Short- and Long-Run Differences in the Treatment Effects of Inflation Targeting on Developed and Developing Countries

WenShwo Fang  
Department of Economics  
Feng Chia University

Stephen M. Miller*  
Department of Economics  
University of Nevada, Las Vegas  
Las Vegas, Nevada, U.S.A. 89154-6005  
stephen.miller@unlv.edu

ChunShen Lee  
Department of Economics  
Feng Chia University

Abstract

Allowing for time-varying treatment effects, this paper provides new findings on the effects of inflation targeting on economic performance over time. First, developed countries lower inflation and reach their targets rapidly in two years and developing countries reduce inflation gradually in that disinflation still continues moving to their long-run targets. 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 significant effects occur in the 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 and long-run. Output growth catches up in a longer time horizon, although this effect is not significant. The paper discusses the interpretations of our empirical findings and the implications for monetary policy.

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

JEL classification: C52; E52, E58

* Corresponding author
1. Introduction

Recently, an increasing number of central banks have adopted inflation targeting (IT) as their monetary policy control mechanism, since New Zealand adopted this policy in 1990. Today 26 countries use IT, about two third of them developing countries (see Table 1). 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; Gonçalves and Salles, 2008; Svensson, 2009; and Brito and Bystedt, 2010).

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

Macro and monetary economists have long argued that monetary policy affects prices with a lag. In earlier studies, Friedman (1961, 1972) and Friedman and Schwartz (1982) find that prices respond to monetary changes over a long time period in the US and the UK. Friedman and Schwartz (1982, p. 412) 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. This result persists despite changes in monetary policy arrangements in the two countries.

Svensson (1999, 2010) suggests flexible IT, where the central bank strives not only to
stabilize inflation around the inflation target but also to stabilize the real economy. Time plays a crucial role in a flexible IT 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). 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 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 IT countries cannot place too much emphasis on inflation, potentially at the expense of economic recovery.

IT policy garners limited support based on evidence from developed countries. Ball and Sheridan (2005) employ cross-section difference-in-difference ordinary least squares estimation to compare economic improvements in seven OECD targeting countries to the improvements in thirteen OECD non-targeting countries. They discover that after countries adopt IT, the level and variability of inflation and output growth of these countries do improve. Non-targeting countries, however, also experience these improvements around the same time. They argue that better
economic performance reflects factors other than the monetary regime and conclude that IT does not produce a major effect. In other words, IT is irrelevant. Based on Markov-switching estimates, Dueker and Fischer (1996, 2006) provide comparative analysis for six developed countries (Australia, Canada, Germany, New Zealand, the UK and the US) and conclude that no clear evidence supports different inflation performance between targeters and non-targeters.

Lin and Ye (2007) use the propensity score matching method to evaluate the treatment effects, if any, from adopting IT in seven industrial countries with a control set of 15 non-inflation targeting (NIT) industrial countries. They show no significant effects on inflation and its variability, supporting the window-dressing view of IT. Walsh (2009) uses the same method and sample data as Lin and Ye (2007), finding that IT does not significantly affect output growth or its variability. Angeriz and Arestis (2008), employing intervention analysis, find lower inflation rates for both targeting and non-targeting countries. Gonçalves and Carvalho (2009), however, show that IT OECD countries suffer smaller output losses in terms of sacrifice ratio during the disinflationary period than non-targeting counterparts.

Vega and Winkelried (2005) apply matching methods to evaluate treatment effects of IT for 109 developed and developing countries jointly, and find that IT countries reduce the level and volatility of inflation. Batini and Laxton (BL, 2007) and Gonçalves and Salles (GS, 2008) apply the same method of Ball and Sheridan (2005) to test whether the adoption of IT affects inflation and output growth of 42 and 36 developing countries, respectively, both including 13 IT countries. They show that IT countries lower average inflation (BL and GS), inflation volatility (BL), and output growth volatility (GS) relatively more than NIT countries. Lin and Ye (2009) extend their propensity score matching model for developed countries to evaluate the IT treatment effect in a sample of 52 developing countries and discover that IT significantly lowers
inflation and its variability. Brito and Bystedt (2010) use panel data analysis for 46 developing countries, showing that IT lowers inflation, but at the cost of lower output growth. Additionally, neither a reduction of inflation volatility nor of output growth volatility proves significant.

The empirical findings produce mixed evidence in economic performance for developed and developing countries. Different methodologies may lead to different findings that are difficult to compare directly. Since time lags in the effect of monetary policy generally imply different effects at different times after policy adoption, ignoring such effects, we argue, may contribute to the mixed conclusions in the existing literature. Also, developed and developing countries may exhibit different time profiles when adopting IT due to different fiscal, financial, and monetary institutions with different inflation histories. This paper compares the effects of IT on inflation and output growth in eight developed countries to thirteen developing countries, addressing intertemporal, short-run, and long-run treatment effects. The analysis also uses 12 NIT major developed economies in the OECD and 55 NIT developing countries in the non-treated control groups, respectively. The propensity scoring exercise sheds light on different effects of IT over time in developed and developing countries.

We report new findings. First, IT lowers inflation rates for all the targeting countries. This effect decays and becomes insignificant in the short run in developed countries, but remains significant in developing countries. Second, short-run costs emerge in reduced output growth as well as increased inflation and output growth variabilities in developed countries, but no such costs occur in developing countries. Third, while the short-run costs disappear over time in developed countries, inflation, inflation variability, and output growth variability remain lower from the short-run to the long-run in developing countries. Further, output growth does not significantly change in the short- or long-run for developing countries. Developing countries
gain more from IT 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 IT policy over time. Section 3 discusses the data and performs some preliminary (long-run) 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 IT through time-varying treatment effects on the level and variability of inflation and output growth. Consider the average treatment effect on the treated (ATT) of IT that depends on the following equation:

$$ATT = E[Y_{it} | D_i = 1] - E[Y_{it} | D_i = 0],$$

where $D_i = 1$ ($= 0$) denotes the treatment (non-treatment) state or country $i$ adopts (does not adopt) IT. Thus, $(Y_{it} | D_i = 1)$ equals the value of the outcome (e.g., the inflation rate) actually observed in the targeting country and $(Y_{it} | D_i = 0)$ 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 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. This specification provides no room for a lag effect when implementing the targeting policy or for differing magnitudes of effects over time. This second issue provides the major impetus for this paper.

The existing literature developed the propensity score matching methods to address the first issue.¹ The matching method chooses a non-targeting control group of countries to mimic a

¹ Caliendo and Kopeinig (2008) provide an excellent review and practical guide for implementing the matching estimator.
randomized experiment to reduce the bias in the estimation of the treatment effects with observational data sets. Empirically, studies replace \( E[Y_{i0} | D_i = 1] \) with \( E[Y_{i0} | D_i = 0, X] \), which is observable. That is, under the conditional independence assumption, the \( i^{th} \) country's outcome (the inflation rate, \( Y_{i1} \) or \( Y_{i0} \)) does not depend on the targeting policy chosen conditional on a set of explanatory variables \( (X) \). Rosenbaum and Rubin (1983) propose probit (or logit) models to estimate propensity scores, which measure the probabilities that countries \( i \) and \( j \) adopt IT policy, given \( X \), to match the targeting countries \( (i) \) and control countries \( (j) \). In the selection process, the common support condition, \( P(D = 1 | X) < 1 \), holds to ensure that analogous non-treatment units exist to compare with the treated ones.

Using propensity score matching, Lin and Ye (2007, 2009) and Walsh (2009) estimate the \( ATT \) of equation (1) as follows:

\[
ATT = \frac{1}{N} \sum_{i} \left( Y_i - \sum_{j \in S_p} w(p_i, p_j)Y_j \right), \tag{2}
\]

where \( p_i \) and \( p_j \) equal the propensity scores for observation \( i \) in the targeting group and \( j \) in the control group, respectively. \( N \) is the number of observations of the targeting group in the sample. \( S_p \) is the region of common support. \( w(p_i, p_j) \) is the weight given to observation \( j \) when matched to observation \( i \). This specification measures the long-run \( ATT \) during IT.

The second issue motivates the estimation of the \( ATT \) immediately after the policy adoption. This estimation strategy relies on Olley and Pakes (1996) and De Loecker (2007). That is, we modify equation (2) to get at the \( ATT \) at every time \( t \) as follows:

\[
ATT_t = \frac{1}{N_t} \sum_{i} \left( Y_{it} - \sum_{j \in S_p} w(p_i, p_j)Y_{jt} \right), \tag{3}
\]
where \( t = \{1, 2, 3, 4\} \) denotes the four years after the policy adoption.\(^2\)

We also estimate the cumulative average treatment effect over a period as follows:

\[
ATT_T = \frac{1}{N_T} \sum_i \left[ \sum_{t=1}^{T} Y_{it} - \sum_{t=1}^{T} \sum_{j \in S_t} w(p_i, p_j) Y_{jt} \right].
\]

where \( t = \{1, \ldots, T\} \). This estimator provides an effect of IT in a short-run (e.g., the first four years or less) or a medium to the long-run time frame.

Different matching algorithms produce different weights for the matching estimator and, thus, different results for the \( ATTs \). We apply four commonly used matching methods -- nearest neighbor matching, caliper matching, kernel matching, and local-linear matching techniques, programmed by Leuven and Sianesi (2003), to obtain results. Caliendo and Kopeinig (2008) provide detailed discussion for the four matching methods. 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.

---

\(^2\) 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.
3. Data and preliminary analysis

3.1. Data description

We use annual observations from 20 developed countries in the OECD and 68 developing countries over the years 1985 to 2007. The developed countries include 8 IT countries – Australia, Canada, Iceland, New Zealand, Norway, Sweden, Switzerland, and the UK -- and 12 NIT countries. The developing countries include 13 IT countries – Brazil, Chile, Columbia, the Czech Republic, Hungary, Israel, Korea, Mexico, Peru, the Philippines, Poland, South Africa, and Thailand -- and 55 NIT countries. Table 1 lists the targeting countries, their policy adoption years and targets, as well as the NIT control countries for the developed and developing countries in Panels A and B, respectively.

The numerical inflation target in developed countries typically reflects an annual 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 UK). All targets range between zero and three percent. The average of their mid-points equals 2.19 percent. The annual CPI inflation target in developing countries conforms to either a range or a point target with a range. Target ranges generally exceed those for developed countries in level and/or range (dispersion). The

---

3 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 IT countries in our developing country sample. We also exclude Finland and Spain, even though they adopted IT 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).

4 We exclude five countries that adopt IT 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 IT for developing countries.

5 The adoption years and targets of the IT countries come from International Monetary Fund (2005), except for the five developing countries adopting IT after 2005. They come from the Central Bank of Iceland (2007).
average of their mid-points equals 3.37 percent, much higher than the 2.19 percent for developed countries.

In this study, while inflation equals the annual percent change of the CPI, inflation 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 (developing) countries, each of the data sets contains 460 (1,329) observations, of which 103 (109) belong to the treated group and 357 (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.

Table 2 presents the mean values of inflation (variability) and output growth (variability) for the full-sample, the pre- and post-IT periods of the targeters as well as the t-statistics testing for equal means between each of the two sub-samples. For developed countries, the 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 t-statistic (=5.98) testing for equality of the pre- and post-IT inflation means suggests a significant decline at the 1-percent level. For developing countries, the average inflation rate falls significantly from 148.81 percent in the pre-IT period 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. The other outcomes, inflation and output growth variability significantly moderate for all targeters. The output growth rate increases significantly for developed countries; increases, but insignificantly, for developing countries.
Two facts are worth noting. First, 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. Second, the low and high inflation rates in the pre-IT period for developed and developing countries may imply different motivations for countries who adopt IT. Walsh (2009) argues that the OECD developed countries who adopt IT do so because they cannot match the inflation improvements of other OECD developed countries, such as the US. Developing countries tell another story. 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. Abnormally high inflation, thus, motivates developing countries to adopt IT to lower their inflation rates, as argued by Neumann and von Hagen (2002) and Mishkin and Schmidt-Hebbel (2007a).

The improvement in macroeconomic performance for targeters, however, also appears in the data for the NIT countries, as first noted by Ball and Sheridan (2005). Figures 1 and 2 plot the time series of mean inflation and output growth rates for our 88 developed and developing countries, divided into three groups: the non-targeters, and pre- and post-IT periods for the targeters. Figure 1a makes obvious the stylized fact that developed countries reduced the high inflation rates in the late eighties. Starting in the early nineties and overlapping with the IT adoption, inflation rates kept falling among both targeters and non-targeters without much difference. This makes clear that comparisons of IT effectiveness in our sample are valid: both the treated and control groups of countries experience similar disinflation processes during the IT era. Figure 1b shows that developing countries lowered sharply their very high inflation rates in the early nineties. Although targeters suffered from higher inflation levels than non-targeters up to the early nineties, the former group reached the mid-nineties, before IT adoption, with lower
average rates than the latter. Targeters experienced a monotonic decline in inflation more than ten years to the end of our sample. Non-targeters exhibit a spike in inflation in 1997 and a small upturn in the 2003 and 2004. The visible inflation gap (more than 3-percent) between the targeters and non-targeters after the policy adoption may suggest different effects of IT in developing countries, as compared with developed countries. Figures 2a and 2b show that the mean output growth rates experienced much volatility in general and after 2000 developed country targeters grew slightly more quickly. Developing country targeters grew slightly less quickly, however.

More information emerges from Figure 1 that can assist in policy evaluation. First, the pattern that the higher inflation suffered by targeters in the pre-IT period, particularly for developing countries, provides a cautionary note that between-group comparisons of their post-pre-IT inflation differences might cause a bias in favor of IT’ effectiveness. We use the matching method to overcome this issue. Second, when countries perform differently before they adopt IT, they may actually also perform differently after the policy adoption. Therefore, we do not expect developed countries to derive important economic gains from their IT adoption, since they did not suffer from severe inflation problems or other destabilizing macroeconomic disturbances. We do expect compliance with IT to prove more important for the performance of developing, rather than developed, countries. We check whether our dynamic ATT estimates differ in developed and developing countries.

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 IT 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 IT 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. The dependent variable takes on the value 1 in the years in which the country adopts IT, 0 otherwise.

Table 3 reports 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. First, the central bank’s fear of losing public credibility causes them to adopt IT 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 an IT monetary framework. Third, a strong fiscal position enhances the probability of adopting IT. Conversely, when the central bank must finance a large fiscal deficit, IT becomes problematic. Fourth, greater openness to trade reduces the vulnerability of economies to external disturbances. Consequently, such countries can more easily adopt IT along with a floating exchange rate regime. That is, a floating exchange rate regime provides the flexibility for an IT monetary policy.

---

6 We use the exchange rate classification proposed by Reinhart and Rogoff (2004) and Ilzetzki, Reinhart, and 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, we do not try to build a statistical model to explain the choice of IT policy in the best possible way.
This probit regression achieves a reasonable overall fit with pseudo-$R^2$ of 0.29 for both developed and developing country models. The common support region shows that the estimated propensity scores fall between 0.02 and 0.86 and between 0.01 and 0.56 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 either fall below the lowest score or lie above the highest score 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 (four) covariates used in the probit model do not differ significantly between the two groups.

Table 4 reports the estimated ATTs 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 IT 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 IT sample countries and a much longer sample period, generally, than these authors, 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). Different developed targeting countries and sample periods do not influence

---

7 Both Lin and Ye (2007) and Walsh (2009) evaluate the treatment effect of IT in seven industrial countries –
much of the \textit{ATTs} under different matching methods and the window-dressing view of IT.

Panel B of Table 4 reports the findings for developing countries. Consistent with the findings of Lin and Ye (2009), the estimation results for developing countries suggest that IT significantly lowers the inflation rate and its variability. In addition, we find that IT also significantly lowers the variability of the growth rate, but does not significantly affect the growth rate itself.

The ineffectiveness of IT for developed countries generally reflects a long-run average effect. Does it mean that IT does not matter? How long is the long-run (short-run)? No theory gives a definite answer, suggesting that the answer is a purely empirical issue. Developed and developing countries probably need different times to achieve their respective targets. When evaluating IT, 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, our specifications of equations (3) and (4) test whether inflation and output growth (and their variabilities) change in four consecutive years right after adopting the inflation target, and then to the end of our sample. The next section presents the estimation results of the intertemporal and cumulative \textit{ATTs} for developed and developing countries.

\footnote{Australia, Canada, Finland, New Zealand, Spain, Sweden, and UK -- that adopted this policy in the 1990s for the years 1985 to 1999. As noted in Footnote 3, Finland and Spain adopted IT in 1993 and 1995, respectively, and both adopted the Euro in 1999. We replace the two countries with Iceland, Norway, and Switzerland, who adopted IT in the early 2000s (see Table 1). We evaluate the treatment effect of IT in eight industrial countries over a much longer period 1985 to 2007.
4. Dynamic treatment effects of inflation targeting

4.1 Intertemporal treatment effects

Table 5a and 5b present intertemporal $ATT$ estimates from the first year ($ATT_1$) to the fourth year ($ATT_4$) after the adoption, reflecting how IT affects inflation, inflation variability, output growth, and growth variability with lagged effects under the seven different matching algorithms. The results are consistent and robust.

4.1.1 Developed country findings

For the treatment effect on inflation, a significant negative effect emerges in the first year after adoption. The estimated $ATT_1$s range from -0.54 percent to -1.33 percent. Targeting countries become, on average, -0.88 percent less inflationary in the first year. The inflation gap shrinks in the second year and widens in the third year, although none of these effects are significant. The $ATT_4$ becomes volatile across different matching methods. They are negative, but insignificantly estimated. The evidence from matching suggests that IT lowers inflation in the first year after the policy adoption.

The treatment effect on inflation variability increases significantly in the seven matching methods in the first year after adoption ($ATT_1$). A robust, narrow range of the seven estimates falls between 0.61 and 0.69. In the second year, the inflation variability gap ($ATT_2$) becomes even larger in magnitude and more significant. In the third and the fourth year, the estimated $ATT_3$ and $ATT_4$ fall to small levels quantitatively, nearly half negative, although none prove significant. Thus, no beneficial effect of IT emerges for inflation rate variability.

Conceptually, under an IT framework, the central bank places increased weight on inflation stabilization and reduced weight on 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 output cost of disinflation 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. Gonçalves and Carvalho (2009) show that inflation targeters suffer smaller output losses during disinflations when compared to non-targeters. Benhabib and Spiegel (2009) provide long-term evidence of a threshold effect for the relationship between inflation and output growth. That is, for inflation rates under (above) 3.23%, the correlation between inflation and output growth is positive (negative).

We follow the same procedures to evaluate the treatment effect on output growth. 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, where the negative output growth rate falls (-0.39 percent, on average), but the decrease is insignificant. 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 (2002) observe that while the variability of inflation falls more in the IT 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 IT 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 IT and NIT countries, the ratio in the NIT countries exceeds that in the IT countries.

The variability increases sharply in the first two years after IT begins. All $ATT_1$ 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. The $ATT_2$ 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, we find positive, but insignificant, effects.

Thus, 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 IT. That is, both inflation and output growth variability increase in the short run with IT. That shift disappears in a
significant sense in the following years.

4.1.2 Developing country findings

IT decreases the inflation rate significantly in all four future periods considered for developing countries employing radius matching (r=0.03), kernel matching, and local linear regression matching. The average of the estimated treatment effects range from -3.44 percent of \( ATT_2 \) in the second year to -4.24 percent of \( ATT_4 \) 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 \( ATT_4 \). The 1- and 3- nearest neighbor matching and the radius matching (r=0.01 and 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 \( ATT_4 \). Significant and large lagged effects of IT on inflation emerge in developing countries as compared to the effects in developed countries reported in Table 5a.

IT significantly decreases the inflation rate variability in the four years after adoption, except the 1-nearest neighbor matching. The average \( ATT_i \)s ranges from -2.46 percent of \( ATT_3 \) to -3.36 percent of \( ATT_1 \). The 1-nearest neighbor matching always achieves a negative effect, which frequently achieve significance. Again, long time-lag effects exist. 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, in the first two years after adoption, this monetary policy 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, IT significantly lowers output growth variability and the largest effect occurs in the fourth year for \( ATT_4 \) across all matching methods. These findings suggest that no cost, only benefit but with time lags, for developing countries
who adopt IT.

Therefore, 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 IT since both inflation and output growth variabilities decrease with IT.

4.2 Cumulative treatment effects

Table 6a and 6b report cumulative treatment effects of IT for developed and developing countries, where $\sum_{t=2}^{4} \text{ATT}$ equals a cumulative treatment effect taking from the first year to the $t^{th}$ year, and $\sum_{5}^{T} \text{ATT}$ equals the cumulative effect from the fifth year to the end of our sample.

4.2.1 Developed country findings

The cumulative treatment effect on inflation is negative across the seven matching methods when we accumulate across the first year and the next three years after adoption ($\sum_{2}^{4} \text{ATT}$, $\sum_{3}^{4} \text{ATT}$, and $\sum_{4}^{4} \text{ATT}$) and eventually becomes positive in some cases at the end of our sample ($\sum_{5}^{T} \text{ATT}$). Significant effect of IT on inflation generally occurs in the first three years ($\sum_{2}^{2} \text{ATT}$ and $\sum_{3}^{3} \text{ATT}$), and insignificant from the fifth year to the last year in our sample ($\sum_{5}^{T} \text{ATT}$). The cost of IT emerges significantly in higher inflation variability ($\sum_{2}^{2} \text{ATT}$, $\sum_{3}^{3} \text{ATT}$, and $\sum_{4}^{4} \text{ATT}$), lower output growth ($\sum_{3}^{3} \text{ATT}$), and higher growth variability ($\sum_{2}^{2} \text{ATT}$, $\sum_{3}^{3} \text{ATT}$, and $\sum_{4}^{4} \text{ATT}$) in the four-year short period. Cumulative output growth becomes positive and the inflation rate and output growth rate variability generally become negative in the medium to long term ($\sum_{5}^{T} \text{ATT}$). These effects are not significant, however. Thus, adopting IT leads to lower inflation with higher inflation and output growth variabilities as well as lower output growth in the short-run. IT developed countries gain, but with pain. In a longer horizon, we see no significant differences in the economic performances of the targeters and non-targeters. Or we find no evidence that the
Taylor tradeoff between output growth and inflation rate variabilities shifts permanently.

4.2.2 Developing country findings

The cumulative treatment effects on inflation and its variability are significantly negative in all cases in the four-year short-run (\( \Sigma^2_{\text{ATT}} \), \( \Sigma^3_{\text{ATT}} \), and \( \Sigma^4_{\text{ATT}} \)) and remains significantly negative at the end of our sample (\( \Sigma^5_{\text{ATT}} \)). Therefore, IT is effective and successful for developing countries. The cumulative treatment effects on output growth and its variability in the short-run are insignificant for the former, and negative and significant for the latter in the periods of \( \Sigma^3_{\text{ATT}} \), and \( \Sigma^4_{\text{ATT}} \). Then the output growth effect becomes positive with no significance and the negative variability effect increases its size significantly at the end of our sample (\( \Sigma^5_{\text{ATT}} \)). The output cost of IT appears trivial in the short-run, and benefit emerges significantly in much lower output growth variability in the medium to long term. In sum, IT countries lower inflation with lower inflation variability as well as lower output growth variability than their matched counterparts that do not adopt inflation targeting along with insignificant impact on output growth in the short-run. Developing countries adopting IT gain without cost. In a longer horizon, targeters do better for all the four outcomes, although the improved output growth is not significant. We, therefore, find evidence that the Taylor tradeoff between output growth and inflation rate variabilities shifts permanently in a favorable direction toward lower variabilities of both measures.

4.3 Remark

Our estimated treatment effects explain well the inflation trajectories in Figure 1a,b, suggesting that our econometric specifications used to evaluate IT for developed and developing countries are appropriately modeled. To illustrate, we report the inflation rates of targeters in the four years after the policy adoption, the end year of our sample, and their mean values in Table 7. For
developed-country targeters, 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 (= 2.17), which is slightly higher than the mean inflation rate (= 2.03) for non-targeters in 2007. The insignificant ATT estimate in Table 4 generally reflects the fact that no substantial difference in the inflation rates between the targeters and non-targeters in the post-IT period, particularly after 2000 in Figure 1a. Significant ATT estimates in Table 6a reflect the lower inflation rates in the few years immediately after the policy adoption. For developing-country targeters, 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), which still exceeds the average of the mid-points of the targeted rate (=3.37), but much less than the mean inflation rate (=7.01) for non-targeters in 2007. The ATT estimates in Tables 4 and 6b demonstrate exactly the path of the inflation rates in the post-IT period in Figure 1b: the above three-percent significant treatment effect corresponds to the distance of the inflation difference between targeters and non-targeters in both a short and longer time horizons.

4.4 Discussion

Several reasons may explain why other studies do or do not find significant effects of IT on inflation and its variability or output and its variability. First, and most obvious, the specific countries examined influence the outcomes. On the one hand, 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 IT brings the inflation rate and its variability down or affects the output growth rate and its variability. On the other hand, Gonçalves and Salles (2008) and Lin and Ye (2009) find that developing countries can significantly lower both the inflation rate and its variability by adopting IT. These differences may reflect different inflation
performances and, therefore, the motivation to adopt this monetary policy in developed and developing countries. In Table 2, developed countries experience much lower mean inflation rate (variability) than developing countries in the full sample and the pre-IT period. Since the monetary authorities choose IT to maintain their already low inflation rates or to converge to a lower rate, rather than to squeeze high inflation rates down, researchers find no significant effects for developed countries. Figure 1a illustrates this view. The OECD developed countries who adopt IT generally match the inflation performance of other OECD developed countries. In contrast, studies find significant negative effects for developing countries, where policy attempts to reduce a high inflation rate to achieve real results of lower inflation. Figure 1b corresponds to this argument. The developing country targeters consistency experience better inflation performance than their non-targeter partners.

Second, different time horizons may lead to different findings. Lin and Ye (2007) and Walsh (2009) use a long sample of data (15 years from 1985 to 1999) to evaluate IT and find no significant effects for seven developed countries in the OECD. Lin and Ye (2009), on the other hand, use a long sample of data (21 years from 1985 to 2005) and find significant effects for thirteen developing countries. We report similar findings in Table 4 over an even longer period (23 years from 1985 to 2007) for both developed and developing countries. Our methodology mainly checks whether the outcome trajectory differs in a short period of 4 years following the adoption of IT for eight developed and thirteen developing countries. Considering the lagged effects of this monetary policy, we show that for developed-country targeters, the inflation gain, output growth loss, and the inflation and output growth rate variabilities increase come in the years after the initial targeting. These three costs of disinflation disappear over time (see Tables 5a and 6a), suggesting that the effects of IT are short-lived. A different story emerges, however,
for developing countries. Now, we show that for developing-country targeters, the inflation gain in the four-year short-run and the medium term occurs without output cost, and the inflation and output growth rate variabilities decrease in the short-run as well as the medium term (see Tables 5b and 6b), suggesting that the effects of IT are time-dependent. The evidence shows the importance of considering the timing of the performance outcomes, not just the overall result (Table 4, for example), when evaluating IT.

Third and most important, the evidence of treatment effects needs careful interpretation, when evaluating effectiveness of IT. The policy irrelevance or window-dressing view generally comes from the long-run treatment effect for developed countries, as shown in Table 4. Ball and Sheridan (2005) note that the inflation rate declines in the inflation targeting era for both targeters and non-targeters. Our intertemporal and cumulative treatment effects suggest that IT does matter if targeters simply want to keep low the inflation rate as in other developed countries in the OECD (e.g., the US and Japan). IT lowers inflation rates immediately in the first few years after the policy adoption (Table 5a). Targeters reach their target at the end of the second year (Table 7) and keep inflation low to the end of our sample (Tables 2 and 7). In sum, 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), Bernanke et al. (1999), and Batini and Nelson (2002). Inflation rates of targeters beyond the second year after the policy adoption prove no different from those of non-targeters and, thus, no more treatment effects emerge. Moreover, our dynamic analyses 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).

---

8 That is, the US and Japan did not need to adopt inflation targeting, since inflation did not seem a threat.
In contrast, developing countries experience success of IT with significant intertemporal and cumulative treatment effects in the four-year short-run and the medium term as well as in the long-run. This success may reflect the following observations or views. First, targeters who adopt IT want to substantially reduce inflation from a high to a low level. Figure 1 shows clearly that targeters experience a lower inflation rate than non-targeters. The long-run treatment effect on the inflation rate in Table 4 illustrates this fact. The significant treatment effect or the above three-percent difference between targeters and non-targeters reflects the fact that more than a 3-percent gap exists in the mean inflation rate of 3.66 in targeters and of 7.01 in non-targeters in 2007. This observation explains why in previous studies, researchers find support for IT 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. Tables 1, 2, and 7 illustrate this principle. The inflation rate of 3.98 in Panel B 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 the 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 continues. We find a much longer lag length between IT monetary policy and inflation for developing countries than for developed countries. Our intertemporal treatment effects show no costs of disinflation in such a gradual 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 the long-run (Table 4), along with no significant output growth effect in each of the time horizons (Tables 4, 5b, and 6b).
5. Conclusion

This paper evaluates IT through dynamic treatment effects for eight industrial countries -- Australia, Canada, Iceland, New Zealand, Norway, Sweden, Switzerland, and the UK -- as well as thirteen 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 long-run average effects, if any, of IT on the inflation and output growth rates and their variabilities. Our initial results, based on the treatment effect on the treated, find no significant effects of IT 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 analyses for developed countries and more information emerges in the four 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.

Our dynamic treatment effect leads to different results with respect to how IT policy affects the inflation and output growth rates 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 intertemporal treatment effect of IT on inflation is significantly negative in the first year after the policy adoption. The cumulative effect is negative and significant in the first three years. Targeters reach their inflation targets at the end of the second year. No free lunch exists, however.
The intertemporal 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 individual 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 IT worsens the output growth rate as well as the inflation and output growth rate variabilities, as most critics of IT stress, tells only the short-run costs of IT. The critics concerns do not materialize in the long-run.

The analysis of developing countries tells a totally different story of the outcomes. That is, the treatment effect of IT on inflation is significantly negative, beginning with the first year after IT adoption year through the end of our sample. The significant cumulative effects confirm that the targeters experience lower inflation than non-targeters. Moreover, almost no costs exist; only gains emerge. No negative intertemporal treatment effect on output growth is significant and the cumulative effect eventually becomes positive, although not significantly so. The inflation rate variability is significantly lower in each of the four years right after the policy adoption and the cumulative effect exhibits lower inflation variability significantly from the first 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 starting the third year to the end year of our sample. The fact that developing country targeters do not yet reach their long-run targets in our sample period suggests that 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 IT in developed and developing countries. First, the monetary policy of IT 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 IT. 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 is accompanied with 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. Finally, IT can achieve a beneficial shift in the Taylor tradeoff between the inflation and output growth rate variabilities for developing, but not developed, countries.

References:


Table 1: Inflation Targeting Countries and Control Countries

Panel A: Developed Countries

<table>
<thead>
<tr>
<th>Targeting Countries</th>
<th>Adoption Year*</th>
<th>Inflation Target (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1993</td>
<td>2-3</td>
</tr>
<tr>
<td>Canada</td>
<td>1991</td>
<td>1-3</td>
</tr>
<tr>
<td>Iceland</td>
<td>2001</td>
<td>2.5</td>
</tr>
<tr>
<td>New Zealand</td>
<td>1990</td>
<td>1-3</td>
</tr>
<tr>
<td>Norway</td>
<td>2001</td>
<td>2.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>1993</td>
<td>2(±1)</td>
</tr>
<tr>
<td>Switzerland</td>
<td>2000</td>
<td>&lt;2</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1992</td>
<td>2</td>
</tr>
</tbody>
</table>

Control Countries

<table>
<thead>
<tr>
<th>Austria</th>
<th>Germany</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>Greece</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Denmark</td>
<td>Ireland</td>
<td>Portugal</td>
</tr>
<tr>
<td>France</td>
<td>Italy</td>
<td>United States</td>
</tr>
</tbody>
</table>

Panel B: Developing Countries

<table>
<thead>
<tr>
<th>Targeting Countries</th>
<th>Adoption Year*</th>
<th>Inflation Target (percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>1999</td>
<td>4.5(±2.5)</td>
</tr>
<tr>
<td>Chile</td>
<td>1999</td>
<td>2-4</td>
</tr>
<tr>
<td>Colombia</td>
<td>1999</td>
<td>5(±0.5)</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>1998</td>
<td>3(±1)</td>
</tr>
<tr>
<td>Hungary</td>
<td>2001</td>
<td>3.5(±1)</td>
</tr>
<tr>
<td>Israel</td>
<td>1997</td>
<td>1-3</td>
</tr>
<tr>
<td>Korea</td>
<td>1998</td>
<td>2.5-3.5</td>
</tr>
<tr>
<td>Mexico</td>
<td>2001</td>
<td>3(±1)</td>
</tr>
<tr>
<td>Peru</td>
<td>2002</td>
<td>2.5(±1)</td>
</tr>
<tr>
<td>Philippines</td>
<td>2002</td>
<td>5-6</td>
</tr>
<tr>
<td>Poland</td>
<td>1999</td>
<td>2.5(±1)</td>
</tr>
<tr>
<td>South Africa</td>
<td>2000</td>
<td>3-6</td>
</tr>
<tr>
<td>Thailand</td>
<td>2000</td>
<td>0-3.5</td>
</tr>
</tbody>
</table>

After 2005

<table>
<thead>
<tr>
<th>Ghana</th>
<th>2007</th>
<th>0-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>2005</td>
<td>6(±1)</td>
</tr>
<tr>
<td>Romania</td>
<td>2005</td>
<td>4(±1)</td>
</tr>
<tr>
<td>Slovak Republic</td>
<td>2005</td>
<td>0-2</td>
</tr>
<tr>
<td>Turkey</td>
<td>2006</td>
<td>4(±2)</td>
</tr>
</tbody>
</table>

Control Countries

<table>
<thead>
<tr>
<th>Algeria</th>
<th>Costa Rica</th>
<th>Honduras</th>
<th>Maldives</th>
<th>Solomon Islands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Cote d'Ivoire</td>
<td>Hong Kong</td>
<td>Mauritania</td>
<td>Sri Lanka</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Dominican Republic</td>
<td>India</td>
<td>Mauritius</td>
<td>St. Lucia</td>
</tr>
<tr>
<td>Botswana</td>
<td>Ethiopia</td>
<td>Jordan</td>
<td>Nigeria</td>
<td>Tonga</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>Fiji</td>
<td>Kenya</td>
<td>Pakistan</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>Burundi</td>
<td>Gambia, The</td>
<td>Lao PDR</td>
<td>Papua New Guinea</td>
<td>Tunisia</td>
</tr>
<tr>
<td>Cape Verde</td>
<td>Guatemala</td>
<td>Lesotho</td>
<td>Paraguay</td>
<td>Uganda</td>
</tr>
<tr>
<td>Chad</td>
<td>Guyana</td>
<td>Madagascar</td>
<td>Rwanda</td>
<td>Vanuatu</td>
</tr>
<tr>
<td>China</td>
<td>Haiti</td>
<td>Malawi</td>
<td>Samoa</td>
<td>Vietnam</td>
</tr>
</tbody>
</table>

* This year indicates when countries de facto adopted inflation targeting. Official adoption dates may vary.
Table 2: Economic Performance of Targeters, 1985-2007

Panel A: Developed Countries

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Pre-IT</th>
<th>Post-IT</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>3.8481</td>
<td>5.9361</td>
<td>2.0352</td>
<td>-5.9820**</td>
<td>[0.0000]</td>
</tr>
<tr>
<td>Inflation Variability</td>
<td>1.3744</td>
<td>2.0490</td>
<td>0.8102</td>
<td>-3.0122***</td>
<td>[0.0034]</td>
</tr>
<tr>
<td>Output Growth</td>
<td>2.7761</td>
<td>2.4759</td>
<td>3.1579</td>
<td>2.3923**</td>
<td>[0.0181]</td>
</tr>
<tr>
<td>Growth Variability</td>
<td>1.3170</td>
<td>1.4910</td>
<td>1.1884</td>
<td>-2.2300**</td>
<td>[0.0272]</td>
</tr>
<tr>
<td>Observations</td>
<td>184</td>
<td>81</td>
<td>95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Panel B: Developing Countries

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Pre-IT</th>
<th>Post-IT</th>
<th>t-statistic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation</td>
<td>93.9060</td>
<td>148.81</td>
<td>3.9839</td>
<td>-2.7838**</td>
<td>[0.0060]</td>
</tr>
<tr>
<td>Inflation Variability</td>
<td>83.5661</td>
<td>133.68</td>
<td>1.6326</td>
<td>-3.2870***</td>
<td>[0.0012]</td>
</tr>
<tr>
<td>Output Growth</td>
<td>3.8190</td>
<td>3.6683</td>
<td>4.4307</td>
<td>0.9582</td>
<td>[0.3388]</td>
</tr>
<tr>
<td>Growth Variability</td>
<td>2.3326</td>
<td>2.6782</td>
<td>1.5548</td>
<td>-4.1594***</td>
<td>[0.0000]</td>
</tr>
<tr>
<td>Observations</td>
<td>287</td>
<td>178</td>
<td>96</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The pre- or post-IT period does not include the adoption year. t-statistic tests for equal means of the pre- and post-IT sub-samples. 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

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation Rate</td>
<td>-0.1153***</td>
<td>0.0378</td>
</tr>
<tr>
<td>Real GDP Growth Rate</td>
<td>-0.0824*</td>
<td>0.0431</td>
</tr>
<tr>
<td>Budget Surplus</td>
<td>0.0447**</td>
<td>0.0218</td>
</tr>
<tr>
<td>Openness</td>
<td>0.0082***</td>
<td>0.0029</td>
</tr>
<tr>
<td>Fixed Exchange Rate Dummy</td>
<td>-1.6647***</td>
<td>0.2089</td>
</tr>
<tr>
<td>Constant Term</td>
<td>0.0964</td>
<td>0.2397</td>
</tr>
<tr>
<td>No. of Observation</td>
<td>460</td>
<td></td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.2938</td>
<td></td>
</tr>
<tr>
<td>Common Support Region</td>
<td>[0.0199, 0.8575]</td>
<td></td>
</tr>
</tbody>
</table>

Panel B: Developing Countries

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation Rate</td>
<td>-0.1076***</td>
<td>0.0119</td>
</tr>
<tr>
<td>Real GDP Growth Rate</td>
<td>-0.0285*</td>
<td>0.0160</td>
</tr>
<tr>
<td>Openness</td>
<td>0.0012</td>
<td>0.0012</td>
</tr>
<tr>
<td>Fixed Exchange Rate Dummy</td>
<td>-1.4246***</td>
<td>0.1344</td>
</tr>
<tr>
<td>Constant Term</td>
<td>0.1490</td>
<td>0.1639</td>
</tr>
<tr>
<td>No. of Observation</td>
<td>1329</td>
<td></td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.2921</td>
<td></td>
</tr>
<tr>
<td>Common Support Region</td>
<td>[0.0111, 0.5637]</td>
<td></td>
</tr>
</tbody>
</table>

*** 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**

<table>
<thead>
<tr>
<th>Method</th>
<th>Treatment Effect on Inflation</th>
<th>Treatment Effect on Inflation Variability</th>
<th>Treatment Effect on Output Growth</th>
<th>Treatment Effect on Growth Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest-Neighbor Matching</td>
<td>-0.3041 [0.329]</td>
<td>0.0043 [0.986]</td>
<td>0.2059 [0.574]</td>
<td>0.2412 [0.145]</td>
</tr>
<tr>
<td>3 Nearest-Neighbor Matching</td>
<td>-0.1828 [0.542]</td>
<td>0.0841 [0.777]</td>
<td>0.2900 [0.378]</td>
<td>0.0842 [0.560]</td>
</tr>
<tr>
<td>Radius Matching Kernel</td>
<td>0.0043 [0.986]</td>
<td>0.0841 [0.777]</td>
<td>0.2900 [0.378]</td>
<td>0.0842 [0.560]</td>
</tr>
<tr>
<td>Matching</td>
<td>0.0587 [0.864]</td>
<td>0.0496 [0.724]</td>
<td>0.1524 [0.218]</td>
<td>0.1524 [0.218]</td>
</tr>
<tr>
<td>Local Linear Regression</td>
<td>-0.0610 [0.796]</td>
<td>0.0713 [0.376]</td>
<td>0.1391 [0.421]</td>
<td>0.1391 [0.421]</td>
</tr>
<tr>
<td>Matching</td>
<td>-0.2981 [0.283]</td>
<td>0.0713 [0.376]</td>
<td>0.1927 [0.280]</td>
<td>0.1927 [0.280]</td>
</tr>
</tbody>
</table>

**Panel B: Developing Countries**

<table>
<thead>
<tr>
<th>Method</th>
<th>Treatment Effect on Inflation</th>
<th>Treatment Effect on Inflation Variability</th>
<th>Treatment Effect on Output Growth</th>
<th>Treatment Effect on Growth Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest-Neighbor Matching</td>
<td>-4.0282*** [0.001]</td>
<td>-3.5703*** [0.000]</td>
<td>0.5205 [0.465]</td>
<td>-1.4086*** [0.001]</td>
</tr>
<tr>
<td>3 Nearest-Neighbor Matching</td>
<td>-3.7615*** [0.000]</td>
<td>-3.4506*** [0.000]</td>
<td>0.3701 [0.529]</td>
<td>-1.0621*** [0.000]</td>
</tr>
<tr>
<td>Radius Matching Kernel</td>
<td>-3.5703*** [0.000]</td>
<td>-3.4506*** [0.000]</td>
<td>0.4232 [0.306]</td>
<td>-1.0331*** [0.000]</td>
</tr>
<tr>
<td>Matching</td>
<td>-3.4539*** [0.000]</td>
<td>-3.4539*** [0.000]</td>
<td>0.4286 [0.387]</td>
<td>-1.1370*** [0.000]</td>
</tr>
<tr>
<td>Local Linear Regression</td>
<td>-3.9864*** [0.000]</td>
<td>-3.9864*** [0.000]</td>
<td>0.1295 [0.321]</td>
<td>-1.1544*** [0.000]</td>
</tr>
<tr>
<td>Matching</td>
<td>-3.8696*** [0.000]</td>
<td>-3.8696*** [0.000]</td>
<td>0.3843 [0.225]</td>
<td>-1.0672*** [0.000]</td>
</tr>
</tbody>
</table>

**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: Intertemporal Treatment Effects of Inflation Targeting: Developed Countries

<table>
<thead>
<tr>
<th></th>
<th>1 Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>$r=0.03$</th>
<th>$r=0.01$</th>
<th>$r=0.005$</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Effect on Inflation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATT1</strong></td>
<td>-1.1758**</td>
<td>-0.9916**</td>
<td>-0.6402**</td>
<td>-0.6219*</td>
<td>-1.3348**</td>
<td>-0.5381*</td>
<td>-0.8525**</td>
</tr>
<tr>
<td></td>
<td>[0.024]</td>
<td>[0.023]</td>
<td>[0.076]</td>
<td>[0.063]</td>
<td>[0.022]</td>
<td>[0.089]</td>
<td>[0.047]</td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>-0.6266</td>
<td>-0.7995</td>
<td>-0.5571</td>
<td>-0.5202</td>
<td>-0.3677</td>
<td>-0.3850</td>
<td>-0.7103</td>
</tr>
<tr>
<td></td>
<td>[0.478]</td>
<td>[0.390]</td>
<td>[0.322]</td>
<td>[0.445]</td>
<td>[0.599]</td>
<td>[0.494]</td>
<td>[0.632]</td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>-0.8717</td>
<td>-1.2704</td>
<td>-1.0901</td>
<td>-0.7542</td>
<td>-0.5728</td>
<td>-1.0239</td>
<td>-1.2890</td>
</tr>
<tr>
<td></td>
<td>[0.243]</td>
<td>[0.118]</td>
<td>[0.141]</td>
<td>[0.310]</td>
<td>[0.485]</td>
<td>[0.139]</td>
<td>[0.147]</td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>-1.1632</td>
<td>-0.6261</td>
<td>-0.2679</td>
<td>-0.4208</td>
<td>-1.5222</td>
<td>-0.6496</td>
<td>-0.9803</td>
</tr>
<tr>
<td></td>
<td>[0.289]</td>
<td>[0.439]</td>
<td>[0.567]</td>
<td>[0.695]</td>
<td>[0.364]</td>
<td>[0.227]</td>
<td>[0.274]</td>
</tr>
<tr>
<td>Treatment Effect on Inflation Variability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATT1</strong></td>
<td>0.6150**</td>
<td>0.6899**</td>
<td>0.6164**</td>
<td>0.6082**</td>
<td>0.6213**</td>
<td>0.6073**</td>
<td>0.6239**</td>
</tr>
<tr>
<td></td>
<td>[0.022]</td>
<td>[0.029]</td>
<td>[0.031]</td>
<td>[0.005]</td>
<td>[0.001]</td>
<td>[0.031]</td>
<td>[0.041]</td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>1.0134***</td>
<td>0.8369***</td>
<td>0.8837***</td>
<td>0.8705***</td>
<td>1.2194***</td>
<td>0.8400***</td>
<td>0.8885***</td>
</tr>
<tr>
<td></td>
<td>[0.002]</td>
<td>[0.007]</td>
<td>[0.009]</td>
<td>[0.005]</td>
<td>[0.000]</td>
<td>[0.002]</td>
<td>[0.000]</td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>0.0198</td>
<td>-0.1558</td>
<td>0.0573</td>
<td>-0.0722</td>
<td>-0.2705</td>
<td>0.1119</td>
<td>0.1580</td>
</tr>
<tr>
<td></td>
<td>[0.949]</td>
<td>[0.722]</td>
<td>[0.658]</td>
<td>[0.896]</td>
<td>[0.614]</td>
<td>[0.562]</td>
<td>[0.387]</td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>0.2215</td>
<td>-0.0930</td>
<td>-0.0265</td>
<td>0.2926</td>
<td>-0.4463</td>
<td>0.0907</td>
<td>0.1426</td>
</tr>
<tr>
<td></td>
<td>[0.766]</td>
<td>[0.781]</td>
<td>[0.918]</td>
<td>[0.583]</td>
<td>[0.529]</td>
<td>[0.514]</td>
<td>[0.694]</td>
</tr>
<tr>
<td>Treatment Effect on Output Growth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATT1</strong></td>
<td>-2.2457***</td>
<td>-1.5203***</td>
<td>-1.0704</td>
<td>-1.2666</td>
<td>-1.7439*</td>
<td>-1.1083**</td>
<td>-1.0912**</td>
</tr>
<tr>
<td></td>
<td>[0.002]</td>
<td>[0.009]</td>
<td>[0.046]</td>
<td>[0.036]</td>
<td>[0.012]</td>
<td>[0.027]</td>
<td>[0.011]</td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>-0.9588</td>
<td>-0.6187</td>
<td>-0.1649</td>
<td>0.0678</td>
<td>-0.0384</td>
<td>-0.4645</td>
<td>-0.5344</td>
</tr>
<tr>
<td></td>
<td>[0.418]</td>
<td>[0.415]</td>
<td>[0.882]</td>
<td>[0.947]</td>
<td>[0.958]</td>
<td>[0.525]</td>
<td>[0.588]</td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>1.3720</td>
<td>1.1096</td>
<td>1.0957</td>
<td>1.8926</td>
<td>2.3470</td>
<td>0.9550</td>
<td>0.8257</td>
</tr>
<tr>
<td></td>
<td>[0.434]</td>
<td>[0.216]</td>
<td>[0.321]</td>
<td>[0.175]</td>
<td>[0.113]</td>
<td>[0.330]</td>
<td>[0.565]</td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>1.3738</td>
<td>1.6860</td>
<td>2.1007</td>
<td>3.1284</td>
<td>2.7112</td>
<td>1.0231</td>
<td>0.9415</td>
</tr>
<tr>
<td></td>
<td>[0.204]</td>
<td>[0.181]</td>
<td>[0.112]</td>
<td>[0.147]</td>
<td>[0.161]</td>
<td>[0.205]</td>
<td>[0.566]</td>
</tr>
<tr>
<td>Treatment Effect on Growth Variability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATT1</strong></td>
<td>0.6903***</td>
<td>0.5360**</td>
<td>0.6260***</td>
<td>0.6008***</td>
<td>1.0390***</td>
<td>0.6287***</td>
<td>0.7226***</td>
</tr>
<tr>
<td></td>
<td>[0.040]</td>
<td>[0.045]</td>
<td>[0.003]</td>
<td>[0.002]</td>
<td>[0.008]</td>
<td>[0.003]</td>
<td>[0.005]</td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>1.0967***</td>
<td>0.6873***</td>
<td>0.8417***</td>
<td>0.8194***</td>
<td>0.7976***</td>
<td>0.6334***</td>
<td>0.7719***</td>
</tr>
<tr>
<td></td>
<td>[0.002]</td>
<td>[0.026]</td>
<td>[0.000]</td>
<td>[0.001]</td>
<td>[0.001]</td>
<td>[0.002]</td>
<td>[0.001]</td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>0.7299</td>
<td>0.8423</td>
<td>0.8966</td>
<td>1.1333</td>
<td>0.9890</td>
<td>0.8034</td>
<td>0.8703</td>
</tr>
<tr>
<td></td>
<td>[0.311]</td>
<td>[0.261]</td>
<td>[0.256]</td>
<td>[0.289]</td>
<td>[0.256]</td>
<td>[0.255]</td>
<td>[0.358]</td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>0.4827</td>
<td>0.2440</td>
<td>0.4625</td>
<td>0.2621</td>
<td>0.2904</td>
<td>0.4898</td>
<td>0.6302</td>
</tr>
<tr>
<td></td>
<td>[0.281]</td>
<td>[0.348]</td>
<td>[0.362]</td>
<td>[0.724]</td>
<td>[0.552]</td>
<td>[0.211]</td>
<td>[0.404]</td>
</tr>
</tbody>
</table>

Notes: See Table 4.
*** denotes 1-percent significance level.
** denotes 5-percent significance level.
* denotes 10-percent significance level.
### Table 5b: Intertemporal Treatment Effects of Inflation Targeting: Developing Countries

<table>
<thead>
<tr>
<th>Treatment Effect on Inflation</th>
<th>Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r=0.03$</td>
<td>$r=0.01$</td>
<td>$r=0.005$</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ATT1</strong></td>
<td>-6.2250*</td>
<td>-4.7213**</td>
<td>-3.6739***</td>
<td>-4.6020**</td>
<td>-7.3195***</td>
</tr>
<tr>
<td></td>
<td>[0.057]</td>
<td>[0.037]</td>
<td>[0.001]</td>
<td>[0.016]</td>
<td>[0.015]</td>
</tr>
<tr>
<td></td>
<td>[0.096]</td>
<td>[0.026]</td>
<td>[0.005]</td>
<td>[0.051]</td>
<td>[0.182]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>-5.6261*</td>
<td>-2.7631</td>
<td>-3.5522***</td>
<td>-3.0603*</td>
<td>-2.4785</td>
</tr>
<tr>
<td></td>
<td>[0.096]</td>
<td>[0.026]</td>
<td>[0.005]</td>
<td>[0.051]</td>
<td>[0.182]</td>
</tr>
<tr>
<td></td>
<td>[0.036]</td>
<td>[0.063]</td>
<td>[0.002]</td>
<td>[0.110]</td>
<td>[0.233]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>-2.2516</td>
<td>-3.4126*</td>
<td>-3.0580***</td>
<td>-1.9428</td>
<td>-2.3352</td>
</tr>
<tr>
<td></td>
<td>[0.366]</td>
<td>[0.063]</td>
<td>[0.002]</td>
<td>[0.110]</td>
<td>[0.233]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>-5.3360</td>
<td>-5.1243**</td>
<td>-4.2098***</td>
<td>-4.5515**</td>
<td>-4.2890**</td>
</tr>
<tr>
<td></td>
<td>[0.133]</td>
<td>[0.047]</td>
<td>[0.002]</td>
<td>[0.001]</td>
<td>[0.000]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Inflation Variability</th>
<th>Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ATT1</strong></td>
<td>-4.9884*</td>
<td>-3.4788*</td>
<td>-2.4261***</td>
<td>-4.5129*</td>
<td>-2.2739***</td>
</tr>
<tr>
<td></td>
<td>[0.066]</td>
<td>[0.066]</td>
<td>[0.007]</td>
<td>[0.030]</td>
<td>[0.058]</td>
</tr>
<tr>
<td></td>
<td>[0.142]</td>
<td>[0.041]</td>
<td>[0.000]</td>
<td>[0.033]</td>
<td>[0.000]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.146]</td>
<td>[0.043]</td>
<td>[0.000]</td>
<td>[0.022]</td>
<td>[0.000]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Output Growth</th>
<th>Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ATT1</strong></td>
<td>-2.6803</td>
<td>-0.7776</td>
<td>0.2087</td>
<td>0.1382</td>
<td>0.2401</td>
</tr>
<tr>
<td></td>
<td>[0.284]</td>
<td>[0.626]</td>
<td>[0.773]</td>
<td>[0.851]</td>
<td>[0.797]</td>
</tr>
<tr>
<td></td>
<td>[0.953]</td>
<td>[0.889]</td>
<td></td>
<td>[0.953]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>-0.9893</td>
<td>-0.3624</td>
<td>0.4044</td>
<td>0.2677</td>
<td>-1.1835</td>
</tr>
<tr>
<td></td>
<td>[0.958]</td>
<td>[0.806]</td>
<td>[0.587]</td>
<td>[0.819]</td>
<td>[0.220]</td>
</tr>
<tr>
<td></td>
<td>[0.810]</td>
<td>[0.730]</td>
<td></td>
<td>[0.810]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>1.0111</td>
<td>0.6634</td>
<td>0.5150</td>
<td>-0.1099</td>
<td>0.7168</td>
</tr>
<tr>
<td></td>
<td>[0.609]</td>
<td>[0.682]</td>
<td>[0.506]</td>
<td>[0.911]</td>
<td>[0.687]</td>
</tr>
<tr>
<td></td>
<td>[0.464]</td>
<td>[0.417]</td>
<td></td>
<td>[0.464]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>1.0337</td>
<td>0.5917</td>
<td>0.4015</td>
<td>0.4804</td>
<td>0.3104</td>
</tr>
<tr>
<td></td>
<td>[0.515]</td>
<td>[0.640]</td>
<td>[0.636]</td>
<td>[0.617]</td>
<td>[0.814]</td>
</tr>
<tr>
<td></td>
<td>[0.488]</td>
<td>[0.430]</td>
<td></td>
<td>[0.488]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Growth Variability</th>
<th>Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ATT1</strong></td>
<td>-1.0994</td>
<td>-0.0186</td>
<td>-0.2463</td>
<td>-0.0049</td>
<td>-0.2226</td>
</tr>
<tr>
<td></td>
<td>[0.336]</td>
<td>[0.983]</td>
<td>[0.679]</td>
<td>[0.994]</td>
<td>[0.774]</td>
</tr>
<tr>
<td></td>
<td>[0.533]</td>
<td>[0.487]</td>
<td></td>
<td>[0.533]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT2</strong></td>
<td>-0.6233</td>
<td>-0.5265</td>
<td>-0.5493</td>
<td>-0.8675</td>
<td>-0.9192*</td>
</tr>
<tr>
<td></td>
<td>[0.341]</td>
<td>[0.393]</td>
<td>[0.377]</td>
<td>[0.140]</td>
<td>[0.071]</td>
</tr>
<tr>
<td></td>
<td>[0.292]</td>
<td>[0.304]</td>
<td></td>
<td>[0.292]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT3</strong></td>
<td>-1.3437**</td>
<td>-1.3127**</td>
<td>-1.1597***</td>
<td>-1.3123***</td>
<td>-1.3923**</td>
</tr>
<tr>
<td></td>
<td>[0.029]</td>
<td>[0.014]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.014]</td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td>[0.000]</td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
<tr>
<td><strong>ATT4</strong></td>
<td>-2.2179*</td>
<td>-1.7724*</td>
<td>-1.5916***</td>
<td>-2.1251**</td>
<td>-2.0028*</td>
</tr>
<tr>
<td></td>
<td>[0.072]</td>
<td>[0.052]</td>
<td>[0.001]</td>
<td>[0.027]</td>
<td>[0.091]</td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td>[0.000]</td>
<td></td>
<td>[0.000]</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
- See Table 4.
- *** denotes 1-percent significance level.
- ** denotes 5-percent significance level.
- * denotes 10-percent significance level.
<table>
<thead>
<tr>
<th>Treatment Effect on Inflation</th>
<th>1 Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum^2_{\text{ATT}}$</td>
<td>-0.9012**</td>
<td>-0.8084**</td>
<td>-0.5750*</td>
<td>-0.8885*</td>
<td>-0.4615*</td>
</tr>
<tr>
<td></td>
<td>[0.039]</td>
<td>[0.045]</td>
<td>[0.038]</td>
<td>[0.054]</td>
<td>[0.058]</td>
</tr>
<tr>
<td>$\sum^3_{\text{ATT}}$</td>
<td>-0.8914*</td>
<td>-0.9624*</td>
<td>-0.7625*</td>
<td>-0.6315</td>
<td>-0.7888</td>
</tr>
<tr>
<td></td>
<td>[0.070]</td>
<td>[0.098]</td>
<td>[0.069]</td>
<td>[0.233]</td>
<td>[0.199]</td>
</tr>
<tr>
<td>$\sum^4_{\text{ATT}}$</td>
<td>-0.9593</td>
<td>-0.8783</td>
<td>-0.6526</td>
<td>-0.5876</td>
<td>-0.9416</td>
</tr>
<tr>
<td></td>
<td>[0.102]</td>
<td>[0.119]</td>
<td>[0.107]</td>
<td>[0.128]</td>
<td>[0.125]</td>
</tr>
<tr>
<td>$\sum^T_{\text{ATT}}$</td>
<td>-0.1981</td>
<td>-0.0015</td>
<td>0.1085</td>
<td>0.2442</td>
<td>0.3907</td>
</tr>
<tr>
<td></td>
<td>[0.640]</td>
<td>[0.997]</td>
<td>[0.695]</td>
<td>[0.436]</td>
<td>[0.420]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Inflation Variability</th>
<th>1 Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum^2_{\text{ATT}}$</td>
<td>0.8142***</td>
<td>0.7634***</td>
<td>0.7500***</td>
<td>0.7293***</td>
<td>0.8974***</td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td>[0.002]</td>
<td>[0.000]</td>
<td>[0.045]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>$\sum^3_{\text{ATT}}$</td>
<td>0.5494**</td>
<td>0.4570**</td>
<td>0.5191**</td>
<td>0.4761*</td>
<td>0.5285*</td>
</tr>
<tr>
<td></td>
<td>[0.019]</td>
<td>[0.026]</td>
<td>[0.013]</td>
<td>[0.056]</td>
<td>[0.065]</td>
</tr>
<tr>
<td>$\sum^4_{\text{ATT}}$</td>
<td>0.4674***</td>
<td>0.3195*</td>
<td>0.3979*</td>
<td>0.3160*</td>
<td>0.3254</td>
</tr>
<tr>
<td></td>
<td>[0.038]</td>
<td>[0.071]</td>
<td>[0.046]</td>
<td>[0.085]</td>
<td>[0.160]</td>
</tr>
<tr>
<td>$\sum^T_{\text{ATT}}$</td>
<td>-0.1451</td>
<td>-0.2689</td>
<td>-0.1379</td>
<td>-0.2091</td>
<td>-0.2212</td>
</tr>
<tr>
<td></td>
<td>[0.341]</td>
<td>[0.124]</td>
<td>[0.201]</td>
<td>[0.247]</td>
<td>[0.368]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Output Growth</th>
<th>1 Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum^2_{\text{ATT}}$</td>
<td>-1.6023**</td>
<td>-1.0695*</td>
<td>-0.5876*</td>
<td>-0.6507*</td>
<td>-0.9568</td>
</tr>
<tr>
<td></td>
<td>[0.014]</td>
<td>[0.069]</td>
<td>[0.077]</td>
<td>[0.072]</td>
<td>[0.085]</td>
</tr>
<tr>
<td>$\sum^3_{\text{ATT}}$</td>
<td>-0.6108</td>
<td>-0.3431</td>
<td>-0.0265</td>
<td>0.1524</td>
<td>0.0865</td>
</tr>
<tr>
<td></td>
<td>[0.104]</td>
<td>[0.467]</td>
<td>[0.946]</td>
<td>[0.730]</td>
<td>[0.908]</td>
</tr>
<tr>
<td>$\sum^4_{\text{ATT}}$</td>
<td>-0.1146</td>
<td>0.1641</td>
<td>0.4462</td>
<td>0.7724</td>
<td>0.6333</td>
</tr>
<tr>
<td></td>
<td>[0.866]</td>
<td>[0.754]</td>
<td>[0.501]</td>
<td>[0.135]</td>
<td>[0.388]</td>
</tr>
<tr>
<td>$\sum^T_{\text{ATT}}$</td>
<td>0.5636</td>
<td>0.5811</td>
<td>0.5318</td>
<td>0.9024</td>
<td>1.0015</td>
</tr>
<tr>
<td></td>
<td>[0.308]</td>
<td>[0.257]</td>
<td>[0.258]</td>
<td>[0.125]</td>
<td>[0.118]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Growth Variability</th>
<th>1 Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sum^2_{\text{ATT}}$</td>
<td>0.8935****</td>
<td>0.6119***</td>
<td>0.7339***</td>
<td>0.7017***</td>
<td>0.6889**</td>
</tr>
<tr>
<td></td>
<td>[0.001]</td>
<td>[0.004]</td>
<td>[0.002]</td>
<td>[0.013]</td>
<td>[0.011]</td>
</tr>
<tr>
<td>$\sum^3_{\text{ATT}}$</td>
<td>0.8390**</td>
<td>0.6887***</td>
<td>0.7881***</td>
<td>0.8443***</td>
<td>0.7837**</td>
</tr>
<tr>
<td></td>
<td>[0.021]</td>
<td>[0.009]</td>
<td>[0.001]</td>
<td>[0.002]</td>
<td>[0.010]</td>
</tr>
<tr>
<td>$\sum^4_{\text{ATT}}$</td>
<td>0.7499**</td>
<td>0.5775**</td>
<td>0.7157***</td>
<td>0.7230***</td>
<td>0.6809**</td>
</tr>
<tr>
<td></td>
<td>[0.012]</td>
<td>[0.040]</td>
<td>[0.003]</td>
<td>[0.006]</td>
<td>[0.024]</td>
</tr>
<tr>
<td>$\sum^T_{\text{ATT}}$</td>
<td>0.0247</td>
<td>-0.1266</td>
<td>-0.0489</td>
<td>-0.0845</td>
<td>-0.1403</td>
</tr>
<tr>
<td></td>
<td>[0.852]</td>
<td>[0.208]</td>
<td>[0.520]</td>
<td>[0.757]</td>
<td>[0.686]</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Treatment Effect on Inflation Variability</th>
<th>1 Nearest-Neighbor Matching</th>
<th>3 Nearest-Neighbor Matching</th>
<th>Radius Matching</th>
<th>Kernel Matching</th>
<th>Local Linear Regression Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Sigma^2_{ATT} )</td>
<td>-5.9255***</td>
<td>-3.7422**</td>
<td>-3.6130***</td>
<td>-3.7592***</td>
<td>-3.6310***</td>
</tr>
<tr>
<td></td>
<td>[0.009]</td>
<td>[0.033]</td>
<td>[0.001]</td>
<td>[0.008]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>( \Sigma^3_{ATT} )</td>
<td>-4.7099***</td>
<td>-3.6323***</td>
<td>-3.4280***</td>
<td>-3.2017***</td>
<td>-4.1329***</td>
</tr>
<tr>
<td></td>
<td>[0.008]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.002]</td>
<td>[0.022]</td>
</tr>
<tr>
<td>( \Sigma^4_{ATT} )</td>
<td>-4.8597**</td>
<td>-4.0053**</td>
<td>-3.6235***</td>
<td>-3.5193***</td>
<td>-4.0715***</td>
</tr>
<tr>
<td></td>
<td>[0.019]</td>
<td>[0.013]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>( \Sigma^5_{ATT} )</td>
<td>-4.3230**</td>
<td>-3.9820**</td>
<td>-3.8367***</td>
<td>-3.5672***</td>
<td>-3.3416***</td>
</tr>
<tr>
<td></td>
<td>[0.009]</td>
<td>[0.006]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.001]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Output Growth</th>
<th>Radius Matching</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Sigma^2_{ATT} )</td>
<td>-1.3848</td>
<td>-0.5700</td>
<td>0.3065</td>
<td>0.2029</td>
<td>-0.4432</td>
</tr>
<tr>
<td></td>
<td>[0.413]</td>
<td>[0.614]</td>
<td>[0.541]</td>
<td>[0.798]</td>
<td>[0.549]</td>
</tr>
<tr>
<td>( \Sigma^3_{ATT} )</td>
<td>-0.5862</td>
<td>-0.1588</td>
<td>0.3760</td>
<td>0.0986</td>
<td>-0.0669</td>
</tr>
<tr>
<td></td>
<td>[0.734]</td>
<td>[0.748]</td>
<td>[0.477]</td>
<td>[0.833]</td>
<td>[0.889]</td>
</tr>
<tr>
<td>( \Sigma^4_{ATT} )</td>
<td>-0.8182</td>
<td>0.2087</td>
<td>0.3824</td>
<td>0.1884</td>
<td>0.0254</td>
</tr>
<tr>
<td></td>
<td>[0.890]</td>
<td>[0.970]</td>
<td>[0.503]</td>
<td>[0.795]</td>
<td>[0.972]</td>
</tr>
<tr>
<td>( \Sigma^5_{ATT} )</td>
<td>2.1870</td>
<td>1.6407</td>
<td>1.3248</td>
<td>1.5181</td>
<td>1.1789</td>
</tr>
<tr>
<td></td>
<td>[0.157]</td>
<td>[0.119]</td>
<td>[0.196]</td>
<td>[0.102]</td>
<td>[0.315]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treatment Effect on Growth Variability</th>
<th>Radius Matching</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Sigma^2_{ATT} )</td>
<td>-0.8613</td>
<td>-0.2726</td>
<td>-0.3978</td>
<td>-0.4362</td>
<td>-0.5570</td>
</tr>
<tr>
<td></td>
<td>[0.173]</td>
<td>[0.508]</td>
<td>[0.338]</td>
<td>[0.307]</td>
<td>[0.281]</td>
</tr>
<tr>
<td>( \Sigma^3_{ATT} )</td>
<td>-1.0221*</td>
<td>-0.6193*</td>
<td>-0.6518</td>
<td>-0.7282*</td>
<td>-0.8279*</td>
</tr>
<tr>
<td></td>
<td>[0.077]</td>
<td>[0.073]</td>
<td>[0.135]</td>
<td>[0.058]</td>
<td>[0.092]</td>
</tr>
<tr>
<td>( \Sigma^4_{ATT} )</td>
<td>-1.3211**</td>
<td>-0.9075**</td>
<td>-0.8867**</td>
<td>-1.0569**</td>
<td>-1.1156***</td>
</tr>
<tr>
<td></td>
<td>[0.031]</td>
<td>[0.025]</td>
<td>[0.017]</td>
<td>[0.019]</td>
<td>[0.008]</td>
</tr>
<tr>
<td>( \Sigma^5_{ATT} )</td>
<td>-2.2288***</td>
<td>-1.8100***</td>
<td>-1.7323***</td>
<td>-1.7646***</td>
<td>-1.7413***</td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
</tbody>
</table>

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 after Inflation Targeting Adoption

Panel A: Developed Countries

<table>
<thead>
<tr>
<th>Targeting Countries</th>
<th>$t_1$</th>
<th>$t_2$</th>
<th>$t_3$</th>
<th>$t_4$</th>
<th>$t_{2007}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>1.89</td>
<td>4.63</td>
<td>2.61</td>
<td>0.25</td>
<td>2.33</td>
</tr>
<tr>
<td>Canada</td>
<td>1.49</td>
<td>1.86</td>
<td>0.13</td>
<td>2.18</td>
<td>2.14</td>
</tr>
<tr>
<td>Iceland</td>
<td>4.84</td>
<td>2.09</td>
<td>3.22</td>
<td>4.02</td>
<td>5.02</td>
</tr>
<tr>
<td>New Zealand</td>
<td>2.61</td>
<td>0.98</td>
<td>1.31</td>
<td>1.75</td>
<td>2.37</td>
</tr>
<tr>
<td>Norway</td>
<td>1.28</td>
<td>2.45</td>
<td>0.44</td>
<td>1.55</td>
<td>0.76</td>
</tr>
<tr>
<td>Sweden</td>
<td>2.15</td>
<td>2.56</td>
<td>1.02</td>
<td>1.80</td>
<td>1.67</td>
</tr>
<tr>
<td>Switzerland</td>
<td>0.98</td>
<td>0.64</td>
<td>0.63</td>
<td>0.80</td>
<td>0.73</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>2.49</td>
<td>2.07</td>
<td>2.62</td>
<td>2.44</td>
<td>2.34</td>
</tr>
<tr>
<td>Mean value</td>
<td>2.21</td>
<td>2.16</td>
<td>1.49</td>
<td>1.84</td>
<td>2.17</td>
</tr>
</tbody>
</table>

Panel B: Developing Countries

<table>
<thead>
<tr>
<th>Targeting Countries</th>
<th>$t_1$</th>
<th>$t_2$</th>
<th>$t_3$</th>
<th>$t_4$</th>
<th>$t_{2007}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>7.05</td>
<td>6.83</td>
<td>8.42</td>
<td>14.7</td>
<td>3.63</td>
</tr>
<tr>
<td>Chile</td>
<td>3.84</td>
<td>3.56</td>
<td>2.48</td>
<td>2.81</td>
<td>4.40</td>
</tr>
<tr>
<td>Colombia</td>
<td>9.22</td>
<td>7.96</td>
<td>6.34</td>
<td>7.13</td>
<td>5.54</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>2.25</td>
<td>3.82</td>
<td>4.69</td>
<td>1.81</td>
<td>2.80</td>
</tr>
<tr>
<td>Hungary</td>
<td>5.26</td>
<td>4.63</td>
<td>6.78</td>
<td>3.55</td>
<td>7.93</td>
</tr>
<tr>
<td>Israel</td>
<td>5.43</td>
<td>5.19</td>
<td>1.25</td>
<td>1.11</td>
<td>0.51</td>
</tr>
<tr>
<td>Korea</td>
<td>0.81</td>
<td>2.25</td>
<td>4.06</td>
<td>2.76</td>
<td>2.53</td>
</tr>
<tr>
<td>Mexico</td>
<td>5.03</td>
<td>4.54</td>
<td>4.68</td>
<td>3.98</td>
<td>3.96</td>
</tr>
<tr>
<td>Peru</td>
<td>2.25</td>
<td>3.33</td>
<td>1.62</td>
<td>2.06</td>
<td>1.78</td>
</tr>
<tr>
<td>Philippines</td>
<td>3.47</td>
<td>5.97</td>
<td>7.65</td>
<td>6.23</td>
<td>2.8</td>
</tr>
<tr>
<td>Poland</td>
<td>10.1</td>
<td>5.5</td>
<td>1.9</td>
<td>0.8</td>
<td>2.49</td>
</tr>
<tr>
<td>South Africa</td>
<td>5.7</td>
<td>9.17</td>
<td>5.80</td>
<td>1.39</td>
<td>7.09</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.66</td>
<td>0.63</td>
<td>1.80</td>
<td>2.76</td>
<td>2.22</td>
</tr>
<tr>
<td>Mean value</td>
<td>4.77</td>
<td>4.87</td>
<td>4.42</td>
<td>3.92</td>
<td>3.66</td>
</tr>
</tbody>
</table>

Notes: $t_1$, $t_2$, $t_3$, and $t_4$ denote the first four years after the policy adoption, $t_{2007}$ equals the year of 2007.
Figure 1a: Mean inflation rate from 1985 to 2007: Developed Countries

Figure 1b: Mean inflation rate from 1985 to 2007: Developing Countries
Figure 2a: Mean output growth rate from 1985 to 2007: Developed Countries

Figure 2b: Mean output growth rate from 1985 to 2007: Developing Countries