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Macro Effects of Formal Adoption of Inflation Targeting

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ABSTRACT: We examine the impact of formal adoption of inflation targeting (IT) on inflation, growth and anchoring of inflation expectations in advanced economies and emerging markets and developing economies (EMDEs). Our paper reports several findings relevant to assessing the success of IT regimes. We find that while the early adopters of IT (pre-2000) all saw declines in inflation rates following adoption, IT adopters since then have enjoyed such success in only about half the cases. Since there is not much difference, on average, between IT and non-IT countries in mean inflation, inflation volatility and the extent of inflation anchoring, it is not easy to sort out what role IT has played in ensuring good outcomes; in particular, we cannot rule out the possibility that the success of IT may be due to 'regression to the mean'. Our country-level analysis—using the Synthetic Control Method (SCM) to compare outcomes in IT countries to a synthetic cohort—shows that IT adoption delivers significant inflation gains in about a third of the cases. At the same time, we also find limited support for the concern that adoption of IT systematically leads to poorer growth outcomes. At a time when central banks are struggling to keep inflation in check, our results suggest that the belief that IT adoption will be sufficient to achieve this goal cannot be taken for granted.

JEL Classification Numbers:	E32, D83, D84
Keywords:	Inflation targeting; Inflation expectations; Inflation forecasts
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Macroeconomic Effects of Formal Adoption of Inflation Targeting

Surjit Bhalla, Karan Bhasin and Prakash Loungani*

Abstract

We examine the impact of formal adoption of inflation targeting (IT) on inflation, growth and anchoring of inflation expectations in advanced economies and emerging markets and developing economies (EMDEs). Our paper reports several findings relevant to assessing the success of IT regimes. We find that while the early adopters of IT (pre-2000) all saw declines in inflation rates following adoption, IT adopters since then have enjoyed such success in only about half the cases. Since there is not much difference, on average, between IT and non-IT countries in mean inflation, inflation volatility and the extent of inflation anchoring, it is not easy to sort out what role IT has played in ensuring good outcomes; in particular, we cannot rule out the possibility that the success of IT may be due to 'regression to the mean'. Our country-level analysis—using the Synthetic Control Method (SCM) to compare outcomes in IT countries to a synthetic cohort—shows that IT adoption delivers significant inflation gains in about a third of the cases. At the same time, we also find limited support for the concern that adoption of IT systematically leads to poorer growth outcomes. At a time when central banks are struggling to keep inflation in check, our results suggest that the belief that IT adoption will be sufficient to achieve this goal cannot be taken for granted.

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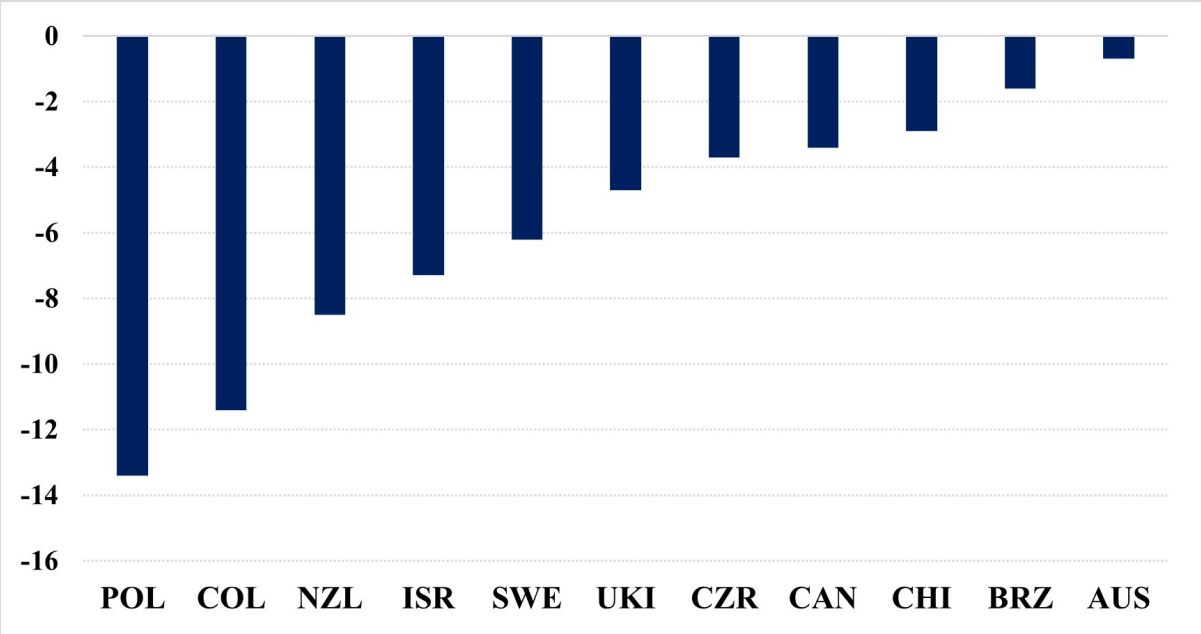
1 Introduction

Over three decades have elapsed since New Zealand's bold adoption of inflation targeting (IT) in 1989. The country's annual inflation rate, which had averaged nearly 12 percent in the three years prior to the adoption of IT, plummeted to an average of only about 3 percent in the three years after adoption. Four other advanced economies—Canada, UK, Australia and Sweden—followed in quick succession. The next six adopters in the 1990s included several emerging markets, such as Brazil, Colombia and Poland.

Figure 1: Inflation Declines in Early Adopters of Inflation Targeting (1989-99, percentage points)



As shown in Figure 1, average inflation rates in the 3 years following IT adoption dropped in all eleven of these early adopters compared to their average inflation rates in the three years prior to adoption. This remarkable outcome prompted many prominent observers to advocate for the widespread adoption of IT by central banks. Proponents have cited numerous benefits of IT:

1. ***Lower inflation:*** (Bernanke et al., 2000) argued that the IT adopters had reduced "inflation and inflation expectations beyond that which would likely have occurred in the absence of inflation targets" (see also (Mishkin and Schmidt-Hebbel, 2002), and (Mishkin, 2002)).

2. ***Stable ('more anchored') inflation:*** Central bankers pointed not just to declines in inflation but to declines in the volatility of inflation after IT adoption (see, e.g. (King, 2002)).

3. ***Better growth performance:*** Low and stable inflation contributes to better medium- and long-run growth performance ((Bernanke et al., 2000)).

4. ***Lower sacrifice ratio:*** (Gonçalves and Carvalho, 2009) and (Huang et al., 2019) found that economies that adopted IT were able to dis-inflate at a smaller output cost.

5. ***Wider effects of IT adoption:*** (Bernanke and Mishkin, 1997) and (Bernanke et al., 2000) also argue that there may be wider benefits of IT adoption. For instance, Bernanke and Mishkin argued that adoption of the IT framework leads to "more transparent and coherent policymaking, increased accountability, and greater attention to long-run considerations in day-to-day policy debates and decisions." IT is also said to improve communication between central banks and markets.

Along with academics and policymakers, international financial institutions (IFIs) like the IMF have also advocated adoption of IT by countries. Initially, some authors at the IMF ((Masson et al., 1997)) had been concerned that the prerequisites for successful adoption of an IT framework were "largely absent among developing countries." But by the mid-2000s the IMF viewed the experience of EMs that had adopted IT favorably. A notable example is IMF (2005), which concluded that "while the short time that has elapsed since the adoption of these frameworks certainly means that any assessment must be preliminary, the evidence from the initial years of operation [in EMs] is encouraging." [1]

Despite the strong early track record of IT, and the considered judgments of leading central bankers and IFIs on its benefits, some observers have been more skeptical of claims about the benefits of inflation targeting on a number of grounds.

First, some have pointed to the pervasiveness of the decline in inflation across countries and suggested that improved monetary management (including adoption of IT) is unlikely to have been the sole or major cause. An early and prominent example of this line of argument is a paper by the IMF's then-chief economist Ken Rogoff at the Jackson Hole conference ((Rogoff, 2003)). He noted that between 1992 and 2003, global inflation had dropped from 30 percent to 4 percent, and that this "breathtaking drop in inflation" had occurred in advanced and developing countries alike and in countries "facing significantly different institutional, political and historical circumstances." Rogoff argued that it was unlikely that improved monetary policy regimes deserved all of the credit for this pervasive decline and presented evidence that increased globalization could have a persistent—and not just a one-off—effect on prices and wages.[2] While this 'structural' view of inflation does not rule out a role for IT, or improved monetary management in general, these factors are not the dominant cause for the decline in inflation. Nor, under this view, is IT critical to the anchoring of inflation expectations; if inflation declines and remains low, inflation expectations will remain subdued regardless of IT adoption. Rogoff's paper has sparked a large literature on the

[1] The main authors of the paper, which appeared in the IMF's World Economic Outlook, were leading monetary economists—Nicoletta Batini, Ken Kuttner and Doug Laxton ((International Monetary Fund., 2005)); see also (Batini and Laxton, 2006). (Ball, 2010) reviewed studies on IT adoption in EMs and found that the evidence tended to be more favorable than for advanced economies, but he also pointed out reasons to be cautious about the robustness of the results—see section III of his paper and particularly the discussion in Appendix III of (Gonçalves and Carvalho, 2009).

[2] (Bhalla, 2017) explores the expansion in education in developing world – the "unlimited supply" of skilled labor as an explanation behind the moderation in inflation, while (Choi et al., 2018) offer unfettered mobility of capital as an explanation.

role of global factors in driving inflation. A comprehensive analysis by (Forbes, 2019) concludes that the explanatory power of basic models of inflation can be "meaningfully improved" by the addition of global variables, but this does not rule out a role for central banks or monetary frameworks.

Second, (Ball and Sheridan, 2004) have argued that 'regression to the mean' rather than IT could be responsible for the decline in inflation rates observed in IT adopters. They wrote that "just as short people on average have children who are taller than they are, countries with unusually high and unstable inflation tend to see these problems diminish, regardless of whether they adopt inflation targeting." In their study of 20 OECD countries, including 7 IT adopters, they found that—in data through 2001—it was regression to the mean that accounted for the lower inflation and not formal adoption of IT. They also found little difference in inflation volatility between IT and non-IT countries.

Third, some are skeptical about the benefits of IT to growth; in fact, they argue the opposite, namely that an enhanced or single-minded focus on achieving low and single-digit inflation targets can be deleterious for the rate of economic growth or raise the variability of growth. The point has been made in a number of papers (see (Meyer, 2002); (Rivlin, 2002); (Blanchard, 2003)), and particularly by (Friedman, 2003)), who opined that "inflation targeting fosters over time the atrophication of concerns for real outcomes" or "hides from public view whatever concerns for real outcomes policymakers do maintain."

In the two decades since such concerns were expressed, central banks have moved in the direction of flexible inflation targeting, which makes explicit the importance of real outcomes within an IT framework. Nevertheless, concerns that growth gets short shrift persist; for instance, (Anwar et al., 2017)) summarize the evidence in favor of the view that IT "can negatively affect growth and development in a number of ways," particularly a study by (Brito and Bystedt, 2010)) that found that IT actually resulted in lower output growth in a panel of 46 developing economies of which 13 were IT adopters using data for 1980 to 2006.[3]

This paper revisits the debate on the benefits of the formal adoption of inflation targeting, taking a look at each of these three arguments of the skeptics. We add two decades of evidence that has become available since the Rogoff and Ball and Sheridan papers. Over this period, several other advanced economies adopted IT, allowing us to see if the apparent success of the early adopters continued to hold for later adopters. Moreover, the passage of time also allows us to look into the durability of inflation gains made by the early adopters and whether any effects on growth are apparent. We also bring in the rich body of evidence from the inflation experiences of emerging markets and developing economies (EMDEs), a number of whom adopted inflation targeting in the 2000s and 2010s. Assessing the experience of these IT adopters can be particularly important in helping guide the decisions of the many central banks in the EMDE group that have still not adopted it.

[3]See (Chowdhury and Sundaram, 2022)) for a recent statement about the concerns that IT is bad for growth.

We use both panel data and country-level econometric analyses in our work.

1. To investigate if inflation anchoring differs between IT and non-IT groups we use the panel data framework of (Levin et al., 2004) and (Choi et al., 2018), which involves testing if inflation surprises lead to changes in inflation expectations.

2. Evidence on regression to the mean is provided using the panel data test suggested by Ball and Sheridan, which is to see if inclusion of pre-IT inflation levels in the estimation eviscerates the effect otherwise attributed to inflation targeting.

The panel data methods are useful in testing whether there are differences on average between the IT and non-IT groups. But it is also interesting to see if specific countries may have benefitted from IT. Hence, we complement the panel data evidence with a country-by-country comparison—using the synthetic control method (SCM)—of inflation and growth outcomes in IT adopters to counterfactual outcomes, namely the outcomes in a synthetic country that shared the profile of the IT adopters prior to adoption.

Based on the collective evidence from these methods, our findings on each of the three criticisms noted above are as follows. First, there is not much difference on average between IT and non-IT countries in mean inflation, inflation volatility or the extent of inflation anchoring. We find that inflation surprises have little effect on inflation expectations in both IT and non-IT countries. For countries with very high inflation rates (annual rates exceeding 20 percent), we find modest evidence that there is less inflation anchoring in non-IT countries than in IT countries. Our country-by-country SCM analysis shows that IT adoption delivers significant inflation gains in a few countries but not in the vast majority of our sample. Overall, our results lead us to conclude that formal adoption of IT is neither necessary nor sufficient for attaining low inflation outcomes. We explain our findings in two ways. First, the decline in inflation over the last three decades coincided with the formal adoption of inflation targeting. This makes it challenging to estimate the causal impact of the adoption of inflation targeting on inflation. In addition, theoretically, formal adoption of inflation targeting reduces inflation by 'anchoring expectations' and enhanced credibility of the central bank. The same, could, in theory be achieved through a persistent period of low inflation as experienced over the last three years. This too, contaminates the sample of non-targeters.

Second, 'regression to the mean' continues to offer a powerful possible explanation for the apparent effects of IT in advanced economies and, moreover, holds with strong force for emerging market economies as well.

Third, our evidence on the growth impacts of IT is mixed. From our panel data analysis we found little difference, on average, between IT and non-IT countries. But our country-level SCM analysis does show modest evidence that countries where the inflation declines from the adoption of IT were greater also experienced larger output declines; there is thus some limited support for the concern that inflation gains come at the expense of output. This is partly consistent with the observation of (Bernanke et al., 2000) where they note that disinflation, in particular the first disinflation under targeting does not appear to be less costly than it would be absent in inflation targeting.

The structure of the paper is as follows. In section II, we outline the dataset we use for our analysis. We also provide information on the inflation performance of IT adopters that are considered as full inflation targeters. Section III compares inflation, inflation volatility and anchoring of expectations in IT vs. non-IT countries. We find limited evidence to suggest that inflation targeting leads to reduced inflation volatility or better anchoring of inflation expectations. In Section IV we extend the Ball and Sheridan method while adding 2 decades of data and expanding their analysis to emerging markets. We find that their results of regression to mean hold up over time and are applicable even for emerging markets. In section V we provide the results from the Synthetic Control Method to find evidence of improved macroeconomic outcomes in inflation targeters. For some countries, IT leads to improved outcomes however, for most countries there is limited impact of a formal targeting framework. This suggests that the experience of IT as being a superior monetary policy framework is not as universal as it is often claimed. Section VI concludes with our interpretation of our findings and their implications.

2 Description of the Data

Our panel comprises a total of 190 countries, of which 24 are classified as advanced economies (AEs) and the remainder as emerging markets and developing economies (EMDEs). We use annual data on inflation and GDP compiled by the World Bank ((Ha et al., 2019)) and the IMF's International Financial Statistics. Inflation forecasts are from Consensus Forecasts; using forecasts from the IMF's World Economic Outlook gives similar results.

Table 1 shows the mean inflation rates by decade for the two country groups. There is a clear moderation over time in inflation rates in both groups.

Table 1: Mean Inflation in Advanced Economies and EMDEs

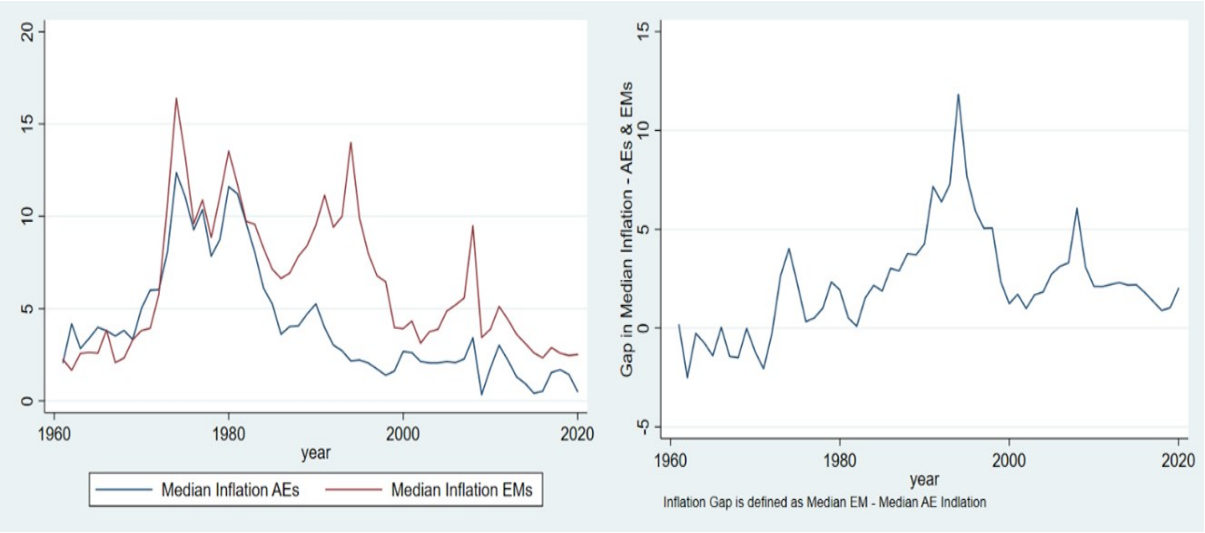
Period	**All**	**AE**	**EMDEs**
1990-99	5.3	3.0	5.9
2000-09	4.7	2.3	5.2
2010-19	3.4	1.3	3.7

We refer to a simple mean here, however, using population as weights does not change the results.
Source: World Bank

Looking over a longer time period, there is a similar decline in median inflation rates (Figure 2, left panel), suggesting that the movement of the mean is not driven simply by declines in a few high-inflation countries but is more widespread. After the run-up in inflation in the 1970s and early-1980s, the median inflation rate in advanced economies has trended down for the last three decades. In EMDE, median inflation remained high through the 1990s but has since also trended down (albeit with a flare-up during the Global Financial Crisis). The gap between median inflation in the two groups, which had increased to 10 percent by the 1990s has since closed substantially (Figure 2, right

panel).

Figure 2: Median Inflation, 1960-2020



: AE and EMDE : Gap Between AE & EM inflation

These decades of the great moderation in inflation coincided with increasing adoption of inflation targeting. Table 2 provides the list of countries that have adopted inflation targeting. Excluding the ECB and its constituent countries there are a total of 33 countries that have been identified as full-fledged inflation targeters, of which 9 are advanced economies. Issues with the data lead us to drop Kazakhstan and Argentina from the analysis.

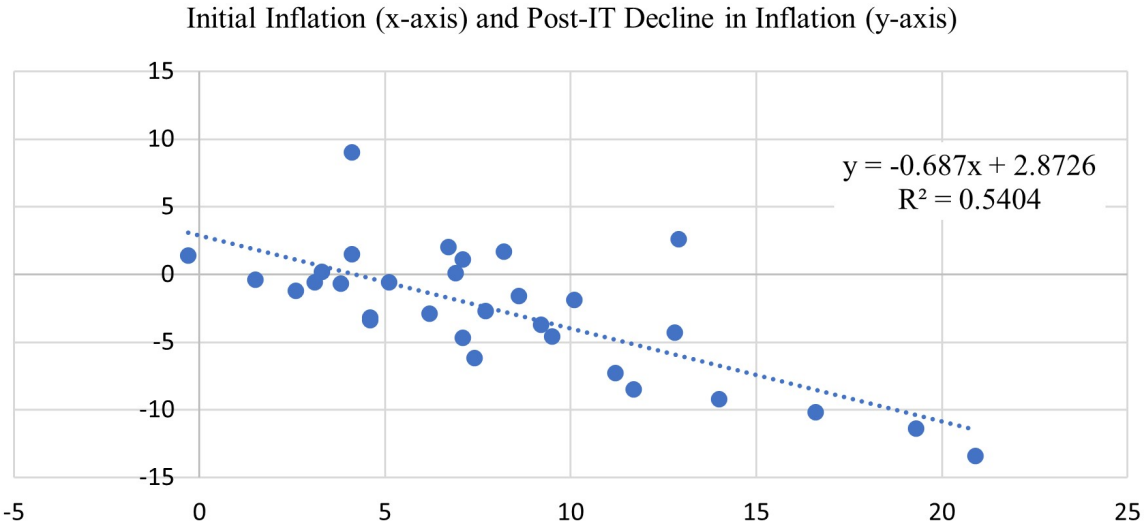
As a first test of whether IT adoption makes a difference to inflation outcomes, we compare the mean inflation rates in three years prior to and the three years after the IT adoption. As the directional arrows (↓) show, all 11 adopters in the first decade (1989-1999) saw post-adoption declines in mean inflation rates. In contrast, only half of the 22 subsequent adopters saw post-adoption declines. Figure 3 plots the extent of the post-IT decline in inflation against the initial inflation rate at the time of IT adoption. There is a very strong relationship: countries with high initial inflation rates saw bigger post-adoption declines in inflation rates. Of course, this relationship by itself does not tell us if IT adoption has a causal impact on inflation. Late adopters of IT did so when inflation had already declined, so the possibility—and the need—for making gains was limited.

Table 2: Adoption of Inflation Targeting—Country List and Summary Statistics

No.	Country	Year of IT Adoption	Average Inflation (over 3 years)		Change	Year of Structural Break in Inflation	
			Pre- IT	Post- IT		1960-2019	1990-2019
1	New Zealand	1989	11.7	3.2	↓	1988	2012
2	Canada	1991	4.6	1.2	↓	1983	1995
3	UK	1992	7.1	2.4	↓	1981	2014
4	Australia	1993	3.8	3.1	↓	1991	2000
5	Sweden	1993	7.4	1.2	↓	1992	1995
6	Czech R.	1997	9.2	5.5	↓	1999	1999
7	Israel	1997	11.2	3.9	↓	1988	2000
8	Poland	1998	20.9	7.5	↓	1992	1997
9	Brazil	1999	8.6	7.0	↓	1995	1997
10	Chile	1999	6.2	3.3	↓	1980	2014
11	Colombia	1999	19.3	7.9	↓	1999	1999
12	South Africa	2000	6.9	7.0		1993	2007
13	Thailand	2000	4.6	1.4	↓	1982	1999
14	Iceland	2001	3.3	3.5		1984	2008
15	Mexico	2001	14.0	4.8	↓	1989	2000
16	Norway	2001	2.6	1.4	↓	1989	2004
17	Peru	2002	3.1	2.5	↓	1992	1996
18	Philippines	2002	5.1	4.5	↓	1987	1995
19	Guatemala	2005	7.1	8.2		1994	2015
20	Indonesia	2005	8.2	9.9		1998	2000
21	Romania	2005	16.6	6.4	↓	2005	2005
22	Armenia	2006	4.1	5.6		2001	2001
23	Turkey	2006	12.8	8.5	↓	1999	2003
24	Ghana	2007	12.9	15.5		1984	1997
25	Georgia	2009	9.5	4.9	↓	2012	2012
26	Serbia	2009	10.1	8.2	↓	2002	2002
27	United States	2012	1.5	1.1	↓	1982	2009
28	Japan	2013	-0.3	1.1		1981	1999
29	Russia	2014	6.7	8.7		2015	2015
30	Kazakhstan	2015	-	-		-NA-	-NA-
31	Ukraine	2015	4.1	13.1		1997	1997
32	Argentina	2016	-	-		-NA-	-NA-
33	India	2016	7.7	5.0	↓	1979	2008

We use the Zivot Andrews Test to identify the year for structural beaks in the data and look for breaks in both trend and intercept. Full sample represents the data from 1960 – 2019.

Figure 3: Change in Inflation and Initial Inflation in IT countries



To dig a big further into whether IT adoption had an impact, we look for structural breaks in the inflation series in a five-year window around the time of adoption.[4] If we use the full 1960-2019 sample period, 4 of the 11 early adopters had breaks close to the year of adoption, compared with 3 of the 22 later ones; the corresponding numbers are 6 in each case if we restrict the sample to the post-1990 period. There is therefore some modest support, that IT adoption may have helped lower trend inflation in some countries. However, as noted earlier, there was a strong downward trend in inflation rates over the past three decades for almost all countries. To further tease out the possible effects of IT adoption, we now turn to a comparison of IT vs. non-IT countries.

3 Inflation in IT vs. Non-IT Countries: Level, Volatility, Anchoring

3.1 Level and Volatility

Table 3 shows mean and median inflation for IT and non-IT regimes for the two country groups (AE and EMDE).

[4]We use the (Zivot and Andrews, 2002) test for identification of endogenous structural breaks. It is a sequential test that uses different dummy variables for every potential break date. The break date is selected using the t-statistic from the Augmented Dickey Fuller Test for unit root. The minimum value of t-statistic is used for selection of the break date. We start the window in the year prior to adoption to allow for announcement effects or for the possibility that transition to IT may have begun the year before formal adoption. See also (Creel et al., 2010).

Table 3: Average Inflation in IT and Non-IT Country Groups

	Number of Countries		Mean Inflation		Median Inflation	
	IT	Non-IT	IT	Non-IT	IT	Non-IT
Advanced Economies						
1990-99	5	22	2.0	3.1	2.3	2.7
2000-09	7	19	2.8	2.1	2.2	2.2
2010-19	9	17	1.8	1.2	1.4	1.5
Emerging Markets & LDCs						
1990-99	6	123	7.2	5.4	5.1	8.4
2000-09	19	147	4.7	5.0	5.0	4.7
2010-19	22	139	4.0	3.5	3.1	3.1

Table 4: Average Inflation Volatility

	IT Regime	Non-IT Regime
Advanced Economies		
1990-99	1.5	2.3
2000-09	2.2	1.4
2010-19	1.1	1.2
Emerging Markets & LDCs		
1990-99	3.2	4.4
2000-09	3.0	4.1
2010-19	2.7	3.4

Inflation Volatility is measured by the standard deviation

It is evident that there is a striking similarity in the pattern of decline in average inflation rates between IT and non-IT countries for both groups. Over the 2000-19 decade, average inflation rates have been quite similar in the two regimes; if anything, inflation has been lower in the non-IT regime on average. Turning to inflation volatility, we again find a decline in both IT and non-IT regimes over time, but IT countries have lower inflation volatility (Table 4).

3.2 Inflation Anchoring

Table 5 provides summary statistics for inflation forecasts for 3-year ahead, 5-year ahead and 10-year ahead inflation. For advanced economies, there is limited material difference in mean inflation expectations, irrespective of whether a country is an inflation targeter or not. Further, inflation expectations, whether short-, medium- or long-run have moderated substantially over the last three decades for advanced and emerging economies. The non-inflation targeters have had somewhat lower average inflation expectations in the last decade compared to their inflation targeting peers.

Table 5: Mean Inflation Expectations

	Inflation Targeters			Non-Inflation Targeters		
	3-	5-	10-	3-	5-	10-
	years ahead			years ahead		
Advanced Economies						
1990-99	2.5	2.4	2.4	2.5	2.5	2.5
2000-09	2.0	2.0	2.0	1.9	1.9	1.9
2010-19	1.9	1.9	1.8	1.7	1.8	1.8
Emerging Markets						
1990-99				6.0	5.5	5.2
2000-09	3.7	3.5	3.5	3.5	3.4	3.3
2010-19	3.7	3.6	3.5	3.0	2.9	2.9

We exclude high inflation observations, defined as an inflation rate above 20 per cent.

Table 6: Standard Deviation of Inflation Expectations

	Inflation Targeters			Non-Inflation Targeters		
	3-	5-	10-	3-	5-	10-
	years ahead			years ahead		
Advanced Economies						
1990-99	2.5	2.4	2.4	2.5	2.5	2.5
2000-09	2.0	2.0	2.0	1.9	1.9	1.9
2010-19	1.9	1.9	1.8	1.7	1.8	1.8
Emerging Markets						
1990-99				6.0	5.5	5.2
2000-09	3.7	3.5	3.5	3.5	3.4	3.3
2010-19	3.7	3.6	3.5	3.0	2.9	2.9

We exclude high inflation observations, defined as an inflation rate above 20 per cent.

Another important feature of inflation expectations is whether they are well anchored around a particular level. As a preliminary test, well-anchored inflation expectations would imply lower standard deviation of inflation expectations. Table 6 shows that non-inflation targeters have a lower standard deviation in inflation expectations for advanced economies than their inflation targeting peers. This is true for 3-, 5- and 10-years ahead inflation expectations. Further, there is a reduction in the standard deviation of expectations over the last three decades. For emerging markets, the non-inflation targeting countries exhibit a slightly higher standard deviation than their inflation targeting peers, perhaps reflecting the somewhat higher volatility of inflation noted earlier.

Following this preliminary look at the data which does not show material difference between the IT and non-IT groups, we follow the statistical approach of (Levin et al., 2004) and (Choi et al., 2018) to assess formally the extent of anchoring of inflation expectations: if inflation expectations are anchored, inflation surprises should have little impact on changes in long-term inflation expectations. Specifically, we estimate

the following equation;

$$\Delta\pi^{e}_{t+n} = \alpha + \theta_j + \beta_1 Inflation\ Surprise + \beta_2 Median\ Inflation + \epsilon_t \quad (1)$$

where $_j$ represents country fixed effects and *Inflation Surprise* is defined as the deviation from the 3-period moving average, that is, the difference between inflation in period t and the 3-period moving average for inflation at time t-1.

Table 7 presents the results of the estimation for 3-year ahead inflation expectations (i.e., for n=3 in the equation above). The main finding is that inflation surprises have no impact of inflation expectations in either the IT or the non-IT regime. [5]
It could be that inflation targeting is particularly helpful in anchoring expectations

Table 7: Determinants of 3-Year Ahead Inflation Expectations

	Advanced Economies		Emerging Economies	
	IT	Non-IT	IT	Non-IT
Inflation Surprise	0.00	0.00	0.11	0.00
	(0.01)	(0.00)	(0.07)	(0.00)
Median CPI Inflation	0.054	0.12***	0.05	0.06*
	(0.03)	(0.02)	(0.04)	(0.02)
Constant	-0.12	-0.33***	-0.33	-0.35*
	(0.05)	(0.04)	(0.14)	(0.11)
R-Square	0.033	0.089	0.13	0.02

** p<0.05, ** p<0.01, ***p<0.001*

in countries experiencing high inflation. We define High Inflation Economies as those which have had at least one year of inflation above 20 per cent. Table 8 provides the results. Here, we do find modest evidence that inflation expectations are more anchored in IT adopters; though the coefficient estimates are not significantly different from zero, they are larger in non-IT countries than in IT countries.

Table 8: Determinants of Inflation Expectations for High Inflation EMs

	3-Yr Ahead Inflation Expectations		5-Yr Ahead Inflation Expectations	
	IT	Non-IT	IT	Non-IT
Inflation Surprise	0.03	0.11	0.01	0.10
	(0.02)	(0.07)	(0.02)	(0.07)
Median CPI Inflation	0.03	0.02	0.03*	-0.42
	(0.02)	(0.43)	(0.01)	(0.65)
Constant	-0.08	1.26	-0.15**	4.03
	(0.06)	(1.68)	(0.04)	(2.55)
R-Square	0.01	0.00	0.01	0.00

** p<0.05, ** p<0.01, ***p<0.001*

[5] We undertook the same estimation with changes in 5 and 10 years ahead expectations and the results remain unchanged.

4 Inflation Growth in IT vs. non-IT Countries: Cross-Country Results

To uncover the effects of IT on inflation (or growth) outcomes, we use the differences-in-differences approach proposed by Ball and Sheridan. For their sample of 20 OECD countries, of which 7 were inflation targeters, they ran the regression:

$$X_{post} - X_{pre} = \alpha_o + \alpha_1 D + \alpha_2 X_{pre} + \epsilon \tag{2}$$

where X_{post} is a country's average value of inflation in the post-IT period, X_{pre} is the average value of inflation in the pre-targeting period, and D is a dummy variable equal to 1 if the country is a targeter. They argued that including X_{pre} on the right hand side was critical to measuring the true effect of IT (given by a_1 above) because it controls for regression to the mean. Without the inclusion of this variable, it could be the case that if IT adopters were starting out from poor initial inflation performance, they would improve more than non-IT adopters, even if IT does not affect inflation performance. But if a_1 was significantly negative once X_{pre} was included, "then a targeter with poor initial performance improves more than a non-targeter with equally poor initial performance."

Their estimation approach was replicated by (**?**)for emerging markets. (Geraats, 2013) however illustrates that equation 2 leads to a biased estimate of the treatment effect of inflation targeting. While commenting on Ball (2010), (Geraats, 2013) argues that equation (2) gives an unbiased estimator of the treatment effects of inflation targeting under the special case where the structural inflation dynamics are same across both inflation targeters and non-targeters. This is a strong assumption; however, sections II and sections III above show that the trends in the level of inflation and its volatility have been similar across the groups over the last three decades.

Ball and Sheridan used quarterly data from 1960 to 2001 period in their regressions. They used two starting points to measure the pre-IT period, 1960 and 1985 (i.e. the corresponding periods were 1960 to the year before IT adoption and 1985 to the year of IT adoption). In the main text of the paper we report results with 1985 as the starting point; the results if we start in 1960 are fairly similar and are provided in the Appendix.

We begin by checking if the use of annual rather than quarterly data makes a material difference to the BS results. The regression in the first column of Table 9 is taken from their paper, while the one in column (2) is with our annual data. It is evident that the two are virtually identical in magnitude and significance of the coefficient estimates and overall explanatory power; hence both (misleadingly) point to a large impact from IT. The regression in column (3) is again directly from BS and shows that adding the initial inflation performance sharply attenuates the estimated impact of IT (the coefficient drops from -2.19 to -0.55 and is no longer significant). With annual data, as shown in column (4), we get a similar strong impact from the inclusion on X_{pre}, though the drop is not as sharp (-2.32 to -1.14) and the effect of IT is statistically significant. Overall, therefore, it does not seem that the use of annual data diminishes the thrust of the BS argument.

Table 9: Impact of IT on Inflation

	$X_{post} - X_{pre}$			
	Ball & Sheridan	Our Computation	Ball & Sheridan	Our Computation
	(1)	(2)	(3)	(4)
IT Dummy	-2.19*	-2.32*	-0.55	-1.14**
	(0.88)	(1.03)	(0.35)	(0.30)
Inflation (Pre)			-0.74***	-0.77***
			(0.08)	(0.04)
Constant	-1.77**	-1.79**	1.12***	1.44***
	(0.52)	(0.58)	(0.32)	(0.24)
R-Square	0.21	0.23	0.90	0.93
N	20	20	20	20

** p<0.05, ** p<0.01, ***p<0.001*
Note – (1) & (3) use quarterly data while (2) & (4) use annual data.

We now extend the results to bring in data through 2019 and to provide evidence for EMDEs (A minor change is to add three advanced economies to the sample). The regressions in columns (1) and (2) of Table 10 show extending the data to 2019 does not change the BS finding for advanced economies in essence. Adding X_{pre} leads to a sharp reduction in the point estimate of the impact of IT (from about -1 to essentially 0). However, the estimated impact is not statistically different from zero in either case.

For EMDEs, the results are striking. As shown in column (3), without X_{pre}, the estimated impact of IT is very strong in magnitude and statistically different from zero—a reduction in average inflation rates by -4.75 percentage points. But once X_{pre} is included, as in column (4), the estimated impact falls considerably (to -0.78 percentage points) and is no longer statistically different from zero. Hence, regression to the mean can explain the apparent success of IT in lowering EM inflation.

Our results are different from (Gonçalves and Salles, 2008) due to the exclusion of high inflation economies from our analysis. In addition, they note that their p values are not below the 5% threshold due to a small sample of countries. Our sample is substantially larger and covers a longer time period. Further, when they substitute inflation volatility for inflation, they find no strong evidence to suggest that adopting IT has any significant difference.

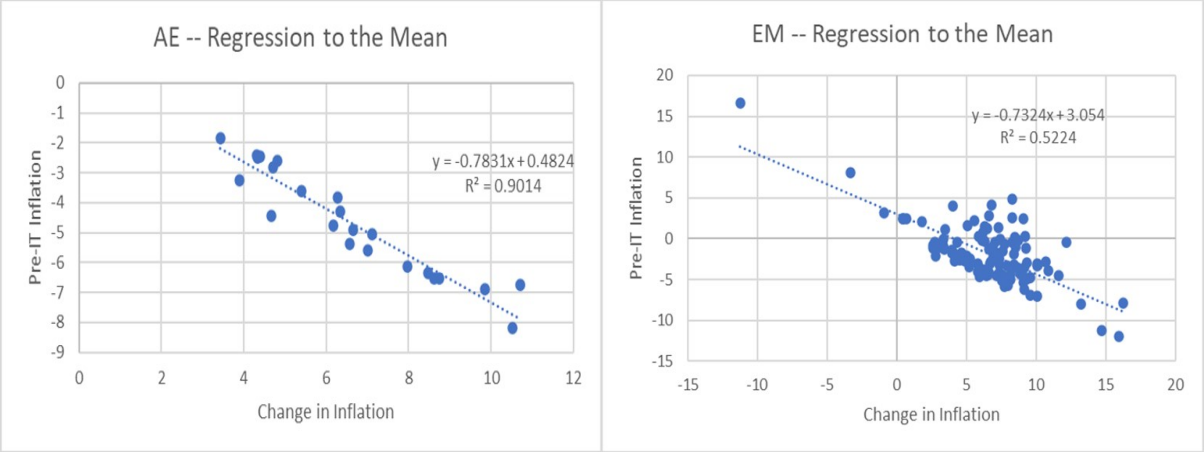
Figure 4 illustrates the strong regression to the mean for both advanced economies and EMDEs: the higher the initial inflation rate, the greater is the subsequent decline in inflation.

Table 10: Impact of IT on Inflation

	$X_{post} - X_{pre}$			
	AE	AE	EM	EM
	(1)	(2)	(3)	(4)
IT Dummy	-1.02	0.00	-4.75***	-0.78
	(1.30)	(0.27)	(1.28)	(0.79)
Inflation (Pre)		-0.87***		-1.01***
		(0.04)		(0.05)
Constant	-3.04**	1.19***	-1.74***	2.76***
	(0.97)	(0.23)	(0.45)	(0.41)
R-Square	0.03	0.97	0.12	0.77
N	23	23	101	101

** p<0.05, ** p<0.01, ***p<0.001*
Details of pre & post period for countries are provided in the appendix.

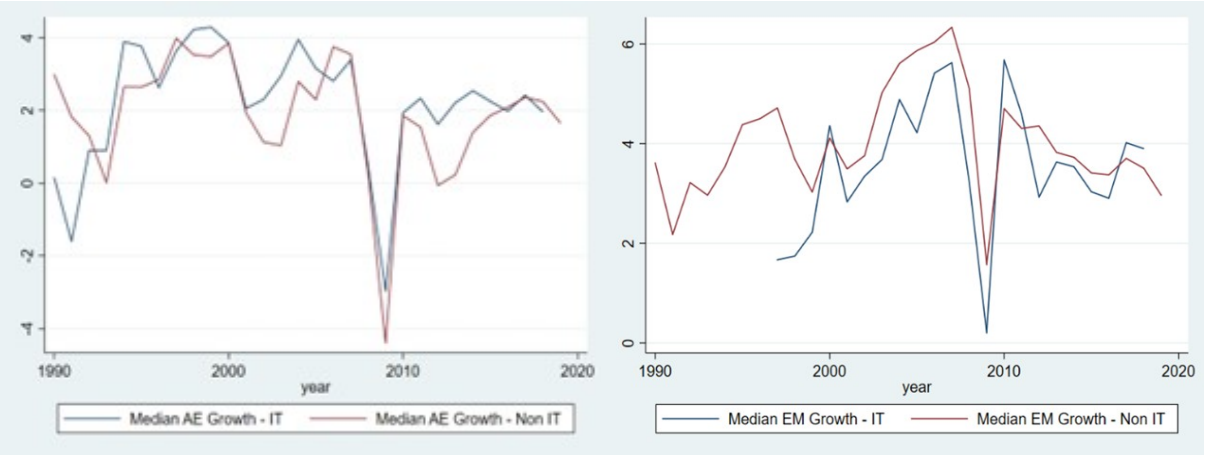
Figure 4: Illustration of Regression to the Mean



: AEs : EMDCs

We turn now to the growth impacts of the adoption of IT. Figure 5 shows that there is not much difference between median growth in the IT and non-IT groups for both advanced and emerging economies.

Figure 5: Illustration of Regression to the Mean



: AEs : EMDCs

The results in Table 11 bear this out. For both groups, the IT dummy is not significantly different from zero. So while there is regression to the mean in growth, as in inflation, there is scant evidence of IT having an impact on growth in the first place.

Table 11: Impact of IT on Growth

	$X_{post} - X_{pre}$			
	AE	AE	EM	EM
	(1)	(2)	(3)	(4)
IT Dummy	0.79	0.49	-0.48	-0.01
	(0.61)	(0.41)	(0.91)	(0.43)
Lagged Growth		-0.80**		-1.01***
		(0.22)		(0.05)
Constant	-0.86*	1.44***	0.17	4.09***
	(0.33)	(0.52)	(0.61)	(0.31)
R-Square	0.08	0.51	0.00	0.86
N	23	23	101	101

** p<0.05, ** p<0.01, ***p<0.001*
Details of pre & post period for countries are provided in the appendix.

To show that the Ball Sheridan specification holds when the assumption of similar structural inflation level across both groups is satisfied, then as shown by (Geraats, 2013), for inflation process defined as

$$X_{it} = \mu_{ot} + \epsilon_{it} for I_i = 0 \quad (3)$$

$$X_{it} = \mu_{1t} + \epsilon_{it} for I_i = 0 \quad (4)$$

Where μ_{0t}=μ_{1t}
And σ^2_{0t}=σ^2_{it}=σ^2_t

For the special case where we assume that the selection into inflation targeting is based on

$$I_i = u_o + u_1 X_{1i} + \eta_i$$

and η_i is assumed to be independent of X_i, we get an unbiased estimator as shown in (Ball, 2010)

However, (Geraats, 2013) argues that given that the dependent variable here is an indicator function, therefore η_i must depend on X_i. When η_i depends on X_i then we do not have an unbiased treatment effect using the Ball and Sheridan specification.

There is evidence of a selection bias in adoption of inflation targeting. (Gonçalves and Carvalho, 2009) explored this issue while studying the impact of inflation targeting on sacrifice ratios for OECD economies. To correct for the selection bias, they used the two-stage Heckman procedure and found a link between inflation targeting and lower sacrifice ratios.

5 Inflation Growth in IT vs. Non-IT Countries: Country-Level Analysis

The previous section has used panel data to look for differences between outcomes of IT and non-IT countries. These methods are useful to test whether average outcomes differ between the two groups. In this section, we supplement this evidence on the average effects of IT with a country-level analysis of the impact of IT in each country that formally adopted it.

Specifically, we use the Synthetic Control Method (SCM), which compares the impact of policy interventions by comparing outcomes in the country carrying out the intervention (the 'treatment' country) with those of a synthetic cohort (the 'control' group) that did not carry out the intervention but was similar to the treatment country prior to the intervention. The cohort can be a weighted-average composite of other countries rather than a single country. In our case, we compare each IT-adopting country with a synthetic cohort of countries that did not adopt IT.

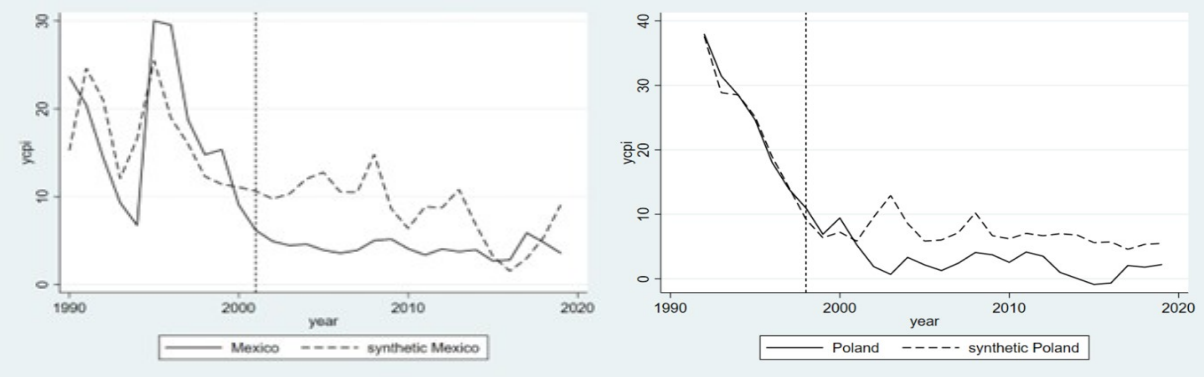
The method, developed by (Abadie and Gardeazabal, 2003), has become an important analytical tool to study the impacts of policies and shocks. For instance, (Billmeier and Nannicini, 2013) use it for studying the effects of trade liberalization on growth and (Adhikari et al., 2018) study the impacts of labor and product market reforms in advanced economies during the 1990s and 2000s. As discussed in these papers, SCM does require several decisions, such as the set of countries to include in the control group, the length of the pre- and post-treatment period, and how close the match should be between treatment and control in the pre-treatment period. Nevertheless, used judiciously the method provides an interesting complement to evidence from

other sources.[6]

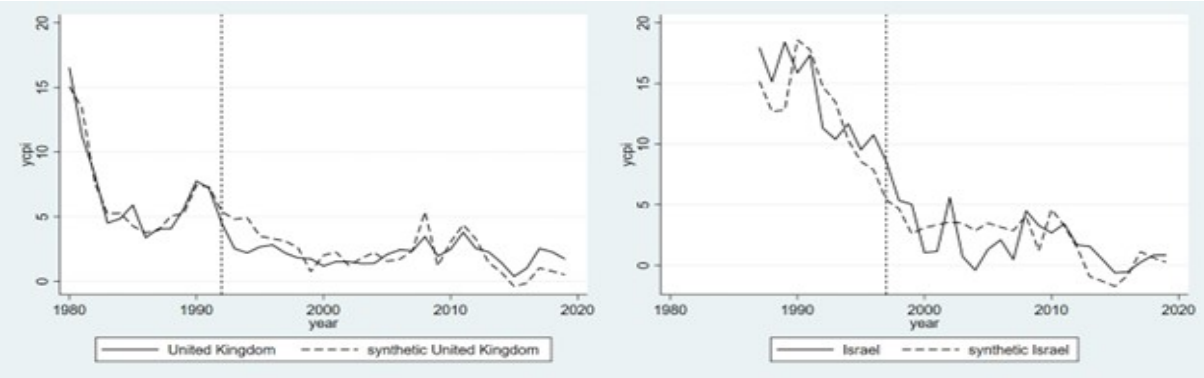
To illustrate the SCM, Figure 6 looks at four specific cases, two where IT appears to have delivered good outcomes and two where it did not make a difference. The left-hand side of Panel A compares the experience of Mexico with its synthetic cohort. As shown, the experience of the two in the pre-treatment period is similar in its gyrations. After the adoption of IT, Mexico clearly had noticeably lower inflation than its counterpart. In the case of the Poland (right-hand side of Panel B, the evolution of inflation in the treatment and control groups is remarkably close in the pre-treatment period, but Poland's inflation is much lower than that of its synthetic counterpart after it's adoption of inflation targeting.

Figure 6: Adopters vs. Synthetic Counterparts—Illustrative Examples

: Panel A: Success Cases



: Panel B: No Impact Cases



[6]After work on this paper was well underway, we became aware that (Duncan et al., 2021) also use the SCM to investigate the effects of IT on inflation. Our work looks at advanced economies as well and also at the impact of IT on growth. Moreover, the SCM results of our section are a part of our paper, with the evidence using other methods presented in earlier sections providing a fuller picture of the impacts of IT.

Panel B shows two cases, the United Kingdom and Israel, where the adoption of IT does not seem to have affected the inflation outcome. In the UK case, the evolution of inflation essentially tracks that of the synthetic cohort very closely over the whole period, with the adoption of IT not making much difference. A similar finding holds for Israel, though inflation is more volatile in the country than in the synthetic control.

The results for the full set of IT-adopting countries is given in Table 12. In this table, we first provide the root mean square prediction error (RMSPE) between inflation outcomes in the IT-adopter and its synthetic cohort in the pre-adoption period. Smaller numbers indicate a better match, as is the case with the Poland and UK examples just discussed. In most cases the RMSPE is below 3. The table then shows the gap between the average inflation in the five years post-IT adoption between the IT country and its synthetic cohort, and the p-values associated with a T-test of whether the gap is statistically significant. In the case of Mexico that was shown above, for instance, the gap is -6.84 (p=0.00), while in Israel's case the gap is 0.20 (p=0.74), confirming the visual impression conveyed by the charts that Mexico was a successful case while Israel was not, at least through the lens of the SCM. Table 12 also provides a similar set of statistics—RMSPE, gap and p-values—for growth.

We use the T-test as it allows us to test for the difference in the mean for two samples. We perform a two-sided test here for both inflation and growth to test for statistically significant difference between the actual inflation (or growth) and the synthetic counterpart for each country. We construct the test statistic under the null hypothesis of no difference between the two sample means.

In addition to the country tests, we evaluate whether inflation targeting led to lower inflation or higher growth on an average across the countries that adopted IT. We consider the 5 year post inflation targeting period and conduct the two-sided T-test. Under the null, there is no difference between actual inflation or growth and its synthetic counterpart. This is true for all observations across countries. This allows us to construct a test statistic that follows the T-distribution. This allows us whether adoption of inflation targeting on an average led to a significant difference in inflation and growth. Further, we perform the T-test on sub-sample of countries classified as advanced and emerging market economies.

What do the results show? In 8 of the 23 cases, IT-adoption is associated with lower average inflation compared with the synthetic cohort; in three cases (Colombia, Mexico, Poland), the difference is statistically significant (using a cut-off of p ¡ 0.05). In the remaining 15 cases, there is either no difference in average inflation performance or average inflation is actually higher in the IT adopter than in the synthetic cohort.

Turning to growth impacts, in 11 of the 23 cases, IT-adoption is associated with higher average real GDP growth compared with the synthetic cohort, and significantly so in four of those cases (Ghana, Indonesia, Peru, Philippines). In the other 12 cases, there is either no difference in average growth performance or average growth is lower in the IT adopter than in the synthetic cohort.

Table 12: Inflation and Growth Outcomes in IT Adopters vs. Synthetic Counterparts

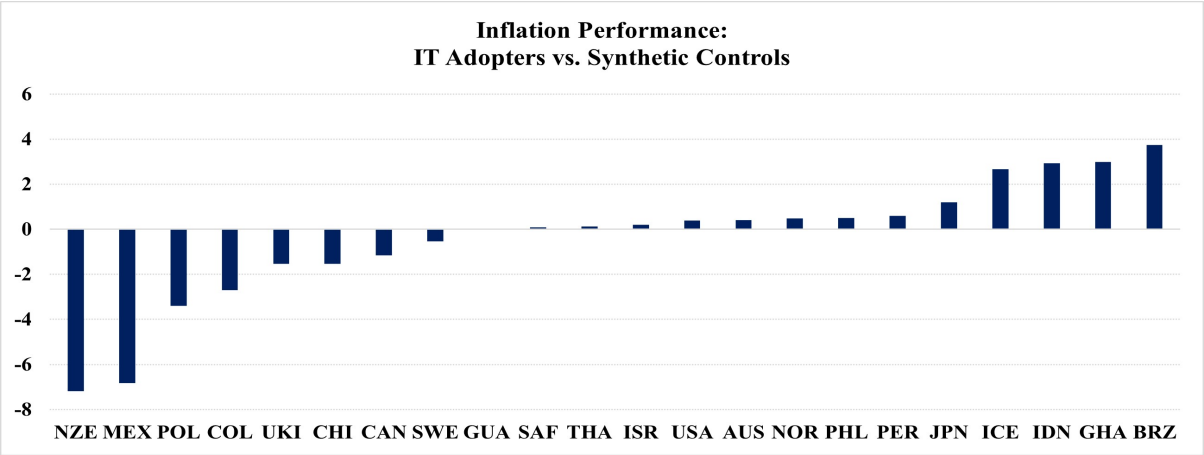
S. No	Country	Inflation			Growth		
		RMSPE	Gap	T-test P values	RMSPE	Gap	T-test P values
1	Australia	2.76	0.41	0.00	1.58	-1.38	0.67
2	Brazil	2.35	3.74	0.07	1.81	0.90	0.02
3	Canada	1.54	-1.15	0.71	2.95	-0.79	0.39
4	Chile	1.45	-1.53	0.07	2.19	1.12	0.71
5	Colombia	4.70	-2.71	0.05	1.36	1.26	0.44
6	Ghana	5.96	2.99	0.23	0.89	4.67	0.01
7	Guatemala	1.61	0.03	0.75	1.11	-1.04	0.06
8	Iceland	1.24	2.66	0.00	1.48	1.27	0.36
9	India	2.67	NA	0.73	2.28	NA	0.48
10	Indonesia	14.19	2.93	0.02	5.40	0.57	0.00
11	Israel	3.35	0.20	0.74	2.83	-3.56	0.42
12	Japan	1.21	1.20	0.06	1.50	-0.45	0.37
13	Mexico	7.84	-6.82	0.00	3.23	-1.30	0.08
14	New Zealand	3.12	-7.18	0.26	2.78	-2.20	0.31
15	Norway	1.56	0.48	0.96	1.58	-0.76	0.37
16	Peru	1.52	0.59	0.25	2.35	2.40	0.02
17	Philippines	2.49	0.51	0.78	2.14	0.72	0.00
18	Poland	2.28	-3.40	0.00	0.78	0.52	0.67
19	South Africa	0.84	0.08	0.21	1.62	0.00	0.13
20	Sweden	2.62	-0.54	0.17	1.53	-0.74	0.52
21	Thailand	1.73	0.12	0.02	3.18	1.07	0.53
22	United Kingdom	1.08	-1.54	0.68	2.00	0.08	0.83
23	United States	0.73	0.38	0.22	1.16	-0.36	0.55
	5-year post IT						
	21 Countries			0.24			0.71
	Advanced Economies			0.07			0.24
	Emerging Markets			0.77			0.21

Notes - Gap is defined as actual - synthetic inflation/growth averaged over 5 years post IT years
For countries that adopted IT in early to mid-2010s we have a fairly small post-IT sample size
The P values are for the t-test to check for any statistical difference between the synthetic & the actual for the entire post IT period.
We perform the two-side t-test here with the null hypothesis that there is no difference between IT and its synthetic counterpart.

Figure 7 provide an illustration of the results by showing the gap between IT-adopters and the synthetic cohort for inflation (Panel A) and growth (Panel B). It is evident that inflation outcomes are lower in IT-adopters in only a small number of cases, while the growth outcomes are split about evenly (i.e. growth is just as likely to be lower in the IT-adopter as higher). The results in Table 12 and Figure 7 thus support the findings of the previous sections that IT-adoption seems neither necessary nor sufficient for better macroeconomic outcomes.

Figure 7: IT and Growth Performance – Synthetic Control Analysis

: Panel A: Inflation



: Panel B: Growth

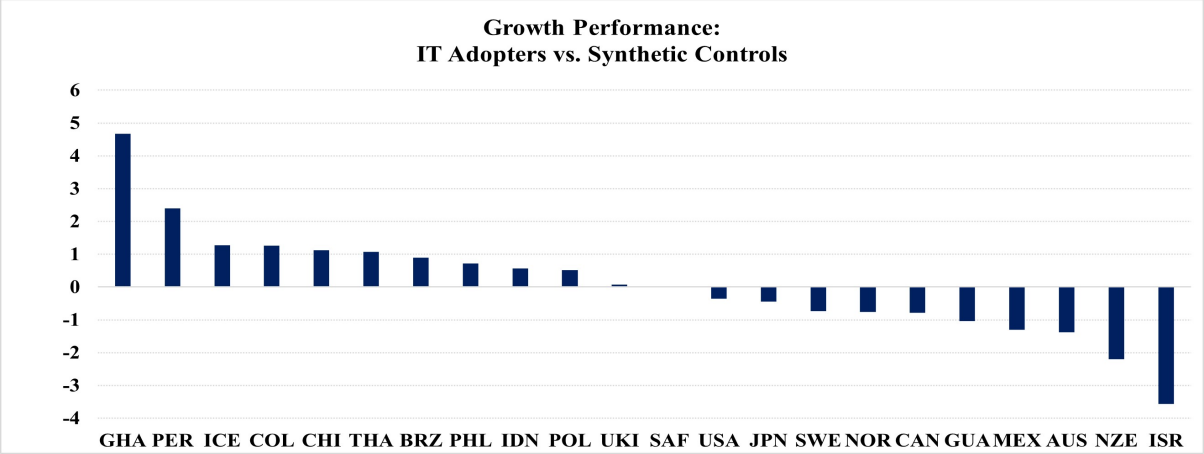
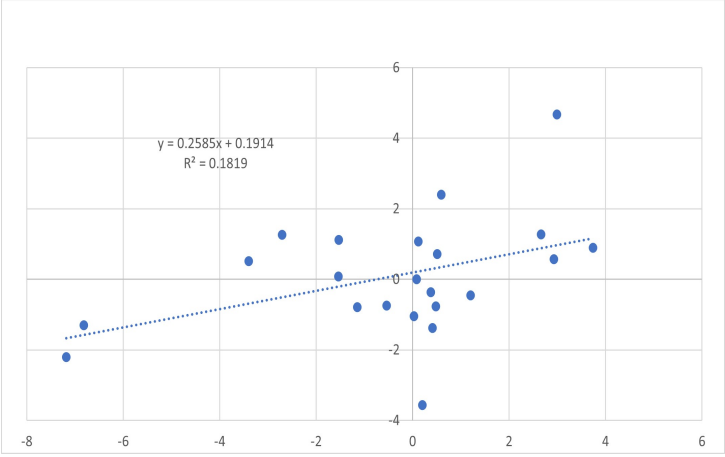


Figure 8: IT and Growth Performance – Synthetic Control Analysis



As a final result that deserves greater attention in future work, Figure 8 shows the correlation between the inflation gap and the output gap across countries. As shown, there is a modest positive correlation between the two, viz., IT-adopting countries that had better inflation outcomes than their synthetic cohorts also tended to have worse growth outcomes than their synthetic cohorts. As noted in the introduction, (Friedman, 2003) and others had worried that a single-minded focus on inflation would come at the expense of a focus on growth, and this correlation provides a glimmer of evidence in that direction.

6 Conclusion

In their conclusions, Ball and Sheridan wrote that "a paper that replicates this study in twenty-five or fifty years may find ample evidence that [inflation] targeting improves performance. The evidence is not there, however, in the data through 2001." Our results suggest that the evidence is still not there in the data through 2019, even though we have used a much wider array of methods than in Ball and Sheridan and a broader set of countries that includes both advanced economies and EMDEs. To review our results, we find that:

1. Though early IT-adopters saw inflation declines post adoption, only half of the 22 subsequent adopters saw post-adoption inflation declines (Section II).

2. There is no difference between IT-adopters and other countries in the average level and volatility of inflation; likewise there is no difference in expected inflation and no difference in the anchoring of inflation between the two groups (Section III).

3. Regression to the mean continues of offer a plausible explanation for the assumed benefits of IT-adoption, and we have shown that it holds for EMDEs just as well as for advanced economies (Section IV).

4. A comprehensive country-level analysis comparing inflation and growth outcomes in IT-adopters with a counterfactual turns up little evidence that adoption improves macroeconomic performance (Section V).

We conclude with our views on the interpretation and implications of our findings. First, it has become commonplace for central bankers and international financial institutions to assert the benefits of the adoption on inflation targeting. We do not deny that these claims sometimes rest on a more sophisticated judgment about the evidence than can be obtained through either broad cross-country regressions or the country-by-country SCM approach (see, e.g., (Roger, 2009)). However, central banks and IFIs could nevertheless benefit from looking at the evidence on IT with a more critical eye, given the dangers of groupthink at these institutions as highlighted in some quarters (Staff, 2011). This is particularly important given the findings of (Balima et al., 2017) and (Balima et al., 2020) who carry out a meta-analysis of the effects of IT using a data set of 8,059 estimated coefficients from a sample of 113 studies. They find that the empirical literature suffers from publication biases because "authors, editors and reviewers prefer results featuring beneficial effects of IT adoption" and "they promote

results with estimated coefficients that are significantly different from zero".[7]

Second, proponents of IT could still make the case that even countries that have not formally adopted IT have nevertheless improved monetary management by adopting IT-like practices. Under this line of argument, however, it is not clear why IFIs should continue to advocate formal adoption of IT, since our results show that formal adoption is neither necessary nor sufficient to the attainment of beneficial inflation and growth outcomes. Instead, the focus ought to be on why some countries had better outcomes than others, and what could be learned from their experience that would be useful to other countries.

Third, our results do not provide a full cost-benefit analysis of inflation targeting. There are several possible advantages to IT that we have not considered here. At the same time, adherence to IT can also lead to policy mistakes if policymakers become too focused on attaining the inflation objective to the detriment of other objectives. In a companion paper, we attempt to provide a fuller cost-benefit analysis of India's adoption on inflation targeting.

Fourth, to us the results of this paper suggest that alternative explanations for the great moderation in inflation should be given serious consideration. The main alternative explanation is that various structural factors, such as demographic changes and globalization have played a key role in moderation of inflation over the last few decades. In ongoing work, we are looking into whether these factors can offer an explanation for the evolution of inflation and what role IT-adoption plays over and above these factors.

[7] Interestingly, the working paper version of their paper states that the "genuine effect"—the effect after filtering out the publication biases—of IT on inflation is small (p. 15, line 6) while the published version states that it is large (section 4.1.2).

A Appendix

A.1 High Inflation Economies

We defin high inflation economies as those that experienced at least one year of greater than 20 per cent inflation during the last three decades.

Table 13: High Inflation Economies

S. No.	Country	S. No.	Country	S. No.	Country
1	Afghanistan	26	Estonia	51	Malawi
2	Albania	27	Ethiopia	52	Mali
3	Algeria	28	Gabon	53	Mexico
4	Azerbaijan	29	Ghana	54	Moldova
5	Brazil	30	Guinea	55	Mongolia
6	Bulgaria	31	Guinea-Bissau	56	Myanmar
7	Burundi	32	Haiti	57	Nicaragua
8	Cambodia	33	Honduras	58	Niger
9	Cameroon	34	Hungary	59	Nigeria
10	Chad	35	Indonesia	60	Pakistan
11	China	36	Iraq	61	Paraguay
12	Colombia	37	Islamic Republic of Iran	62	Peru
13	Costa Rica	38	Jamaica	63	Poland
14	Cote d'Ivoire	39	Kenya	64	Romania
15	Croatia	40	Kyrgyz Republic	65	Russia
16	Democratic Republic of the Congo	41	Lao P.D.R.	66	Sao Tome And Principe
17	Dominican Republic	42	Latvia	67	Senegal
18	Ecuador	43	Liberia	68	Serbia
19	Egypt	44	Lithuania	69	Seychelles
20	Equatorial Guinea	45	Madagascar	70	Slovenia
21	Tajikistan	46	Uruguay	71	South Sudan
22	Tanzania	47	Venezuela	72	Sri Lanka
23	The Bahamas	48	Viet Nam	73	Sudan
24	Turkey	49	Yemen	74	Suriname
25	Ukraine	50	Zambia	75	Syrian Arab Republic

A.2 Sample Periods for Ball & Sheridan Extension

Table 14: Sample Periods for Tables 9 & 10

Pre Period			Post Period		
Country	Begin	End	Country	Begin	End
Advanced Economies			Advanced Economies		
Australia	1985	1993	Australia	1994	2019
Canada	1985	1990	Canada	1991	2019
Finland	1985	1992	Finland	1993	2019
New Zealand	1985	1989	New Zealand	1990	2019
Spain	1985	1994	Spain	1995	2019
Sweden	1985	1993	Sweden	1995	2019
United Kingdom	1985	1991	United Kingdom	1993	2019
Japan	1985	1992	Japan	1993	2019
Denmark	1985	1992	Denmark	1993	2019
Austria	1985	1992	Austria	1993	2019
Belgium	1985	1992	Belgium	1993	2019
France	1985	1992	France	1993	2019
Germany	1985	1992	Germany	1993	2019
Ireland	1985	1992	Ireland	1993	2019
Italy	1985	1992	Italy	1993	2019
Netherlands	1985	1992	Netherlands	1993	2019
Portugal	1985	1992	Portugal	1993	2019
Norway	1985	1992	Norway	1993	2019
Switzerland	1985	1992	Switzerland	1993	2019
United States	1985	2011	United States	2012	2019
Emerging Markets			Emerging Markets		
Armenia	1985	2015	Armenia	2016	2019
Brazil	1985	1998	Brazil	1999	2019
Chile	1985	1998	Chile	1999	2019
Colombia	1985	1998	Colombia	1999	2019
Czech Republic	1985	1996	Czech Republic	1997	2019
Georgia	1985	2008	Georgia	2009	2019
Ghana	1985	2006	Ghana	2007	2019
Guatemala	1985	2004	Guatemala	2005	2019
Iceland	1985	2000	Iceland	2001	2019
India	1985	2015	India	2016	2019
Indonesia	1985	2004	Indonesia	2005	2019
Israel	1985	1996	Israel	1997	2019
Mexico	1985	2000	Mexico	2001	2019
Peru	1985	2001	Peru	2002	2019
Philippines	1985	2001	Philippines	2002	2019
Poland	1985	1997	Poland	1998	2019
Romania	1985	2004	Romania	2005	2019
Russia	1985	2013	Russia	2014	2019
Serbia	1985	2008	Serbia	2009	2019
South Africa	1985	1999	South Africa	2000	2019
Thailand	1985	1999	Thailand	2000	2019
Turkey	1985	2005	Turkey	2006	2019
Ukraine	1985	2014	Ukraine	2015	2019
Others	1985	1994	Others	1994	2019

A.3 Results with extended time period

Here we present the results from Tables 9 & 10 with an extended pre-period in tables 13 and 14. We begin the sample here from 1960 instead of 1985.

Table 15: Impact of IT on Inflation

	$X_{post} - X_{pre}$			
	AE	AE	EM	EM
IT Dummy	-0.11	0.096	-2.126	0.157
	(0.71	(0.28	(1.07	(0.75
Lagged Inflation		-0.784***		-0.737***
		(0.07		(0.09
Constant	-4.613***	0.454	-1.575***	3.063***
	(0.55	(0.47	(0.37	(0.66
R-Square	0.001	0.902	0.042	0.523
N	23	23	107	107

** p<0.05, ** p<0.01, ***p<0.001*

Table 16: Impact of IT on Growth

	$X_{post} - X_{pre}$			
	AE	AE	EM	EM
IT Dummy	0.43	0.416	-0.551	0.087
	(0.67	(0.39	(0.8	(0.39
Lagged Growth		-1.167***		-1.010***
		(0.19		(0.05
Constant	-1.538***	2.600***	-0.114	4.110***
	(0.4	(0.65	(0.56	(0.33
R-Square	0.02	0.577	0.002	0.848
N	23	23	101	101

** p<0.05, ** p<0.01, ***p<0.001*

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