and maximums of these variables are also expected. Since the interaction Treatment x After is a result of multiply the two dummy variables, we find the

correct expected mean of 0.25: half of half of the time – or one-quarter of the time – we will find an observation in which the country implements inflation targeting, and the year is on or after 2001.

Table 1: Summary Statistics

Statistic	Count	Mean	SD	Min	Max
Inflation Rate	200	13.657	33.125	-1.401	255.167
Interest Rate	156	4.035	6.302	-43.051	15.143
GDP	194	4.021	4.439	-12.918	14.520
Year	200	2000.5	5.781	1991	2010
Treatment	200	0.5	0.501	0	1
After	200	0.5	0.501	0	1
Treat x After	200	0.25	0.434	0	1

Note: Treat x After is the interaction term for the treatment group that implemented inflation targeting during 2001.



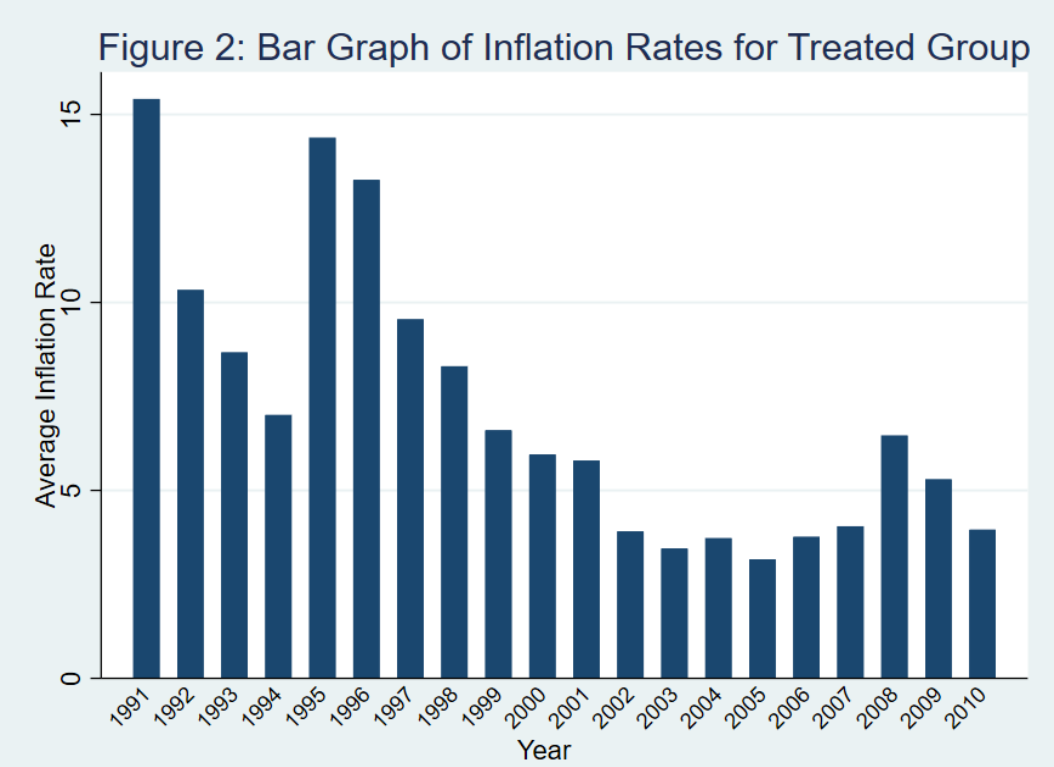


Figure 2: Bar Graph of Inflation Rates for Treated Group
Average Inflation Rate
0
5
10
15
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year

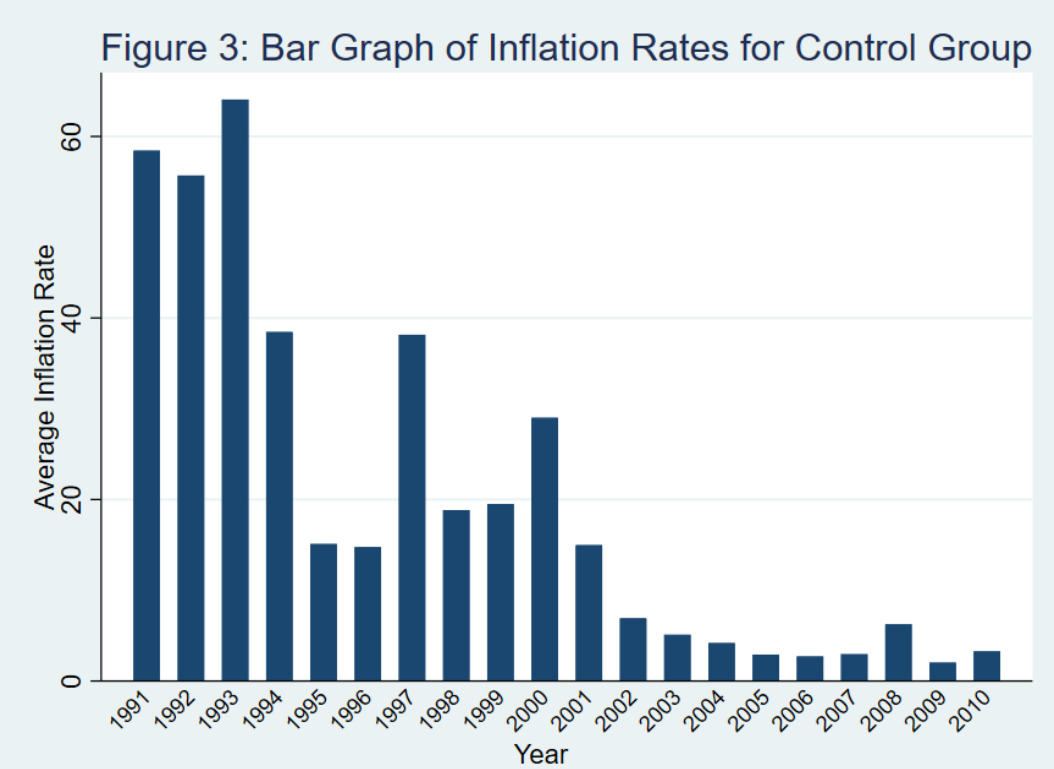


Figure 3: Bar Graph of Inflation Rates for Control Group
Average Inflation Rate
0
20
40
60
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year

4. Modeling Approach

The empirical research design we chose to use is a Difference-in-Difference model that will allow us to evaluate a policy by looking at changes in treated units compared to untreated units. In our research, there are countries that did implement inflation targeting policy in 2001 and countries that did not. We have two models that we use in our analysis to analyze this policy. The first is a standard regression DiD model with control variables and robust standard errors. The second is a DiD two-way fixed effects (TWFE) model with clustered standard errors that uses unit and time fixed effects, which helps us further address endogeneity.

Our first model can be written as follows:

$$(1) \quad InflationRate_{it} = \beta_0 + \beta_1 InterestRate_{it} + \beta_2 GDP_{it} + \beta_3 Treatment_i + \beta_4 After_t + \beta_5 (Treatment_i \, x \, After_t) + \epsilon_{it}$$

where the subscript "i" denotes a country and "t" is the year. Note that if a variable has subscript "it," it indicates that we are observing that variable in country i and in time t. $InflationRate_{it}$ is the dependent variable, which measures the rate at which the average price level of a basket of selected goods and services in an economy rises or falls (annual %). $\beta_1 InterestRate_{it}$ is our independent variable of interest being measured as the real interest rate (%). $\beta_2 GDP_{it}$ is another independent variable that accounts for a country's GDP annual growth rate (annual %) on the inflation rate. $\beta_3 Treatment_i$ is an indicator variable that takes the value of 1 if the country has implemented inflation targeting at any point and 0 if the country has not. $\beta_4 After_t$ is an indicator variable that takes the value of 1 if the country implemented inflation targeting in 2001 to 2010

and 0 if the country did not implement it during those years. $\boldsymbol{\beta_5}(Treatment_i \; x \; After_t)$ is an interaction term for the Treatment and After which equals 1 when the country is treated after 2001 and 0 if it is not. $\boldsymbol{\beta_5}$ is the most important coefficient estimate in the DiD model because it represents the "treatment effect" and accounts for the difference in slopes between the treatment group and control group after the policy was implemented. Lastly, $\boldsymbol{\epsilon_{it}}$ is the error term which captures the random error in the model between the observed values and the fitted values.

Our second model can be written as follows:

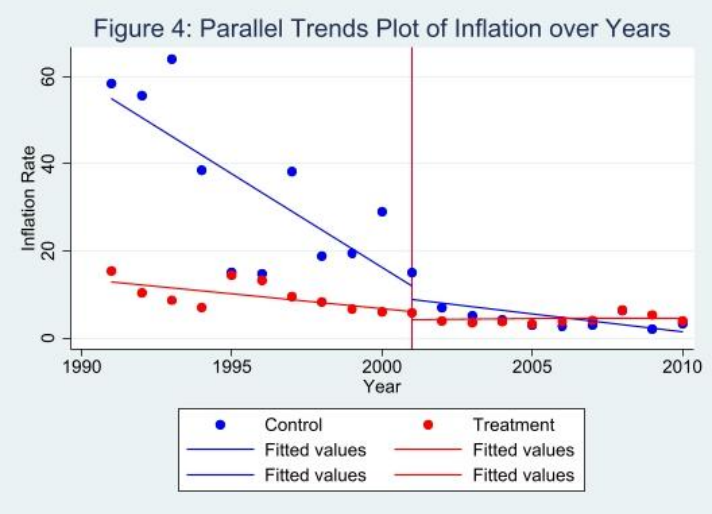
$$(2) \qquad InflationRate_{it} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} InterestRate_{it} + \boldsymbol{\beta_2} GDP_{it} + \boldsymbol{\beta_5}(Treatment_i \; x \; After_t) + \alpha_i + \tau_t + \boldsymbol{\epsilon_{it}}$$

where we add the two-way fixed effects for unit and time. We are able to use two-way fixed effects with our panel data looking at observations collected over multiple periods for the same country. We know that endogeneity is still present in our model. Potential endogeneity could be observed or unobserved omitted variable bias. Meaning that we could be leaving out some terms from our model that do explain variability in the dependent variable and by not having these in the model the coefficient estimates could be skewed. In future research we plan to address this by adding more variables into our models such as the rate of unemployment or GDP per capita. Another source of endogeneity could be the differences between units and time for each country which we address with the two-way fixed effects. The unit fixed effect is denoted by alpha α_i which controls for unexplained differences that affect the inflation rate associated with each country (unit) that are constant over time. An example could be controlling for legal systems or historical events in each country. The time fixed effect is denoted by tau τ_t which controls for

unexplained differences that affect inflation rate across different time periods, for example, seasonal trends or shocks in an economy. By controlling for both unit and time fixed effects, we aim to isolate the variation in the independent variables that is not due to unobserved unit-specific or time-specific factors. This helps us produce more reliable and less biased estimates of the causal relationships between variables in our model, further reducing endogeneity concerns and enhancing the internal validity of our regression results.

We must check the Gauss Markov Assumptions (GMA) for unbiased estimates. The first gauss markov assumption is linearity, which our model satisfies because we have a linear function with our independent variables meaning that all of the $\boldsymbol{\beta}$'s are to the power of 1. The second assumption is random sampling, which our study does not fully meet. The sample we have, more specifically the treatment group, were the only five countries that implemented inflation targeting in 2001 meaning we had to use them. Then our control group was randomly selected from *CBONDS MONTHLY RESEARCH: COUNTRIES WITH INFLATION TARGETING* (Kalinin and Aleksandr 2021, 2-3). The third assumption is no perfect collinearity, which we satisfy because we have not put two of the same variables in our model (no two explanatory variables are perfectly correlated). The last GMA is exogeneity, which our model does not satisfy because we know that endogeneity still presents a concern in our model and analysis (there could be important independent variables that explain a large proportion of variation in the dependent variable captured within the error term). Since our model does not satisfy all of the GMA we understand that our coefficient estimates may include some biases that could impact the external validity of our results. Therefore we cannot make definite conclusions of causality from our results.

Lastly before testing our model on the data, we need to check the four DiD assumptions to have confidence that our model shows that the difference in treated units vs untreated units is due to the policy. The first DiD assumption is that the composition of groups is unchanged, which our design satisfies because there are no changes in the groups over time. The second DiD assumption is that there are no anticipatory effects, which our model satisfies because the anticipation of implementation of inflation targeting does not cause central bank and monetary policy behavior to change. The third DiD assumption is that nothing else changes across the threshold, which our model does not satisfy because there are a variety of factors that could be contributing to inflation rate fluctuations and driving our results. The last and arguably the most important DiD assumption is parallel trends which means that there are common trends between the treatment and control group before the policy implementation. To test this assumption we plotted a two-way trend scatter plot in Stata and can see that our groups do not meet this assumption. In *Figure 4*, we notice the control group having a greater negative slope prior to 2001 compared to the treatment group. This variation can be explained by Ecuador and Romania having external events that effectively reduced their respective inflation rates in a similar time frame to the treatment countries that implement inflation targeting. By not satisfying all of the GMA and DiD assumptions we must understand that endogeneity is present in our model and that the coefficient estimates could be misleading in our analysis. Also, there could be other factors impacting the



treatment effect that are not related to the policy. The assumptions are not all satisfied. We need to be aware that our estimates could be biased and inaccurate in our analysis, which is important to note before interpreting our research and results.

5. Results and Interpretation

In this section we present the results and interpretations to our DiD models (*Equations 1* and *2*) from the policy implementation. *Table 2* displays the results of our first and second models. Starting with our first model titled "DiD" we find that the coefficient estimates for interest rate, GDP, After, and Constant are all statistically significant at the 0.001 alpha level – or a 99.9% confidence level. This means that the estimated relationship between the independent variables and the inflation rate is unlikely to have occurred by random chance. In other words, we have evidence that these variables explain a lot of the variation in the inflation rate and that the population coefficients for these variables are not zero. We can interpret the coefficient of interest on interest rate as a one percentage point increase in the interest rate is associated with an estimated 3.0592 percentage point decrease in the inflation rate holding all else constant. We believe this is economically significant as increasing the inflation rate will reduce borrowing and spending by consumers,

Table 2: DiD regression output for inflation targeting policy effect estimates on inflation rates.

Inflation Rate	DiD	DiD - TWFE
Interest Rate	-3.0592***	-3.1455**
	(-4.00)	(-4.40)
GDP	-1.7129***	-1.5350**
	(-4.69)	(-3.82)
Treatment	-4.2438	
	(-0.76)	
After	-18.6361***	
	(-4.14)	
Treat x After	3.3582	-0.9246
	(0.58)	(-0.12)
Constant	42.2890***	34.58**
	(6.72)	(4.56)
# of Obs	156	156
Adjusted R^2	0.6475	0.7654

* p<0.05, ** p<0.01, *** p<0.001.
T-statistics in parentheses.
Note: In the DiD – TWFE output, we just include the interaction term but add fixed effects.

thereby decreasing demand and reducing prices, which would likely decrease inflation. GDP is also statistically significant, in which a one percentage point increase in GDP is associated with an estimated 1.7129 percentage point decrease in inflation rate, holding all else constant. Typically, we would expect an increase in GDP to lead to an increase in inflation rate; but if GDP is driven by productivity or expanding the supply-side of the economy, then we should expect a decrease in GDP. Hence, it is difficult to determine the impact of GDP on inflation rates in regards to economic theory. We see that the Treatment dummy has a negative impact on overall inflation rate, which is in line with our expectations: a change from the control to treatment group is associated with an estimated 4.2438 percentage point decrease in the inflation rate, holding everything else constant. This is expected, as treatment should contribute to lowering the inflation rate. However, it is statistically insignificant. Conversely, we see that the After dummy has a statistically significant negative impact, where a change from before 2001 to after/including 2001 is associated with an estimated 18.6361 percentage point decrease in the inflation rate with all else constant. As discussed in the data section, we can somewhat attribute the large negative correlation to the drastic decrease in inflation rate for Ecuador and Romania, which had external influencing factors. Observing the interaction term between Treatment and After, we observe a positive correlation: a change from control group prior to 2001 to treatment group after 2001 is associated with an estimated 3.3582 percentage point increase in the inflation rate, holding everything else constant. This contradicts expectations, as we assume that implementing inflation targeting would reduce (or maintain) inflation rate; hence, we should find a negative coefficient estimate for the interaction term. The reason for a positive coefficient can likely be explained by including Treatment and After variables. To better improve on our first model, we add fixed effects to control for year and country variability and observe the direct

impact of inflation targeting on inflation rates, while removing both Treatment and After variables to solely observe the interaction between them.

Looking at our second model, we incorporate fixed effects for both country and year, which allows us to better estimate the impacts of inflation targeting on inflation rates and help us address heterogeneity in our model. Our second model also helps us address robustness by clustering our error terms by country. The coefficient estimates within our secondary model have little variation compared to our initial model. A one percentage point increase in the interest rate is associated with a 3.1455 percentage point decrease in the inflation rate holding all else constant. Economic intuition confirms a negative correlation between interest rate and inflation rate and is in line with our results. Similarly, we find that GDP has statistically significant results: a one percentage point increase in annual GDP is associated with an estimated 1.5350 percentage point decrease in inflation rate holding all else constant. Finally, the most important coefficient is the "treatment effect" which is the coefficient estimate on the interaction term between the after and treated variables. This estimate indicates the change in inflation rate that is seen in the group that has implemented inflation targeting after 2001. It represents a change in slopes between the treatment and control group after 2001. Thus, when a country goes from not implementing the policy to implementing it, we get an estimated 0.9246 percentage point decrease in the inflation rate with a 1.0 percentage point increase in the interest rate, holding all else constant. This variable is economically significant because we believe this result supports that inflation targeting is an effective policy to keep inflation levels low.

Overall, the variables interest rate and GDP were statistically significant for both models. Within the first model, the After dummy variable was also statistically valid. In contrast, the Treatment dummy variable was insignificant, which remains unexplained. Although the

interaction term within the final model is statistically insignificant, we still observe a strong negative correlation. Adding fixed effects allowed us to lower the likelihood of homogeneity and endogeneity, thereby improving the robustness of our model. While the interaction is insignificant, we cannot draw any conclusions on our results; however, we can improve upon our model with several methodologies, which will be discussed in the next section.

6. Discussion

As we chose to utilize two way fixed effects to control for variation across years and between countries. However, this does not remove potentially biased estimates, as our choice of countries within this study presents concerns. For one, we note several randomly sampled control countries that contain large variation within their inflation rate largely caused by external events – Ecuador and Romania. While this should not directly impact our results, increasing the size of our control group will allow us to better observe the impacts of implementing inflation targeting. In a similar manner, we are unable to randomly sample our treatment group, as all countries within the treatment group implement inflation targeting during the 2001 calendar year.

There are several limitations within our study. There was difficulty finding interest rates of certain countries and so we had to deal with several missing observations. With the simplicity of our model, we are unable to fully capture all influencing factors of inflation rate – this can be fixed by adding more controls. Consequently, our model runs the risk of omitted variable bias. Similarly, we must be wary of the potential endogeneity within our model. Furthermore, we fail to meet the Difference-in-Difference assumption of parallel trends prior to the treatment effect; adding more control variables would likely improve having parallel trends at a larger window. If

the parallel trends assumption fails to be met with more observations, then reducing the time window would be necessary to maintain reliability of results.

Observing the effects of inflation targeting can also be tricky. Like any monetary policy, inflation targeting is more inclined to be observed as a lagged impact rather than an immediate one. Milton Friedman observes an estimated adjustment period between one and two years for monetary policies, which confirms initial intuitions in regards to inflation targeting being realized at a later date (Friedman 1961, 3-4). It is important to account for the time it takes for policy adjustments to be realized within a country's economy. As such, we should look to observe short-term and long-term impacts of inflation targeting through changing the time window. With a small sample size our research is considerably less reliable. Increasing the sample size – by either incorporating more countries within the control group or considering adding countries that implement inflation targeting in years other than 2001 – will help improve the robust effects observed within our model.

Going forward, we could collect more data and look over more years and add more terms (such as a country's unemployment rate) to the model to see if we observe a causal relationship between inflation targeting and inflation rates. As inflation targeting is utilized, we can better compare the impacts between the treatment and control groups over several decades instead of five years. However, it is important to note the difficulty in controlling external factors such as the 2008 economic crisis, the COVID-19 pandemic, and other influencing factors that are difficult to control. Furthermore, we find that implementation and realization of monetary policies are potentially lagged, and thus may skew any current and future results.

Within future research, we could implement more variables to better control for variation within each country's annual inflation rate. Our current model is quite simple, as stated before,

and could lead to omitted variable bias. Future variables could include unemployment rate, exchange rate, and government expenditures. Inflation is a complex phenomena, and attempting to control for its variation will be a difficult task. However, we believe that there is much to be analyzed in regards to the effectiveness of inflation targeting as a policy. We encourage fellow economists to look into the qualifications of a country to deem inflation targeting as an effective strategy.

7. Conclusion

In this paper, we analyzed the inflation targeting policy and estimated the effects of this policy using a Difference-in-Difference regression model with the interest rate as the independent variable and inflation rate as the dependent variable. Inflation rate is a very complex mix of macroeconomic factors and can be caused by many factors. We controlled for GDP and utilized a diff-in-diff model to address a policy implementation, though there are limitations to our research. As a testing ground, we created aggregate data from the International Monetary Fund and World Bank that includes panel data on 10 countries during the years 1991-2012. Five of the countries implemented inflation targeting in the year 2001 (treatment group) and five of them never implemented the policy at all (control group). We utilized a Difference-in-Difference two-way fixed effects regression model design that improves our ability to address endogeneity. Our results suggest that when a country goes from not having inflation targeting to implementing the policy, a one percentage point increase in the interest rate (monetary policy action) is associated with an estimated 0.9246 percentage point decrease in the inflation rate, while holding all else constant. This treatment coefficient was not statistically significant at any alpha level, although we do believe it is economically significant as it would pose a significant impact on the

overall prices and stability in an economy. Though our research has limitations and assumption violations that make it harder to make firm conclusions about the causal effect of inflation targeting.

So, the next time you see news of the Fed tightening monetary policy, they are raising the interest rate in an attempt to lower the rate of inflation to the 2% target. Raising the interest rate disincentivizes borrowing and incentivises savings, driving the demand for goods down, therefore decreasing the equilibrium price in an economy. Lag time between policy implementation and impact causes uncertainty around the results of our model. The St. Louis Fed "estimates from U.S. central bankers put the time that it takes for changes in monetary policy to affect inflation at 18 months to two years and at nine months to a year" (St Louis Fed, 2023). This confirms our idea that the treatment effect estimate is not instantaneous but rather lagged over time. The Fed gets to decide to publicly announce monetary policy action once a month at the The Federal Open Market Committee (FOMC) meeting. In most cases the Fed hikes interest rates at 0.25 percentage points which is a quarter of what we have estimated (1.0). For more interpretable results we divided the treatment effect by four to get an estimated 0.2312 percentage point decrease in the inflation rate with a 0.25 percentage point increase in the interest rate holding all else constant.

In conclusion, we agree with past literature that countries with inflation targeting as a monetary policy framework appear to have many advantages such as increasing the transparency of monetary policy actions, promoting conditions for economic growth, and lowering the inflation rate without negative outcomes for output (NBER, 1998) and suggest that all countries consider implementing it.

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