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What Can Low-Income Countries Expect from Adopting Inflation Targeting?

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Abstract

Inflation targeting (IT) is a relatively new monetary policy framework for low-income countries (LICs). The limited number of LICs with an IT framework and the short time that has elapsed since the adoption of this framework explains why there are no previous empirical studies on the performance of IT in LICs. This paper has made a first attempt at filling this gap. It finds that inflation targeting appears to be associated with lower inflation and inflation volatility. At the same time, there is no robust evidence of an adverse impact on output. This may explain the appeal of IT for many LICs, where building credibility of monetary policy is difficult and minimizing output costs of reducing inflation is imperative for social and political reasons.

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I. INTRODUCTION

The popularity of inflation targeting (IT) as a monetary policy regime has been growing since its inception two decades ago. But, IT is still a new type of framework among low-income countries (LICs). [2] Only three LICs (Armenia, Ghana, and Albania) are officially inflation targeters (ITers) according to the IMF classification. [3] There are several other LICs which have adopted elements of IT while retaining a policy role for exchange rate or monetary targets, making them informal inflation targeters. Many more are considering shifting to an IT framework. [4]

Our focus in this paper will be to try to answer a simple question "*What impact could the adoption of inflation targeting have on the macroeconomic performance of low-income countries*?" While the effects of inflation targeting in advanced and emerging economies have been studied extensively in the literature, a similar study focusing exclusively on low-income countries does not exist to the best of our knowledge. [5] One reason for this might be that only a few LICs have adopted inflation targeting and only in the recent past, making the task of evaluating the net benefits for these countries of adopting a monetary regime such as IT extremely difficult.

A first attempt to empirically analyze the benefits of IT for LICs is made in this paper. Ideally, the method for this evaluation would be to compare LIC inflation targeters with non-ITers. As this cannot be done for LICs, we try to draw conclusions in several ways. First, we present several case studies of LICs that have either adopted IT or are on their way to adopting IT, with the aim of giving a flavor of the circumstances under which LICs have decided to shift to IT as well as the results it has yielded. Second, we compare the macroeconomic outcomes of emerging economies who are ITers with LICs. To deal with the problem of heterogeneity across these groups, we select in our sample only the emerging LICs which are identified as mature stabilizers.

Our empirical findings show that inflation targeting appears to be associated with lower inflation and inflation volatility. At the same time, we find limited evidence of an adverse impact on output. This may explain the appeal of IT for LICs where building credibility of monetary policy is difficult and minimizing output costs of reducing inflation is imperative for social and political reasons.

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[2] For the purpose of this paper we define LICs as those countries that were PRGT-eligible up to 2008, as our sample period runs up to that year. Therefore, Albania, Angola, Azerbaijan, India, Pakistan, and Sri Lanka, which graduated from the PRGT list in 2010, are classified as LICs in this paper.

[3] See IMF's *Classification of Exchange Rate Arrangements and Monetary Frameworks*, available via the internet: http://www.imf.org/external/np/mfd/er/index.asp

[4] See Sub-Saharan African REO, 2008 for details.

[5] Although, some low-income countries do appear in studies of emerging economies, e.g., Cote d'Ivoire, India, Nigeria, Pakistan, Ghana, and Tanzania.

The paper, however, cautions that several economic and structural problems in LICs may weaken the effectiveness of the IT framework. In general, the IT framework is effective in countries that have (a) a well functioning monetary transmission mechanism; (b) a degree of independence of monetary policy; (c) absence of commitment to a particular level for the exchange rate; and (d) a certain amount of fiscal credibility.

The remainder of this paper is structured as follows. In the next section, we describe the global emergence of IT. In Section III, we present case studies of LICs that adopted IT or are well on the way of doing so. Section IV provides a literature review on studies assessing the impact of IT in advanced and emerging market economies. Section V outlines the methodologies we use to study the impact of IT on the macroeconomic performance of LICs and reports the results of this exercise. Section VI discusses the challenges LICs face in adopting an effective IT framework. Finally, Section VII summarizes the findings and concludes.

II. GLOBAL EMERGENCE OF INFLATION TARGETING

Under an inflation targeting framework, the central bank commits to a publicly announced numerical range for inflation, subordinates other intermediate targets and institutionalizes its commitments through a set of mechanisms that emphasize transparency and accountability for outcomes (see Box 1 for the elements of inflation targeting). The first central bank to adopt inflation targeting was New Zealand's in December 1989 and the most recent one Serbia's in 2009. While for a time, the IT framework was confined to a select number of industrial countries, since the late 90s, it has been adopted in a number of emerging market and developing countries. The only central banks to have exited from inflation targeting are Finland, Spain, and Slovakia, in each case when they adopted the euro. Many other countries have adopted elements of IT while retaining a policy role for exchange rate or monetary targets.

Box 1. Key Elements of Inflation Targeting

Inflation targeting frameworks include five main elements:

- An explicit central bank mandate to pursue price stability as the primary objective of monetary policy and a high degree of operational autonomy;
- An explicit quantitative target for inflation;
- An information inclusive strategy in which many variables, not just monetary aggregates and the exchange rate, are used to inform policy decisions;
- Central bank accountability for performance in achieving the inflation objective, mainly through high-transparency requirements for policy strategy and implementation; and
- A policy approach based on a forward-looking assessment of inflation pressures, taking into account a wide array of information.

Source: Bernanke and Mishkin, 1997; Mishkin, 2004; Heenan, Peter and Roger, 2006.

In most cases, the adoption of an IT framework was in response to difficulties these countries faced in conducting monetary policy using an exchange rate peg or some monetary aggregate as an intermediate target (Batini et al., 2006). However, other factors also included the desire to control inflation and to anchor inflation expectations through a simple observable target (Freedman and Laxton, 2009). Several emerging economies adopted inflation targeting in the wake of a crisis, which forced a number of currencies off their fixed exchange rate pegs.[6]

Most advanced economies entered the 1990s with relatively low and stable inflation making it more difficult to discern any incremental improvement due to inflation targeting. Nonetheless, descriptive statistics shows that inflation as well as inflation volatility has decreased when comparing the median of pre and post IT periods. The median inflation rate during the five years prior to the adoption of IT ranged between about 2 to 14 percent while the median inflation in the five years after the adoption of IT fell to the range of 1 to 5 percent. Inflation and growth volatility also fell dramatically. This, however, can also be attributed to the well known "Great Moderation" era which saw a decline in macroeconomic volatility in advanced economies.

Figure 1. Advanced Economies: Inflation and Growth
(Median of Pre and Post Inflation Targeting Periods)
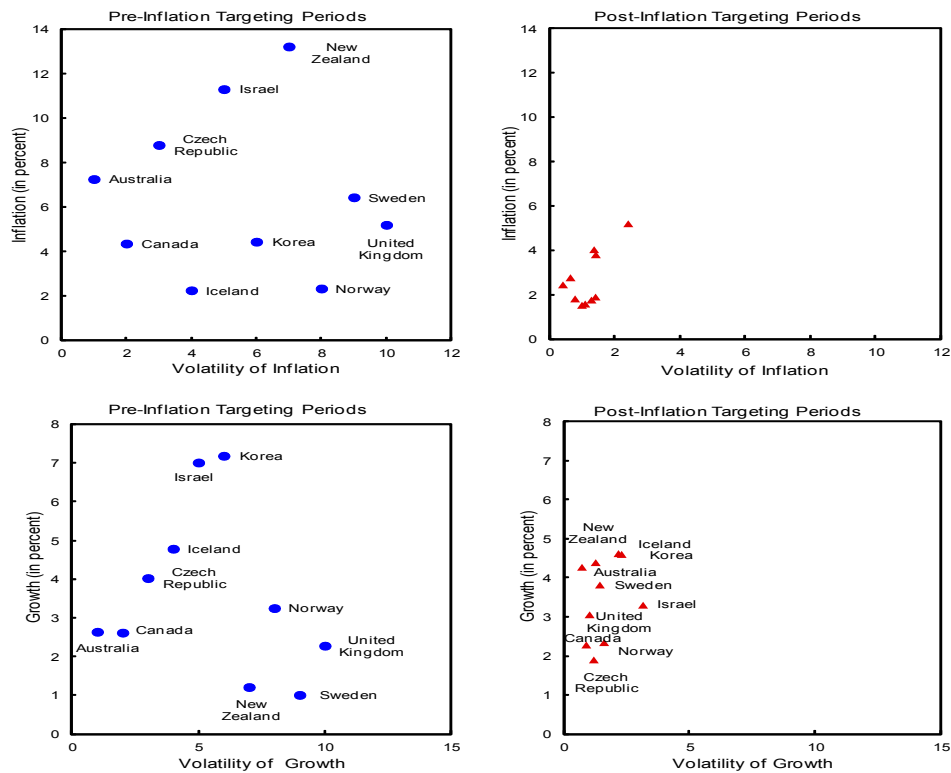
Sources: International Monetary Fund, WEO Database, and IMF staff estimates.

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[6] Brazil and Indonesia are both examples of this. Brazil adopted IT after it was forced to abandon its crawling exchange rate peg due to the Russian financial crisis. Similarly, Indonesia adopted IT after it restructured its banking system and institutional framework in response to the Asian financial crisis.

The inflation targeting emerging economies began their inflation targeting frameworks with much higher and more variable rates of inflation compared to the advanced economies (Schaechter et al., 2000). The median inflation rate, in the five years prior to adopting IT, ranged between 4 to over 25 percent. This range, however, dropped to 2 to 8 percent in the five years after adoption of IT. The aggregate data, however, masks the experience of individual countries. Of course, descriptive statistics alone cannot provide conclusive evidence of improvement in macroeconomic performance due to adoption of IT. The results of more detailed studies are discussed in Section IV.

Figure 2. Emerging Economies:Inflation and Growth
(Median of Pre and Post Inflation Targeting Period)
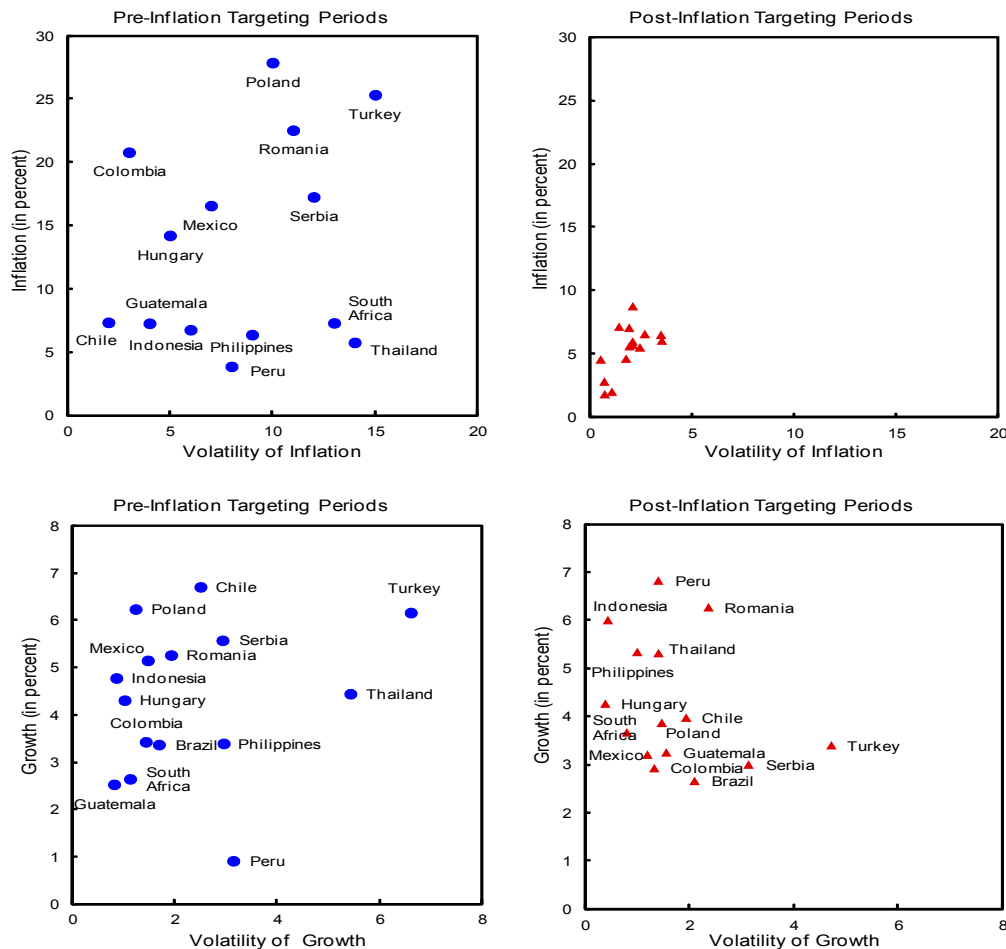
Note: Brazil is missing from the inflation panels because of its high inflation rate.
Sources: International Monetary Fund, WEO Database, and IMF staff estimates.

In addition to changes in macroeconomic performance, the literature suggests that the implementation of the IT framework has brought a number of benefits to the countries that have adopted it. In particular, IT has contributed to (i) countries' efforts to disinflate; (ii) better anchor inflation expectations; (iii) allow the floating exchange rate regimes accompanying the IT framework in becoming efficient shock-absorbers; (iv) reduce

exchange rate pass-through; (v) improve communication and transparency; and (vi) clearly assign institutional responsibilities for inflation control.

Yet, economists are more or less divided on the benefits of switching to an IT framework. For instance, proponents of IT argue that this framework allows central banks to anchor inflation expectations, making it easier to stabilize the economy. Skeptics, on the other hand, suggest that IT stabilizes inflation, however at the expense of restraining output (Box 2).

Box 2. Why Inflation Targeting?

*Proponents of Inflation Targeting argue***:**

- *Inflation targeting can help build credibility and anchor inflation expectations more rapidly and durably.* Inflation targeting makes it clear that low inflation is the primary goal of monetary policy and it involves greater transparency to compensate for the greater operational freedom that inflation targeting offers. Inflation targets are also intrinsically clearer and more easily observable and understandable than other targets since they typically do not change over time and are controllable by monetary means.

- *Inflation targeting grants more flexibility.* Since inflation cannot be controlled instantaneously, the target on inflation is typically interpreted as a medium-term goal. This implies that inflation targeting central banks pursue the inflation target over a certain horizon, by focusing on keeping inflation expectations at target. Short-term deviations of inflation from target are acceptable and do not necessarily translate into losses in credibility.

- *Inflation targeting involves a lower economic cost in the face of monetary policy failures.* The output costs of policy failure under some alternative monetary commitments, like exchange rate pegs, can be very large, usually involving massive reserve losses, high inflation, financial and banking crises, and possibly debt defaults. In contrast, the output costs of a failure to meet the inflation target are limited to temporarily higher-than-target inflation and temporarily slower growth, as interest rates are raised to bring inflation back to target.

*Opponents of Inflation Targeting argue***:**

- *Inflation targeting offers too little discretion and so it unnecessarily restrains growth.* Some believe that inflation targeting constrains discretion inappropriately: it is too confining in terms of an *ex ante* commitment to a particular inflation number and a particular horizon over which to return inflation to target. By obliging a country to hit the target so restrictively, inflation targeting can unnecessarily restrain growth.

- *Inflation targeting cannot anchor expectations because it offers too much discretion.* Contrary to those who worry that inflation targeting may be too restraining, some argue that it cannot help build credibility in countries that lack it, because it offers excessive discretion over how and when to bring inflation back to target and because targets can be changed as well.

- *Inflation targeting implies high exchange rate volatility.* It is often believed that, because it elevates price stability to the status of the primary goal for the central bank, inflation targeting requires a benign neglect of the exchange rate. If true, this could have negative repercussions on exchange rate volatility and growth.

- *Inflation targeting cannot work in countries that do not meet a stringent set of "preconditions",* making the framework unsuitable for the majority of emerging market economies. Preconditions often considered essential include, for example, the technical capability of the central bank in implementing inflation targeting, absence of fiscal dominance, financial market soundness, and an efficient institutional setup to support and motivate the commitment to low inflation.

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Source: World Economic Outlook, September 2005, International Monetary Fund.

III. EMERGENCE OF IT IN LOW-INCOME COUNTRIES

According to the IMF's Monetary and Capital Market Department (MCM) classification there are only three LICs worldwide that have adopted IT– Ghana, Armenia[7] and Albania. Given that all of these countries have adopted IT recently, it would be premature to draw generalized conclusions about the performance of IT in LICs. Nonetheless, the analysis of their diverse experience may be informative for other LICs contemplating about switching to this regime.

A. Ghana

Ghana provides an example of where the IT framework has gradually been put in place but the authorities have used discretion in reacting to shocks.[8]

Adoption of IT

In May 2007, the Bank of Ghana (BoG) formally announced its adoption of formal inflation targeting, becoming the first country in Sub-Saharan Africa (SSA) besides South Africa to do so. The BoG had been informally pursuing an inflation targeting regime for the previous few years and had chosen to publicly announce the adoption of the IT framework so that BoG could be held accountable for its mandate of delivering price stability under the 2002 Bank of Ghana Act.

After several years of preparation and a successful disinflation strategy, inflation had been brought down from over 30 percent in the early 2000s to near 10 percent by mid-2006, creating the stable environment needed to move forward with IT. The framework targets the 12-month change in the headline Consumer Price Index (CPI) which includes energy and utility prices, and the BoG, at the same time, also monitors a number of other core inflation measures.

BoG had gradually started building the main institutional, analytical and communication elements of this framework since 2002.[9] By 2007, the key institutional arrangements for an IT framework were in place, including central bank policy independence, instrument independence, bi-monthly meetings of a Monetary Policy Committee (MPC), and generally good transparency, although further progress on financial sector development and

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[7] According to MCM, Armenia has taken preliminary steps toward inflation targeting and is preparing for the transition to full-fledged inflation targeting.

[8] According to King (2005), IT combines two distinctive elements of successful monetary policy: a medium-term inflation target anchoring expectations and a sufficient degree of policy discretion for mitigating shocks. Thus, in essence, IT is guided by 'constrained discretion' (Bernanke et al., 1999) where within the rule-like framework, the central bank has the discretion to react to shocks, for example in how quickly to bring inflation back to target.

[9] See Appendix 1 for more details on the IT framework in Ghana.

communications were still needed to strengthen the framework. [10] BoG also needed to improve its understanding of the monetary transmission mechanism.

Performance

The Bank of Ghana set a medium-term goal of 5 percent inflation within a band of +/- 1 per-cent, along with some intermediate inflation-reduction targets. Within a few months of formally switching to IT, however, global food and fuel price shocks pushed inflation up. In addition to the external factors, domestic factors were critical for the acceleration in inflation during 2008-2009. And as these shocks began to unwind in 2008, expansionary fiscal policy created further inflationary pressures. At the same time, monetary policy was not adequately tightened during the period of rising inflation, as the policy interest rates were negative in real terms (unlike in other emerging IT countries where they were positive in real terms). Hence, the effects of rising global food and fuel prices, and currency depreciation on domestic prices were compounded by expansionary fiscal policy and loose monetary policy. As a result, headline inflation has diverged from the announced targets.

The global shocks have, therefore, made it extremely difficult to ascertain the benefits of IT in Ghana. In responding to shocks, the Bank of Ghana, like many other monetary authorities, sought to reduce the variability of output and interest rates, rather than try to hit pre-announced annual inflation targets at all cost.

Inflation in Ghana has traditionally been above the average of SSA. But it has drastically fallen from its peak of about 33 percent in 2001 to about 10 percent in 2006. After falling briefly in 2006, inflation rose through 2007–08, reflecting global food and fuel price shocks, strong domestic demand, and the pass through from currency depreciation. In early 2009, inflation stabilized in the 20 percent range in part due to the slowdown of the economy. With the

Ghana : Inflation and Growth Performance : 2000-2010
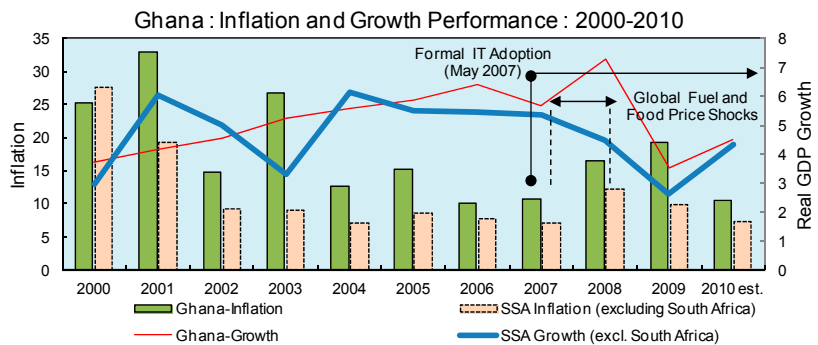
moderation of domestic demand, in part due to fiscal tightening, inflation was brought down to single digits by mid-2010 and to 8.6 percent by December 2010 (actual). But, inflation expectations are not well anchored in Ghana, reflecting the history of high and volatile inflation. To succeed in anchoring inflation expectations at a low level, it would be necessary to maintain low inflation over an extended period.

Growth, on the other hand, has been on an upward trend and mostly above the SSA average since 2002 when Ghana informally adopted IT.

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[10] IMF Country Report No. 09/256, 2009.

B. Armenia

Armenia provides an example where the country has officially declared itself to be an inflation targeter but has retained a policy role for exchange rate or monetary targets.

Adoption of IT:

Armenia officially adopted inflation targeting in 2006 by shifting from a monetary anchor. Price stability is the primary objective, while other targets are subordinate to it. The Central Bank of Armenia (CBA) has a clear quantified inflation target of 4 percent +/-1.5 percent. The inflation target is measured by the annual rate of change in the headline Consumer Price Index, as calculated and published by the CBA. The target is reset each year in agreement with the government – in the context of the annual budget and has been revised upward on two occasions. However, the monetary transmission mechanism has remained relatively weak owing to the limited depth of financial markets.

Under the IT framework, the CBA independence was considerably strengthened. The law clearly stipulates its independence; the right to recapitalization; protection from external pressure; term of office exceeds election cycle; conflict of interest prohibition; fit and proper practice; and disclosure requirements. Most importantly, there is no fiscal dominance, and direct financing of government prohibited. The CBA is accountable to parliament, through regular reporting requirements and this reporting requirement can be enhanced in case the target is missed. The decisions and minutes of the CBA Board meeting are regularly published. In case of failure to meet the target, there are no explicit sanctions.

Performance

Prior to the shifting to inflation targeting, prudent fiscal and monetary policies, large external inflows, and ongoing structural reforms have contributed to double-digit growth in a low-inflation environment. Following the sharp contraction of the early 90s, economic growth averaged around 5 percent for the period 1996–2000, before accelerating to 12 percent during 2001–05, while inflation averaged 5.6 percent and 3.3 percent, respectively. Compared to the Commonwealth of Independent states (CIS), Armenia has had higher growth and much lower inflation rates.

Armenia : Inflation and Growth Performance : 2000-2010
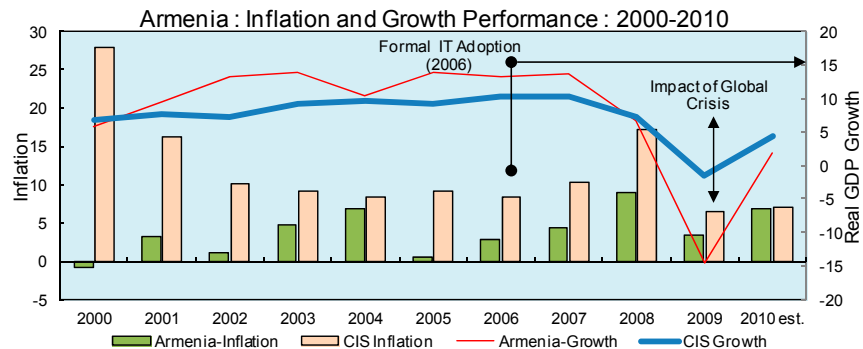
Since 2006, inflation remained within the CBA band, except in 2008 where it exceeded it largely due to the global spike in food and fuel prices. Yet, growth remained in double digit during 2006-07, before dropping to about 7 percent in 2008, and turning negative (-4 percent) during the global crisis.

C. Others

There is great heterogeneity among other LICs that are in different stages of adopting IT. Albania is the latest addition to the IT family. There are several countries (such as Moldova, Georgia, etc.) that could be described as informal inflation targeters, as their policy frameworks are geared toward price stability but inflation-targeting infrastructure is not fully in place.

Below is a brief description of their monetary regimes:

Albania[11]

The Central Bank of Albania (BoA) has been preparing for adopting inflation targeting since 2004. Implementation was effective in 2009. The inflation target for the 2009-2011 period is set at 3.0 percent, with a symmetrical tolerance band of +/- 1 percentage points. The inflation target will be measured by the annual rate of change in the Consumer Price Index.

The inflation target is applicable throughout the 2009-2011 period, implying that the actual inflation rates may temporarily deviate from target. This deviation, according to the BoA is acceptable given that the economy may be hit by external shocks or unforeseen circumstances beyond the control of the central bank.

To enhance its IT framework, the BoA has taken several steps to making its communication policy more effective, expanding its information set, and improving its inflation forecasting methodologies. Besides these achievements, significant progress has been made in the area of central bank independence.
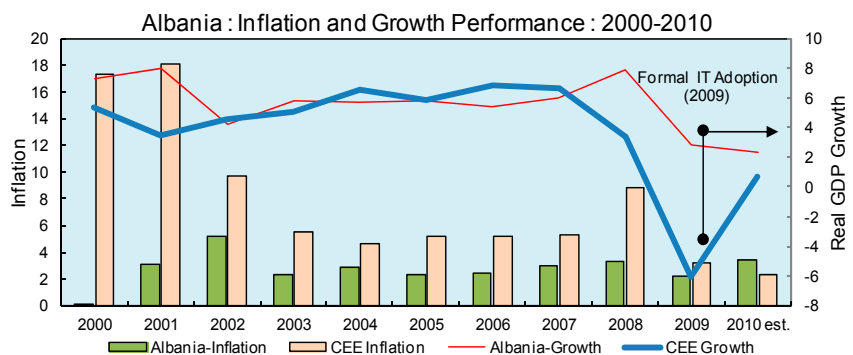
Albania : Inflation and Growth Performance : 2000-2010

Over the past decade, Albania has managed to maintain its headline inflation largely within the BOA 3+/-1 percent target range. Recently, during the crisis inflation rose above 4 percent mainly due to depreciation pass-through and higher electricity prices. Administrative price increases over the next two years may drive headline inflation temporarily above the 3±1 percent target band in the near term. However, underlying inflation is expected to remain under control, and annual inflation is also expected to remain within the band.

Since 1992 the Albanian economy experienced high growth rates, significantly higher than other transition economies. These rates also persisted in the 2000s but were in line with Central and Eastern Europe (CEE) –growth averaged around 6 percent over the past five years—when Albania implemented its inflation targeting framework.

Moldova

Moldova shifted at the beginning of 2010 to an inflation targeting framework. The target for 2010 is 5 percent +/- 1.5 percent. The inflation target will be measured by the annual rate of change in the headline CPI.

Under the new IT framework, the central bank will have full independence. The law provides: (i) the right to recapitalize; (ii) protection from external pressure; (iii) term of office exceeds election cycle; (iv) prohibition of conflict of interest; (v) fit and proper practice; and (vi) disclosure requirements. Most importantly, there is no fiscal dominance, and direct financing of government is prohibited.

In the past, Moldova had high inflation, except in 2009. It also suffered, from a weak monetary transmission mechanism, low monetization and financial development, imperfectly operating money and foreign exchange markets, and dollarization.

Georgia

Georgia is in the process of moving to a formal inflation targeting regime. In recent years, the national bank has made considerable progress in strengthening the effectiveness of monetary policy instruments and internal analytical capacity. As a result, the national bank has much greater traction on market interest rates than it did only a couple of years ago. However, monetary policy transmission is still hampered by extensive dollarization and inflation remains quite volatile, largely on account of the large weight of food prices in the CPI.

IV. LITERATURE SURVEY ON THE OUTCOMES OF IT

As more and more countries followed New Zealand's example of adopting inflation targeting as their monetary framework, a growing body of literature has examined whether IT matters for macroeconomic performance. In this literature, the main question is how ITers have performed compared to non-ITers and whether IT has made a significant difference. This

question is analyzed using various approaches, including different country samples, performance measures, and estimation methods. However, the studies do not give a conclusive answer on the impact of IT. The good news is that so far no study has found that macroeconomic performance deteriorated after the introduction of IT. Studies focusing mainly on advanced countries found small, mostly insignificant results, showing the irrelevance of inflation targeting for better macroeconomic performance in this country group. On the other hand, studies using a dataset comprised of emerging market economies or both emerging and advanced economies mostly show a statistically significant effect of inflation targeting.

Performance Measures

Based on what criteria does the existing literature assess the performance of IT? The first measure when evaluating this monetary policy is inflation dynamics (inflation, its volatility, as well as its expectations) but also important are its effects on the real economy. A priori, however, there is ambiguity on the direction of change of the real economy caused by IT as the following paragraphs will show.

Inflation dynamics can be assessed by looking at average inflation rates, inflation volatility, and inflation persistence. For average inflation and inflation variability the direction is clear: IT should be associated with lower inflation and lower inflation volatility. However, the effects of IT on persistence are ambiguous and can either lead to higher or lower persistence, depending on the central bank's credibility and how flexible the central bank uses the IT framework.

By anchoring inflation expectations, IT can influence the real economy by improving the short-run trade-off between output gap and inflation volatility (see Walsh, 2009), and thereby lowering output volatility. It can also reduce uncertainty and therby lengthen investor horizons and increase long-term investments. Opponents of inflation targeting, however, argue that it might restrain output growth by complying to the inflation target too restrictively.

Methodology to Assess Performance

What are the methods that are used to evaluate the performance of IT? A survey of the literature shows that primarily three econometric methods are applied (i) difference-in-difference; (ii) propensity score matching; and (iii) panel estimations including generalized methods of moments (GMM).

The difference-in-difference method compares the difference in the performance between the periods prior to IT-adoption (pre-period) and after IT adoption (post-period) are compared to

the difference between similar periods in non-IT countries. [12] Using this method it is important to control for initial performance, as a higher performance change in IT countries might be solely due to a regression to the mean. If, for example, IT countries had higher average inflation in the beginning, a relative higher inflation decrease might have occurred regardless of IT adoption.

Several studies argue that the difference-in-difference method does not take into account a self-selection problem of policy adoption. [13] In their view, it is therefore warranted to interpret IT adoption as a natural experiment and use a variety of propensity score matching methods. That way treatment and control countries (in our case, the ITers and non-ITers) are appropriately matched.

Both the difference-in-difference and the propensity score matching approaches are cross-section methods and are, by construction, not able to exploit information such as time-varying and country fixed effects. For this reason, several studies have evaluated the effect of inflation targeting using panel estimation methods, including Difference-GMM (D-GMM) and System-GMM (S-GMM).

A. Results for Advanced Economies

Studies focusing on advanced economies mainly found insignificant and small effects of inflation targeting on the various performance measures used. Ball and Sheridan (2005), using a difference-in-difference approach, show that there is no significant effect of IT on inflation, inflation variability, output growth, output variability and long-term interest rates. [14] Additionally, inflation persistence is very similar between the targeting and non-targeting group. Using the same method but updating data and taking into account the establishment of the European Monetary Union, Ball (2010) supports these earlier findings.

Using the propensity score matching method that controls for self-selection bias, Lin and Ye (2007) show that IT does not have any significant impact on the level and volatility of inflation. Vega and Winkelried (2005) find the exact opposite results by using the same method but by expanding the sample to include advanced as well as emerging countries. They also analyze the effects of IT on inflation persistence and find that IT lowers the persistence of inflation, although the effects are very small.

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[12] This method is the mostly widely used out of the three e.g., by Ball and Sheridan (2005), Batini and Laxton (2006), Goncalves and Salles (2008), Naqvi and Rizvi (2009), and Ball (2010).

[13] Vega and Winkelried (2005) and Lin and Ye (2007).

[14] In an earlier study, focusing mainly on advanced economies (the IT group contains Chile), Neumann and von Hagen (2002) find that IT countries had a greater improvement of inflation performance compared to non-IT countries, although this effect is not statistically significant, and experienced higher credibility.

Panel estimations also find contrasting results. Using a panel dataset of 22 OECD countries, Wu (2004) finds that IT significantly reduces inflation. However, Willard (2006), using the same dataset as Wu (2004), but different methods, finds only small and insignificant effects.[15] This is supported by Mishkin and Schmidt-Hebbel (2007) who find that, although ITers have improved their macroeconomic performance in terms of reducing inflation, inflation volatility, and output volatility over time, compared to non-ITers the difference is insignificant.

Analyzing inflation expectations in industrialized countries, Johnson (2002) finds that after the announcement of IT the level of inflation expectations were significantly reduced in IT countries, whereas the effect on uncertainty and forecast errors was not significant. Levin, Natalucci and Piger (2004) also show that IT has a significant role anchoring long-run inflation expectations.

B.   Results for Emerging Market Economies

Whereas empirical evidence for industrialized countries shows the irrelevance of IT for macroeconomic improvement compared to non-ITers, empirical evidence for emerging economies shows a more favourable picture of the effects of IT. This may be due to a stronger degree of performance heterogeneity in the sample of emerging markets that adopted IT (Batini and Laxton, 2006) and the weaker credibility emerging countries face when implementing macroeconomic policies (Goncalves and Salles, 2008).

Most studies focusing on emerging economies find that IT significantly reduces average inflation.[16] This result is robust to country selections, time periods and estimation methods although the magnitude of the impact differs and performance of an IT regime is very heterogeneous across countries.[17] There are fewer consensuses on the impact of inflation volatility. Batini and Laxton (2006), Li and Ye (2009), and Vega and Winkelried's (2005) results show a significant dampening effect of IT on inflation volatility, whereas the effects in Goncalves and Salles (2008) and Brito and Bysted (2010) are insignificant.

Similarly, the impact of inflation targeting on the real economy is not unanimous. Brito and Bystedt (2010) find a significant negative effect of inflation targeting on average growth suggesting that inflation targeting and the associated lower average inflation come at the cost

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[15] Willard (2006) uses a cross-sectional setup as in Ball & Sheridan (2005), but additionally controlling for endogeneity with instrument variables, and Arellano-Bond panel estimation including more lags than Wu (2004).

[16] Mishkin and Schmidt-Hebbel (2007) find that emerging countries only gained in terms of better inflation, inflation volatility and output volatility performance if compared to their own pre-targeting performance, but not if compared to a group of highly performing industrialized non-targeting countries.

[17] Goncalves and Salles (2008) and Batini and Laxton (2006) use diff-in-diff estimation. Li and Ye (2009) use propensity score matching methods, while Biondi and Toneto (2008) and Brito and Bystedt (2010) use panel estimation techniques.

of lower growth. Naqvi and Rizvi (2009) find an insignificant effect of IT on growth, but their country sample is very small and restricted to Asian economies. Theoretically, output volatility might fall or increase following IT adoption, however, empirically the effect found, if at all significant, is one of falling output volatility. Goncalves and Salles (2005) find that IT reduces output volatility, whereas Batini and Laxton (2006) do not find a significant effect for output volatility.

Finally, there are only a few studies that have assessed the performance of IT during the recent crisis. Filho (2010) finds that that the monetary policy of IT countries appears to have been more suited to dealing with this crisis. He finds that relative to other countries, IT countries lowered nominal policy rates by more and this loosening translated into an even larger differential in real interest rates. With this monetary stimulus, IT countries on average seem to have dodged the deflation bullet better than other countries. Based on macro-economic forecasts, Roger (2010) also finds that inflation-targeting countries may be less adversely affected by the financial crisis.

V. ASSESSMENT OF IMPACT ON LICs: EMPIRICAL ANALYSES

The small number of LIC inflation targeters and their short time span under the IT framework makes it futile to attempt getting conclusions by comparing LIC ITers with LIC non-ITers. To get a picture about the benefits and drawbacks of IT for LICs nevertheless, we choose to use a group of inflation targeting emerging countries as an approximation. The idea is to compare the effects of inflation targeting for the performance of a set of macroeconomic variables by using the same methodology as in the literature with the difference that we choose our IT and control group according to our focus on LICs. That way, we hope to get an idea of what changes inflation targeting would bring for the set of low-income countries we analyze. In this case, the usual caveats apply since we only use an approximation and LICs adopting inflation targeting today would face a different macroeconomic environment.[18]

To check the robustness of our results and whether the choice of our control group being LICs has an influence, we compare the effects of IT with a LIC control group to the effects of IT when the control group consists of emerging market economies that do not target inflation.

For our analysis it is important to choose the IT group as well as the control group very carefully as we want to minimize to the extent possible the influence of country group characteristics on our results. To have a relatively homogeneous group of countries, we choose to exclude emerging markets in Europe because none of the LICs in the control group lies in this region. In addition, we only include emerging countries with IT adoption dates

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[18] Another caveat to note is that the decision of IT adoption is endogenous and thus splitting the sample into IT targeters and non-IT targeters might suffer from sample selection bias.

prior to 2006 to allow IT to unfold its effects for at least three years. With these assumptions in place, the IT group consists of 10 countries.[19]

To have a set of LICs that can be compared to the emerging country IT group, we choose to include countries in the control group that are classified as "mature stabilizers". These countries have fared well on the basis of 8 macroeconomic criteria ranging from reasonable growth to debt sustainability.[20] In order to have a bigger sample we also include countries that narrowly missed one of the criteria. Thus, our LIC control group consists of 29 countries.[21]

We proceed similarly in choosing the non-IT emerging market control group. To be comparable this control set includes countries that lie in the same regions as the two aforementioned groups thereby again excluding European emerging market economies and ending with a non-IT emerging economy control group of 18 countries.[22]

Tables 1 through 3 in Appendix II show that ITers (emerging countries/target group) and non-ITers (LICs and emerging countries/control group) share common macroeconomic characteristics. Average inflation and growth as well as growth volatility are very similar in the period before IT adoption. Only inflation volatility is much higher in the non-ITers, which holds both for the LICs and the emerging economies control group. Average inflation fell in both groups (ITers and non-ITers) comparing periods before and after IT adoption, however, it fell stronger in the IT group. In the non-IT group, the inflation decline was slightly higher in the LIC control group compared to the emerging economies control group. Inflation and growth volatility also fell from pre- to post-period in both groups. On average growth increased in IT and control group. However, in the post period the average growth rate in the LIC control group was higher than the average growth rate in IT emerging market and non-IT emerging market economies, implying that factors inherent in the LIC control group are responsible for the growth differential.

These simple averages of macroeconomic performance measures already give a rough picture of what to expect from inflation targeting. However, a more thorough analysis is needed to estimate the potential effects of IT. In keeping with the literature we use both the difference-in-difference method and panel regressions to assess the potential impact of

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[19] A detailed country list of the emerging economies that have adopted IT and their adoption dates can be found in Appendix II Table 1.

[20] The Fund defines "mature stabilizers" based on the performance of eight indicators averaged over a five year period. These indicators include a reasonable growth rate, a low underlying inflation, an adequate level of international reserves, external and domestic debt sustainability and institutional capacity.

[21] A detailed country list of the LIC control group can be found in Appendix II Table 2.

[22] A detailed country list of the non-IT emerging economies control group can be found in Appendix II Table 3.

adopting IT on the macroeconomic performance of LICs. The application of the two different approaches we hope will provide robustness to our findings.[23]

A. Difference-in-Difference Analysis

Data

We base the evaluation of inflation targeting on four different indicators: Inflation, inflation volatility, real GDP growth and growth volatility.[24] The data for annual inflation and real GDP growth rates are taken from the IMF's World Economic Outlook (WEO).

One major issue when analyzing inflation performance of emerging markets and LICs is the treatment of hyperinflation periods. Some of the South American and Central Asian countries in our sample have very high inflation rates in the beginning and middle of the nineties. These periods of very high inflation rates could possibly contaminate the results (Goncalves and Salles, 2008). For the baseline difference-in-difference estimation we exclude all countries that have periods with inflation rates higher than the 50 percent threshold from the analysis.[25] In doing so, the country sample reduces to 26 countries in the regressions using the LIC control group and to 36 countries in the regressions using a control group combining LICs and non-IT emerging markets.[26] However, we conduct several robustness checks with the country sample.

To analyze the effects of IT, the exact date of IT adoption is important. However, for some countries the existing literature does not agree on the IT adoption date.[27] Part of the difference can be explained by the diverging views on IT adoption starting with "inflation targeting lite" or with full-fledged inflation targeting.[28] For consistency we take our IT adoption dates from Roger (2010), as he provides the IT adoption dates for all countries in our sample in a consistent manner.

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[23] We do not use propensity score matching methods, because the literature review showed that the results compared to the diff-in-diff approach do not change and the majority of studies use either diff-in-diff or panel estimation methods.

[24] Some of the other indicators used in the literature, e.g., interest rates or variability of output gap, are only available for a small subset of our country sample.

[25] We use the same threshold as Goncalves and Salles (2008). However, we exclude the entire country series, not only the high inflation periods. Ball (2010) recommends excluding the countries entirely instead of just a few years.

[26] Countries with at least one year of inflation rates above 50 percent are Brazil, Indonesia, Peru, Albania, Armenia, Azerbaijan, Georgia, Kyrgyz Republic, Moldova, Mongolia, Mozambique, Nigeria, Vietnam, Argentina, Dominican Republic, Jamaica, Kazakhstan, Suriname, Turkmenistan, Uruguay, and Venezuela.

[27] See Vega and Winkelried (2005) or Brito and Bystedt (2010).

[28] Goncalves and Salles (2008) and Naqvi and Rizvi (2009) use the former, while Batini and Laxton (2006) and Brito and Bystedt (2010) use the latter.

Methodology[29]

We use the difference-in-difference setup controlling for reversion to the mean as first proposed by Ball and Sheridan (2005). The idea is to regress the difference of an economic indicator, e.g., inflation, between the period before and after a policy change – in our case IT adoption - on a policy dummy and on the pre-period value of the economic indicator. The basic specification is:

$$(1) \quad Y_{post}^{j} - Y_{pre}^{j} = c + \alpha \cdot Y_{pre}^{j} + \beta \cdot IT + \varepsilon,$$

where Y_{pre}^{j}, Y_{post}^{j} are the values of the performance measure j in the period before and after IT adoption, respectively. The economic indicators, indexed by j, that we consider are inflation, inflation volatility, real GDP growth and growth volatility. *IT* is a policy dummy that takes the value 1 if a country targets inflation and 0 otherwise. Our main focus will be the sign and significance of β which shows whether inflation targeting has a significant effect on economic performance. Including the pre-policy level of the indicator j, Y_{pre}^{j} controls for reversion to the mean. Countries with higher initial inflation might have more significant inflation reductions than countries with lower initial inflation which should not be attributed to IT. Finally, we include a constant c in the regression and ε is an error term.

Partitioning the time period between pre- and post-period is straightforward for inflation targeting countries. The pre-period ends with the year before inflation targeting is adopted and the post-period starts with the year inflation targeting was first used. However, for the control group such a date does not exist. We follow the literature and use the average adoption date, the year 2002, to partition the time period for non-IT countries.

As a robustness check, we analyze how the effects of inflation targeting in our regression are driven by the choice of LICs as control group. For this purpose, we also include non-IT emerging market economies in our control group, keeping the rest of our specification as in the baseline setup. The added LIC dummy is set to 1 if a country is a low-income country and 0 otherwise. In this setup, the coefficient on the IT dummy shows the effect of inflation targeting having only emerging market economies in the control group, whereas the coefficient on the LIC dummy shows how the effect of inflation targeting differs if the control group is comprised of LICs only. For example, suppose the LIC dummy has a negative coefficient for inflation. This means, that we measure a higher effect of inflation targeting on inflation reduction using emerging markets as the control group than if using LICs.

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[29] Appendix III provides more details on the methodology.

Period and Country Samples

The baseline case spans the period 1990-2008 and includes all countries which did not have a year with an inflation rate above 50 percent. For robustness, we experiment with the beginning of the pre-period and the country sample. Table 1 gives an overview of the time periods and country samples used in the different regression models. For comparability, we do the exact same robustness checks for the combined control group.

One robustness check is to shorten the time period and begin in 1996 as most countries in our sample experienced high inflation periods prior to 1995.[30] To facilitate comparison with the baseline case, model 2 is estimated with the same country sample as model 1 but with a time period ranging from 1996-2008. Model 3, on the other hand, uses the shorter time period, but includes the entire country sample with the exception of Indonesia which had inflation rates over 50 percent. Finally, model 5 includes all countries and spans the time period 1990-2008 to check whether the effect of IT changes excluding only high inflation periods instead of the entire time series of countries with high inflation periods.

Another robustness check is based on the issue about the inclusion of countries with hard currency pegs in the control group raised by Ball (2010) Our country sample includes four countries that are members of a currency union: Burkina Faso, Mali, Senegal and St. Lucia. Inflation rates for these countries show a distinctively different behavior compared to the rest of the low-income country group (numbers are provided in Appendix II Table 2).[31] Inflation is three times smaller than average inflation in the pre-period and still less than half the size of average inflation in the post-period. The countries already have stable inflation rates and, thus, Model 4 excludes these countries from the country sample.[32]

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[30] The only high inflation year (with an inflation rate above 50 percent) after 1996 occurred in Indonesia in 1998 and can be ascribed to the Asian Crisis. The average inflation increased dramatically from 6 percent in 1997 to 58 percent in 1998 before it decreased to 20 percent in 1999 and subsequently to 4 percent in 2000. For consistency reasons we do not include Indonesia in any of our models, although it adopted inflation targeting in 2005. Naqvi and Rizvi (2009) also exclude Indonesia because of its high inflation rates during the Asian crisis in one of their models. Including Indonesia in Model (3) does not change the results significantly.

[31] In the combined control group, we exclude Gabon, who is also a member of a currency union, in model 4.

[32] In addition to these robustness checks, we also use the median adoption date instead of the average adoption date as well as shorten the sample period to 2007. The results still hold, albeit with minor changes in coefficient or significance. This also helps in addressing the issue that the timing of the IT adoption may be endogenous.

Table 1. Specification Overview: Period and Country Samples

	Period	Country Sample
Model 1	1990-2008	All countries with inflation rates smaller than 50% in the entire sample period.
Model 2	1996-2008	Same country sample as in Model (1).
Model 3	1996-2008	All countries with inflation rates smaller than 50% in the period 1996-2008.
Model 4	1990-2008	All countries with inflation rates smaller than 50% in the entire sample period but excluding members of a currency union.
Model 5	1990-2008	All countries.

Regression Results

The inflation targeting dummy has the expected negative sign and is statistically significant in all five of the models estimated (Table 2). The baseline case shows that if a country of the control group would have adopted IT, average inflation would have fallen by 1.96 percentage points more than without adopting inflation targeting. These results remain very similar when we change the sample period or the country sample (models 2-5). They are also similar to Goncalves and Salles (2008) and Batini and Laxton (2006), although they find a more pronounced effect.

It may be noted that strongest effect of IT is obtained when we exclude countries that are part of a currency union (model 4) which shows that inflation falls by 2.33 percentage points more in ITers. Since these countries have low and stable inflation in pre- and post-period, excluding them favors the positive effect of inflation targeting. This result is supported by Batini and Laxton's (2006) finding that including a dummy for exchange rate pegs increases the coefficient on the IT dummy.

Inflation also shows signs of regression to the mean indicated by highly significant initial conditions. This implies that inflation would have fallen in ITers even if they had not adopt IT. But, the adoption of IT (as shown by the coefficient of the IT dummy) has resulted in a higher decline of inflation.

The regression results also show that IT leads to a stronger fall in inflation volatility of about 1.4 percentage points in the baseline case. The same results hold in all our robustness checks. This is result is similar to Batini and Laxton (2006) who also find lower inflation volatility in ITers, but their coefficient is twice as high as ours. Inflation volatility also shows signs of regression to the mean.

The results using the combined control group (Table 3) show that the effects of inflation targeting on inflation are similar for LICs and non-IT emerging markets. However, the effect is higher for emerging countries as a comparison between the coefficients of the IT dummies

in table 2 and 3 and the negative sign of the LIC dummy shows. The difference is not significant (except for model 5) as indicated by the LIC dummy being not significant.

For inflation volatility the results change for some specifications using emerging markets as a control group, but for other specifications the differences in the effects inflation targeting has between LIC control group and non-IT emerging markets control group are not significant.

These positive effects of IT on average inflation and inflation variability might come at a cost as Table 4 shows. The IT dummy has a significant, but negative coefficient meaning that inflation targeting leads to a smaller increase of growth in ITers compared to the low-income control group. Brito and Bystedt (2010) support our results.

The negative effect on growth, however, might be an effect only due to using LICs as the control group. The LIC dummy coefficient in the regression with the combined control group is significant and positive (Table 5). This shows that the effect of inflation targeting on growth is significantly different when using an emerging economy control group, hinting at the fact that the growth differential might be due to the LIC characteristics and not the adoption of inflation targeting.

In contrast to the three indicators considered so far, growth volatility is not affected by inflation targeting. The coefficient is never significant in any of the specifications, a result also found by Batini and Laxton (2006). In addition, the effect is not significantly different using emerging market economies.

To sum up, the difference-in-difference method finds that introducing IT may lower the level and volatility of inflation. There is limited evidence that this may come at the cost of smaller growth increases, which has to be seen with caution. Growth variability seems to be not affected. In addition, this section shows that the estimated effects of inflation targeting are not driven by the choice of the control group consisting of LICs with the exception of the effects on growth.

Table 2. Regression Results for Inflation and Inflation Volatility, Low-Income Country Control Group (Diff-in-Diff method)

	Inflation					Inflation Volatility				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
IT Dummy	-1.96*	-2.06*	-2.21**	-2.33**	-1.62*	-1.41**	-1.54**	-1.64***	-1.49**	-1.47***
	(1.05)	(1.18)	(0.87)	(0.99)	(0.98)	(0.55)	(0.71)	(0.50)	(0.64)	(0.51)
Initial Conditions	-0.73***	-0.76***	-0.79***	-0.86***	-0.78***	-0.89***	-0.90***	-0.93***	-0.89***	-0.89***
	(0.09)	(0.16)	(0.08)	(0.10)	(0.07)	(0.07)	(0.28)	(0.09)	(0.08)	(0.06)
Constant	3.90***	5.06***	5.45***	5.91***	4.64***	2.81***	3.27***	3.51***	2.91***	2.96***
	(1.11)	(1.26)	(0.93)	(1.49)	(1.01)	(0.55)	(0.88)	(0.57)	(0.69)	(0.61)
Observations	26	26	38	22	39	26	26	38	22	39
R-squared	0.76	0.71	0.75	0.79	0.78	0.83	0.52	0.81	0.82	0.83

Notes: Standard errors in parentheses were bootstraped using 5000 simulations. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Table 3. Regression Results for Inflation and Inflation Volatility, Combined Country Control Group (Diff-in-Diff method)

	Inflation					Inflation Volatility				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
IT Dummy	-2.56**	-2.49*	-3.07***	-2.61**	-3.24***	-0.57	-0.54	-1.14**	-0.73	-1.48***
	(1.09)	(1.29)	(1.01)	(1.05)	(1.18)	(0.43)	(0.46)	(0.50)	(0.45)	(0.53)
Initial Conditions	-0.66***	-0.66***	-0.76***	-0.76***	-0.66***	-0.91***	-0.97***	-0.93***	-0.89***	-0.85***
	(0.08)	(0.15)	(0.08)	(0.09)	(0.07)	(0.05)	(0.16)	(0.07)	(0.07)	(0.05)
LIC Dummy	-0.38	-0.02	-0.83	-0.13	-1.57*	0.88*	1.05*	0.50	0.75	-0.13
	(0.82)	(0.91)	(0.93)	(0.95)	(0.83)	(0.51)	(0.54)	(0.55)	(0.61)	(0.57)
Constant	3.58***	4.43***	6.00***	4.85***	4.85***	2.10***	2.48***	3.03***	2.11***	2.70***
	(0.97)	(1.15)	(1.10)	(1.08)	(1.03)	(0.36)	(0.44)	(0.52)	(0.39)	(0.49)
Observations	36	36	52	31	57	36	36	52	31	57
R-squared	0.74	0.65	0.72	0.78	0.72	0.87	0.72	0.83	0.84	0.83

Notes: Standard errors in parentheses were bootstraped using 5000 simulations. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Table 4. Regression Results for Growth and Growth Volatility, Low-Income Country Control Group (Diff-in-Diff method)

	Growth					Growth Volatility				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
IT Dummy	-1.35**	-0.81	-1.55*	-1.66***	-2.10***	-0.45	-0.61	-0.80	-0.55	-0.65
	(0.61)	(0.72)	(0.81)	(0.63)	(0.68)	(0.52)	(0.59)	(0.50)	(0.61)	(0.43)
Initial Conditions	-0.71***	-0.64***	-0.62***	-0.80***	-1.19***	-0.80***	-0.78***	-0.88***	-0.80***	-0.78***
	(0.22)	(0.15)	(0.20)	(0.23)	(0.30)	(0.18)	(0.29)	(0.23)	(0.26)	(0.13)
Constant	4.30***	3.74***	4.76***	4.95***	7.25***	1.64***	1.81**	2.34***	1.71**	1.58***
	(1.02)	(0.73)	(0.92)	(1.08)	(1.44)	(0.54)	(0.73)	(0.66)	(0.68)	(0.51)
Observations	26	26	38	22	39	26	26	38	22	39
R-squared	0.38	0.46	0.22	0.45	0.56	0.76	0.43	0.38	0.76	0.72

Notes: Standard errors in parentheses were bootstraped using 5000 simulations. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Table 5. Regression Results for Growth and Growth Volatility, Combined Country Control Group (Diff-in-Diff method)

	Growth					Growth Volatility				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
IT Dummy	-0.19	-0.13	-0.16	-0.44	-0.67	-0.09	-0.10	-0.57	-0.12	-1.12*
	(0.61)	(0.68)	(0.73)	(0.57)	(0.73)	(0.46)	(0.50)	(0.55)	(0.51)	(0.64)
Initial Conditions	-0.67***	-0.65***	-0.61***	-0.79***	-1.20***	-0.82***	-0.89***	-0.85***	-0.81***	-0.81***
	(0.16)	(0.10)	(0.14)	(0.16)	(0.23)	(0.15)	(0.20)	(0.17)	(0.20)	(0.11)
LIC Dummy	1.16**	0.70	1.37**	1.21**	1.43*	0.37	0.49	0.22	0.44	-0.42
	(0.51)	(0.46)	(0.66)	(0.57)	(0.82)	(0.48)	(0.51)	(0.62)	(0.60)	(0.66)
Constant	2.98***	3.10***	3.34***	3.68***	5.88***	1.31**	1.57**	2.03***	1.32*	2.17***
	(0.83)	(0.55)	(0.64)	(0.89)	(1.13)	(0.55)	(0.67)	(0.63)	(0.70)	(0.70)
Observations	36	36	52	31	57	36	36	52	31	57
R-squared	0.44	0.52	0.25	0.53	0.55	0.75	0.57	0.40	0.75	0.67

Notes: Standard errors in parentheses were bootstraped using 5000 simulations. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

B. Panel Analysis

Often times, adopting IT is not an exogenous choice, but might be related to unobservable country specific characteristics and time trends.[33] But, the endogeneity of the IT adoption choice cannot be captured in the difference-in-difference method which uses cross-section data. Hence, we follow Brito and Bystedt (2010) to reevaluate the effects of IT by taking into account additional time and country-specific information of a panel dataset.

Our setup is very similar to Brito and Bystedt (2010). However, there are two aspects, where we deviate from their set-up. First, our focus lies on LICs and we use the country sample described at the beginning of this chapter. Second, our sample period starts in 1990 and ends in 2008.[34] The data is analyzed first using simple pooled cross-section OLS and subsequently adding time fixed effects and country fixed effects. However, the OLS estimates might be biased due to omitted variable bias, reverse causation between inflation and IT and a dynamic panel bias. To control for this, we use a GMM estimation strategy.

Data

The country sample is similar to the difference-and-difference estimation. The country set consists of 10 emerging market IT countries and 29 LICs, which either entirely or to a high extent fulfill the "mature stabilizer" criteria.

As mentioned previously, the analysis of this country group makes it necessary to decide on the treatment of high inflation periods. Hyperinflation periods with inflation rates above 1000 percent are excluded. They lie at the beginning of the sample and therefore do not pose a problem for the time-series dimension. Even after excluding hyperinflation periods, there are still a small number of countries with very high inflation rates. Therefore, the data is transformed to prevent these data points from having a disproportionate influence on our results. We use the transformation $y_{i,t} = 100 \cdot \log\left(1 + Y_{i,t}/100\right)$ as in Brito and Bystedt (2010). In addition, we include a high inflation dummy that is 1 if transformed inflation is higher than 40 percent and 0 otherwise as in Batini and Laxton (2006) and Brito and Bystedt (2010).

When using GMM estimation it is important to take into account that it is suited for datasets where the number of time periods should be much smaller than the number of individuals (or in our case countries) to avoid overfitting by too many instruments. In our dataset the number of time periods (T=27) is similar in size to the number of countries (N=39). To avoid

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[33] See Gertler (2005) and Brito, and Bystedt (2010).

[34] For some countries the time period starts later due to lack of data or due to the exclusion of hyperinflation periods with inflation rates above 1000 percent. These countries and their starting years are: Moldova in 1993, Kyrgyz Republic in 1994, Armenia, Azerbaijan, Brazil, and Georgia in 1995.

over-fitting through a high number of instruments we summarize our yearly data into three-year intervals. As Brito and Bystedt (2010) suggest this gives the opportunity to infer information from the time series while constraining the number of instruments.

Methodology

In our estimation strategy we use the following model:

$$(2) \quad y_{i,t} = \alpha \cdot y_{i,t-1} + \beta \cdot IT_{i,t} + \gamma \cdot HI_{i,t} + \delta_t + \eta_i + \epsilon_{i,t}.$$

The term $y_{i,t}$ stands for the value of one of our four performance measures (inflation, real GDP growth, inflation volatility and growth volatility) at time t in country i. Similar to the initial value in the cross-section estimation, the lagged variable of y is included to capture reversion to the mean, but also to capture persistence dynamics. Our main focus is again on the coefficient β of the IT dummy, $IT_{i,t}$. In this model, as discussed above, we also include $HI_{i,t}$, a dummy that takes the value 1 if a country has a transformed inflation rate above 40 percent in period t and 0 otherwise. Additionally, we include time fixed effects, δ_t , country fixed effects, η_i, and an error term, $\epsilon_{i,t}$.

The model in equation (2) is estimated using simple OLS, but also accounting for time and country fixed effects. To control for simultaneity and omitted variable bias a two-step S-GMM panel estimator is used. The S-GMM is preferred over a D-GMM because it is better instrumented for estimations that include highly persistent variables. In our case the inflation targeting dummy is a highly persistent variable, since countries moved towards inflation targeting, but never abandoned it.[35] For comparison we also report results from the D-GMM.

The S-GMM is used in two different specifications. First, the dummy for high inflation periods, $HI_{i,t}$, is treated as endogenous, while the IT dummy is assumed to be predetermined. Second, the possible endogeneity of IT adoption due to reverse causation or omitted variables is accounted for by treating the IT dummy as an endogenous variable.

Regression Results

Results for estimating equation (2) using different estimators are shown in Tables 6 and 7. After accounting for time and country fixed effects and the endogeneity of IT adoption, the results still support our findings from the difference-in-difference method discussed in the previous section. The overall picture shows that the IT framework causes a reduction of inflation as well as inflation and growth volatilities. But, the effect on output growth is negative under certain specifications.

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[35] The only countries that abandoned inflation targeting are Finland, the Slovakia, and Spain by joining the European Monetary Union.

The positive effect of IT on inflation reduction is still found using panel estimation methods. Inflation falls by around 2 percentage points more in inflation targeting countries compared to the LIC control group. The coefficient remains significant except when taking into account country fixed effects in the OLS estimation (Table 6, column 3). The size of the effect is similar to the cross-section analysis. Lagged inflation contributes little to explaining inflation. The coefficient is very small, under 10 percent. This might stem from the 3-year averaging, used in the panel analysis. The high inflation dummy, on the other hand, has a high and significant coefficient. The results are very similar to Brito and Bystedt (2010).

The picture for inflation volatility is also very similar to the cross-section analysis. Using an IT framework yields a lower volatility of inflation. At odds is the result when estimating equation (2) using OLS with country and time fixed effects. The coefficient is positive and significant (Table 6, column 9). In comparison to Brito and Bystedt (2010), we estimate a slightly higher effect of IT on inflation volatility and our estimates are significant in most cases, while they do not find a significant effect except for simple OLS estimation.

The negative effect of IT on real GDP growth is only significant in certain specifications. Again the size of the coefficient is in a similar range as the coefficients from the cross-section results. Brito and Bystedt (2010) find a milder effect, which might be driven by the different country selections. The high inflation dummy is only significant in the estimation with country and time fixed effects, showing that high inflation periods–apart from the hyperinflation periods we excluded–have only a significant effect on output growth once country characteristics are controlled.

In contrast to the cross-section results, IT seems to have a significant effect on reducing growth volatility. This also differs from Brito and Bystedt (2010), who do not find a consistent negative influence of IT on growth volatility. Similar to the growth results, high inflation periods do not have a significant impact on growth volatility.

Both the difference-in-difference method and the panel regressions show that inflation targeting is associated with lowering inflation and its volatility. This reduction in inflation comes at the cost of lower output, albeit only for some model specifications. The conclusions of this analysis are, however, subject to several important caveats.

- First, comparing advanced LICs with emerging markets that have adopted inflation targeting may be less than ideal. Nonetheless, by selecting a set of emerging economies that displayed similar macroeconomic performance as advanced LICs during the sample period bodes well for what may result from inflation targeting for LICs.

- Second, it is difficult to draw definite conclusions about the effects of inflation targeting as the time elapsed since these countries adopted inflation targeting is short. As these countries may not be in their steady states, we can only see the short to medium term impact.

- Third, many countries adopting inflation targeting did so as part of broader structural and policy reforms. In such cases, adoption of inflation targeting may not fully explain the improvement in relative performance and even makes it difficult to resolve whether inflation targeting is "causal" in lowering inflation.

Table 6. Regression Results for Inflation and Inflation Volatility (Panel Analysis)

Dependent Variable:	Log Inflation						Log Inflation Volatility					
	OLS	TE-OLS	CTE-OLS	D-GMM P	S-GMM P	S-GMM E	OLS	TE-OLS	CTE-OLS	D-GMM P	S-GMM P	S-GMM E
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Inflation Targeting Dummy	-2.11***	-1.70***	-1.98	-1.91	-1.75**	-3.13***	-2.20***	-1.02***	3.28*	7.61	-1.02***	-1.25***
	(-3.56)	(-2.89)	(-1.41)	(-0.50)	(-2.08)	(-3.21)	(-5.46)	(-3.24)	(1.91)	(1.05)	(-3.60)	(-3.08)
Lagged Inflation (Volatility)	0.10***	0.09***	0.04*	0.03	0.06	0.07	0.09***	0.09***	0.08***	0.07***	0.08***	0.08***
	(3.34)	(3.02)	(1.83)	(0.87)	(1.19)	(1.20)	(3.96)	(3.66)	(7.18)	(4.21)	(3.81)	(3.70)
High Inflation Dummy	33.06***	29.98***	30.08***	34.08***	33.94***	34.20***	19.06*	16.66	12.99***	11.25	74.57	71.84
	(12.36)	(11.28)	(10.59)	(4.77)	(4.11)	(3.69)	(1.77)	(1.51)	(3.79)	(0.33)	(1.21)	(1.24)
AR(1) Test				0.09	0.07	0.06				0.08	0.04	0.04
AR(2) Test				0.30	0.38	0.35				0.13	0.19	0.20
Hansen Test				0.43	0.45	0.53				0.11	0.16	0.13
Instrument Columns				24	34	31				24	34	31
Observations	190	190	190	151	190	190	189	189	189	150	189	189
R-squared	0.62	0.68	0.71				0.44	0.47	0.49			

t statistics in parentheses, significance levels: * p<0.1, ** p<0.05, * **p<0.01

Table 7. Regression Results for Output Growth and Output Volatility (Panel Analysis)

Dependent Variable:	Log Growth						Log Growth Volatility					
	OLS	TE-OLS	CTE-OLS	D-GMM P	S-GMM P	S-GMM E	OLS	TE-OLS	CTE-OLS	D-GMM P	S-GMM P	S-GMM E
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Inflation Targeting Dummy	-0.39	-1.22***	-0.33	-3.80	-1.35***	-2.03**	-0.73***	-0.47**	-0.03	1.73	-0.56**	-0.59*
	(-1.06)	(-3.17)	(-0.38)	(-1.05)	(-2.92)	(-2.63)	(-3.54)	(-2.25)	(-0.04)	(0.68)	(-2.43)	(-2.01)
Lagged Growth (Volatility)	0.29***	0.22**	0.01	0.09	0.15**	0.12*	0.24***	0.23***	-0.10	0.09***	0.15	0.14***
	(2.68)	(2.11)	(0.19)	(1.37)	(2.38)	(1.95)	(3.15)	(3.01)	(-1.36)	(2.93)	(1.39)	(3.58)
High Inflation Dummy	-4.76	-4.87	-7.14***	-6.15	-1.70	0.08	0.51	0.12	0.39	2.28	11.86	4.49
	(-1.17)	(-1.17)	(-4.73)	(-0.61)	(-0.17)	(0.01)	(0.63)	(0.10)	(0.25)	(0.53)	(1.02)	(1.12)
AR(1) Test				0.02	0.03	0.05				0.05	0.13	0.04
AR(2) Test				0.44	0.35	0.32				0.11	0.16	0.12
Hansen Test				0.38	0.26	0.28				0.24	0.15	0.21
Instrument Columns				24	34	31				24	34	31
Observations	190	190	190	151	190	190	189	189	189	150	189	189
R-squared	0.17	0.24	0.28				0.09	0.11	0.07			

t statistics in parentheses, significance levels: * p<0.1, ** p<0.05, * **p<0.01

VI. UNDER WHAT CONDITIONS CAN INFLATION TARGETING BE ADOPTED?

The shift to an inflation targeting regime has contributed to the relatively low inflation observed in economies even where, the preconditions for successful implementation were not in place. Often cited preconditions include full central bank independence, a well developed technical infrastructure to forecast and model inflation, an economic structure under which domestic prices are not overly sensitive to commodity prices and exchange rates and a healthy financial system (Box 3). Overall, the evidence indicates that no inflation targeter had these preconditions fully in place before adopting inflation targeting, although—unsurprisingly—industrial economy targeters were generally in better shape than emerging market inflation targeters at least in some dimension (WEO, September 2005).

The fact that none of today's inflation targeters neither individually nor on average met fully the preconditions suggests that failure to meet them is not by itself an impediment to shifting to IT.[36] Nonetheless, there are factors that may weaken the efficacy of IT. The existence of managed exchange rate regimes commonly associated with a fear of floating, a narrow base of domestic nominal financial assets, the lack of market instruments to hedge exchange rate risk, and dollarization are among these factors.[37]

Box 3. PreConditions for the Adoption of Inflation Targeting

The preconditions for inflation targeting can be divided into the following four broad categories:

• *Institutional independence*. The central bank must have full legal autonomy and be free from fiscal and/or political pressure that would create conflicts with the inflation objective.
(i) absence of fiscal obligation; (ii) operational independence; (iii) inflation-focused mandate; (iv) favorable fiscal balance; (v) low public debt; and (vi) central bank independence.

• *A well-developed technical infrastructure*. Inflation forecasting and modeling capabilities, and the data needed to implement them, must be available at the central bank.

• *Economic structure*. For effective inflation control, prices must be fully deregulated, the economy should not be overly sensitive to commodity prices and exchange rates, and dollarization should be minimal. There are four indicators that capture a variety of economic conditions that are often thought to affect the likelihood of success of inflation targeting (i) low exchange rate pass-through; (ii) low sensitivity to commodity prices; (iii) low dollarization; and (iv) extent of trade openness.

• *A healthy financial system*. To minimize potential conflicts with financial stabilization objectives and guarantee effective monetary policy transmission, the banking system should be sound, and capital markets well developed.

Source: Batini and Laxton, 2006; and WEO, September 2005.

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[36] Batini and Laxton (2006) find that no precondition enters significantly in the equations explaining the improvement in macroeconomic performance following the adoption of inflation targeting. Instead, the adoption of inflation targeting was subsequently associated with improvement in all areas, which suggests that inflation targeting may encourage the central bank to take a proactive approach to making improvements. This analysis was, however, conducted only for advanced and emerging economies. Therefore, it may not capture the deficiencies in LICs.

[37] However, there is evidence that the inflation targeting framework can be successfully adapted in highly dollarized economies (Leiderman et al., 2006; Armas et al., 2006).

There are, however, several factors that may enhance inflation targeting, particularly[38] (a) a well functioning monetary transmission mechanism; (b) a degree of independence of monetary policy; and (c) absence of commitment to a particular level for the exchange rate. A country satisfying these requirements could choose to conduct its monetary policy under an IT framework despite not having all the preconditions (Box 3). Nonetheless, as described below, the following features can impact the effectiveness of an IT framework:

A. Weak Monetary Transmission Mechanism. Implementing an inflation targeting regime requires a clear understanding of the monetary policy transmission mechanism and methods of projecting inflation that are consistent with that understanding. Adopting IT in LICs is often constrained by the fact that the monetary policy transmission mechanism is weak and its understanding of it is rudimentary. However, this is a problem for every type of monetary policy implementation. In addition, weak institutional frameworks, reduced role of securities markets, imperfect competition in the banking sector and the resulting high cost of bank lending to private firms, causes the traditional channels (interest rate, bank lending, and asset price) to become impaired in LICs (Mishra et al., 2010). These impediments make the adoption of IT more challenging in LICs.

B. Independent Monetary Policy. The central bank's scope for conducting an independent monetary policy tends to be hampered by heavy reliance on seigniorage, shallow financial markets, and fragile banking systems (Masson et al., 2007).

- **Reliance on Seigniorage.** Reliance on seigniorage is perhaps the simplest and most common indication of fiscal dominance. The link between a government's inability to raise the revenue it needs from conventional sources and its recourse to seigniorage is well documented. In developing countries, this link is often strong because of structural features (concentrated and unstable sources of tax revenue, poor tax collection procedures, and skewed income distributions) and a proclivity to abuse seigniorage, particularly in times of crisis. Other manifestations of fiscal dominance are the government forcing the central bank to monetize government debt, and pressure from the government to maintain an expansionary monetary policy stance.

- **Financial Markets.** Shallow capital markets are also a common, though more subtle, indication of fiscal dominance. They are often a by-product of government schemes to extract revenue from the financial system through various forms of financial repression, including interest rate ceilings, high reserve requirements, sectoral credit policies, and compulsory placements of public debt. In some low-income countries, undeveloped capital markets may be as much a cause as a consequence of fiscal

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[38] Many of these factors are not limited to implementing inflation targeting but also to any other monetary policy.

dominance, leaving seigniorage and other forms of fiscal repression as the only options. Underdeveloped foreign exchange markets have also held back LICs from adopting IT.[39]

- **Banking Systems.** Fragile banking systems are an obvious consequence of prolonged periods of financial repression. In the aftermath of financial sector reforms, however, the banking system can impart an independent influence on the conduct of monetary policy, but in this context conflicts can arise between the goals of attaining price stability and restoring banking sector profitability.

C. Conflicts with other Objectives. The necessary conditions for inflation targeting, the primacy of the inflation target over other policy objectives and a forward-looking operating procedure using inflation forecasts, are difficult to satisfy in a context where exchange rate stability is a stated or an implicit objective of monetary policy (as when the authorities adopt de facto a target level, path, or band for the exchange rate even when that rate is de jure flexible). As long as an inflation target co-exists with other objectives of monetary policy, tension between the inflation target and the other policy objectives is unavoidable. In such circumstances, the benefits of inflation targeting are diminished.

VII. CONCLUSION

Inflation targeting has been gaining popularity over the last two decades but it is a fairly new monetary policy framework in LICs. To date only three LICs, Ghana and Armenia, and Albania have officially declared themselves to be inflation targeters. There are several countries (such as Moldova, Georgia, etc.) that could be described as informal inflation targeters, in that they informally follow an IT framework but have yet to declare it.

The small number of LICs that have adopted IT and the short time span since its adoption makes the drawing of any conclusions rather difficult. Nonetheless, we used two different methods to understand the impact of IT on the macroeconomic performance of LICs. Both methods reveal that shifting to IT will lower inflation and its volatility in LICs. The result that IT improves inflation performance more than other regimes is in a sense unsurprising, as the control of inflation is, after all, the central bank's overriding medium-term objective. An interesting question is how performance compares on other dimensions, particularly with regard to output. This paper finds that there is limited evidence of a trade-off between inflation and output. In fact, the negative impact on growth might be due to the LIC characteristics and not the adoption of inflation targeting.

It, however, should be noted that the benefits of IT can be limited when the basic conditions for its adoption are not in place. Often, the economic structure of LICs makes the adoption of

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[39] For details see IMF Occasional Paper No. 267 (2009).

IT more challenging. Yet, the adoption of IT may be an appropriate monetary policy framework for LICs as it allows central bankers to pay considerable attention to monetary aggregates or the exchange rate, either because these variables contain valuable information about the state of the economy and the financial system, or because of their role in the monetary transmission mechanism.[40]

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[40] For details see Berg, Portillo, and Unsal (2010).

Appendix I. Synopsis of the Inflation Targeting Framework in Armenia and Ghana

Armenia

1. Inflation-targeting Framework	
1.1 Monetary authority	Central Bank of Armenia (CBA)
1.2 Legal mandate	Armenian Law on 'The Central Bank' specifies that its key objective is ensuring price stability
1.3 Operational Independence	Yes
1.4 Date IT adopted	January 2006
1.5 Who sets the target?	CBA jointly with the Government
1.6 Target measure; headline or core?	Headline CPI
1.7 Current target	4% ±1.5 percentage points. From 2011, 3%± 1 percentage points.
1.8 Target horizon	Twelve months
1.9 Key policy rate	One week repo rate
2. Decision Making	
2.1 Decision-making body	CBA Board: Governor, Vice Governor, five Board Members
2.2 External members?	No.
2.3 Terms of appointment of members	The Governor is appointed by the National Assembly for six years, the Vice Governor is appointed by the President for six years and five Board members are appointed by the President for five years on a rotating schedule.
2.4 Decision-making process	A technical committee including the Board member responsible for monetary policy makes recommendations to the Board. The Board makes decisions based on majority voting. Governor has a casting vote.
2.5 Frequency of decision making meeting	Monthly
3. Modeling and Forecasting	
3.1 Type of models used by central bank	Core medium-term projection model. A micro-founded DSGE model will be used in parallel. Other models include behavioral single equation models, ECMs and VARs
3.2 Published forecasts	Monthly
3.3 Forecast assumption on interest rates	Constant interest rates
3.4 Forecast owned by	CBA
4. Accountability Mechanism	
4.1 Open letter	No
4.2 Parliamentary hearings	Once a year
5. Communication and Publications	
5.1 Immediate announcement of policy decision	Press release
5.2 Press notice/conference after decision	Press release
5.3 Publication of minutes	Within ten days after decision
5.4 Publication of individual votes/balance of votes	No
5.5 Inflation Report	Yes
5.6 Frequency	Quarterly Monetary Programs and Inflation Report

Source: *Hammond (2010)*

Ghana

1. Inflation-targeting Framework	
1.1 Monetary authority	Bank of Ghana
1.2 Legal mandate	Bank of Ghana Act 2002
1.3 Operational Independence	Yes
1.4 Date IT adopted	Informally in 2002, formally from May 2007
1.5 Who sets the target?	Government and central bank
1.6 Target measure; headline or core?	Headline CPI
1.7 Current target	9.2% ±2 percentage points. 5%± 2 percentage points by 2012.
1.8 Target horizon	18-24 months
1.9 Key policy rate	Prime rate
2. Decision Making	
2.1 Decision-making body	By law, proposals are initiated by the Monetary Policy Committee (MPC), while the Board of Directors is formally responsible for monetary policy decisions. In practice, the monetary policy decisions taken by the MPC have never to date been reversed by the Board. The Board consists of twelve members: the Governor as Chairman, the First and Second Deputy Governors and nine directors
2.2 External members?	The two external members are appointed by the Ministry of Finance and Economic Planning
2.3 Terms of appointment of members	The Governor and the Deputy Governors are appointed by the President in consultation with the Council of State for a four-year term and can be re-appointed. Board members are appointed for three years and are eligible for re-appointment
2.4 Decision-making process	By consensus
2.5 Frequency of decision making meeting	Six times a year
3. Modeling and Forecasting	
3.1 Type of models used by central bank	Autoregressive (AR) forecasting model; error correction forecasting model; macro econometric model and calibrated macroeconomic model (being developed)
3.2 Published forecasts	Fan chart forecasts for headline and core inflation and GDP are published in the *Monetary Policy Report*.
3.3 Forecast assumption on interest rates	Not communicated
3.4 Forecast owned by	Monetary Policy Committee
4. Accountability Mechanism	
4.1 Open letter	No
4.2 Parliamentary hearings	No. However, by law, the Governor could be called by the Parliament.
5. Communication and Publications	
5.1 Immediate announcement of policy decision	Yes, with a press release
5.2 Press notice/conference after decision	Press conference
5.3 Publication of minutes	No, but statistical releases are published after each policy meeting
5.4 Publication of individual votes/balance of votes	No
5.5 Inflation Report	Yes. *Monetary Policy Report*
5.6 Frequency	Four to six per year, after every MPC meeting

Source: *Hammond (2010)*

Appendix II. Tables on Average Inflation and Growth Rates

Table 1. Average Inflation and Growth rates in Pre- and Post-Period, IT-Countries

Country	IT adoption date	Pre-Period	Post-Period	Average Inflation		St. d. of Inflation		Average Growth		St.d. of Growth		used in Model
				Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Brazil	1999	1996-1998	1999-2008	8.7	6.9	6.6	3.1	1.9	3.4	1.7	2.0	3,5
Chile	1999	1990-1998	1999-2008	12.7	3.7	7.2	2.0	7.2	3.8	2.9	1.8	1,2,3,4,5
Colombia	1999	1990-1998	1999-2008	23.4	6.9	4.4	2.0	3.7	3.5	1.7	3.3	1,2,3,4,5
South Africa	2000	1990-1999	2000-2008	9.9	6.0	3.5	3.0	1.4	4.2	2.1	1.1	1,2,3,4,5
Thailand	2000	1990-1999	2000-2008	5.0	2.8	2.1	1.7	5.3	4.8	6.6	1.6	1,2,3,4,5
Mexico	2001	1990-2000	2001-2008	19.4	4.7	9.6	0.9	3.7	2.4	3.5	1.7	1,2,3,4,5
Peru	2002	1993-2001	2001-2008	13.3	2.5	14.6	1.8	4.3	6.8	4.4	2.2	3,5
Philippines	2002	1990-2001	2001-2008	9.0	5.5	3.8	2.5	3.0	5.3	2.4	1.1	1,2,3,4,5
Guatemala	2005	1990-2004	2005-2008	12.3	8.5	10.2	2.2	3.5	4.5	0.8	1.5	1,2,3,4,5
Indonesia	2005	1990-2004	2005-2008	9.0	9.8	4.0	2.9	5.7	5.9	2.0	0.4	5
Average				**12.3**	**5.7**	**6.6**	**2.2**	**4.0**	**4.5**	**2.8**	**1.7**	

Table 2. Average Inflation and Growth Rates in Pre- and Post-Period, Low-Income Countries

Country	Pre-Period	Post-Period	Average Inflation		St. d. of Inflation		Average Growth		St.d. of Growth		used in Model
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Albania	1994-2001	2002-2008	12.6	3.1	12.0	1.0	1.7	5.8	13.3	1.1	3,5
Armenia	1996-2001	2002-2008	7.4	4.2	7.8	3.0	5.9	12.2	2.4	2.7	3,5
Azerbaijan	1996-2001	2002-2008	2.9	9.6	9.3	6.9	6.9	17.9	3.0	10.5	3,5
Bangladesh	1990-2001	2002-2008	5.7	6.6	3.1	1.7	4.9	6.0	0.4	0.6	1,2,3,4,5
Bolivia	1990-2001	2002-2008	9.3	5.9	6.1	4.3	3.7	4.2	1.6	1.3	1,2,3,4,5
Burkina Faso	1990-2001	2002-2008	4.2	3.3	7.2	4.0	5.0	5.7	3.6	1.9	1,2,3,5
Cape Verde	1990-2001	2002-2008	6.2	2.5	4.1	3.0	6.2	6.5	3.1	2.2	1,2,3,4,5
Ethiopia	1990-2001	2002-2008	6.3	11.0	8.8	10.0	3.5	7.8	7.1	6.3	1,2,3,4,5
Georgia	1996-2001	2002-2008	13.0	7.5	14.2	2.1	5.6	8.0	3.9	3.6	3,5
Honduras	1990-2001	2002-2008	18.2	8.0	8.4	1.8	3.0	5.3	2.7	1.2	1,2,3,4,5
India	1990-2001	2002-2008	8.6	5.3	3.5	1.7	5.4	7.9	1.6	1.8	1,2,3,4,5
Kenya	1990-2001	2002-2008	15.2	10.1	12.9	4.0	2.2	4.1	2.0	2.6	1,2,3,4,5
Kyrgyz Rep.	1995-2001	2002-2008	24.4	7.7	13.5	7.9	4.0	4.8	4.9	3.8	3,5
Lesotho	1990-2001	2002-2008	10.4	7.6	3.9	3.2	4.2	3.2	2.1	2.0	1,2,3,4,5
Madagascar	1990-2001	2002-2008	15.8	11.1	14.0	6.3	2.2	3.7	3.2	7.3	1,2,3,4,5
Mali	1990-2001	2002-2008	3.8	2.7	7.9	4.3	5.4	4.9	5.7	1.9	1,2,3,5
Moldova	1995-2001	2002-2008	21.9	11.3	12.3	2.7	-1.0	6.4	4.6	1.8	3,5
Mongolia	1996-2001	2002-2008	19.7	9.4	17.5	8.5	2.9	8.2	1.4	2.0	3,5
Mozambique	1990-2001	2002-2008	26.7	11.6	19.8	3.5	6.6	7.7	5.4	1.2	3,5
Nepal	1990-2001	2002-2008	8.7	5.5	4.6	1.9	5.0	3.5	1.5	1.7	1,2,3,4,5
Nigeria	1990-2001	2002-2008	16.1	12.1	13.0	4.2	4.1	9.5	4.3	5.6	3,5
Pakistan	1990-2001	2002-2008	8.7	6.7	3.4	3.5	3.8	5.3	1.6	2.1	1,2,3,4,5
Rwanda	1990-2001	2002-2008	15.1	9.1	16.4	4.1	2.7	8.0	16.6	3.9	1,2,3,4,5
Senegal	1990-2001	2002-2008	4.0	2.6	9.2	2.3	2.9	4.1	2.3	2.2	1,2,3,5
Sri Lanka	1990-2001	2002-2008	11.1	12.4	4.6	5.1	4.7	6.0	2.2	1.2	1,2,3,4,5
St. Lucia	1990-2001	2002-2008	3.5	2.7	2.1	2.5	2.2	2.8	3.5	1.8	1,2,3,5
Tanzania	1990-2001	2002-2008	18.8	6.0	9.7	2.3	3.5	7.2	1.9	0.4	1,2,3,4,5
Uganda	1990-2001	2002-2008	15.2	5.3	15.6	3.4	6.2	8.0	2.7	1.6	1,2,3,4,5
Vietnam	1992-2001	2002-2008	9.1	8.9	11.4	6.6	7.4	7.6	1.7	0.8	3,5
Average			**11.8**	**7.2**	**9.5**	**4.0**	**4.2**	**6.6**	**3.8**	**2.7**	

Table 3. Average Inflation and Growth Rates in Pre- and Post-Period, non IT Emerging Market Countries

Country	Pre-Period	Post-Period	Average Inflation		St. d. of Inflation		Average Growth		St.d. of Growth		used in Model
			Pre	Post	Pre	Post	Pre	Post	Pre	Post	
Argentina	1992-2001	2002-2008	4.9	11.7	9.1	6.8	2.8	5.7	5.3	7.4	3,5
Belize	1990-2001	2002-2008	1.8	3.5	2.0	1.5	6.4	4.5	4.7	2.5	1,2,3,4,5
Botswana	1990-2001	2002-2008	10.4	9.2	3.0	2.2	5.8	5.1	3.8	2.3	1,2,3,4,5
Costa Rica	1990-2001	2002-2008	15.9	11.3	6.1	2.0	4.8	5.6	3.0	2.4	1,2,3,4,5
Dominican Rep.	1991-2001	2002-2008	10.8	10.2	12.3	8.7	5.7	6.5	2.9	3.9	5
Egypt	1990-2001	2002-2008	9.5	7.1	6.5	3.8	4.1	5.1	2.0	1.8	1,2,3,4,5
Gabon	1990-2001	2002-2008	5.8	1.8	16.5	2.5	2.1	2.2	4.5	1.8	1,2,3,5
Jamaica	1993-2001	2002-2008	17.0	12.2	10.4	5.2	0.8	1.5	1.8	1.4	3,5
Kazakhstan	1996-2001	2002-2008	15.7	9.2	12.1	3.9	4.4	8.7	6.0	2.5	3,5
Malaysia	1990-2001	2002-2008	3.3	2.6	1.2	1.5	6.8	5.7	5.2	0.7	1,2,3,4,5
Mauritius	1990-2001	2002-2008	7.6	6.8	3.6	2.4	5.7	3.8	3.0	1.6	1,2,3,4,5
Namibia	1990-2001	2002-2008	9.9	6.7	3.0	3.2	3.7	5.7	2.7	3.3	1,2,3,4,5
Paraguay	1990-2001	2002-2008	15.1	9.1	9.2	3.1	1.9	4.0	2.5	2.2	1,2,3,4,5
Suriname	1990-2001	2002-2008	22.4	12.8	16.1	5.5	2.0	5.3	2.5	1.9	5
Swaziland	1990-2001	2002-2008	9.2	7.7	2.8	3.6	3.3	2.7	2.2	0.7	1,2,3,4,5
Turkmenistan	1998-2001	2002-2008	15.0	8.6	6.7	3.2	15.5	13.4	6.1	2.5	5
Uruguay	1994-2001	2002-2008	20.1	9.9	16.7	5.1	1.6	3.9	4.4	5.3	3,5
Venezuela	1990-2001	2002-2008	29.1	22.0	10.4	6.7	3.0	5.0	4.8	9.9	5
Average			**12.4**	**9.0**	**8.2**	**3.9**	**4.5**	**5.2**	**3.7**	**3.0**	

Appendix III. Difference–in–Difference Method

In line with Ball and Sheridan (2005), macroeconomic performance is considered to depend partly on its own past history, and partly on some underlying mean value of the variable in question. In the case of the inflation rate for inflation targeters, this mean should, of course, correspond to the inflation target; for other countries, this would simply be the "normal" level of inflation to which observed inflation reverts. Mathematically, this process can be expressed as follows:

$$X_{i,t} = \varphi[\alpha^T d_{i,t} + \alpha^N(1 - d_{i,t})] + (1 - \varphi)X_{i,t-1} \qquad (1)$$

where,
$X_{i,t}$ is the value of a macroeconomic performance indicator X for country i at time t,
α^T is the mean to which X reverts for inflation targeters,
α^N is the mean to which X reverts for *non* inflation- targeters,
and $d_{i,t}$ is a variable equal to 1 for inflation targeters and 0 for non-inflation targeters.

The parameter φ represents the speed with which X reverts to its group-specific α: a value of φ equal to 1 means X reverts completely after one period, while a value of φ equal to 0 would imply that X depends only on its past history, with no tendency to revert to any particular value.

The regression used by Ball and Sheridan (2005), and in the results reported in the main text, is a version of equation (1), rewritten in terms of the change in X, appending an error term e, and assuming there are two periods: "pre" and "post":

$$X_{i,\text{post}} - X_{i,\text{pre}} = \varphi\alpha^T d_i + \varphi\alpha^N(1 - d_i) - \varphi X_{i,\text{pre}} + e_i \qquad (2)$$

or, letting $a_0 = \varphi\alpha^N$, $a_1 = \varphi(\alpha^T - \alpha^N)$, and $b = -\varphi$,

$$X_{i,\text{post}} - X_{i,\text{pre}} = a_0 + a_1 d_i + bX_{i,\text{pre}} + e_i \qquad (3)$$

In this framework, the relevant parameter for gauging inflation targeting's economic impact is a_1, the coefficient on the inflation targeting dummy variable. a_0 instead captures whether there has been a generalized improvement in macroeconomic performance across countries independently of differences in monetary regimes). If φ were known to be zero (i.e., complete mean reversion, the estimated a_1 would be nothing more than the difference in average $X_{\text{post}} - X_{\text{pre}}$ for inflation targeters versus non-inflation-targeters; the only advantage of the regression method is to be able to control for the initial level of X_{pre}. Furthermore, by focusing on relatively long periods of time, the analysis is largely a comparison of steady states, saying nothing about what happens during the transition to inflation targeting (or any other) policy framework; to do so would obviously require a very careful control of cyclical conditions to distinguish transition effects from the normal trajectory of the business cycle.

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