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What Can We Learn about Inflation Targeting? Evidence from Time-Varying Treatment Effects

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Abstract

Recent studies that evaluate inflation targeting through average treatment effects generally conclude the window-dressing view for industrial countries and policy effectiveness for developing countries. Allowing for a time-varying relationship (treatment effect) between the monetary policy and its effects on economic performance over time, this paper provides new findings. First, developed countries lower inflation and reach their targets rapidly in two years and developing countries reduce inflation and move to their targets gradually in that disinflation still continues seven years after the policy adoption in our sample. Second, intertemporal tradeoffs occur for eight developed-country targeters. That is, targeting inflation significantly reduces inflation at the costs of higher inflation and growth variability and a lower output growth in the short-run, although no substantial effects in either the medium term or long-run. In contrast, no costs, only gains, emerge for thirteen developing-country targeters. Now, targeters achieve lower inflation following policy adoption as well as lower inflation and output growth variability in the short-run, medium term, and long-run. Output growth catches up in the medium term, although this effect is not significant in the long run. Interpretations of empirical findings and implications for monetary policy are discussed.

Journal of Economic Literature Classification: C5; E5

Keywords: inflation targeting evaluation, time-varying treatment effects, developed and developing countries

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1. Introduction

Monetary economists have evaluated the effectiveness of monetary policy for many years. Recently, more and more central banks have adopted inflation targeting as their monetary policy control mechanism, since New Zealand's adoption of this monetary policy in 1990. Closely related research on central banking falls into many categories, such as optimal central bank contracts, independence, credibility, accountability, transparency, and communication of central banks as well as the evaluation of monetary policy strategies (e.g., Walsh, 1995a,b; Faust and Svensson, 2001; Issing, 2005; Fatás *et al*., 2007; Lin and Ye, 2007; Acemoglu *et al*., 2008; Blinder *et al*., 2008; Goncalves and Salles, 2008; Brito and Bystedt, 2009; and Svensson, 2009).

Bernanke *et al*. (1999), Truman (2003), Bernanke and Woodford (2005), and Mishkin and Schmidt-Hebbel (2007a, b) provide detailed discussion of how central banks conduct inflation targeting in the world economy and how to improve the framework and institutions of monetary policymaking. Walsh (2009) surveys recent evidence on the effects of inflation targeting on macroeconomic performance. Surprisingly, the empirical literature does not explicitly account for lagged effects of inflation targeting.

Macroeconomists have long known that monetary policy affects prices with a lag. For example, in earlier studies Friedman (1961, 1972) and Friedman and Schwartz (1982) find that the response of prices to monetary changes is distributed over a long time period in the US and the UK. Friedman and Schwartz (1982, p. 412) also report a long-run one-for-one response of inflation to an increase in money growth, with most of the response occurring within four years for both countries. Two decades later, Batini and Nelson (2002) reaffirm these results, showing that it takes one to four years between changes in monetary policy and the resulting change in inflation. Moreover, this result persists despite changes in monetary policy arrangements in the two countries.

In the inflation targeting era, Svensson (1999, 2009) supports flexible inflation targeting, where the central bank strives not only to stabilize inflation around the inflation target but also to stabilize the real economy. A strict inflation targeting regime strives only to stabilize inflation.[1] Time plays a crucial role in a flexible inflation targeting regime. Svensson (1997, 1999) demonstrates theoretically that when policy makers also target output fluctuations, gradual adjustment of the intermediate inflation target to the long-run goal is optimal. Bernanke *et al*. (1999) conclude that "output and employment remain concerns of policy-makers after the switch to inflation targeting can be seen in the fact that all the targeting countries have undertaken disinflation only gradually, to avoid putting undue pressure on the real economy." (p.291). They describe a two-year lag between this monetary policy and its effect on inflation as a common estimate (p.320).[2] The time necessary for the central bank to achieve its inflation target may depend on the weight assigned to output stabilization. Smets (2003) shows in the Euro area that when the society puts equal weight on inflation stabilization and output gap stabilization, the optimal policy horizon for maintaining an inflation target equals 4 years. An increasing (decreasing) weight on output implies that the optimal policy horizon becomes longer (shorter) and the central bank moves more (less) gradually. This issue becomes more complicated in today's worldwide economic recession, originating in the US subprime mortgage market and the run up in energy and food prices. The inflation targeting countries cannot place too much emphasis on inflation, potentially at the expense of economic recovery.

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[1] Friedman (2004) argues that in crucial ways, inflation targeting is opaque. It hides from public view whatever concerns for real outcomes policy makers do maintain, thereby not fostering transparency in policy making but undermining it.

[2] Bernanke *et al*. (1999) observe that this estimate is embodied in the forecasting and decision-making of several inflation-targeting central banks (e.g., Canada and New Zealand), and assume such lags in their recommendation of an inflation target for the US. (pp. 315-329).

With no consideration of lagged effects, Vega and Winkelried (2005) use the propensity score matching method to evaluate treatment effects of inflation targeting for a sample of 109 countries, including both developed and developing countries, and find that inflation targeting reduces the level and volatility of inflation-targeting countries. Gonçalves and Salles (2008) and Lin and Ye (2009) discover that inflation-targeting developing countries significantly lower inflation and its variability. Brito and Bystedt (2009) use panel data, however, and find no evidence that the inflation targeting regime improves performance of inflation and output growth in developing countries. That is, inflation targeting regimes do not lower the costs of disinflation.

The inflation-targeting policy garners even less support based on evidence exclusively from industrial countries. Ball and Sheridan (2005) employ cross-section difference-in-difference regressions to examine the treatment effects of inflation targeting in 20 OECD countries, seven of which adopt inflation targeting. They discover that after adopting inflation targeting, the economic performance of these countries improves. But, non-targeting countries also experience improvements around the same time. Thus, they argue that better economic performance reflects factors other than the monetary regime and conclude that inflation targeting does not produce a major effect. In other words, inflation targeting is irrelevant.

Dueker and Fisher (2006) provide comparative analysis. They match three inflation-targeting countries (New Zealand, Canada, and the United Kingdom) with three nearby non-inflation-targeting countries (Australia, the United States, and Germany), finding little empirical evidence that an inflation-targeting regime performs better than a non-inflation-targeting regime. Lin and Ye (2007) use matching methods to evaluate the treatment effects of adopting inflation targeting on seven industrial countries with fifteen non-inflation targeting industrial countries as the non-treatment group. They show no significant effects on inflation and its variability, arguing the window-dressing view of inflation targeting. Walsh (2009) uses the same method and sample data as Lin and Ye (2007), finding that inflation targeting does not significantly affect output growth or its variability. Gonçalves and Carvalho (2009), however, show that inflation targeting OECD countries suffer smaller output losses in terms of sacrifice ratio during the disinflationary period than non-targeting counterparts. Angeriz and Arestis (2008), employing intervention analysis, find lower inflation rates, well-anchored and accurate inflation expectations for both targeting and non-targeting countries.

The empirical findings produce mixed evidence in economic performance for developing and developed countries. These studies assess inflation targeting implicitly assuming a constant average treatment effect, or a constant relationship between the monetary policy and its effect on economic performance over time.[3] More specifically, the method of analysis assumes that inflation targeting immediately changes inflation and other macroeconomic variables and that those effects are full and permanent. No delayed response exists.

Time lags in the effect of monetary policy generally imply different treatment effects at different times after policy adoption. Misspecification of the treatment effects will occur when we specify them as instantaneous and constant. Laporte and Windmeijer (2005) demonstrate that different estimations lead to different estimates of treatment effects, when such effects, in fact, vary over time. Ignoring time-varying treatment effects, we argue, contributes to the mixed conclusions in the existing literature.

This paper focuses on the effects of inflation targeting on inflation and output growth in eight industrial countries and thirteen developing countries, addressing intertemporal treatment effects, while twelve non-inflation targeting major industrial economies in the OECD and

[3] One exception is Brito and Bystedt’s (2009) panel methodology that allows for different time effects in inflation targeting adoption.

fifty-five non-inflation targeting developing countries constitute the non-treated control groups, respectively, used in the propensity scoring exercise. We report significant evidence that inflation targeting does lower inflation rates for the targeting countries in the short run. The effects occur after the year of adopting inflation targeting and decay gradually in developed countries, but remain permanently in developing countries. Policy evaluation that ignores the dynamics of the inflation process concludes that inflation targeting does not affect macroeconomic performance and is, thus, irrelevant for developed countries. Moreover, no free lunch exists. Short-run costs emerge in reduced output growth as well as increased inflation and output growth variabilities in developed countries, but no such costs in developing countries. Developing countries gain more from inflation targeting policy than do developed countries.

The rest of the paper is organized as follows. Section 2 presents the sample matching techniques and demonstrates how to evaluate inflation targeting policy over time. Section 3 discusses the data and performs some preliminary analyses. Section 4 reports intertemporal and cumulative treatment effects and interprets the findings. Section 5 concludes.

2. Treatment effect, matching, and propensity score

This study evaluates inflation targeting through the treatment effects on the level and variability of inflation and output growth. Consider the average treatment effect on the treated (*ATT)* of inflation targeting that depends on the following equation:

$$ATT = E[Y_{i1} | D_i = 1] - E[Y_{i0} | D_i = 1], \tag{1}$$

where D_i is the 0-1 binary dummy variable for the treatment under consideration. That is, $D_i = 1$ denotes the treatment state or country i adopts inflation targeting while $D_i = 0$ denotes the non-treatment state or country i does not adopt inflation targeting. Thus, $(Y_{i1} | D_i = 1)$ equals the value of the outcome (e.g., the inflation rate) actually observed in the inflation targeting country and $(Y_{i0} \mid D_i = 1)$ equals the counterfactual outcome that would occurred, if the targeting country did not adopt the policy. Two issues arise in this equation. First, we cannot observe the second term in the *ATT*. We do not know the inflation rate of the inflation-targeting country, absent such a policy. Second, the first term assumes implicitly that once the binary variable switches from 0 to 1, the inflation rate adjusts instantaneously and remains constant thereafter. No room exists for a lag effect when implementing the targeting policy or for differing magnitudes of effects over time.

The existing literature developed the propensity score matching methods to address the first issue. Caliendo and Kopeinig (2008) provide an excellent review and practical guide for implementing the matching estimator. Most macroeconomic data do not come from randomized trials, but from observational studies. The matching method chooses a non-targeting control group of countries to mimic a randomized experiment to reduce the bias in the estimation of the treatment effects with observational data sets.

Logically, we can replace $E[Y_{i0} \mid D_i = 1]$ with $E[Y_{i0} \mid D_i = 0, X_i]$, which is observable. We assume conditional independence assumption, which requires that the ith country's outcome (the inflation rate, Y_{i1} or Y_{i0}) does not depend on the targeting policy chosen (i.e., the targeting dummy) conditional on a set of explanatory variables (X_i). In practice, however, the curse of dimensionality always exists. Too many covariates in *X* make the matching method difficult to apply. Rosenbaum and Rubin (1983) propose probit (or logit) models to estimate propensity scores in the binary dummy variable., The propensity scores measure the probabilities that countries *i* and *j* adopt inflation targeting policy, given *X*, to match the targeting countries and control (non-targeting) countries. In the selection process, we require that the common support condition, $P(D = 1 \mid X) < 1$, holds to ensure that analogous non-treatment units exist to compare with the treated ones. Becker and Ichino (2002) and Caliendo and Kopeinig (2008) suggest a test of the balancing condition in data. Failure to pass the test indicates misspecification in the propensity score model.

Using propensity score matching, we estimate the *ATT* of equation (1) as follows:

$$ATT = \frac{1}{N_T} \sum_{i \in T \cap S_p} \left[Y_i - \sum_{j \in C} w(P_i, P_j) Y_j \right], \qquad (2)$$

where P_i and P_j equal the predicted probabilities of adopting inflation targeting for countries *i* (in the targeting group *T*) and *j* (in the control group *C*), respectively. N_T equals the number of treated countries in the set $T \cap S_p$. S_p is the region of common support. We construct the match for each treated unit $i \in T \cap S_p$ as a weighted average of the outcomes of non-treated countries, where $w(p_i, p_j)$ equals the weight function.

The second issue motivates the estimation of the *ATT* of inflation targeting at and after the year of adoption to capture its time-varying effects. This estimation strategy relies on Olley and Pakes (1996) and De Loecker (2007). That is, we modify equation (2) to implement dynamic specifications as follows:

$$ATT^t = \frac{1}{N_T} \sum_{i \in T \cap S_p} \left[Y_{it} - \sum_{j \in C} w(P_i, P_j) Y_{jt} \right], \qquad (3)$$

where t equals 0, 1, 2, 3, 4, denoting the adopting year (t=0) and four years after (t=1…4).[4]

Different matching algorithms produce different weights for the matching estimator and, thus, different results for the *ATT*. We apply four commonly used matching methods -- nearest neighbor matching, caliper matching, kernel matching, and local-linear matching techniques,

[4] The selection of the lag length seems somewhat arbitrary, since we do not know exactly the weight the targeting countries put on inflation stabilization or other objectives. Smets (2003) shows that the optimal policy horizon equals four years when inflation and output stabilization receive equal weights.

programmed by Leuven and Sianesi (2003), to obtain results. Caliendo and Kopeinig (2008) provide detailed discussion for the four matching methods. Generally, the nearest neighbor matching algorithm finds for each treated unit, the non-treated group match with the closest propensity score. We implement this method with replacement, considering a single nearest-neighbor as well as the three nearest-neighbors. The caliper matching algorithm selects the nearest-neighbor within a caliper of width, *r*, and imposes a tolerance level on the maximum distance between the propensity score of the treated and the non-treated units. We consider three tolerance levels as *r*=0.03, 0.01, and 0.005. The kernel matching algorithm, a non-parametric estimator, matches a treated unit with a kernel weighted average in proportion to its proximity to the treated one of all the non-treated units. The local-linear matching algorithm involves a non-parametric regression on a constant and the propensity score. In each of the cases, we use 1,000 bootstrap replications to obtain the standard errors of the matching estimator.

3. Data and preliminary analysis

3.1. Data description

We use annual observations from 20 developed countries in the OECD over the years 1985 to 2007, including 8 inflation-targeting countries – Australia, Canada, Iceland, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom -- and 12 non-inflation-targeting countries.[5] Table 1, Panel A lists the targeting countries, their policy adoption years and targets, as well as the 12 control countries.[6] The numerical inflation target typically reflects an annual

[5] To limit the variability of economic environments for policy evaluation, we exclude ten OECD member countries from our sample. We exclude seven emerging market countries – the Czech Republic, Hungary, Korea, Mexico, Poland, Slovak Republic, and Turkey. We include these seven inflation-targeting countries in our developing country sample. We also exclude Finland and Spain, even though they adopted inflation targeting in 1993 and 1995. They both adopted the Euro in 1999. Finally, we exclude Luxembourg due to its lack of an independent currency before the euro (see Ball and Sheridan 2005).

[6] The adoption years and targets of the inflation targeting countries come from International Monetary Fund (2005). The sample also confines the analysis generally to the period called the Great Moderation.

rate for the consumer price index (CPI) in the form of a range, such as one to three percent (e.g., New Zealand and Canada). Alternatively, the inflation rate target equals a point target with a range, such as a two-percent target plus or minus one percent (e.g., Sweden) or a point target without any explicit range, such as a two-percent target (e.g., the United Kingdom). All targets range between zero and three percent. The average of their mid-points equals 2.19 percent.

We also use annual observations from 68 developing countries over the years 1985 to 2007, including 13 inflation-targeting countries – Brazil, Chile, Columbia, the Czech Republic, Hungary, Israel, Korea, Mexico, Peru, the Philippines, Poland, South Africa, and Thailand -- and 55 non-inflation-targeting countries.[7] Table 1, Panel B lists the targeting countries, their policy adoption years and targets, as well as the 55 control countries.[8] The numerical inflation target typically reflects either an annual rate for the consumer price index (CPI) in the form of a range or a point target with a range. Target ranges generally exceed those for developed countries in level and/or range (dispersion). The average of their mid-points equals 3.37 percent, much higher than the 2.19-percent average for developed countries. The criterion to choose the numerical target is unclear. Establishing price stability provides a generally accepted principle (Mishkin and Schmidt-Hebbel 2007a). In this study, we show that the announced inflation targets in developed and developing countries can explain different treatment effects over time, which may partly explain the mixed conclusions in the existing literature.

The performance outcome includes the levels and variabilities of the inflation and output growth rates. The inflation rate equals the annual percent change of the CPI, while inflation

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[7] We exclude five countries that adopt inflation targeting after 2005 – Ghana, Indonesia, Romania, the Slovak Republic, and Turkey, since two-year experience or less seems too short to tell meaningful treatment effects of inflation targeting for developing countries.

[8] Once again, the adoption years and targets of the inflation targeting countries come from International Monetary Fund (2005) except for the five countries adopting inflation targeting after 2005. They come from the Central Bank of Iceland (2007).

variability equals the three-year moving-average standard deviation. The output growth rate equals the annual growth rate of 2000 base-year constant-price GDP, and output growth variability equals the three-year moving-average standard deviation. For the developed countries, each of the data sets contains 460 observations, of which 103 belong to the treated group and 357 belong to the non-treated group. For the developing countries, each of the data sets contains 1,329 observations, of which 109 belong to the treated group and 1,220 belong to the non-treated group. We take the data for inflation rates and output growth rates from the International Monetary Fund *World Economic Outlook* Database.

Panels A1 and A2 of Table 2 present the performance of inflation and output growth for the full-sample of developed countries, the target-adoption year, and pre- and post-inflation targeting (IT) periods for the targeters and the non-targeters as well as the t-statistics testing for equal means between samples. Since no natural break point exists to split the observations of the non-targeting group, we follow Ball and Sheridan (2005) and use the average adoption year of our targeting countries, which is 1995, to split the sample into pre-1995 and post-1995 period to serve as a comparison. Targeters experienced lower inflation, lower inflation variability, higher output growth, and lower growth variability than they did prior to the policy adoption. Comparing columns 2 and 4 in Panel A1 for targeters, the average inflation rate equals 5.94 percent in the pre-IT period and falls to 2.04 percent in the post-IT period, which falls below the upper inflation target bound of 3 percent and the mid-point average of 2.19 percent in Table 1. The decline in average inflation equals 3.90 percent. The t-statistic (=5.9820) testing for equality of the pre- and post-IT inflation means suggests a significant decline at the 1-percent level (column 3 of Panel A2). The other outcomes, inflation and output growth variability significantly moderate at the 1- and 5-percent levels, respectively, and the output growth rate increases significantly at the 5-percent level.

Panels B1 and B2 of Table 2 present the performance of inflation and output growth for developing countries. Once again, we use the average adoption year of our targeting countries, which is 2000, to split the sample into pre-2000 and post-2000 period to serve as a comparison for the non-targeters. Generally, targeters experienced much lower inflation and inflation variability, higher output growth, and lower growth variability than they did prior to the policy adoption, although the output growth rate does not prove significantly higher. Comparing columns 2 and 4 in Panel B1 for targeters, the average inflation rate equals 148.81 percent in the pre-IT period and falls to 3.98 percent in the post-IT period, which still lies at or above the upper end of the inflation target ranges for 8 of the 13 developing countries and exceeds the 3.37 percent average of the mid-points of the ranges in Panel B of Table 1 for all 13 countries.[9] The decline in average inflation equals 144.83 percent. The t-statistic (=2.7838) testing for equality of the pre- and post-IT inflation means suggests a significant decline at the 1-percent level (column 3 of Panel B2). The other outcomes, inflation and output growth variability significantly moderate at the 1-percent level and the output growth rate increases, but not significantly.

This improvement in macroeconomic performance, however, also appears in the data for the non-inflation-targeting countries, as first noted by Ball and Sheridan (2005). In Panels A1 and A2 of Table 2, the non-targeters of the developed countries also experienced significant declines in the inflation rate, inflation and output growth rate variabilities after 1995, and an insignificant increase in the output growth rate. Panels B1 and B2 of Table 2 report the same information for developing countries. Non-targeters exhibit significantly lower inflation and inflation and output growth variabilities after 2000, and significantly higher output growth.

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[9] Thus, in our sample developed countries generally reach their target inflation rates, developing countries, however, do not. This observation proves important in interpreting results from policy evaluation as discussed below.

Comparing targeters and non-targeters for the post-inflation targeting (post-1995) sample of developed countries (Column 5 in Panel A2) indicates that across the four outcomes of economic performance, the non-inflation-targeting countries generally perform better in volatility of inflation and output growth, no different in the inflation rate, and worse only in the output growth rate than the targeters after the policy adoption. For the post-inflation targeting (post-1995) sample of developing countries (Column 5 in Panel B2), however, the non-inflation-targeting countries perform worse in inflation and volatility of inflation and output growth, and no different in the output growth rate than the targeters after the policy adoption.

For the full sample (Column 1 in Panel A2), the non-targeting developed countries exhibit lower inflation and output growth rates and their variabilities, although only the two variability measures are significantly lower. The developing country non-targeters (Column 1 in Panel B2) achieve lower inflation and its variability, but higher output growth and its variability than targeters. Only output growth variability proves significantly higher.

For the pre-inflation targeting (pre-1995) sample of developed countries (Column 2 in Panel A2), non-targeters achieve lower inflation, and inflation and output growth variability, although only significantly lower for inflation variability at the 10-percent level. The other performance measure shows a higher value for the non-targeters, but not significantly higher. For the pre-inflation targeting (pre-2000) sample of developing countries (Column 2 in Panel B2), non-targeters exhibit lower inflation and its variability, although not significantly lower. On the other hand, non-targeters achieve higher output growth and its variability, but, once again, neither difference proves significant.

Note that the inflation-targeting developed countries experience a high mean inflation rate (=4.24) in the adoption year for inflation targeting, as compared to the mean inflation rate

(=2.82) of the non-targeters. Walsh (2009) argues that the OECD industrial countries who adopt inflation targeting do so because they cannot match the inflation improvements of other OECD industrial countries. The inflation difference between the two groups appears pronounced in the adoption year of inflation targeting. The mean inflation rate among the targeters drops substantially from 4.24 of the year of adoption to 2.04 in the post-IT period, and to below the 2.13 value over the period after 1995 of the non-targeters. Developing countries tell a different story. The targeters exhibit a lower inflation rate (=6.09) in the adoption year than non-targeters (=6.36). The average inflation rate in the post-IT and post-2000 periods sees the targeters with a much lower rate (=3.98) than non-targeters (=6.78). In fact, targeters decrease and non-targeters increase the inflation rate in the post-IT and post-2000 periods, respectively. This inflation difference between the targeters and non-targeters after the policy adoption may provide the explanation for developing countries who adopt inflation targeting. Friedman (1977) and Ball (1992) argue that high inflation creates uncertainty about future monetary policy and, thus, higher inflation variability, which lowers welfare and output growth. High inflation motivates developing countries to adopt inflation targeting to lower their inflation rates.

The upper bounds or the mean values of mid-points of the inflation targets for developed and developing countries reported in Table 1 importantly fall below the actual mean inflation rate in nearly all cases of 4.24 and 6.09 in the policy adoption year (i.e., Brazil is the exception). That is, the timing of monetary policy effects may confound the results of prior studies. This study focuses on the dynamic features of the treatment effect to shed light on the effect of inflation targeting on inflation and output processes over time.

Figures 1a and 1b present inflation trajectories for targeters and non-targeters among developed and developing countries, respectively, to illustrate the intuition behind our evaluation of the targeting policy. The horizontal axis captures a rescaled time line, where t_0 equals the year that the countries adopt inflation targeting and equals 1995 and 2000 for the non-inflation-targeters. The vertical axis measures the mean inflation rate for the two groups. The policy evaluation deals on the right side of the vertical line (at t_0) and asks whether countries become less inflationary after adopting inflation targeting. These Figures provide some evidence of better performance by inflation-targeting countries. For developed countries, the mean inflation rate of countries that start inflation targeting decreases, but only in the year after adopting inflation targeting. In the adoption year, the mean inflation rate actually increases for these inflation-targeting countries. The non-inflation-targeting countries experience a continual decline in the inflation rate over the sample period. For developing countries, targeters experience a monotonic decline in inflation over the nine years, the four pre, the four post, and the one of the adoption year. Non-targeters exhibit a spike in inflation in 1997 and a small upturn in the 2003 and 2004.

Figures 2 to 4 plot trajectories of inflation variability, output growth, and its variability for the targeters and non-targeters. Inflation variability in targeting developed countries exceeds that in non-targeting countries, not only in the adoption year, but also in subsequent years. This reverses for developing country targeters, who now exhibit a lower inflation rate except for three and four years before adopting inflation targeting. Also, targeting developed countries experience a catch-up effect in output growth rates to non-targeting countries and experience higher output growth rate variability. Targeting developing countries only see the growth rate catch up in the first year after adoption of targeting and the growth rate variability exhibits a continual decline falling below non-targeting countries in the second post-adoption year.

Useful information emerges from the data analyses (Tables and Figures) that can assist in policy evaluation. Generally, the effects of inflation targeting differ between developed and developing countries in certain ways. First, in a longer term, both developed and developing targeters successfully lower their inflation rates after the policy adoption. Developed countries, however, take much shorter time than developing countries to reach and fall below their upper bounds of the inflation target as shown in Figure 1. Thus, time plays an important role in explaining effectiveness of this monetary policy. Second, in the short-run (i.e., four years) after the policy adoption in Figures 2-4, the cost of disinflation or the trade-off between inflation and output growth, if any, also appear different in developed and developing countries. A sustained output growth associates with high growth volatility in developed countries and, in contrast, a smoothed growth accompanies declining growth volatility in developing countries. We check whether our dynamic *ATT* estimates confirm these conjectures from the graphical inspections.

3.2. Preliminary analysis

We perform preliminary analyses to compare our findings to those in the existing literature that do not consider the timing issues. That is, using equation (2), we find that inflation targeting exhibits no significant treatment effects on the inflation and output growth rates and their variabilities for developed countries. At the same time, we find that inflation targeting exhibits significant negative treatment effects on inflation and its variability and on output growth variability, but no significant effect on output growth for developing countries. The first-stage probit regression that generate the propensity score matches includes lagged values of the inflation rate, the real GDP growth rate, the government budget surplus as a percentage of GDP, openness measured by exports plus imports as a percentage of GDP, and a dummy for a fixed exchange rate regime.[10] The dependent variable takes on the value 1 in the year in which the

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[10] We use the exchange rate classification proposed by Reinhart and Rogoff (2004) and Ilzetzki, Reinhart and

country adopts inflation targeting.

Tables 3a and 3b report probit estimates of propensity scores. All coefficients are significant at least at the 10-percent level, except for openness in developing countries, and with reasonable signs. These signs conform to the theoretical thinking in the exiting literature as follow. First, the central bank's fear of losing public credibility causes them to adopt inflation targeting only with low inflation rates, which makes the targeted inflation rates easier to reach and/or maintain. Second, a country experiencing rapid economic growth may accept its economic performance and, therefore, may see no need to switch to a monetary framework of inflation targeting. Third, a strong fiscal position enhances the probability of adopting inflation targeting. Conversely, when the central bank must finance a large fiscal deficit, inflation targeting becomes problematic. Fourth, greater openness to trade reduces the vulnerability of economies to external disturbances. Consequently, such countries can more easily adopt inflation targeting along with a floating exchange rate regime. That is, a floating exchange rate regime provides the flexibility for monetary policy to adopt inflation targeting.

This probit regression achieves a reasonable overall fit with pseudo-$\boldsymbol{R^2}$ of 0.29 for developed and developing country models. The common support region shows that the estimated propensity scores fall between 0.0199 and 0.8575 and between 0.0111 and 0.5637 among the treated units for developed and developing countries, respectively. We exclude 66 out of 357 and 434 out of 1,220 control units whose estimated propensity scores fall below the lowest score of

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Rogoff (2008). They classify exchange rate regimes into five categories – hard peg, soft peg, managed floating, freely floating, and freely falling. Following Lin and Ye (2007), we consider the first two categories as fixed exchange rate regimes. We exclude the government budget surplus in estimating the probit regression for developing countries since the data do not appear in the International Monetary Fund *World Economic Outlook* Database or the World Bank World Development Indicators for most developing countries. According to the conditional independence assumption, as argued by Persson (2001), no problem emerges if some variables that systematically influence the policy adoption, but not inflation, do not appear in the estimation of the propensity score. In other words, our goal is not to build a statistical model to explain the choice of inflation targeting policy in the best possible way, 0.0199 and 0.0111 for the developed and developing countries, respectively, to assure that our treated and control units share the same support. This leaves 291 and 786 units to conduct matching and the *ATT* estimates. Finally, following the algorithm proposed by Becker and Ichino (2002), we verify that our data conform to the balancing property. That is, in each of the five equally spaced blocks of propensity scores, the average propensity scores of the treated and control units as well as the means of each of our five covariates used in the probit model do not differ significantly between the two groups.

Table 4 reports the estimated *ATT*s of equation (2) on inflation and output growth in both level and variability. Each column in the Table uses a different matching method. Consistent with the findings of Lin and Ye (2007) and Walsh (2009), the estimation results in Panel A for developed countries suggest that inflation targeting does not significantly affect the inflation and output growth rates or their variabilities, except the *ATT* on output growth at the 10-percent level when using the radius matching at r = 0.005. Although we use different inflation targeting sample countries and a much longer sample period, generally, the magnitudes and signs of the treatment effect on inflation and its variability closely approximates the estimates in Lin and Ye (2007) and the positive *ATT* estimates of output growth and its variability closely approximate those in Walsh (2009).[11] Different industrial targeting countries and sample periods do not influence much of the *ATT*s under different matching methods and the window-dressing view of inflation targeting.

Panel B of Table 4 reports the findings for developing countries. Consistent with the

[11] Both Lin and Ye (2007) and Walsh (2009) evaluate the treatment effect of inflation targeting in seven industrial countries – Australia, Canada, Finland, New Zealand, Spain, Sweden, and United Kingdom, that adopted this policy in the 1990s for the years 1985-1999. As noted in Footnote 2, Finland and Spain adopted inflation targeting in 1993 and 1995, respectively, and both adopted Euro in 1999. We replace the two countries with Iceland, Norway, and Switzerland, who adopted inflation targeting in the early 2000s (see Table 1). We evaluate the treatment effect of inflation targeting in eight industrial countries over a much longer period 1985-2007.

findings of Lin and Ye (2009), the estimation results for developing countries suggest that inflation targeting significantly lowers the inflation rate and its variability. In addition, we find that inflation targeting also significantly lowers the variability of the growth rate, but does not significantly affect the growth rate itself. Once again, we employ a large sample that includes more countries and a few more years.

The ineffectiveness of inflation targeting for developed countries generally reflects a long-run average effect. Does it mean that inflation targeting does not matter? How long is the long-run (short-run)? No theory gives a definite answer, suggesting that the answer reflects a purely empirical issue. Developed and developing countries probably need different times to achieve their respective targets. When evaluating inflation targeting, we argue that the long-run equals the period over which the central bank reaches its preannounced targeting rate and then maintains the rate thereafter. It could take one or two years or ten. In contrast, the short-run equals the period over which the central bank cannot reach the targeted rate fully. That is, the inflation rate still experiences a declining trend toward its ultimate level. To provide evidence, the rest of this paper considers short-run and medium effects of this monetary strategy. Our methodology tests whether inflation and output growth (and their trajectories) change immediately in the adoption year, then four consecutive years after adopting the inflation target, and finally at the end of our sample.[12] The next section presents the estimation results of the *ATT* for inflation and output growth in level and variability, using the dynamic specification of equation (3) for developed and developing countries.

[12] Note that each of the long-run *ATT*s in Table 4 equals exactly the weighted sum of the short-run and medium *ATT*s estimated in Tables 5 and 6, where the weight generally equals the number of observations used in estimating each of the *ATT*s.

4. Dynamic treatment effects of inflation targeting

4.1 Intertemporal Treatment Effects

Table 5a and 5b present five-period *ATT* estimates from the adoption year (***ATT_0***) to the fourth year (***ATT_4***) after the adoption, reflecting how inflation targeting affects inflation, inflation variability, output growth, and growth variability with lagged short-run effects under the seven different matching algorithms. The results are consistent and robust.

Developed Country Findings:

For the treatment effect on inflation, we expect a lower inflation rate. Inflation targeting, however, actually increases the inflation rate significantly in the adoption year. Each of the estimated ***ATT_0s*** across the seven matching methods generates a positive effect with the average equal to 1.45 percent in terms of the annual inflation rate. A significant negative effect on the inflation rate emerges in the first year after adoption. The estimated ***ATT_1s*** range from -0.54 percent to -1.33 percent. Targeting countries become, on average, -0.88 percent less inflationary the first year after they adopt inflation targeting. The inflation gap shrinks in the second year and widens in the third year, although none of these effects are significant. Three years after adoption, the ***ATT_4*** becomes volatile across different matching methods. All the effects are negative, but insignificantly estimated. The evidence from matching suggests that inflation targeting lowers inflation starting the first year after the policy adoption.

The treatment effects on inflation variability exhibit a different story from the inflation rate. In the adoption year, the estimated ***ATT_0s*** deliver positive, but insignificant, values. That is, the treatment effect initially does not lower the inflation rate variability. More than this, in the first year after adoption, the magnitude of the coefficient, ***ATT_1***, increases consistently and significantly in the seven matching methods. A robust, narrow range of the seven estimates falls between 0.61 and 0.69. In addition, in the second year after adoption, the inflation variability gap (***ATT_2***) becomes even larger in magnitude and more significant.[13] In the third and the fourth year, the estimated *ATT*s (***ATT_3*** and ***ATT_4***) fall to small levels quantitatively, nearly half negative, although none prove significant. Thus, no beneficial effect of inflation targeting emerges for inflation rate variability.

Conceptually, under an inflation targeting framework, the central bank places increased weight on inflation stabilization and reduces its concern for maintaining real economic stability. Thus, a trade-off occurs between the inflation and output growth rates, or the output cost of lowering inflation, particularly, in the short-run. Hutchison and Walsh (1998) find that the short-run trade-off in New Zealand started to rise in the early 1990s around the time of the central bank reform. Once the central bank's disinflationary policy obtains credibility, however, it may receive a credibility bonus that should reduce the output cost of lowering inflation. Goncaives and Carvalho (2009) show that inflation targeters suffer smaller output losses during disinflations when compared to non-targeters. In an early study, Barro (1995) finds that the annual inflation rate significantly and negatively relates to the annual growth rate of GDP for around 100 countries.

We follow the same procedures to evaluate the treatment effect on output growth. In the adoption year (***ATT_0***), the output growth rate falls, although insignificantly, compared to the pre-targeting level (-1.30 percent, on average, across different matching techniques). Targeters experience significantly lower output growth in the first year after adoption (***ATT_1*** = -1.43 percent, on average). The credibility bonus emerges in the second year after adoption, where the negative output growth rate falls (-0.39 percent, on average), but the decrease is insignificant.

[13] A one-year significant decline in the mean inflation rate can generate a multiple-year increase in inflation rate variability, when the measure of variability equals a three-year moving average. Note that the story on output growth rate variability differs.

The targeters enjoy higher output growth in the third and fourth years after adoption, although these effects are also insignificant.

Conventional thinking of the Phillips-curve tradeoff between the inflation rate and the output gap focuses on levels. Taylor (1994) argues that the policy tradeoff more appropriately relates to a tradeoff between the variabilities of the output growth and inflation rates. Fuhrer (1997) demonstrates that the short-run tradeoff between the inflation and output growth rates implies a long-run tradeoff between their variabilities. The optimal monetary policy (that minimizes variability of the central bank's targets of the level of inflation and the level of real output relative to potential) implies dramatic increases in the output growth rate variability, when policy attempts to make the inflation rate variability too small. His empirical results suggest that balanced responses to inflation and output are consistent with balanced preferences over inflation and output variability. Cecchetti and Ehrmann (1999) observe that while the variability of inflation falls more in the inflation targeting countries than in the non-targeters, output variability falls far less in the former than in the latter. When the targeting countries increase their revealed aversion of inflation variability, they suffer increases in output volatility. Erceg (2002) argues that inflation targeting reflects the perceived monetary policy frontier of the economy, the policymaker's tradeoff between the volatilities of inflation and real activity. Adopting a narrow inflation target range may induce considerable volatility in real activity. Arestis *et al*. (2002) report mixed evidence for individual targeting countries. The adoption of inflation targets results in a more favorable monetary policy tradeoff in New Zealand, the UK, and Sweden, meaning a substantial decrease in the output gap volatility for a given inflation volatility. No change occurs in Canada, and a decrease in the inflation rate variability accompanied by an increase in output gap volatility across Australia and Finland. When the authors compare the ratio of output gap volatility to inflation volatility between inflation-targeting and non-inflation-targeting countries, the ratio in the non-inflation-targeting countries exceeds that in the inflation-targeting countries.

In the adoption year, the effects of inflation targeting on output growth variability are trivial (-0.05, on average), either positive or negative, and insignificant. The variability increases sharply in the next two years after inflation targeting begins. All $\boldsymbol{ATT_1}$ are significant, ranging from 0.54 to 1.04, and the average effect across different matching techniques equals 0.69 percent. The variability becomes even larger at the end of second year after the policy adoption. The $\boldsymbol{ATT_2}$ estimates range from 0.63 to 1.10 and prove significant and averages 0.81 percent, an obvious cost of targeting inflation. In the third and fourth years after adoption, we find positive, but insignificant, effects.

In sum, Taylor's inflation and output growth volatility trade-off shifts toward a less advantageous trade-off in the first and second years after the adoption of inflation targeting. That is, both inflation and output growth variability increase in the short run with inflation targeting.

Developing Country Findings:

Inflation targeting actually does significantly decrease the inflation rate in the adoption year for developing countries employing radius matching (r=0.03 and r=0.01), kernel matching, and local linear regression matching. Generally, for these matching techniques, significant negative effects emerge in all four future periods considered. The estimated treatment effects range from -2.46 percent of $\boldsymbol{ATT_0}$ in the adoption year to -4.55 percent of $\boldsymbol{ATT_4}$. in the fourth year. While the effects from one year to the next do not move monotonically, in each case the largest negative effect occurs for $\boldsymbol{ATT_4}$. The 1- and 3- nearest neighbor matching and the radius matching (r=0.005) frequently achieve a significant negative effect. Each of these methods except the 1-nearest neighbor matching also achieves a significant negative effect for $\boldsymbol{ATT_4}$, which also reaches the largest magnitude of the ***ATT_i***s reported. Significant and large lagged effects of inflation targeting on inflation emerge in developing countries as compared to the effects in developed countries reported in Table 5a.

The treatment effects on inflation variability exhibit the same story as that for the inflation rate. Inflation targeting does significantly decrease the inflation rate variability in the adoption year for developing countries employing radius matching (r=0.03 and r=0.01), kernel matching, and local linear regression matching. For these matching techniques, significant negative effects emerge in all four future periods considered. The estimated $\boldsymbol{ATT_i}$s range from -1.82 percent of $\boldsymbol{ATT_0}$ to -3.47 percent of $\boldsymbol{ATT_1}$. The 1- and 3- nearest neighbor matching and the radius matching (r=0.005) always achieve a negative effect, which frequently achieve significance. Again, long time-lag effects exist.

We follow the same procedures to evaluate the treatment effect on output growth. In the adoption year ($\boldsymbol{ATT_0}$), the output growth rate falls significantly, except for the 1- and 3-nearest neighbor matching and the radius matching (r=0.01) approaches (-2.37 percent, on average, across different matching techniques). Targeters, however, experience no significant differences in the growth rate for the four future years considered. That is, no substantial cost of output growth occurs in the process of disinflation.

Finally, although in the year of adoption inflation targeting increases output growth variability, the effects are not significant. In the first two years after adoption, this monetary policy eventually decreases output growth variability, although only the estimate of the second year after adoption for the radius matching (r=0.005) is significant. Then in the third and fourth years after adoption, inflation targeting significantly lowers output growth variability and the largest effect occurs in the fourth year for $\boldsymbol{ATT_4}$ across all matching methods. These findings suggest that no cost, only benefit but with time lags, for developing countries who adopt inflation targeting.

In sum, Taylor's inflation and output growth volatility trade-off shifts toward a more advantageous trade-off in the third and fourth years after the adoption of inflation targeting. That is, both inflation and output growth variability decrease in the long run with inflation targeting.

4.2 Cumulative Treatment Effects

Tables 6a and 6b report cumulative treatment effects of inflation targeting for developed and developing countries, where $\sum_0^t \mathrm{ATT}$, ***t=1, 2, 3, 4***, equals a cumulative treatment effect taking the t-year period from the adoption year to the t^{th} year, and $\sum_5^T \mathrm{ATT}$ equals the cumulative effect from the fifth year to the end of our sample.

Developed Country Findings:

The cumulative treatment effect on inflation becomes negative across the seven matching methods after we accumulate across the adoption year and the first two years after adoption (i.e., $\sum_0^2 \mathrm{ATT}$) and eventually becomes positive in some cases at the end of our sample (i.e., $\sum_5^T \mathrm{ATT}$). No significant effect of inflation targeting on inflation occurs in either the short run, the medium term, or long term. In contrast, the cost of inflation targeting emerges significantly in higher inflation variability, lower output growth, and higher growth variability in the short-run. Cumulative output growth becomes positive and the inflation rate and output growth rate variability generally become negative in the medium to long term. These effects are not significant, however. The long-run treatment effects in Panel A of Table 4 imply only one significant effect, significantly higher output growth with the smallest radius matching technique at the 10-percent level.

We plot the short-run cumulative trajectory for the inflation and output growth rates in

Figure 5a and for the inflation and output growth rate variabilities in Figure 6a.[14] We can see clearly in Figure 5a that inflation-targeting countries experience lower inflation rates than their matched counterparts that do not adopt inflation targeting, beginning in the third year (the end of the second year) after adoption of inflation targeting. Targeters experience a lower level of output growth in the early year of inflation targeting relative to non-targeters. The targeters gradually catch up, nearly matching non-targeters in the four year after adoption. Figure 6a shows that targeters exhibit a higher inflation variability gap with respect to their counterparts, increasing until the second year and decreasing after the second year. The output growth variability gap increases at a decreasing rate, since the adoption year. In sum, adopting inflation targeting lead to higher inflation and output growth variabilities as well as lower output growth, and does not lead to lower inflation in the short run. No gain, but pain. In the long run, we see no significant differences in the economic performances of the targeter and non-targeters.

Developing Country Findings:

The cumulative treatment effects on inflation and its variability are significantly negative across the seven matching methods after we accumulate across the adoption year and the first four years after adoption (i.e., $\sum_0^4 \mathrm{ATT}$) and remains significantly negative at the end of our sample (i.e., $\sum_5^T \mathrm{ATT}$). Inflation targeting is effective and successful for developing countries. In addition, the cumulative treatment effects on output growth and its variability in the four-year short-run are generally negative and insignificant. These effects become significantly positive and negative for output growth and its variability, respectively, at the end of our sample (i.e., $\sum_5^T \mathrm{ATT}$). The cost of inflation targeting appears trivial in the short-run, and benefits emerge significantly in higher output growth and lower growth variability in the medium term. The long-run treatment effects

[14] Each of the cumulative values for the outcomes is calculated as the average of the treatment effects obtained from the seven matching algorithms.

in Panel B of Table 4 imply significantly lower inflation, inflation variability and output growth variability, but no significant effect on output growth.

We plot the short-run cumulative trajectory for the inflation and output growth rates in Figure 5b and for the inflation and output growth rate variabilities in Figure 6b. We see in Figure 5b that inflation-targeting countries always experience lower inflation and output growth rates than their matched counterparts that do not adopt inflation targeting. The output growth difference, however, shrinks gradually to the end of the fourth year. Figure 6b shows that targeters always exhibit lower inflation variability with respect to their counterparts. The output growth variability initially exceeds and then falls below their counterparts in year two. In sum, adopting inflation targeting leads to lower inflation and output growth as well as lower inflation variability in the short-run. This monetary policy produces higher output growth variability shortly after the adoption year, then followed by lower variability. In the medium run, we see significant differences in the economic performances of the targeter and non-targeters, where targeters do better for all the four outcomes, although in the long-run the improved output growth is not significant.

Lastly, our *ATT* estimates shown in Figures 5a,b and 6a,b match closely with the prior inspections in Figures 1a,b to 4a,b for the four outcomes, suggesting that our econometric specifications used to evaluate inflation targeting for developed and developing countries are appropriately modeled. To illustrate, we use performance of the inflation rate as an example. Table 7 reports the inflation rates of targeters in the adoption year, four years after the policy adoption, the end year of our sample, and their mean values. Figure 1a depicts each of the mean values over the five-year short-run period for developed countries. Our estimated treatment effects in Figure 5a explain well the inflation trajectory. That is, the falling inflation rate at the end of second year (= 2.16) reaches the average of the mid-points of the targeted rate (=2.19) and then declines with small deviations (to the end of our sample of 2.17). For developing countries, Figure 5b demonstrates exactly the path of the inflation rates. Figure 1b tells that inflation in non-targeters is always higher than inflation in targeters. Figure 5b shows the inflation rate drops (to 4.77) at the end of the first year, then keeps and falls slowly to the end of our sample (=3.66). The significant treatment effect or the nearly three-percent difference between targeters and non-targeters can also be seen in Table 2: there is around 3-percent gap in the two mean inflation rates (3.98 vs. 6.78) in the post-IT period.

4.3 Discussions

Several reasons may explain why other studies do or do not find significant effects of inflation targeting on inflation and its variability or output and its variability. First and most obvious, the specific countries examined influence the outcomes. For example, Ball and Sheridan (2005), Lin and Ye (2007), and Walsh (2009) show that the available evidence for a group of developed countries does not support the view that adopting inflation targeting brings the inflation rate and its variability down or affects the output growth rate and its variability. Using the same econometric methods, Goncalves and Salles (2008) and Lin and Ye (2009) find that developing countries can significantly lower both the inflation rate and its variability by adopting inflation targeting. The differences between developed and developing countries relate to motivation. If the motivation aims at reducing a high inflation rate, then inflation targeting lowers inflation, as argued by Neumann and von Hagen (2002) and Mishkin and Schmidt-Hebbel (2007a). This may explain the motivation of developing countries – adopting policy to achieve real results of lower inflation. If the monetary authorities choose inflation targeting to maintain their already low inflation rates or to converge to a lower rate, rather than to squeeze high inflation rates down, then we will not observe significant effects from the adoption of inflation targeting. This may capture the motivation of developed countries. Truman (2003) argues that because central banks cherish their public credibility, they may only adopt inflation targeting when inflation rates are low, which makes the targeted inflation rate easier to reach and/or maintain. Walsh (2009) argues that the OECD developed countries who adopt inflation targeting do so because they simply want to match the inflation improvements of other OECD developed countries. Thus, studies that use developing countries, which usually experience high inflation rates, find significant negative effects on the inflation rate and its variability. In contrast, studies that examine developed countries, which usually experience low inflation rates, find no significant effects as shown in Table 4 in this study.

Second, different time horizons may lead to different findings. For example, Lin and Ye (2007) and Walsh (2009) use long-period data (15 years from 1985 to 1999) evaluating inflation targeting and find no significant effects for seven developed countries in the OECD. Lin and Ye (2009), on the other hand, use long-period (21 years from 1985 to 2005) data and find significant effects for thirteen developing countries. We report the same in Table 4 over an even longer period (23 years from 1985 to 2007) for both developed and developing countries. Our methodology also checks whether the outcome trajectory differ in a short period of 4 years following the adoption of inflation targeting for eight industrial countries in the OECD and 13 developing countries. Considering the lagged effects of this monetary policy for developed countries, we show that for targeters, the inflation gain, output growth loss, and the inflation and output growth rate variabilities increases come in the years after the initial targeting (see Tables 5a and 6a as well as Figures 5a and 6a), suggesting that the effects of inflation targeting are short-lived. A different story emerges, however, for developing countries. Now we show that for targeters, both the inflation and output growth gain in the short-run or (and) the medium term, and the inflation and output growth rate variabilities decrease in the short-run as well as the medium term (see Tables 5b and 6b as well as Figures 5b and 6b), suggesting that the effects of inflation targeting are time-dependent. The evidence shows the importance of considering the timing of the performance outcomes, not just the overall result, when evaluating inflation targeting.

Third and most important, the evidence of treatment effects needs careful interpretation, when evaluating effectiveness of inflation targeting. The policy irrelevance or window-dressing view generally comes from the long-run treatment effect for developed countries. This conclusion is eventually consistent with the findings of the t-statistic test for equal means between samples. They show no significant differences in inflation performance between targeters and non-targeters in the full-sample, pre-IT (pre-1995), and post-IT (post-1995) periods. Ball and Sheridan (2005) address the issue that the inflation rate declines in the inflation targeting era for both groups. Our intertemporal treatment effects suggest that inflation targeting does matter if targeters simply want to keep low inflation rates as in other developed countries in the OECD (e.g., the US and Japan),[15] as argued by Walsh (2009). Inflation targeting lowers inflation rates immediately in the first year after the policy adoption (Table 5a). Targeters reach their target at the end of the second year (Table 7 and Figure 5a) and keep inflation low to the end of our sample (Table 2). In other words, developed countries can achieve their policy goal in two years, which proves consistent with a one- to four-year lag in effect of monetary policy on inflation reported in Friedman and Schwartz (1982) and Batini and Nelson (2002). Inflation rates beyond the second year after the policy adoption prove irrelevant and, thus, no more treatment

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[15] That is, the US did not need to adopt inflation targeting, since inflation did not seem a threat.

effect emerges. Moreover, our intertemporal analyses also show that a lower output growth and higher inflation and output growth variability trade off lower inflation in the short-run, although not in the medium to the long-run (Table 5a and Table 6a).

As a comparison, developing countries that experience successfulness of inflation targeting as evidenced by significant intertemporal treatment effects in the short-run and the medium term as well as in the long-run, may reflect the following views or observations. First, targeters who adopt inflation targeting want to substantially reduce inflation from a high to a low level. In Table 2, the t-statistic test for equal means shows no differences in the inflation rates between targeters and non-targeters in the full-sample and pre-IT (pre-2000) periods, but significant lower inflation in the post-IT (post-2000) period. The long-run treatment effect on inflation in Table 4 corresponds to this test. This is the main reason why in previous studies researchers find support for inflation targeting in developing countries. Second, as suggested by Bernanke *et al.* (1999) and Svensson (1997, 1999), targeters choose to reach their inflation targets gradually to avoid costs of disinflation. This principle can be seen in Tables 1, 2, and 7. The inflation rate of 3.98 in Panel B1 of Table 2 or 3.66 at the end of our sample in Table 7 still exceeds the 3.37 percent average of the target range mid-points in Table 1. Thus, developing countries require a much longer time (at least longer than two years for developed countries) to fulfill this monetary policy. In this study, the seven years (from 2000 of the average adoption year to 2007 at the end of our sample) may not achieve the long-run outcome. Disinflation still occurs as shown in Tables 5b and 6b, and Figure 5b. We find a much longer lag length between inflation targeting monetary policy and inflation for developing countries than for developed countries.[16] Our intertemporal treatment effects show no costs of disinflation in such a gradual

[16] To the best of our knowledge, no empirical literature yet examines the lag from inflation targeting to inflation for

process. Targeters eventually benefit from lower inflation variability and lower output growth variability in the short-run, the medium term (Tables 5b and 6b, and Figure 6b), and the long-run (Table 4), along with an output growth catch-up in the medium term (Table 6b), although not significant in the longer term (in Table 4).

5. Conclusion

This paper evaluates inflation targeting through dynamic treatment effects for eight industrial countries -- Australia, Canada, Iceland, New Zealand, Norway, Sweden, Switzerland, and the United Kingdom – as well as 13 developing countries – Brazil, Chile, Columbia, the Czech Republic, Hungary, Israel, Korea, Mexico, Peru, the Philippines, Poland, South Africa, and Thailand -- during the period 1985 to 2007. We begin by considering the average effects, if any, of inflation targeting on the inflation and output growth rates and their variabilities in our longer sample period. Our initial results, based on the treatment effect on the treated, generally find no significant effects of inflation targeting on the four macroeconomic performance measures for developed countries. When considering developing countries, we find significantly lower inflation as well as lower inflation and output growth variability, but no significant effect on the output growth rate. These results generally match the findings in the existing literature. Subsequent analysis reveals that the policy-irrelevance conclusion does not prove robust to short-run specifications of the treatment effect for developed countries and more information emerges in time-varying and significant outcomes at different times for developing countries. This result demonstrates the misspecification (misinterpretation or missed information) of the treatment estimates, if researchers neglect the dynamic adjustment process of policy adoption.

Concerning outcome performance, our dynamic treatment effect leads to different results with respect to how the policy of inflation targeting affects the inflation and output growth rates

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developing countries.

and their variabilities in developed and developing countries. That is, we find significant effects on each of the four variables, differing from those findings of previous studies that only focus on the long-run effects. For developed countries, the treatment effect of inflation targeting on inflation is significantly positive in the inflation targeting adoption year. Thus, the policy exhibits a reverse effect when adopted. The significant negative effect emerges only in the first year after the adoption year. Thus, a one-year time lag exists in experiencing the benefit of this monetary policy. The cumulative effect shows that targeters reach their inflation targets at the end of the second year. No free lunch exists, however. The treatment effect on output growth is significantly negative in the first year after policy adoption and the cumulative effect remains significantly negative in the second year. Moreover, both the inflation and output growth rate variabilities are significantly higher in the next two years after the policy adoption and their cumulative effects are significantly higher to the end of the fourth year. Apparently, to lower the inflation rate, the policy must accept the costs of a lower output growth rate in addition to higher inflation and output growth rate variabilities in the short run. Our results require careful interpretation, however. The evidence that inflation targeting worsened the output growth rate as well as the inflation and output growth rate variabilities, as most critics of inflation targeting stress, tells only the short-run costs of inflation targeting. The critics concerns do not materialize in the long-run.

Interestingly, the analysis of developing countries tells a totally different story of the outcomes. That is, the treatment effect of inflation targeting on inflation is significantly negative, beginning with the inflation targeting adoption year through the end of our sample. No time lag exists until the benefits of this monetary policy emerge. The significant cumulative effects confirm that the targeters experience lower inflation than non-targeters beginning with the year of policy adoption. Moreover, almost no costs exist; only gains emerge. The treatment effect on output growth is significantly negative only in four out of the seven matching methods in the policy adoption year and the cumulative effect eventually becomes significantly positive in the medium term. The inflation rate variability is significantly lower in the four years right after the policy adoption and the cumulative effect exhibits lower inflation variability significantly from the adoption year to the end of our sample period. Significant lower output growth rate variability emerges with a time lag of two years. The cumulative effect shows significantly lower growth variability in the fourth year and in the medium term. The fact that developing country targeters do not reach their long-run targets yet in our sample period suggests that in order to lower the inflation rate, the policy can avoid the costs of a lower output growth rate, higher inflation variability and output growth rate variability in the short run, if a gradual adjustment principle is followed.

In sum, several observations emerge from our study of inflation targeting in developed and developing countries. First, the monetary policy of inflation targeting effectively lowers inflation for both developed and developing countries. Second, time lags play an important role in evaluating this policy. That is, developed and developing countries experience different time profiles when adopting inflation targeting. Developed countries reach their targets rapidly in two years. In contrast, developing countries reduce inflation gradually toward their targets and do not reach their ultimate goal by the end year of our sample in 2007. Third, fast movement leads to short-run costs of disinflation in developed countries and gradual adjustment avoids such costs in developing countries. Fourth, the policy implications suggest that developing countries with high inflation rates can lower inflation by targeting inflation through gradual adjustment of an intermediate inflation target to the long-run inflation goal.

References:

Acemoglu, D., Johnson, S., Querubin, P., and Robinson, J. A., (2008). When does policy reform work? The case of central bank independence. *Brookings Papers on Economic Activity*, 351-417.

Angeriz, A., and Arestis, P., (2008). Assessing inflation targeting through intervention analysis. *Oxford Economic Papers* 60, 293-317.

Arestis, P., Caporale, G. M., and Cipollini, A., (2002). Does inflation targeting affect the trade-off between output gap and inflation variability. *Manchester School* 70(4), 528-545.

Ball, L., (1992). Why does high inflation raise inflation uncertainty? *Journal of Monetary Economics* 29, 371-388.

Ball, L., and Sheridan, N., (2005). Does inflation targeting matter? In B. S. Bernanke and M. Woodford (eds.), *The Inflation Targeting Debate*. Chicago: University of Chicago Press, 2005, 249-276.

Barro, R. J., (1995). Inflation and economic growth. Bank of England Quarterly Bulletin, May, 166-176.

Batini, N., and Nelson, E., (2002). The lag from monetary policy actions to inflation: Friedman revisited. *International Finance* 4, 381-400.

Becker, S. O., and Ichino, A., (2002). Estimation of average treatment effects based on propensity scores. *Stata Journal* 2, 358-377.

Bernanke, B. S., Laubach, T., Mishkin, F. S., and Posen, A., (1999). *Inflation Targeting: Lessons from the International Experience*. Princeton University Press: Princeton.

Bernanke, B. S., and Woodford, M., (2005). *The Inflation Targeting Debate*. Chicago: University of Chicago Press.

Blinder, A. S., Ehrmann, M., Fratzscher, M., Haan, J., and Jansen, D., (2008). Central bank communication and monetary policy: A survey of theory and evidence. *Journal of Economic Literature* 46(4), 910-945.

Brito, R. D., and Bystedt, B., (2009). Inflation targeting in emerging economies: Panel evidence. *Journal of Development Economics*, doi: 10.1016/j.jdeveco.2009.09.010

Caliendo, M., and Kopeinig, S., (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys* 22, 31-72.

Cecchetti, S. C., and Ehrmann, M., (1999). Does inflation targeting increase output volatility? An international comparison of policymakers' preferences and outcomes. *National Bureau of Economic Research Working Paper 7426.*

Central Bank of Iceland, (2007). Economic and monetary developments and prospects. Monetary Bulletin 2007/2, 5-48, Iceland, The Central Bank of Iceland, Website: www.sedlabanki.is

De Loecker, J., (2007). Do exports generate higher productivity? Evidence from Slovenia. *Journal of International Economics* 73, 69-98.

Dueker, M. J., and Fischer, A. M., (2006). Do inflation targeters outperform non-targeters?" Federal Reserve Bank of St. Louis *Review* 88(5), 431-450.

Erceg, C. J., (2002). The choice of an inflation target range in a small open economy. *American Economic Review Papers and Proceedings* 92(2), 85-89.

Fatás, A., Mihov, I., and Rose, A. K., (2007). Quantitative goals for monetary policy. *Journal of Money, Credit and Banking* 39, 1163-1176.

Faust, J., and Svensson, L. E. O., (2001). Transparency and credibility: Monetary policy with unobserved goals. *International Economic Review* 42(2), 369-397.

Friedman, B., (2004). Why the Federal Reserve should not adopt inflation targeting. *International Finance* 7(1), 129-136.

Friedman, M., (1961). The lag in effect of monetary policy. *Journal of Political Economy* 69(5), 447-466.

Friedman, M., (1972). Have monetary policies failed? *American Economic Review Papers and Proceedings* 62, 11-18.

Friedman, M., (1977). Nobel lecture: inflation and unemployment. *Journal of Political Economy* 85, 451-472.

Friedman, M., and Schwartz, A. J., (1982). *Monetary trends in the United States and the United Kingdom: Their relation to income, prices, and interest rates, 1867-1975*. Chicago: University of Chicago Press.

Fuhrer, J. C., (1997). Inflation/output variance trade-offs and optimal monetary policy. *Journal of Money, Credit and Banking* 29(2), 214-234.

Goncalves, C. E. S., and Salles, J. M., (2008). Inflation targeting in emerging economies: What do the data say? *Journal of Development Economics* 85, 312-318.

Gonçalves, C., and Carvalho, A., (2009). Inflation targeting matters: Evidence from OECD economics' sacrifice ratios. *Journal of Money, Credit and Banking* 41, 233-243.

Hutchison, M. M., and Walsh, C. E., (1998). The output-inflation tradeoff and central bank reform: Evidence from New Zealand. *Economic Journal* 108, 703-725.

Ilzetzki, E., Reinhart, C., and Rogoff, K., (2008). Exchange rate arrangements entering the 21st century: Which anchor will hold? manuscript.

International Monetary Fund, (2005). Does inflation targeting work in emerging markets? IMF World Economic Outlook. Washington D.C.: International Monetary Fund.

Issing, O., (2005). Communication, transparency, accountability: Monetary policy in the twenty-first century. Federal Reserve Bank of St. Louis *Review* 87(2), 65-83.

Laporte, A., and Windmeijer, F., (2005). Estimation of panel data models with binary indicators when treatment effects are not constant over time. *Economics Letters* 88, 389-396.

Leuven, E., and Sianesi, B., (2003). PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing. http://ideas.repec.org/c/boc/bocode/s432001.html Version 3.0.0.

Lin, S., and Ye, H., (2007). Does inflation targeting really make a difference? Evaluating the treatment effect of inflation targeting in seven industrial countries. *Journal of Monetary Economics* 54, 2521-2533.

Lin, S., and Ye, H., (2009). Does inflation targeting really make a difference in developing countries. *Journal of Development Economics* 89, 118-123.

Mishkin, F. S., and Schmidt-Hebbel, K., (2007a). A decade of inflation targeting in the world: What do we know and what do we need to know? In F. S. Mishkin (ed.) *Monetary Policy Strategy*. The MIT Press, Cambridge, Massachusetts.

Mishkin, F. S., and Schmidt-Hebbel, K., (2007b). *Monetary Policy under Inflation Targeting*. Banco Central de Chile, Santiago, Chile.

Neumann, M. J. M., and von Hagen, J., (2002). Does inflation targeting matter? Federal Reserve Bank of St. Louis *Review* 84, 127-148.

Olley, A., and Pakes, A., (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica* 64, 1263-1298.

Persson, T., (2001). Currency union and trade: how large is the treatment effect? *Economic Policy* 33, 433-448.

Reinhart, C., and Rogoff, K., (2004). The modern history of exchange arrangements: A reinterpretation. *Quarterly Journal of Economics* 119, 1-48.

Rose, A. K., (2007). A stable international monetary system emerges: Inflation targeting is Brettonwoods, reversed. *Journal of International Money and Finance* 26, 663-681.

Rosenbaum, P., and Rubin D., (1983). The central role of the propensity score in observational studies for causal effects. *Biomertrika* 70, 41-50.

Smets, F., (2003). Maintaining price stability: low long is the medium term? *Journal of Monetary Economics* 50, 1293-1309.

Svensson, L. E. O., (1997). Inflation forecast targeting: Implementing and monitoring inflation targets. *European Economic Review* 41, 1111-1146.

Svensson, L. E. O., (1999). Inflation targeting: Some extensions. *Scandinavian Journal of Economics* 101, 337-361.

Svensson, L. E. O., (2009). Transparency under flexible inflation targeting: Experience and challenges. *Sveriges Riksbank Economic Review* 1, 5-44.

Taylor, J. B., (1994). The inflation-output variability trade-off revisited. In *Goals, Guidelines, and Constrains Facing Monetary Policymakers,* Federal Reserve Bank of Boston Conference Series No. 38, 21-38.

Truman, E., (2003). Inflation Targeting in the World Economy. Washington, District of Columbia: Institute for International Economics.

Vega, M., and Winkelried, D., (2005). Inflation targeting and inflation behavior: A successful story? *International Journal of Central Banking* 1, 153-175.

Walsh, C. E., (1995a). Optimal contracts for independent central banker. *American Economic Review* 85, 150-167.

Walsh, C. E., (1995b). Is New Zealand's Reserve Bank Act of 1989 an optimal central bank contract? *Journal of Money, Credit and Banking* 27, 1179-1191.

Walsh, C. E., (2009). Inflation targeting: What have we learned? *International Finance* 12, 195-233.

Table 1: Inflation Targeting Countries and Control Countries

Panel A: Developed Countries

Targeting Countries	Adoption Year*	Inflation Target (percent)
Australia	1993	2-3
Canada	1991	1-3
Iceland	2001	2.5
New Zealand	1990	1-3
Norway	2001	2.5
Sweden	1993	2(+/-1)
Switzerland	2000	<2
United Kingdom	1992	2
Control Countries		
Austria	Germany	Japan
Belgium	Greece	Netherlands
Denmark	Ireland	Portugal
France	Italy	United States

Panel B: Developing Countries

Targeting Countries	Adoption Year*	Inflation Target (percent)
Brazil	1999	4.5(±2.5)
Chile	1999	2-4
Colombia	1999	5(±0.5)
Czech Republic	1998	3(±1)
Hungary	2001	3.5(±1)
Israel	1997	1-3
Korea	1998	2.5-3.5
Mexico	2001	3(±1)
Peru	2002	2.5(±1)
Philippines	2002	5-6
Poland	1999	2.5(±1)
South Africa	2000	3-6
Thailand	2000	0-3.5
After 2005		
Ghana	2007	0-10
Indonesia	2005	6(±1)
Romania	2005	4(±1)
Slovak Republic	2005	0-2
Turkey	2006	4(±2)

Control Countries

Algeria	Costa Rica	Honduras	Maldives	Solomon Islands
Argentina	Cote d'Ivoire	Hong Kong	Mauritania	Sri Lanka
Bangladesh	Dominican Republic	India	Mauritius	St. Lucia
Bhutan	Egypt, Arab Rep.	Iran, Islamic Rep.	Nepal	Swaziland
Bolivia	El Salvador	Jamaica	Nicaragua	Syrian Arab Rep.
Botswana	Ethiopia	Jordan	Nigeria	Tonga
Bulgaria	Fiji	Kenya	Pakistan	Trinidad and Tobago
Burundi	Gambia, The	Lao PDR	Papua New Guinea	Tunisia
Cape Verde	Guatemala	Lesotho	Paraguay	Uganda
Chad	Guyana	Madagascar	Rwanda	Vanuatu
China	Haiti	Malawi	Samoa	Vietnam

* This year indicates when countries de facto adopted inflation targeting. Official adoption dates may vary.

Table 2: Economic Performance of Targeters (IT) and Non-Targeters (NIT), 1985-2007

Panel A1: Mean Values of Inflation, Output Growth, and Variability: Developed Countries

	Targeters			
	Full Sample	**Pre-IT**	**Adoption Year**	**Post-IT**
Inflation	3.8481	5.9361	4.2352	2.0352
Inflation Variability	1.3744	2.0490	1.2444	0.8102
Output Growth	2.7761	2.4759	1.2818	3.1579
Growth Variability	1.3170	1.4910	1.0818	1.1884
Observations	184	81	8	95
	Non-Targeters			
	Full Sample	**Pre-1995**	**1995**	**Post-1995**
Inflation	3.2992	4.7531	2.8228	2.1274
Inflation Variability	0.8681	1.2633	0.8252	0.5423
Output Gowth	2.7242	2.6773	2.9921	2.7409
Growth Variability	1.1394	1.3394	1.8884	0.9103
Observations	276	120	12	144

Panel A2: t statistic test for equal means: Developed Countries

	Full Sample-IT vs. Full Sample-NIT	**Pre-IT vs. Pre-1995**	**Post-IT vs. Pre-IT**	**Post-1995 vs. Pre-1995**	**Post-IT vs. Post-1995**
Inflation	1.4272	1.5312	-5.9820***	-5.9337***	-0.5925
	[0.1545]	[0.1278]	[0.0000]	[0.0000]	[0.5542]
Inflation Variability	2.5864**	1.8618*	-3.0122***	-6.1033***	3.7759***
	[0.0104]	[0.0658]	[0.0034]	[0.0000]	[0.0002]
Output Growth	0.2822	-0.6793	2.3923**	0.2628	1.8294*
	[0.7780]	[0.4979]	[0.0181]	[0.7929]	[0.0686]
Growth Variability	2.2782**	1.1599	-2.2300**	-5.2353***	3.1003***
	[0.0234]	[0.2481]	[0.0272]	[0.0000]	[0.0023]

Panel B1: Mean Values of Inflation, Output Growth, and Variability: Developing Countries

	Targeters			
	Full Sample	**Pre-IT**	**Adoption Year**	**Post-IT**
Inflation	93.906	148.81	6.0896	3.9839
Inflation Variability	83.566	133.68	2.3122	1.6326
Output Growth	3.8190	3.6683	1.3651	4.4307
Growth Variability	2.3326	2.6782	3.3445	1.5548
Observations	287	178	13	96
	Non-Targeters			
	Full Sample	**Pre-2000**	**2000**	**Post-2000**
Inflation	59.749	91.463	6.3555	6.7824
Inflation Variability	57.748	90.443	3.6832	3.0071
Output Growth	4.1120	3.7980	3.4897	4.7979
Growth Variability	2.6070	2.9247	2.0550	2.0789
Observations	1042	652	48	342

Table 2: Economic Performance of Targeters (IT) and Non-Targeters (NIT), 1985-2007 (continued)

Panel B2: t-Statistic Test for Equal Means: Developing Countries

	Full Sample-IT vs. Full Sample-NIT	Pre-IT vs. Pre-2000	Post-IT vs. Pre-IT	Post-2000 vs. Pre-2000	Post-IT vs. Post-2000
Inflation	0.9026	0.9477	-2.7838***	-2.7270***	-7.0976***
	[0.3671]	[0.3440]	[0.0060]	[0.0066]	[0.0000]
Inflation Variability	0.8729	0.9167	-3.2870***	-3.5273***	-4.9546***
	[0.3831]	[0.3600]	[0.0012]	[0.0004]	[0.0000]
Output Growth	-1.1026	-0.3376	0.9582	3.1554***	-1.2447
	[0.2707]	[0.7359]	[0.3388]	[0.0017]	[0.2141]
Growth Variability	-2.0237**	-1.3876	-4.1594***	-5.7996***	-2.7316***
	[0.0435]	[0.1662]	[0.0000]	[0.0000]	[0.0068]

Note: The post-IT (post-1995 or post-2000) period does not include the adoption year (1995 or 2000). p-values are in brackets.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 3: Probit Estimates of Propensity Scores

Panel A: Developed Countries

	Coefficient	Standard Error
Inflation Rate	-0.1153 ***	0.0378
Real GDP Growth Rate	-0.0824 *	0.0431
Budget Surplus	0.0447 **	0.0218
Openness	0.0082 ***	0.0029
Fixed exchange Rate Dummy	-1.6647 ***	0.2089
Constant Term	0.0964	0.2397
No. of Observation	460	
Pseudo R^2	0.2938	
Common Support Region	[0.0199, 0.8575]	

Panel B: Developing Countries

	Coefficient	Standard Error
Inflation Rate	-0.1076 ***	0.0119
Real GDP Growth Rate	-0.0285 *	0.0160
Openness	0.0012	0.0012
Fixed Exchange Rate dummy	-1.4246 ***	0.1344
Constant term	0.1490	0.1639
No. of Observation	1329	
Pseudo R^2	0.2921	
Common Support Region	[0.0111, 0.5637]	

*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 4: Treatment Effects of Inflation Targeting

Panel A: Developed Countries

	1 Nearest-Neighbor Matching	3 Nearest-Neighbor Matching	Radius Matching *r=0.03*	Radius Matching *r=0.01*	Radius Matching *r=0.005*	Kernel Matching	Local Linear Regression Matching
Treatment Effect on Inflation							
ATT	-0.3041	-0.1828	0.0043	0.0841	0.0587	-0.0610	-0.2981
	[0.329]	[0.542]	[0.986]	[0.777]	[0.864]	[0.796]	[0.283]
Treatment Effect on Inflation Variability							
ATT	0.1057	-0.0328	0.0651	-0.0149	0.0496	0.0713	0.1207
	[0.440]	[0.811]	[0.527]	[0.950]	[0.724]	[0.376]	[0.271]
Treatment Effect on Output Growth							
ATT	0.2059	0.2900	0.3762	0.6822	0.6757*	0.2706	0.1927
	[0.574]	[0.378]	[0.146]	[0.136]	[0.079]	[0.280]	[0.656]
Treatment Effect on Growth Variability							
ATT	0.2412	0.0842	0.1754	0.1524	0.1517	0.1391	0.2249
	[0.145]	[0.560]	[0.218]	[0.239]	[0.421]	[0.280]	[0.335]
No. of Treated	103	103	95	82	69	103	103
No. of Control	291	291	291	291	291	291	291

Panel B: Developing Countries

	1 Nearest-Neighbor Matching	3 Nearest-Neighbor Matching	Radius Matching *r=0.03*	Radius Matching *r=0.01*	Radius Matching *r=0.005*	Kernel Matching	Local Linear Regression Matching
Treatment Effect on Inflation							
ATT	-4.0282***	-3.7615***	-3.5703***	-3.4506***	-3.4539***	-3.9864***	-3.8696***
	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Treatment Effect on Inflation Variability							
ATT	-3.0059***	-2.9540***	-2.8052***	-2.8206***	-2.7154***	-2.9403***	-3.0608***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Treatment Effect on Output Growth							
ATT	0.5205	0.3701	0.4232	0.4286	0.1295	0.3843	0.4709
	[0.465]	[0.529]	[0.306]	[0.387]	[0.799]	[0.321]	[0.225]
Treatment Effect on Growth Variability							
ATT	-1.4086***	-1.0621***	-1.0331***	-1.1370***	-1.1544***	-1.0672***	-1.0423***
	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
No. of Treated	109	109	109	107	102	109	109
No. of Control	786	786	786	786	786	786	786

Notes: We employ Gaussian kernel function with the bandwidth of 0.06 for kernel and local linear regression matching. p-values are in brackets.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 5a: Dynamic Treatment Effects of Inflation Targeting: Developed Countries

	1 Nearest-Neighbor Matching	3 Nearest-Neighbor Matching	Radius Matching			Kernel Matching	Local Linear Regression Matching
			r=0.03	*r=0.01*	*r=0.005*		
Treatment Effect on Inflation							
ATT_0	1.4812**	1.1707*	1.6309**	1.2209**	1.6862**	1.6489***	1.2762**
	[0.041]	[0.079]	[0.028]	[0.026]	[0.050]	[0.004]	[0.020]
ATT_1	-1.1758**	-0.9916**	-0.6402**	-0.6219*	-1.3348**	-0.5381*	-0.8525**
	[0.024]	[0.023]	[0.076]	[0.063]	[0.022]	[0.089]	[0.047]
ATT_2	-0.6266	-0.7995	-0.5571	-0.5202	-0.3677	-0.3850	-0.7103
	[0.478]	[0.390]	[0.322]	[0.445]	[0.599]	[0.494]	[0.632]
ATT_3	-0.8717	-1.2704	-1.0901	-0.7542	-0.5728	-1.0239	-1.2890
	[0.243]	[0.118]	[0.141]	[0.310]	[0.485]	[0.139]	[0.147]
ATT_4	-1.1632	-0.6261	-0.2679	-0.4208	-1.5222	-0.6496	-0.9803
	[0.289]	[0.439]	[0.567]	[0.695]	[0.364]	[0.227]	[0.274]
Treatment Effect on Inflation Variability							
ATT_0	0.6349	0.4168	0.5521	0.2647	0.5748	0.4853	0.4875
	[0.316]	[0.521]	[0.311]	[0.579]	[0.248]	[0.352]	[0.304]
ATT_1	0.6150**	0.6899**	0.6164**	0.6082***	0.6213***	0.6073**	0.6239**
	[0.022]	[0.029]	[0.031]	[0.005]	[0.001]	[0.031]	[0.041]
ATT_2	1.0134***	0.8369***	0.8837***	0.8705***	1.2194***	0.8400***	0.8885***
	[0.002]	[0.007]	[0.009]	[0.005]	[0.000]	[0.002]	[0.000]
ATT_3	0.0198	-0.1558	0.0573	-0.0722	-0.2705	0.1119	0.1580
	[0.949]	[0.722]	[0.658]	[0.896]	[0.614]	[0.562]	[0.387]
ATT_4	0.2215	-0.0930	-0.0265	0.2926	-0.4463	0.0907	0.1426
	[0.766]	[0.781]	[0.918]	[0.583]	[0.529]	[0.514]	[0.694]
Treatment Effect on Output Growth							
ATT_0	-1.3278	-1.4991	-1.2495	-1.2311	-0.9472	-1.4427	-1.3724
	[0.330]	[0.205]	[0.331]	[0.329]	[0.528]	[0.162]	[0.242]
ATT_1	-2.2457***	-1.5203***	-1.0104**	-1.2666**	-1.7439**	-1.1083**	-1.0912**
	[0.002]	[0.009]	[0.046]	[0.036]	[0.012]	[0.027]	[0.011]
ATT_2	-0.9588	-0.6187	-0.1649	0.0678	-0.0384	-0.4645	-0.5344
	[0.418]	[0.415]	[0.882]	[0.947]	[0.958]	[0.525]	[0.588]
ATT_3	1.3720	1.1096	1.0957	1.8926	2.3470	0.9550	0.8257
	[0.434]	[0.216]	[0.321]	[0.175]	[0.113]	[0.330]	[0.565]
ATT_4	1.3738	1.6860	2.1007	3.1284	2.7112	1.0231	0.9415
	[0.204]	[0.181]	[0.112]	[0.147]	[0.161]	[0.205]	[0.566]
Treatment Effect on Growth Variability							
ATT_0	-0.0887	-0.2284	0.0468	-0.0775	-0.0770	0.0031	0.1026
	[0.889]	[0.653]	[0.916]	[0.823]	[0.897]	[0.994]	[0.830]
ATT_1	0.6903**	0.5360**	0.6260***	0.6008***	1.0399***	0.6287***	0.7226***
	[0.040]	[0.045]	[0.003]	[0.002]	[0.008]	[0.003]	[0.005]
ATT_2	1.0967***	0.6879**	0.8417***	0.8194***	0.7976***	0.6334***	0.7719***
	[0.002]	[0.026]	[0.000]	[0.001]	[0.001]	[0.002]	[0.001]
ATT_3	0.7299	0.8423	0.8966	1.1533	0.9890	0.8034	0.8703
	[0.311]	[0.261]	[0.256]	[0.289]	[0.256]	[0.255]	[0.358]
ATT_4	0.4827	0.2440	0.4625	0.2621	0.2904	0.4898	0.6302
	[0.281]	[0.348]	[0.362]	[0.724]	[0.552]	[0.211]	[0.404]

Notes: See Table 4.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 5b: Dynamic Treatment Effects of Inflation Targeting: Developing Countries

	1 Nearest-Neighbor Matching	3 Nearest-Neighbor Matching	Radius Matching			Kernel Matching	Local Linear Regression Matching
			r=0.03	*r=0.01*	*r=0.005*		
Treatment Effect on Inflation							
ATT_0	0.2953	-2.0395	-2.4556***	-2.7952**	-1.4713	-2.6354**	-2.6654**
	[0.911]	[0.366]	[0.010]	[0.034]	[0.310]	[0.012]	[0.015]
ATT_1	-6.2250*	-4.7213**	-3.6739***	-4.6020**	-7.3195**	-3.8212***	-3.7588***
	[0.057]	[0.037]	[0.001]	[0.016]	[0.015]	[0.000]	[0.000]
ATT_2	-5.6261*	-2.7631	-3.5522***	-3.0603*	-2.4785	-3.4407***	-3.3200***
	[0.096]	[0.263]	[0.005]	[0.051]	[0.182]	[0.000]	[0.001]
ATT_3	-2.2516	-3.4126*	-3.0580***	-1.9428	-2.3352	-3.8301***	-3.7192***
	[0.366]	[0.063]	[0.002]	[0.110]	[0.233]	[0.000]	[0.000]
ATT_4	-5.3360	-5.1243**	-4.2098***	-4.5515***	-3.8823***	-4.2182***	-4.2890***
	[0.133]	[0.047]	[0.002]	[0.001]	[0.006]	[0.000]	[0.001]
Treatment Effect on Inflation Variability							
ATT_0	-0.9872	-1.3080	-2.0651***	-1.8204**	-1.3480	-2.0965***	-2.1758***
	[0.357]	[0.213]	[0.002]	[0.016]	[0.121]	[0.000]	[0.001]
ATT_1	-4.9884*	-3.4788*	-2.4261***	-3.4732**	-4.5129*	-2.2739***	-2.3585***
	[0.066]	[0.066]	[0.007]	[0.030]	[0.058]	[0.000]	[0.000]
ATT_2	-2.0886	-3.9564**	-3.2338***	-3.3503***	-3.8100**	-2.8432***	-3.0038***
	[0.412]	[0.041]	[0.000]	[0.006]	[0.033]	[0.000]	[0.000]
ATT_3	-2.0339*	-2.0570**	-2.7039***	-2.2799***	-1.8770***	-3.1127***	-3.1438***
	[0.051]	[0.013]	[0.000]	[0.000]	[0.008]	[0.000]	[0.000]
ATT_4	-2.9949	-3.1410**	-2.9007***	-2.8593***	-2.0661**	-3.0102***	-3.1903***
	[0.146]	[0.043]	[0.000]	[0.002]	[0.022]	[0.000]	[0.000]
Treatment Effect on Output Growth							
ATT_0	-2.3126	-2.5651	-2.4647**	-2.2333	-2.7066*	-2.6217**	-2.5445**
	[0.274]	[0.138]	[0.035]	[0.110]	[0.077]	[0.013]	[0.020]
ATT_1	-2.6803	-0.7776	0.2087	0.1382	0.2401	0.0367	0.0907
	[0.284]	[0.626]	[0.773]	[0.851]	[0.797]	[0.953]	[0.889]
ATT_2	-0.0893	-0.3624	0.4044	0.2677	-1.1835	0.1606	0.2440
	[0.958]	[0.806]	[0.587]	[0.819]	[0.220]	[0.810]	[0.730]
ATT_3	1.0111	0.6634	0.5150	-0.1099	0.7168	0.5135	0.5766
	[0.609]	[0.682]	[0.506]	[0.911]	[0.687]	[0.464]	[0.417]
ATT_4	1.0337	0.5917	0.4015	0.4804	0.3104	0.5061	0.5701
	[0.515]	[0.640]	[0.636]	[0.617]	[0.814]	[0.488]	[0.430]
Treatment Effect on Growth Variability							
ATT_0	1.0176	0.8505	0.7480	0.6246	0.5050	0.7736	0.8230
	[0.384]	[0.367]	[0.287]	[0.422]	[0.546]	[0.217]	[0.261]
ATT_1	-1.0994	-0.0186	-0.2463	-0.0049	-0.2226	-0.3731	-0.3882
	[0.336]	[0.983]	[0.679]	[0.994]	[0.774]	[0.533]	[0.487]
ATT_2	-0.6233	-0.5265	-0.5493	-0.8675	-0.9192*	-0.6972	-0.6630
	[0.341]	[0.393]	[0.377]	[0.140]	[0.071]	[0.292]	[0.304]
ATT_3	-1.3437**	-1.3127**	-1.1597***	-1.3123***	-1.3923**	-1.3660***	-1.3468***
	[0.029]	[0.014]	[0.000]	[0.000]	[0.014]	[0.000]	[0.000]
ATT_4	-2.2179*	-1.7724*	-1.5916***	-2.1251**	-2.0028*	-1.5468***	-1.5581***
	[0.072]	[0.052]	[0.001]	[0.027]	[0.091]	[0.000]	[0.000]

Notes: See Table 4.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 6a: Cumulative Treatment Effects of Inflation Targeting: Developed Countries

	1 Nearest-Neighbor Matching	3 Nearest-Neighbor Matching	Radius Matching			Kernel Matching	Local Linear Regression Matching
			r=0.03	*r=0.01*	*r=0.005*		
Treatment Effect on Inflation							
$\sum_0^1$ **ATT**	0.1526	0.1766	0.4953	0.2994	0.1756	0.5554	0.2118
	[0.815]	[0.759]	[0.345]	[0.615]	[0.814]	[0.174]	[0.710]
$\sum_0^2$ **ATT**	-0.1070	-0.1487	0.1445	0.0535	0.0126	0.2419	-0.0955
	[0.829]	[0.716]	[0.788]	[0.936]	[0.979]	[0.446]	[0.840]
$\sum_0^3$ **ATT**	-0.2982	-0.4291	-0.1641	-0.1328	-0.1224	-0.0745	-0.3939
	[0.216]	[0.317]	[0.663]	[0.826]	[0.792]	[0.823]	[0.305]
$\sum_0^4$ **ATT**	-0.4712	-0.4685	-0.1824	-0.1792	-0.3482	-0.1895	-0.5112
	[0.274]	[0.233]	[0.621]	[0.667]	[0.485]	[0.499]	[0.150]
$\sum_5^T$ **ATT**	-0.1981	-0.0015	0.1085	0.2442	0.3907	0.0205	-0.1629
	[0.640]	[0.997]	[0.695]	[0.436]	[0.420]	[0.938]	[0.597]
Treatment Effect on Inflation Variability							
$\sum_0^1$ **ATT**	0.6249*	0.5533*	0.5843**	0.4364*	0.5980*	0.5463**	0.5557**
	[0.086]	[0.087]	[0.038]	[0.082]	[0.076]	[0.029]	[0.031]
$\sum_0^2$ **ATT**	0.7544***	0.6479***	0.6841***	0.5667***	0.7845***	0.6442***	0.6666***
	[0.001]	[0.006]	[0.000]	[0.004]	[0.000]	[0.000]	[0.000]
$\sum_0^3$ **ATT**	0.5707**	0.4469**	0.5274***	0.4192**	0.5410**	0.5111***	0.5395***
	[0.016]	[0.015]	[0.004]	[0.023]	[0.024]	[0.001]	[0.001]
$\sum_0^4$ **ATT**	0.5009**	0.3389**	0.4296**	0.3044**	0.3817***	0.4271***	0.4601***
	[0.034]	[0.014]	[0.022]	[0.040]	[0.002]	[0.002]	[0.003]
$\sum_5^T$ **ATT**	-0.1451	-0.2689	-0.1379	-0.2091	-0.2212	-0.1545	-0.0947
	[0.341]	[0.124]	[0.201]	[0.247]	[0.368]	[0.147]	[0.444]
Treatment Effect on Output Growth							
$\sum_0^1$ **ATT**	-1.7868***	-1.5097**	-1.1300***	-1.2488**	-1.3456**	-1.2755**	-1.2318*
	[0.005]	[0.018]	[0.001]	[0.020]	[0.031]	[0.023]	[0.085]
$\sum_0^2$ **ATT**	-1.5108**	-1.2127**	-0.8083**	-0.8538**	-0.9534*	-1.0052**	-0.9993*
	[0.017]	[0.028]	[0.024]	[0.046]	[0.089]	[0.014]	[0.088]
$\sum_0^3$ **ATT**	-0.7901	-0.6321	-0.3322	-0.2200	-0.1917	-0.5151	-0.5430
	[0.245]	[0.381]	[0.364]	[0.666]	[0.724]	[0.296]	[0.385]
$\sum_0^4$ **ATT**	-0.3573	-0.1685	0.0970	0.3200	0.2764	-0.2074	-0.2461
	[0.521]	[0.745]	[0.830]	[0.562]	[0.636]	[0.604]	[0.708]
$\sum_5^T$ **ATT**	0.5636	0.5811	0.5318	0.9024	1.0015	0.5743	0.4714
	[0.308]	[0.257]	[0.258]	[0.125]	[0.118]	[0.114]	[0.248]
Treatment Effect on Growth Variability							
$\sum_0^1$ **ATT**	0.3007	0.1538	0.3364	0.2616	0.2594	0.3159	0.4126
	[0.384]	[0.627]	[0.118]	[0.445]	[0.407]	[0.136]	[0.208]
$\sum_0^2$ **ATT**	0.5661*	0.3318*	0.5048**	0.4290*	0.4208*	0.4217**	0.5324*
	[0.069]	[0.060]	[0.018]	[0.055]	[0.063]	[0.023]	[0.077]
$\sum_0^3$ **ATT**	0.6070**	0.4594**	0.6028**	0.5961**	0.5520**	0.5172***	0.6169**
	[0.034]	[0.040]	[0.043]	[0.015]	[0.033]	[0.002]	[0.035]
$\sum_0^4$ **ATT**	0.5822**	0.4163**	0.5780***	0.5422**	0.5098**	0.5117***	0.6195**
	[0.011]	[0.045]	[0.003]	[0.021]	[0.042]	[0.002]	[0.020]
$\sum_5^T$ **ATT**	0.0247	-0.1266	-0.0489	-0.0845	-0.1403	-0.0973	-0.0256
	[0.852]	[0.208]	[0.520]	[0.757]	[0.686]	[0.372]	[0.474]

Notes: See Table 4.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 6b: Cumulative Treatment Effects of Inflation Targeting: Developing Countries

	1 Nearest-Neighbor Matching	3 Nearest-Neighbor Matching	Radius Matching			Kernel Matching	Local Linear Regression Matching
			r=0.03	*r=0.01*	*r=0.005*		
Treatment Effect on Inflation							
$\sum_0^1$ **ATT**	-2.9648	-3.3804**	-3.0648***	-3.6986***	-4.3954***	-3.2283***	-3.2121***
	[0.205]	[0.035]	[0.000]	[0.001]	[0.010]	[0.000]	[0.000]
$\sum_0^2$ **ATT**	-3.8519*	-3.1746**	-3.2272***	-3.4858***	-3.7901**	-3.2991***	-3.2481***
	[0.071]	[0.025]	[0.000]	[0.000]	[0.016]	[0.001]	[0.000]
$\sum_0^3$ **ATT**	-3.4518**	-3.2341**	-3.1849***	-3.1001***	-3.4409***	-3.4319***	-3.3659***
	[0.021]	[0.015]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]
$\sum_0^4$ **ATT**	-3.8287**	-3.6122***	-3.3899***	-3.3722***	-3.5263***	-3.5891***	-3.5505***
	[0.018]	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$\sum_5^H$ **ATT**	-4.3230***	-3.9820***	-3.8367***	-3.5672***	-3.3416***	-4.5733***	-4.3411***
	[0.009]	[0.006]	[0.000]	[0.000]	[0.001]	[0.000]	[0.001]
Treatment Effect on Inflation Variability							
$\sum_0^1$ **ATT**	-2.9878**	-2.3934**	-2.2456***	-2.6468***	-2.9304**	-2.1852***	-2.2671***
	[0.023]	[0.030]	[0.000]	[0.006]	[0.033]	[0.000]	[0.000]
$\sum_0^2$ **ATT**	-2.6881*	-2.9144**	-2.5750***	-2.8813***	-3.2082***	-2.4046***	-2.5127***
	[0.053]	[0.013]	[0.000]	[0.000]	[0.009]	[0.000]	[0.000]
$\sum_0^3$ **ATT**	-2.5245**	-2.7001***	-2.6072***	-2.7310***	-2.8887***	-2.5816***	-2.6705***
	[0.019]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]	[0.000]
$\sum_0^4$ **ATT**	-2.6186***	-2.7883***	-2.6659***	-2.7550***	-2.7295***	-2.6673***	-2.7744***
	[0.009]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
$\sum_5^H$ **ATT**	-3.5780***	-3.1988***	-3.0111***	-2.9182***	-2.6937***	-3.3434***	-3.4839***
	[0.007]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Treatment Effect on Output Growth							
$\sum_0^1$ **ATT**	-2.4965	-1.6713	-1.1279	-1.0475	-1.2332	-1.2924	-1.2269
	[0.104]	[0.185]	[0.131]	[0.175]	[0.205]	[0.143]	[0.137]
$\sum_0^2$ **ATT**	-1.6941	-1.2350	-0.6171	-0.6091	-1.2175	-0.8081	-0.7365
	[0.210]	[0.169]	[0.302]	[0.347]	[0.120]	[0.172]	[0.124]
$\sum_0^3$ **ATT**	-1.0178	-0.7604	-0.3341	-0.4843	-0.7533	-0.4776	-0.4082
	[0.369]	[0.273]	[0.575]	[0.443]	[0.363]	[0.204]	[0.465]
$\sum_0^4$ **ATT**	-0.6074	-0.4900	-0.1869	-0.3034	-0.5474	-0.2809	-0.2126
	[0.498]	[0.517]	[0.694]	[0.556]	[0.397]	[0.526]	[0.619]
$\sum_5^H$ **ATT**	2.1870**	1.6407**	1.3248**	1.5181**	1.1789*	1.3671***	1.4807***
	[0.021]	[0.048]	[0.011]	[0.025]	[0.070]	[0.000]	[0.004]
Treatment Effect on Growth Variability							
$\sum_0^1$ **ATT**	-0.0409	0.4159	0.2508	0.3098	0.1411	0.2002	0.2173
	[0.958]	[0.547]	[0.566]	[0.581]	[0.815]	[0.707]	[0.598]
$\sum_0^2$ **ATT**	-0.2350	0.1017	-0.0158	-0.0826	-0.1936	-0.0989	-0.0760
	[0.651]	[0.830]	[0.969]	[0.839]	[0.645]	[0.850]	[0.878]
$\sum_0^3$ **ATT**	-0.5122	-0.2518	-0.3018	-0.3900	-0.4813	-0.4157	-0.3937
	[0.336]	[0.571]	[0.310]	[0.249]	[0.260]	[0.306]	[0.197]
$\sum_0^4$ **ATT**	-0.8533*	-0.5559	-0.5598*	-0.7153**	-0.7758*	-0.6419**	-0.6266**
	[0.058]	[0.136]	[0.065]	[0.039]	[0.064]	[0.016]	[0.034]
$\sum_5^H$ **ATT**	-2.2288***	-1.8100***	-1.7323***	-1.7646***	-1.7413***	-1.6956***	-1.6564***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Notes: See Table 4.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10 -percent significance level

Table 7: Inflation Rates of Targeters since Inflation Targeting Adoption

Panel A: Developed Countries

Targeting Countries	**Adoption Year**	t_0	t_1	t_2	t_3	t_4	t_{2007}
Australia	1993	1.81	1.89	4.63	2.61	0.25	2.33
Canada	1991	5.62	1.49	1.86	0.13	2.18	2.14
Iceland	2001	6.63	4.84	2.09	3.22	4.02	5.02
New Zealand	1990	6.09	2.61	0.98	1.31	1.75	2.37
Norway	2001	3.03	1.28	2.45	0.44	1.55	0.76
Sweden	1993	4.82	2.15	2.56	1.02	1.80	1.67
Switzerland	2000	1.55	0.98	0.64	0.63	0.80	0.73
United Kingdom	1992	4.29	2.49	2.07	2.62	2.44	2.34
Mean value		4.23	2.21	2.16	1.49	1.84	2.17

Panel B: Developing Countries

Targeting Countries	**Adoption Year**	t_0	t_1	t_2	t_3	t_4	t_{2007}
Brazil	1999	4.85	7.05	6.83	8.42	14.7	3.63
Chile	1999	3.33	3.84	3.56	2.48	2.81	4.40
Colombia	1999	10.8	9.22	7.96	6.34	7.13	5.54
Czech Republic	1998	10.6	2.25	3.82	4.69	1.81	2.80
Hungary	2001	9.22	5.26	4.63	6.78	3.55	7.93
Israel	1997	9.00	5.43	5.19	1.25	1.11	0.51
Korea	1998	7.51	0.81	2.25	4.06	2.76	2.53
Mexico	2001	6.36	5.03	4.54	4.68	3.98	3.96
Peru	2002	0.19	2.25	3.33	1.62	2.00	1.78
Philippines	2002	2.94	3.47	5.97	7.65	6.23	2.8
Poland	1999	7.3	10.1	5.5	1.9	0.8	2.49
South Africa	2000	5.37	5.7	9.17	5.80	1.39	7.09
Thailand	2000	1.55	1.66	0.63	1.80	2.76	2.22
Mean value		6.07	4.77	4.87	4.42	3.92	3.66

Notes: t_0, t_1, t_2, t_3, **and** t_4 denote the adoption year and four years after, t_{2007} equals the year of 2007.

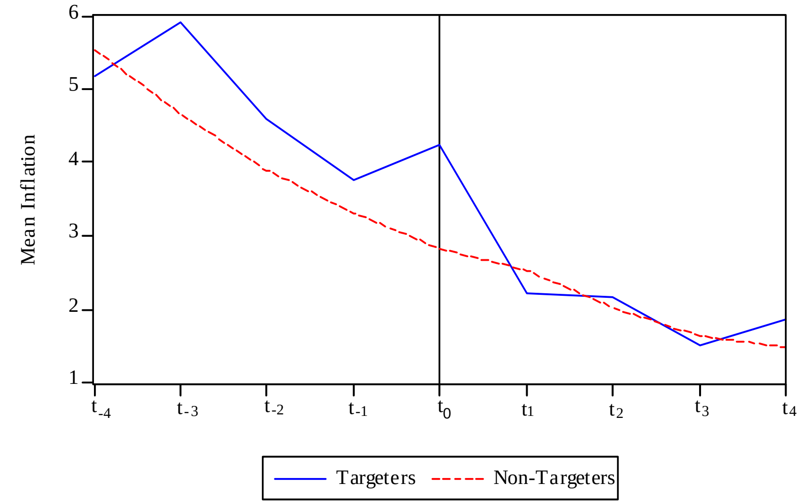

Figure 1a: Inflation Trajectory for Targeters and Non-Targeters: Developed Countries

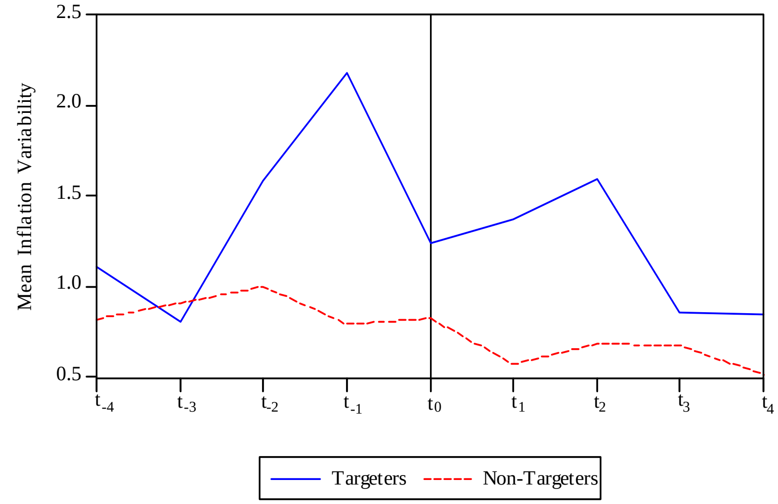

Figure 2a: Inflation Variability Trajectory for Targeters and Non-Targeters: Developed Countries

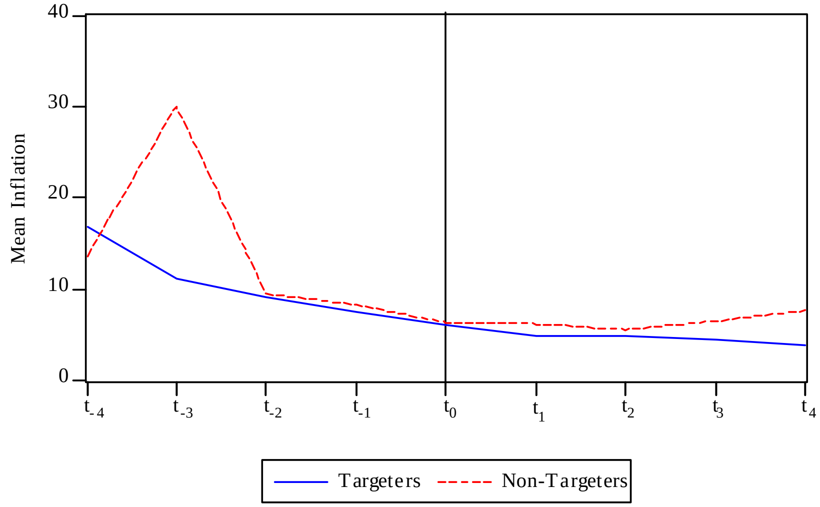

Figure 1b: Inflation Trajectory for Targeters and Non-Targeters: Developing Countries

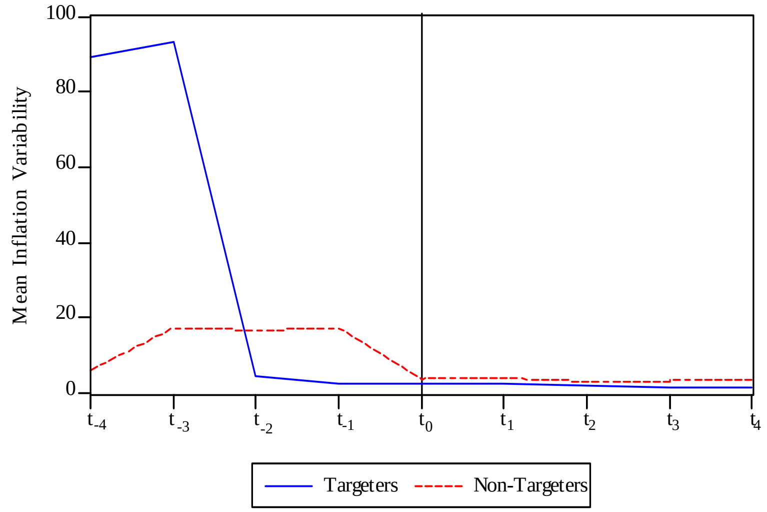

Figure 2b: Inflation Variability Trajectory for Targeters and Non-Targeters: Developing Countries

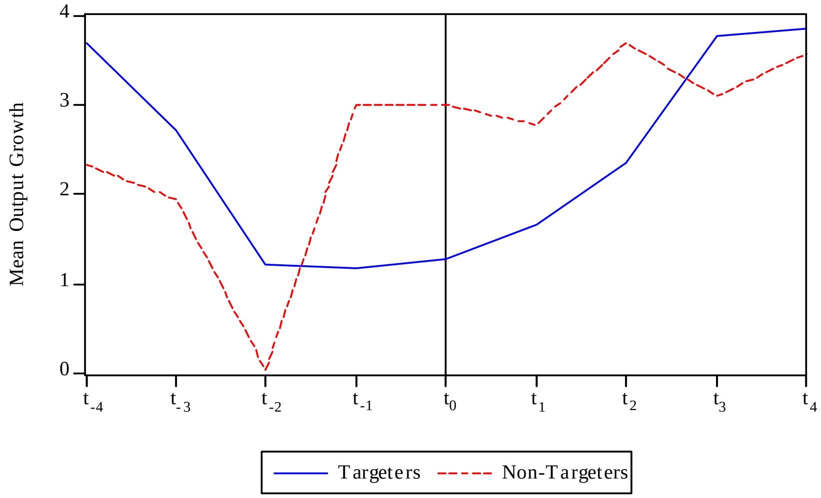

Figure 3a: Output Growth Trajectory for Targeters and Non-Targeters: Developed Countries

Figure 4a: Growth Variability Trajectory for Targeters and Non-Targeters: Developed Countries

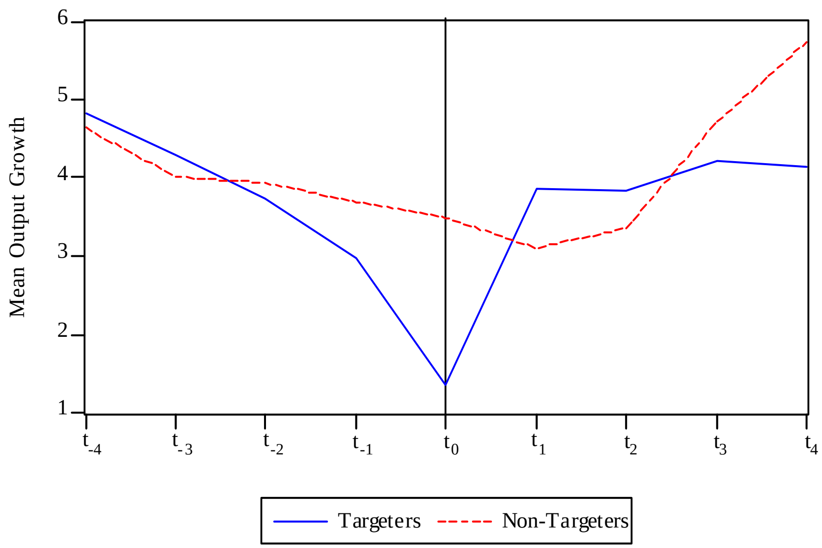

Figure 3b: Output Growth Trajectory for Targeters and Non-Targeters: Developing Countries

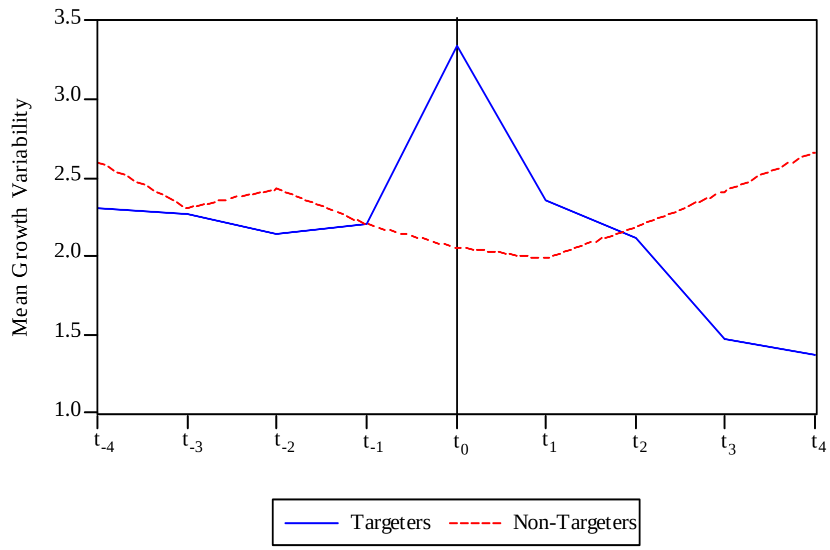

Figure 4b: Growth Variability Trajectory for Targeters and Non-Targeters: Developing Countries

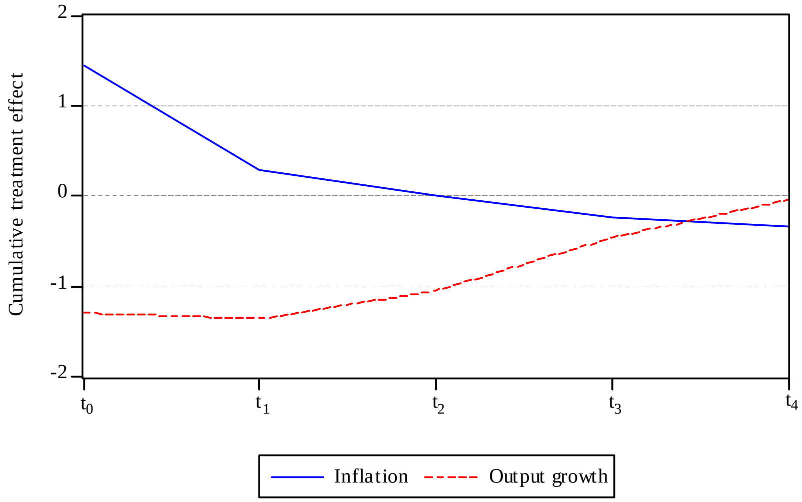

Figure 5a: Cumulative Trajectory for Inflation and Output Growth: Developed Countries

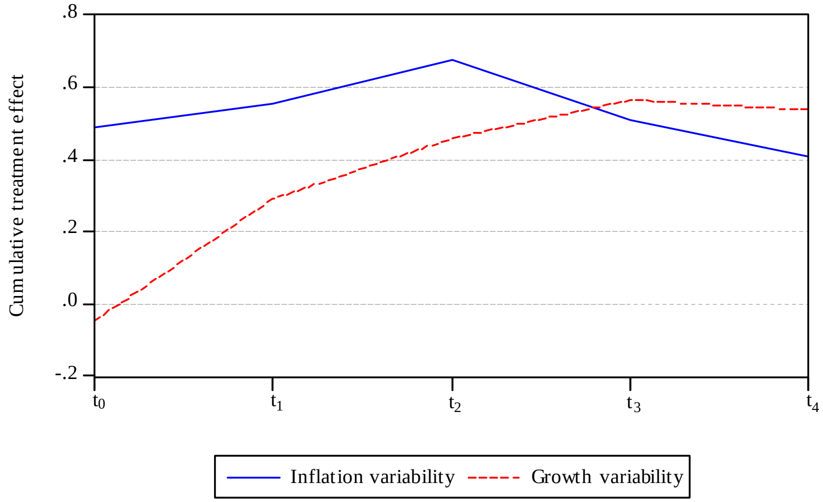

Figure 6a: Cumulative Trajectory for Inflation Variability and Growth Variability: Developed Countries

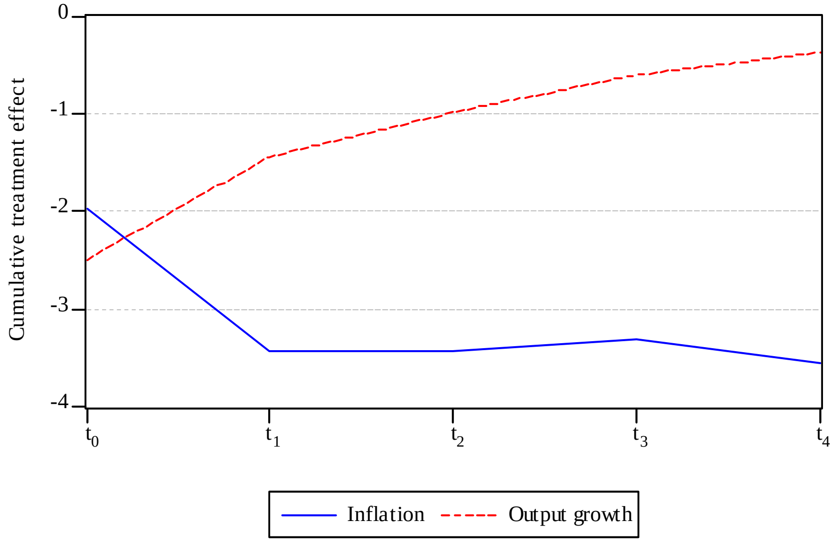

Figure 5b: Cumulative Trajectory for Inflation and Output Growth: Developing Countries

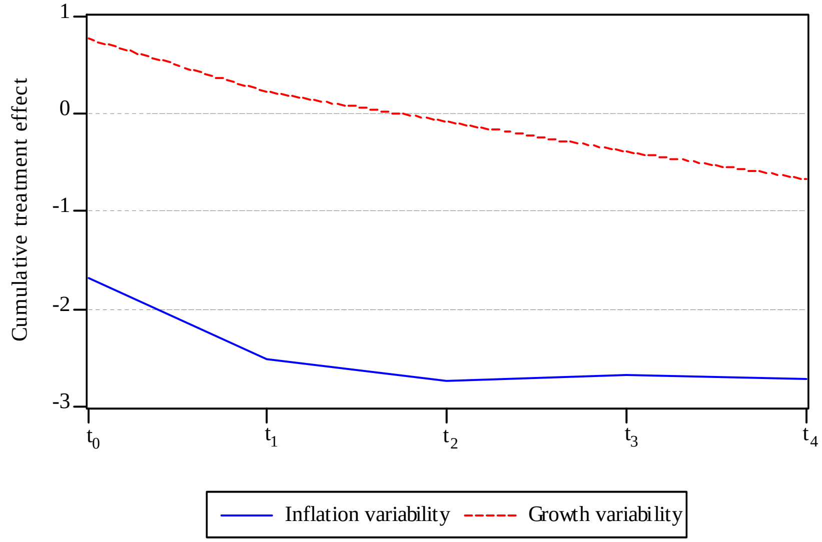

Figure 6b: Cumulative Trajectory for Inflation Variability and Growth Variability: Developing Countries