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The Past and Future of Inflation Targeting:

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Abstract

Inflation targeting (IT) was started in 1990 and spread subsequently to 35 other advanced and emerging/developing countries until now. Drawing from existing and new research, this paper takes stock of IT's past performance and limitations, and discusses its main challenges to remain the monetary regime of choice in the future. Adopting and developing IT takes different forms but central banks gradually converge to a common policy framework – although the framework itself continues evolving over time. There is significant evidence on the success of IT – in particular for emerging economies and lower income countries – in improving central banks' institutional set-up, conduct of monetary policy, and macroeconomic performance. The last decade presented the greatest challenges to IT, due to the commodity price shock of 2006-07 and then the Global Financial Crisis and its aftermath. The future of IT in general, and in developing countries in particular, will be determined by how well central banks manage the transition toward full-fledged stationary-target IT; improve their independence, transparency, and accountability; strengthen flexible IT without giving up low inflation as the key policy mandate; and evaluate seriously adoption of price-level targeting. Continuing IT adoption in developing countries is an encouraging sign of their capacity to face these challenges.

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1. Introduction

Inflation Targeting (IT) was born in 1989 with the Reserve Bank of New Zealand (RBNZ) Act and started by the RBNZ in January 1990. At the time of its birth, this new monetary framework had no name. 25 years later IT has spread world-wide through advanced economies (AEs) and, in particular, through emerging-market and developing economies (EMDEs). As of April 2015, central banks of 36 countries have an IT framework in place.[1]

What is IT? A monetary policy framework focused on price stability as the main policy goal reflected by an explicit numerical inflation target, pursued by a monetary authority endowed with operational and instrument independence, which conducts policy in a transparent way and is accountable for its actions and results to political authorities and the public. In fact, the four key attributes of IT can be summarized as: policy independence, an explicit target for inflation, transparency, and accountability (Kamber et al. 2015, Walsh 2015).

In what sense is IT different from best monetary practice in other monetary regimes, in particular those where nominal anchors are either money growth or the exchange rate? First, under IT the target is obviously a measure of inflation (the ultimate goal of price stability), as opposed to money or exchange-rate targeting (which are intermediate policy goals for all monetary authorities that pursue price stability). Second, because attainment of an inflation target is in principle more elusive to central banks than controlling money growth or the exchange rate, IT requires higher degrees of monetary policy independence, transparency, and accountability than those observed in alternative monetary regimes. Third, considering the key role of inflation expectations for the path of future inflation, IT central banks focus more strongly on different measures of inflation expectations and forecasts in setting policy than other central banks. The paramount role of the inflation forecast as intermediate policy objective under IT has led some researchers to redefine IT as inflation forecast targeting (Svensson 1997).

While the main goal of IT is inflation, it is not the only objective of monetary policy under IT. While pursuing price stability, the monetary authority does so by also attempting to reduce output volatility and ensure financial stability. Therefore the conduct of policy is focused on attaining the inflation objective over the medium term – over an explicit policy horizon – and not in the very short term. This approach is termed flexible IT and is the way central banks have gradually chosen to implement IT, in opposition to strict IT. [2]

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[1] We follow the IMF regarding both the classification of economies into AEs and EMDEs, and the IT country list (IMF 2015).

[2] The foundation of flexible IT is illustrated best by legal acts related to IT in New Zealand. The assigned policy objective for the Reserve Bank of New Zealand (RBNZ) was established in clause 8 of the RBNZ Act of December 1989: "The primary function of the Bank is to formulate and implement monetary policy directed to the economic objective of achieving and maintaining stability in the general level of prices". The flexible part of IT is reflected a decade later by the 1999 Policy Target Agreement between the Government of New Zealand and the RBNZ: "In pursuing its price stability objective, the Bank shall implement monetary policy in

This paper is about the past and the future of IT, with a focus on policy lessons and implications for EMDEs. Section 2 reviews the world experience in adopting and developing the IT regime, focusing on pre-conditions, the likelihood of having IT in place, the transition toward full-fledged IT, and the evolution of the IT framework. Then section 3 reviews selectively the wide international evidence on monetary policy and macroeconomic performance under IT. The IT regime was put to several tests, shortly before and then during and after the Global Financial Crisis – the results are analyzed in section 4. The next section draws the lessons from the experience of IT in EMDEs and identifies their key future policy challenges. Concluding remarks close the paper.

2. Adopting and developing IT

After New Zealand's adoption of IT in 1990, this new monetary regime started slowly to spread around the world. 11 AEs and 25 EMDEs have IT in place in 2015. The gradually growing number of IT countries, reflected in Figure 1, includes both stationary and converging inflation targeters (ITers), as well as full-fledged and partial ITers – important distinctions that we discuss below.

Which are the main pre-requisites that an economy and its central bank should satisfy before adopting IT? What triggers formal adoption of an inflation target in practice? Which is the difference between partial and full-fledged IT? Has the frontier best practice of IT changed over the last 25 years? We address these questions next.

2.1 Pre-conditions for successful IT

In the 1990s it was often thought that IT could only be successfully implemented in countries with high levels of institutional development and macroeconomic stability, and where central banks satisfied the highest standards regarding independence and conduct of monetary policy (Masson et al. 1997). Strict attainment of such conditions would have restricted IT adoption mostly to AEs. However, already in the late 1990s IT had been adopted by more EMDEs than AEs.

To identify pre-conditions for IT, it is useful to start with the key features of IT: (i) price stability is explicitly and publicly stated as the main goal of monetary policy, (ii) a quantitative target for inflation is publicly announced; (iii) conduct of monetary policy is based on a wide set of information, including inflation forecasts; (iv) monetary policy is conducted in a highly transparent way; and (v) the monetary authority complies with high standards of public accountability regarding the conduct of policy and its results. Based on the latter five features, Batini and Laxton (2007) identify four broad categories of pre-conditions for successful IT: (a) central bank institutional independence, (b) well-developed central bank infrastructure, (c) developed economic structure, and (d) a

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a sustainable, consistent and transparent manner and shall seek to avoid unnecessary instability in output, interest rates and the exchange rate" (Grimes 2013, Walsh 2015).

healthy financial system. Then the authors identify specific variables for each category and provide annual measures for 21 ITers, before and after their adoption of IT.[3]

Their findings are surprising. No IT country and its corresponding central bank satisfied to any significant extent the four pre-conditions at the time of IT adoption. Out of a maximum score of 4 points (when meeting all pre-conditions fully), AEs scored on average 2.3 points and EMDEs 1.6 points (Figures 2 and 3). Individual country scores at the time of IT adoption ranged between 1.2 points (The Philippines) and 2.6 points (Switzerland). Generally, the later IT is adopted, the more pre-conditions are satisfied, suggesting that IT central banks learn by importing IT policy frameworks from earlier IT adopters. Moreover, all countries continued improving on their IT pre-conditions for many years after they started IT. This suggests that countries could start IT well before satisfying theoretical pre-conditions. While there is still lack of research that links satisfaction of pre-conditions to the subsequent success of IT, it seems that non-satisfaction of pre-conditions has not hampered IT success. However, central bank efforts toward improving significantly their institutional and policy framework after IT adoption also suggest that they view such upgrades as key for their long-term policy success. Hence theoretical pre-conditions for IT have proven to be *de facto* post-conditions required for gradual strengthening of the IT framework.

2.2 On the likelihood of having an IT regime in place

The issue of IT pre-conditions is closely linked to the question about which institutional and macroeconomic features are observed when central banks adopt IT and hold to it over time. Hence, which conditions raise the likelihood of having an IT framework in place?

Gerlach (1999) performed probit regressions on a small cross-section country sample, finding evidence for the role of inflation, credibility measures, trade openness, and terms-of-trade shocks in shaping the likelihood of IT. Mishkin and Schmidt-Hebbel (2002) also estimate a probit model, applied to a larger cross-country sample, identifying the influence of several pre-condition variables (inflation, fiscal position, proxies of alternative monetary regimes, central bank independence and credibility) and trade openness in shaping the likelihood of IT. Carare and Stone (2003) estimate a cross-country probit model on a larger cross-country sample, adding measures of fiscal and financial pre-conditions, and per-capita GDP, to some variables used in the preceding studies. Hu (2006) is the first study to consider the time dimension of having IT in place, by using a panel-data set (comprised by 66 countries and covering the period 1980-2000) to estimate

[3] The variables in each category are: (i) for institutional independence: full legal independence, goal independence, and operational independence; (ii) for well-developed central bank infrastructure: technical infrastructure, data availability, and systematic inflation forecasting and modeling capabilities; (iii) for developed economic structure: full price deregulation, no excess sensitivity of inflation to commodity prices and the exchange rate, low dollarization, and low trade openness; (iv) healthy financial system: six measures of banking and capital-market development.

a probit pooled-data model (without controlling for country effects) for the IT regime. In addition to some of the variables considered in the previous studies, he finds evidence that the exchange-rate regime, external debt, and GDP growth contribute to the likelihood of having IT in place.

A more recent study extends the existing empirical literature on the likelihood of having IT in place by using a large panel data sample of 98 countries extending from 1975 to 2005 (Calderón and Schmidt-Hebbel 2008).[4] The base-line results, which are robust to alternative specifications and econometric methods, are reproduced here in Table 1. They imply the following.

Five important key pre-condition variables are generally highly significant (and exhibit expected signs) in shaping the likelihood of IT: the level of inflation (with negative sign; a proxy of lack of stabilization progress), the government budget balance (positive sign; a proxy of the absence of fiscal dominance), a measure of financial development (positive sign; a proxy of the absence of financial dominance), an inflexible exchange-rate regime (negative sign; reflecting presence of a competing exchange-rate anchor), and GDP per capita (positive sign; a proxy of central bank capability of conducting monetary policy effectively and independently). Other significant IT likelihood determinants are trade openness (positive sign; a measure of reform progress generally) and a regional dummy variable for Latin America (positive; reflecting early spreading of IT in this region).

2.3 Convergence toward full-fledged IT

The preceding evidence suggests that countries and central banks with IT in place are more likely than others to satisfy several institutional, macroeconomic, and financial conditions. At the same time, macroeconomic conditions in IT countries and the features of the IT framework adopted by their central banks continue improving well after the regime adoption year.

Many countries – most of them EMDEs – adopted IT early on, at a time when they did not satisfy the conditions of a full-fledged IT framework. For example, Chile, Colombia, and Israel adopted a system of partial IT in the 1990s without giving up their exchange-rate anchor. For several years – until the late 1990s or early 2000s – these countries had in place both inflation targets and exchange-rate bands. Facing frequent policy tensions arising from inconsistent inflation and exchange-rate targets and the corresponding lack

[4] This paper expands the existing literature in five ways: allowing for a broader specification that encompasses a wide set of potential determinants of the likelihood of IT; using a large dataset for a treatment group comprised by all IT countries and a large control group of non-IT countries, with three decades of annual data; for robustness checks, applying different panel-data estimation techniques for discrete-choice dependent variables, comprising pooled-data estimators for logit and probit models, the conditional logit estimator for fixed effects, and logit and probit estimators for random effects; conducting robustness checks of the preferred specification by testing its validity for different country and time sub-samples; and subjecting the preferred specification to alternative measures of our treatment group, varying IT starting dates.

of full monetary independence, they adopted eventually a floating exchange-rate regime, which is a key condition of full-fledged IT. Other IT central banks, like those of Brazil (until today) and the UK (until 1998), lack full legal independence, which may affect their operational independence and policy performance.

Another dimension that implies a deviation from full-fledged IT is when countries adopt annual inflation targets in their transition from moderate to low inflation levels. Figure 1 reflects that a majority of countries adopted IT when their initial inflation rates were well above long-term stationary target levels in the range of 1-3%. Many of these "inflation-converging ITers" adopted annual (or sometimes multi-annual) inflation targets that were revised regularly, typically downwards. The list of countries includes a few AEs (New Zealand, Israel, Korea) and many EMDEs that started IT at relatively high levels of inflation (including Chile, Colombia, Poland, Hungary, Mexico, Philippines, Romania, Guatemala, Indonesia, Serbia, Armenia, Turkey, and Ghana, among others). The latest IT adopter, India, started IT in 2015 with an initial target set at 8%.

Inflation-converging ITers adopted IT as a stabilization tool to bring inflation down toward long-term low stationary levels. However, variable annual inflation targets limit severely the conduct of monetary policy during the transition toward low stationary targets and inflation levels. The next section discusses their performance in reducing inflation and inflation expectations.

2.4 Evolution of the IT Framework

Another relevant issue is about the evolving best practice of full-fledged IT over the last 25 years. Even for countries that practiced frontier or full-fledged IT as understood at the start of IT (including New Zealand, Canada, and the UK in the early 1990s), has the meaning and content of IT changed for them and for all other ITers over the course of the last quarter century?

The answer is yes. The world evidence suggests that best-practice IT has changed since it was started by New Zealand in 1990. This evolution has taken place in four dimensions: institutional features of the conduct of monetary policy, specific features of the inflation target, technical capabilities, and acceptance of flexible inflation targeting.

Changes in institutional features have been observed regarding independence, transparency, and accountability of central banks. The central role of operational independence in the conduct of monetary policy – conditioned by the absence of fiscal dominance – has been strengthened since the 1990s. Moreover, the lack of legal independence of some central banks has probably hindered their attainment of full operational independence.

A growing understanding of the key importance of high levels of policy transparency has been reflected in major improvements in IT central banks. In their first years many IT central banks – particularly those in EMDEs in the 1990s – were opaque in their communications with markets and the general public. As documented by Batini and Laxton (2007) and discussed more generally below, IT central banks have upgraded

significantly transparency of their IT regime, their data, models and forecasts, and their internal discussion regarding policy decisions over the last 25 years. This has come together with improvements in accountability of the policy conduct by IT central banks, both regarding political bodies (government and parliament) and the general public.

The last quarter century has also seen convergence toward specific features of the inflation target. While some AEs had initially adopted inflation targets based on a core inflation measure, today all ITers use the headline CPI as their target measure – for reasons that range from high-frequency data availability to relevance as a country's dominant inflation measure.

Numerical mid-points of inflation targets are today between 1% and 3% in AEs (Table 2). There are several EMDEs with current target mid-points at or above 4%, including India, which set its first inflation target at 8% in 2015. EMDE target levels above 4% are typically transition targets toward lower long-term stationary levels. Considering only stationary-target ITers, EMDEs have converged toward inflation target mid-points that vary between 2% and 3%, only slightly above average target mid-points in AEs. Communicating in different ways their tolerance to inflation deviations, central banks use either point targets, point targets with tolerance bands or target ranges. A majority of central banks have in place one of these options, with a typical deviation of 1 pp. from the target mid-point.

Hence best-practice IT has evolved to a relative narrow choice of stationary inflation target mid-points (defined at 2%, 2.5% or 3%), with a small tolerance to inflation deviations that averages 1 pp. This represents the likely medium-term policy objective for the dozen IT EMDEs that are still on their path toward convergence to lower stationary target and inflation levels.

A major evolution of IT over time has taken place regarding central bank technical capabilities in processing data, developing models, and generating forecasts. This progress has come together with global strengthening of data processing capabilities, the development of dynamic stochastic general-equilibrium (DSGE) models, and the capability of using the DSGE models (in conjunction with complementary smaller models) as central bank workhorses for generating forecasts for macroeconomic variables and their own policy rates. No such capabilities existed when IT was adopted by some AEs and EMDEs in the early 1990s. Certainly such progress is not limited to IT central banks. However, the specific need for accurate forecasts of inflation for their publication in the form of fan charts in regular inflation reports, has put particular pressure on IT central banks to build up their in-house capabilities for model development and forecasting. These technical capacities are much more developed in each and every IT central bank today than in the 1990s, and they are on average more developed today in IT central banks than in non-IT central banks.

Since the 1990s the IT regime has evolved toward explicit acknowledgment that it implies flexible IT, as opposed to strict IT. Mervyn King (1997) famously described strict IT as an approach reflecting policy preferences of an "inflation-nutter" central banker.

Svensson (2010) makes the contrast more explicit: "Flexible IT means that monetary policy aims at stabilizing both inflation around the inflation target and the real economy, whereas strict inflation targeting aims at stabilizing inflation only, without regard to the stability of the real economy".

What does flexible IT imply in practice? Price stability is not the only objective of the monetary authority that pursues flexible IT. However, in lexicographic terms, price stability comes first, while output (and possibly financial) stability comes second. As discussed below, this implies that, in addition to price stability, output stability (and possibly financial stability) is included as an argument in policy reaction functions of IT central banks.

Therefore temporary inflation deviations from targets are tolerated as long as their degree of persistence is limited. This leads IT central banks to state explicitly their policy horizon, i.e., the time period at which they expect – for which they forecast – that inflation will return to the target level, conditional on the current policy rate and its future path. IT central banks differ regarding how specific their stated policy horizons are. While circa half of 36 ITers specify generic horizons like "medium term", "on average" or "at all times", the other half commits to explicit horizons that vary between 1 and 3 years and are on average 2 years (Table 2).

3. Evidence on Monetary Policy and Macroeconomic Performance under IT

Are ITers different from NITers regarding central bank independence, transparency, and accountability? Which is the distribution of inflation targets across ITers and do targets change over time? Which are the differences in inflation deviations from targets across ITers and what explains them? Do IT central banks attach a larger weight to inflation than to output stabilization? Is long-term inflation lower in IT countries? Does IT anchor better inflation expectations? How does monetary policy efficiency in ITers compare to NITers?

3.1 Central bank Independence, Transparency, and Accountability

Central bank independence – to be free from fiscal and political pressures that create conflicts with central bank objectives – is a key condition for successful conduct of central bank policies. Independence of a monetary institution is a wide concept that ranges from central bank legal independence to institutional features of selection and duration of board members and to operational independence in the conduct of monetary, exchange-rate, and financial policies. A key condition for central bank monetary independence is the absence of fiscal dominance, i.e., legal prohibition of central bank financing of government budgets and related fiscal or quasi-fiscal operations.

The first cross-country measures of central bank independence, based on 16 criteria, were developed for a world sample by Cukierman et al. (1992). Jácome and Vásquez (2008) broaden these measures for Latin America and the Caribbean. The most

comprehensive dataset for several central bank independence measures that is available to date is Dincer and Eichengreen's (2014) for 89 countries over 1998-2010. In their ranking, IT central banks do not fare very well in comparison to non-IT central banks. The highest ranked ITers are Sweden and Hungary (placed 8 and 9, respectively) and the lowest ranked are South Africa and India (placed 86 and 89, respectively) (Table 3). It comes as a surprise that IT central banks do not rank better on average than non-IT central banks in terms of statutory measures of independence. It is likely that the conduct of monetary policy by IT central banks exhibits larger *de facto* independence than what is reflected by available statutory measures. However, to ensure long-term autonomy in the conduct of their policies, many IT countries face the challenge of giving a greater degree of legal and statutory independence to their central banks.

High degrees of transparency are essential to modern central banking, for reasons that range from political legitimacy to accountability and to monetary policy efficiency (Dincer and Eichengreen 2014).[5]

How important is transparency for central bankers? Two early survey of central bankers provide useful answers to this question. From a 1998 survey of 94 central banks in the world, Fry et al. (2000) report that 74% of central banks consider transparency a "vital" or "very important" component of their monetary policy framework. Based on a separate survey of 88 central banks, Blinder (2000) finds that transparency is considered a very important factor in establishing or maintaining credibility.

Eijffinger and Geraats (2005) propose a central bank transparency index based on 5 criteria: political transparency (policy objectives), economic transparency (data, models, and forecasts), procedural transparency (release of minutes and votes), policy transparency (announcement and explanation of decisions), and operational transparency (implementation of decisions). Eijffinger and Geraats (2005) and Geraats (2008) provide measures of transparency for 100 central banks using annual data for 1998-2006 that reflect IT's comparative strength. The 21 IT central banks in the world sample have raised their levels of transparency in all five dimensions during a short time span (Figure 6). IT central banks display higher levels of overall transparency compared to central banks that have in place exchange rate targets, monetary targets or other monetary regimes, and the differences between ITers and NITers have increased over time (Figure 7).

The results by Geraats (2008) for up to 2006 are confirmed by the transparency data published by Dincer and Eichengreen (2014) for 2010: transparency is highest among

[5] Dincer and Eichengreen (2014) present a wealth of data on central bank independence and transparency, for 120 central banks until 2010, and report regression results to relate fundamentals to the two latter measures, as well as their impact on inflation and inflation volatility. However they do not report descriptive or empirical results for central banks by different monetary regimes, like IT.

IT central banks (Table 3). In fact the 11 most transparent central banks in the world are those of the 11 countries that comprise the universe of AEs that practice IT today.

Transparency is a key component of accountability of independent central banks. With independence of monetary institutions led by unelected government officials comes their duty to account for their decisions about policy regimes and policy decisions. Central bank accountability goes beyond transparency. In addition to providing public access to all relevant policy inputs and outputs on their webpages, central banks are required to satisfy formal acts of accountability. Such acts include regular parliamentary hearings, press releases or press conferences after policy decisions are made, publication of minutes of policy meetings, publication of votes by policy committee members, and publication of regular inflation or monetary policy reports. Many IT central banks lead the world in most of the previous measures of transparency and accountability.

Table 2 lists two important measures of transparency and accountability for the world's 36 IT central banks in 2015. These selective measures show some variance across ITers. On transparency, the minutes of monetary policymaking meetings are published by 75% of all ITers; 9 IT central banks do not publish them. On accountability, 28 IT central banks do appear before parliament to provide testimony on monetary policy; 8 do not. All 36 IT countries publish regular inflation reports.

We conclude from this evidence that IT central banks overall do not satisfy high standards regarding legal and statutory independence, compared to other central banks. However, most of them represent the world's highest standards regarding transparency and accountability.

3.2 Targets and Inflation Deviations from Targets

Inflation-target mid-points among the 36 ITers range from 2% in most AEs to 5% or above in several EMDEs (Table 2). This cross-country variation reflects a combination of country-specific features, as illustrated by the history of targets set by 27 IT countries until 2013 (Figures 8 and 9). First, as noted above, among countries with stationary targets, target levels are slightly higher in EMDEs than in AEs. Second, some countries modified their already low targets shortly after starting IT (Peru, UK). Third, as of 2015, circa 12 EMDEs are on their convergence toward lower stationary targets – particularly those that have adopted IT in recent years. Finally, several EMDEs adjusted upwards their target levels in response to the large inflation shocks in 2007-08 (Ghana, Serbia, Turkey). We conclude that cross-country target variance is much smaller in 2015 than one or two decades ago. Over time most ITers converge toward target mid-points in the range of 2 to 3%.

There is a large dispersion of quarterly inflation deviations from target levels in 27 countries in 1990-2013, both across countries and over time. World inflation shocks in 2006-07 and their subsequent reversion during the 2008-09 Global Financial Crisis cause large inflation deviations that are common to most ITers. Idiosyncratic country shocks and

recessions show up in large inflation deviations in particular country episodes (including Korea 1999, Brazil 2003, Indonesia 2005, and Iceland 2009).

As a summary indicator of deviations, we compute the country average absolute deviation from the quarterly inflation rate deviations from target levels for 28 IT countries, depicted from their corresponding IT start through 2014 (Figures 10 and 11). Average absolute deviations range across countries from a low of 0.8% to a high of 4.3%. Inflation deviations from targets tend to be larger in countries more sensitive to inflation shocks and where average inflation and target levels are higher. The average absolute inflation deviation from target levels over the full IT period is 2.09% in EMDEs, which (unsurprisingly) is significantly higher than the average 1.34% observed in AEs.

Note that the average absolute inflation deviation across all EMDEs includes many country experiences of higher inflation targets and inflation rates than those of AEs. Moreover, considering the lags in monetary transmission, the need of weighting inflation and output in the policymaker's objective function under flexible IT, and the standard length of the monetary policy horizon (typically 2-3 years, which exceeds significantly the 1-year horizon of annual targets), it is remarkable how successful many inflation-transition ITers are in their convergence to low stationary targets and inflation levels.

Panel-data evidence on the determinants of absolute inflation deviations from inflation targets shows that, controlling for oil-price and exchange-rate shocks, deviations are smaller when central bank independence is higher and the country's credit rating is higher (Albagli and Schmidt-Hebbel 2008). Central bank independence and country credit ratings are likely to contribute to a better anchoring of inflation expectations, hence lowering inflation deviations from targets.

3.3 Monetary Policy Conduct and Policy Rules

ITers are not inflation nutters. However, do ITers put a larger weight on inflation than on output (or financial variables) in the conduct of monetary policy?

Cecchetti and Ehrmann (2002) address this question, based on a model that derives a Taylor-type policy function from a central bank objective function that minimizes losses from inflation and output deviations. Using data from 23 countries from the 1980s and 1990s (9 of which became ITers in the 1990s), the authors test if their central banks became more averse to inflation volatility. Their evidence shows that in all countries, whether they targeted inflation or not, aversion to inflation variability increased during the decade of the 1990s, which is consistent with the world's Great Moderation period. The 9 ITers became significantly more averse to inflation volatility after they adopted IT and their aversion increased by more than that of NITers.

More recent evidence reported by Bleich et al. (2012) shows that the introduction of IT has significantly shifted reaction functions of central banks toward inflation stabilization.

Muñoz and Schmidt-Hebbel (2013) specify a generalized Taylor equation that nests backward and forward-looking inflation and activity variables in setting policy rates. The

model is applied to a world panel of real-time monthly 1994-2011 data for 28 advanced and emerging economies, of which 20 are ITers. The evidence for 2002-11 shows that IT central banks react both to past inflation and to inflation forecasts, and the reaction to inflation forecasts is almost four times as large as to past inflation (Table 4). In contrast, NITers do not react to past inflation and their reaction to inflation forecasts is weaker (with smaller and less significant coefficients) than that exhibited by ITers.

We conclude that IT central banks exhibit larger aversion to inflation volatility than NITers and react more aggressively to shocks of inflation and inflation forecasts than NIT central banks.

3.4 Inflation Levels, Inflation Volatility, and Growth

Does adoption of IT reduce average long-term inflation rates? Committing to an explicit inflation target could signal central banks' stronger preference for lower inflation, compared to central banks that adopt alternative monetary regimes. What does the evidence show? The answer depends critically on the selection of the empirical model used to address this issue and the country composition of treatment and control groups.

We review results from 9 studies that estimate inflation differences between IT and NIT countries (Table 5).[6] Eight are based on inflation regressions that test for IT regime dummies using OLS cross-section, propensity matching score methods or panel IV methods, using very different control and treatment groups. Ball and Sheridan find no significant inflation differences in a small cross-section sample comprised only by AEs. Many other studies find that IT has reduced long-term inflation rates.

The point that the results depend critically on the choice of estimation method and composition of treatment and control groups is forcefully made by Mishkin and Schmidt-Hebbel (2007). To start, using a cross-section sample of AEs that is larger than Ball and Sheridan's, Mishkin and Schmidt-Hebbel find that long-term inflation is 1.2% higher in IT than in NIT countries. However, when the time dimension is considered in the previous sample, by applying a panel IV model, these authors report that the inflation difference between IT and NIT countries is not different from zero. Quite a different result is obtained when comparing pre-IT and post-IT inflation rates of 21 ITers: their average reduction in long-term inflation is 5.0%.

One study uses a structural dynamic model for inflation to identify the significance of an IT regime dummy, after controlling for 14 other inflation determinants, in a large panel sample (Calderón and Schmidt-Hebbel 2010). Results from several estimation methods show that long-term inflation rates are from 3% to 6% lower in 24 IT countries compared to a group of 73 NIT countries.

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[6] Further studies include Wu (2004), who finds that IT significantly reduces inflation in a cross section of 22 AEs. However, Willard (2006), using the same dataset as Wu, but different methods, finds only small and non-significant effects for AEs. Other studies, focusing only on EMDEs, find that the introduction of IT has reduced inflation rates, including Goncalves and Salles (2008), Biondi and Toneto (2008), Brito and Bystedt (2010), and Yamada (2013).

We conclude that there is systematic evidence that among EMDEs long-term inflation is lower in IT than in NIT countries. However, there is no conclusive evidence that long-term inflation levels are lower in IT countries compared to samples comprised by AEs that do not target inflation. This does not contradict the finding that compared to the pre-IT period, ITers attained lower inflation rates after adopting IT. However, similar stabilization progress was achieved by NIT AEs after 1990, during the Great Moderation period.

Empirical studies on the effects of IT on inflation volatility are less conclusive. For world samples, Vega and Winkelried (2005) report significant results. However, Lin and Ye (2006) and Mishkin and Schmidt-Hebbel (2007) do not find any significant effects of IT on inflation volatility. Regarding EMDEs alone, and as opposed to the findings on inflation levels, IT is found to have no robust effects on inflation volatility. Vega and Winkelried (2005), Batini and Laxton (2007), and Li and Ye (2009) show that IT reduces inflation volatility in EMDEs, while Mishkin and Schmidt-Hebbel (2007), Goncalves and Salles (2008), and Brito and Bystedt (2010) report non-significant effects. The bottom line here is that IT does not affect inflation volatility robustly – neither in AEs nor in EMDEs.

The impact of IT on the real economy is even less conclusive, for AEs and EMDEs alike. Brito and Bystedt (2010) is the only study reporting a negative significant effect of IT on growth, which the authors attribute to their associated finding that IT has lowered inflation. In contrast to the former, Naqvi and Rizvo (2009) report non-significant effects of IT on growth. On output volatility, Goncalves and Salles (2005) report a negative effect of IT. However, Batini and Laxton (2007) and Mishkin and Schmidt-Hebbel (2007) report non-significant effects of IT on growth volatility.

Summing up, the world evidence suggests that the introduction of IT has not changed significantly macroeconomic performance in AEs, measured by first and second moments of inflation and output. However, IT has helped in reducing inflation significantly in EMDEs, both in comparison to their own pre-IT history and to NIT EMDEs. Yet there is no robust evidence that IT has contributed to lower inflation volatility or to changes in growth and output volatility in EMDEs. [7]

Hence the comparative advantage of IT is generally not reflected in improved first and second moments of inflation and output but in other dimensions of monetary policy and its efficiency, which are discussed below.

3.5 Anchoring inflation expectations

One of the main potential strengths of IT, relative to other monetary regimes, is that an explicit target for inflation could better anchor expectations and forecasts of future inflation. Expectations of future inflation at the monetary policy horizon – around two years – that are close to the inflation target and relatively insensitive to transitory

[7] This conclusion on the effect of IT on output volatility is in contrast to Svensson's (2010) earlier review of the literature, where he reports that IT has reduced output volatility in both AEs and EMDEs.

shocks contribute to low and stable actual inflation. What does the evidence say about the stability of inflation expectations in IT countries, compared to non-IT countries?

Johnson (2002) reports that IT countries have lowered inflation expectations compared to their pre-IT periods. Castelnuovo et al. (2003) find that long-term inflation expectations are well-anchored in all AEs, ITers and NITers, except Japan. Both Levin et al. (2004) and Demertzis et al. (2009) find that IT has contributed significantly to anchor inflation expectations. Cecchetti and Hakkio (2010) report only small effects of IT on stabilizing inflation expectations. Gürkaynak et al. (2010) provide evidence that an explicit and credible inflation target helps to anchor the private sector's views regarding the distribution of long-run inflation outcomes.

How does IT affect inflation expectations in EMDEs? This question is particularly relevant for EMDEs that adopt IT as a stabilization tool, embarking on a path of declining inflation targets toward the medium-term goal of attaining low and stationary target and inflation levels. Early evidence by Schmidt-Hebbel and Werner (2002) for Brazil, Chile, and Mexico on their initial IT years (mostly including IT transition periods with variable yearly targets) shows that IT adoption contributed significantly in stabilizing inflation expectations, both regarding expectation levels and structure. While the weight of past inflation in determining inflation expectations fell gradually during the first years of IT, the weight of target levels increased. More recently, Capistran and Ramos-Francia (2010) show that, controlling for other factors, the dispersion of inflation forecasts in EMDEs is lower in IT countries than in NITers.

A related, key question is how sensitive inflation expectations are to news or shocks. Gürkaynak et al. (2010) and Davis (2014) report that expectations in IT countries react significantly less to shocks than expectations in NIT countries.

In the current policy environment of several industrial countries, where inflation is very low, a relevant issue is about the behavior of expectations when targeting inflation from below. Ehrmann (2015) reports that under persistently low inflation, inflation expectations are not as well anchored as when inflation is around target. Still, even under persistently low inflation, the author concludes that in the IT country group identified by him, expectations are generally better anchored than they were in Japan over its long period of low inflation.[8]

From this evidence we conclude that IT has generally contributed to a better anchoring of inflation expectations than other monetary regimes. This is true for all IT countries but is particularly strong for EMDE ITers.

3.6 Monetary policy effectiveness: policy efficiency frontiers

[8] Ehrmann's panel of 10 advanced countries/regions includes three important economies that are not conventionally classified as ITers (and therefore are also excluded from our set of 36 IT countries): the Euro Zone, Switzerland, and the U.S. It is likely that these three economies suffer more from persistently weak inflation than the other 7 IT countries. Therefore it is possible that the author's reported better anchoring of expectations in IT countries is under-estimated.

Performance of monetary policy can be assessed using the inflation and output variability trade-off faced by the policymaker. This trade-off allows to construct an efficiency frontier, also known as the Taylor curve (Taylor 1979). The inflation-output variability frontier is understood by considering an economy that is hit by two types of disturbances: aggregate demand and aggregate supply shocks. Aggregate supply shocks move output and inflation in opposite directions, forcing the monetary authority to face a trade-off between inflation and output variability. Cecchetti et al. (2006) develop a model to derive the monetary policy efficiency frontier and the distance from actual macroeconomic performance to the frontier, applied to 24 individual countries.

Mishkin and Schmidt-Hebbel (2007) apply the method of Cecchetti et al. (2006) to estimate monetary policy efficiency frontiers for different panels of countries: ITers before IT adoption, ITers after IT adoption, and a stringent control group of NITers comprised by 13 macroeconomic high-performing AEs (including the U.S., the Euro Zone, and Japan). Their results show that efficiency frontiers have significantly improved (i.e., shifted inwards) after IT adoption, both among all ITers and among stationary ITers – and gains are larger under stationary IT. In addition, actual macroeconomic performance has significantly improved after IT adoption and the distance between actual performance and the efficiency frontier has declined, reflecting gains in monetary policy efficiency. Again, these gains are larger when countries have attained stationary inflation and target levels. The relative gains are large among AEs (Figure 13) and even larger among EMDEs (Figure 14). Unsurprisingly, the efficiency frontier of AEs is positioned significantly more inward, and their observed inflation and output variability is significantly less, than in EMDEs (comparing Figures 13 and 14).

4. IT under stress: before, during, and since the Global Financial Crisis

Until the mid-2000s, it was argued that IT had not been tested yet and that it could fail in the face of a major inflation shock or a deep recession. In particular, IT was often seen as free-riding on the benefits of the two preceding decades labeled as the Great Moderation Era, during which most countries in the world – with or without IT – experienced large and sustained reductions in trend inflation and the volatility of both inflation and output.

Soon after, IT (as well as all other monetary regimes) was first tested by the huge oil and food-price shock of 2007-08. The second test was the Global Financial Crisis and Great Recession of 2008-09. In the face of the latter, Stiglitz and Frankel (among others), quoted at the start of this paper, pronounced IT dead. In the following I review how IT fared under both tests and review a related issue: if IT central banks exhibit financial stability concerns when setting policy rates.

4.1 The oil and food price shock of 2007-08

The international commodity price boom was reflected in surging food and energy prices in 2007-08, reverting briefly in 2008-09. As a result, average headline inflation roughly doubled in the first half of 2008, to 4% in AEs and 9% in EMDEs. Although inflation targets were overshot in IT countries, headline inflation generally increased by less than in NIT countries (Habermeier et al. 2009). This result is attributed to more currency appreciation (under more flexible exchange-rate regimes in IT countries) and higher degrees of central bank transparency, leading to higher policy credibility and more stable inflation in IT countries.

4.2 The Global Financial Crisis

The second test to IT in the world was the GFC and subsequent Great Recession of 2008-09. It first brought a temporary reversal of the 2007-08 commodity price shock, compounded by the most serious financial crisis and deepest recession since the Great Depression. Monetary authorities in advanced countries and regions – particularly in those most affected by the GFC, including the US, UK, Euro Zone, and Japan – reacted quickly by reducing interest rates toward the zero lower bound and starting quantitative-easing measures that expanded domestic liquidity and central bank balance sheets in unprecedented ways and amounts. Monetary policy measures where complemented by financial rescue programs targeted at all financial institutions after Lehman Brothers' failure and by expansionary fiscal policies. Financial-sector interventions and expansionary macroeconomic policies in crisis-hit AEs were conducted at a speed, intensity, and international synchronicity that is historically unprecedented. Monetary and fiscal policies Other AEs and EMDEs, not directly affected by financial crises, also adopted expansionary macroeconomic policies, in reaction to the meltdown in private aggregate demand and the deep recession in crisis-affected countries.

How did IT countries cope during the tail event that hit the world economy between August 2008 and 2009-10, compared to NIT countries? ITers lowered policy rates by more and this translated into larger real interest rate differentials than in NITers (De Carvalho Filho 2010). This implied that ITers were less likely to face deflation scares, saw sharper real depreciations, and had lower unemployment rates than NITers. Among AEs, ITers exhibited relatively stronger growth performance than NITers. Roger (2010) also finds that macroeconomic forecasts were less affected by the financial crisis in ITers, compared to NITers.

In more recent work, Fry-McKibbin and Wang (2014) test the performance of ITers during the 2007-2012 downturn compared to NITers, and separately for AEs and EMDEs. Using propensity score methods, the authors show that IT has worked better for AEs: during this period, inflation and GDP growth were found to be higher and unemployment lower in the treatment group of 10 ITers in comparison to the control group of 21 NITers. However for EMDEs (18 ITers, 42 NITers), and during this period, no significant differences

were found regarding inflation and growth performance, while unemployment was (surprisingly) larger in IT countries.[9]

Therefore IT economies, and in particular AEs under IT, performed generally better in the crisis than economies under other monetary regimes. IT central banks adopted a more aggressive monetary response to the crisis, their economies had a better inflation and output performance, and they exhibited more stable macroeconomic forecasts during the crisis.

4.3 Inflation Targeting and Financial Stability

The GFC has implied a quantum shift in the conduct of monetary policy in both IT and NIT countries. The breakdown of financial markets and market liquidity, the deep ensuing recession, and the attainment of the zero lower bound in several AEs forced their central banks to develop and implement very quickly quite extraordinary measures of financial market support and monetization, based on quantitative easing and massive balance-sheet expansion. While much of the action has taken place in countries and regions that are not ITers (in particular, the U.S. and the euro zone) some IT countries have also implemented important non-orthodox policies of quantitative easing (including the U.K., Sweden, and Japan, an ITer since 2013). At the same time, a new macro-prudential framework is developing at the level of individual countries and multilaterally, under regulation agreed under the aegis of the BIS (Basle III).

Quantitative easing and macro-prudential regulation are toolkits that affect the conduct of both monetary policy and macro-prudential policies of central banks, relatively independently of their choice of monetary regime – IT or otherwise. However, a particular question on the relation between monetary policy and financial stability arises here. Do central banks react to financial variables, in addition to inflation and output variability? And do IT central banks react to financial variables too?

Muñoz and Schmidt-Hebbel (2012) address these questions by adding three financial variables to their generalized Taylor equation. These are exchange-rate devaluation (reflecting possible fear of floating and fear of pass-through), the change in stock market prices (signaling possible bubbles), and the growth in bank credit to the private sector (indicating possible overheating), to test for leaning-against-the-wind policy behavior that reflects concern for financial stability.

Using real-time data for a world panel of monthly data extending from 1994 through 2011 and comprising 28 AEs and EMDEs, a dynamic error-correction panel data model is applied to the model. The authors report that central banks generally react to the exchange rate and to credit flows, in addition to inflation and output shocks – both in the full sample of 28 countries and in the sub-sample of IT countries. This confirms that IT

[9] The authors also report that fiscal outcomes (deficit and debt levels) were stronger for both AE and EMDE ITers, compared to NITers, during the 2007-12 period.

central bankers do not behave differently from NIT central banks in their concern and reactions to financial stability objectives when setting policy rates.

5. Lessons for the Future of Inflation Targeting in EMDEs

What are the main lessons for IT in EMDEs? Considering the lessons, which are the main challenges for the future of IT in EMDEs and, in particular, in lower-income countries?

5.1 Lessons from the World Experience of IT in EMDEs

EMDEs in general, and lower-income countries in particular, exhibit lower levels of institutional development and macroeconomic stability than AEs. This weakens there capability of adopting IT. In fact, per capita income – as a proxy of the latter variables – has been found to be a significant determinant of the likelihood of having IT in place.

For many years it was thought that for IT to work successfully, stringent pre-conditions had to be satisfied. Batini and Laxton's (2007) results laid this belief to rest, by showing that pre-conditions are only satisfied in part (and, in many cases, to a poor degree) by all countries at the time they adopted IT. In fact, all IT countries continued strengthening gradually their institutional and macroeconomic conditions after adopting IT.

This is very good news for EMDEs and, in particular, for lower-income countries, who may consider adopting IT before or while they are strengthening their central banks, the conduct of monetary policy, and their macroeconomic performance. In fact, since 2002 half of the new adopters of IT belong to the group of low and lower middle-income countries (according to the World Bank 2016 classification): Armenia, Georgia, Ghana, Guatemala, India, Indonesia, Moldova, Philippines, and Uganda.

Many EMDEs have adopted IT at moderate initial inflation rates that exceed 3% (Figure 5). They have used – or are using – the new monetary regime as an inflation stabilization tool that represents a commitment device for their central banks and a nominal anchor to influence inflation expectations. Often this implies setting annual or multi-annual targets on a declining schedule toward low and stationary target and inflation levels. Many central banks practice initially partial IT, which includes adopting an exchange-rate target in addition to the inflation target (e.g., Chile, Colombia, and Israel in the 1990s) or intervene heavily in foreign exchange markets to stabilize their currency even without committing to an explicit exchange-rate target (e.g., Colombia, Brazil, and Peru). However, transition periods under partial IT are risky. Therefore several partial and converging EMDEs have graduated to full-fledged IT, adopting a free floating exchange rate and committing to a low and constant target level. Among EMDEs stationary targets are on average close to 3%, slightly above the average stationary target of 2% in AEs.

Using descriptive data, we found that the average absolute inflation deviation from target levels over the full IT period in 28 IT countries is 2.1% in EMDEs, which is higher than the average 1.3% observed in AEs. Considering that IT periods include transition periods of high and variable inflation target levels and inflation rates, the average inflation deviation in EMDEs is surprisingly low. This represents significant success of IT in EMDEs, contributing to its appeal to low and middle-income countries, which are often affected by large inflation shocks.

A large number of studies has documented the fact that IT has contributed to reduce significantly long-term inflation rates in EMDEs, both in comparison to their own pre-IT history and to NIT EMDEs. This means that IT has been a successful stabilization device for countries with higher inflation rates. Yet there is no robust evidence that IT has contributed to reduce inflation volatility or to change growth and output volatility in EMDEs.

There is also systematic evidence documenting hat IT has contributed to a better anchoring of inflation expectations in EMDEs than other monetary regimes. Compared to NITers, IT has been found that to reduce inflation expectations and change the structure of inflation expectations toward inflation target levels. Under IT the sensitivity of inflation expectations to shocks is significantly smaller than in NIT countries.

Evidence on monetary policy efficiency shows large gains for EMDEs under IT. After IT adoption, policy efficiency frontiers have shifted significantly toward lower combinations of inflation and output volatility, and the distance between actual performance and the efficiency frontier has declined, reflecting significant improvements in monetary policy efficiency.

5.2 Challenges for the Future of IT in EMDEs

All IT central banks face significant challenges that have to they should addressed if they aim at improving further their macroeconomic performance and monetary policy efficiency. However, IT is significantly more challenging for central banks in EMDEs – and particularly in lower-income EMDEs – than in AEs, due to several reasons.

First, institutional conditions at central banks are weaker in countries with generally less developed institutions and at lower levels of development. This hampers the capacity of central banks to satisfy supporting conditions for successful IT, including lack of legal independence, weaker internal technical capabilities, and weaker domestic financial markets to conduct open-market operations. Second, domestic inflation responds more weakly to monetary policy actions due to les developed financial markets several structural features in EMDEs, particularly those at lower levels of income. Third, goods and labor markets often work less efficiently and flexibly, so that domestic inflation is less responsive to monetary policy actions. Fourth, commodity price shocks (in particular food price shocks) have a larger impact on inflation because the CPI weight of food is larger.

Finally, exchange-rate volatility is higher in EMDEs, and large exchange-rate shocks are reflected in higher domestic inflation variability because devaluation-to-inflation pass-through coefficients are higher in EMDEs.

The first challenge is for EMDEs that are considering IT adoption. They have to evaluate if they satisfy minimum standards of conditions in each of four broad categories for successful IT (Batini and Laxton, 2007): central bank institutional independence, central bank technical infrastructure, economic structure, and financial system development and health. Among the latter, important conditions that enhance the start of IT are: a reasonable degree of functioning monetary transmission, operational independence in the conduct of monetary policy, and absence of commitment to a particular level of the exchange rate (Gemayel et al. 2011). Even if conditions are rather poorly satisfied, IT could be started, as long as central banks commit to a feasible program to upgrade conditions over the medium term.

The second challenge of central banks that are prospective IT adopters or have started IT is to show and to proof a strong commitment to inflation as their dominant policy objective. An empirical result of IT – and possibly one of the key reasons for its success – is that IT central banks exhibit larger aversion to inflation volatility than NITers and react more aggressively to shocks of inflation and inflation forecasts than NIT central banks.

The third challenge is for those EMDEs that have adopted IT but are on a convergence path toward lower inflation and/or are partial ITers (for example, because they have an explicit or an implicit exchange-rate target). As of 2015, half of the world's ITers – all of them EMDEs – have in place target level midpoints of 4% or above (which are likely to be lowered toward lower stationary levels in the future) and many IT EMDEs intervene heavily in foreign-exchange markets. Having in place two nominal anchors and variable annual inflation targets represents a straightjacket that often limits severely the conduct of monetary policy during the transition toward low stationary target and inflation levels. Therefore transition periods toward full-fledged IT and stationary targets should be kept as short as possible.

A final challenge for ITers on a convergence path to low inflation is to avoid accommodation of positive inflation shocks by raising inflation target levels. Several EMDEs raised their target levels for a temporary period, most of them in response to the large commodity price shock of 2007-08. Although the consequences of such actions have not been researched systematically, it seems that their costs (sacrifice of policy credibility and prolongation of adjustment period to low and stationary target levels) have exceeded their benefits (reduction of inflation deviations from targets).

Beyond these four challenges faced by IT EMDEs, we refer now to three final challenging issues faced by EMDEs and AEs alike.

Strengthening central bank independence, transparency, and accountability. Central bank laws are changed at very low frequency and therefore not many improvements in central bank independence should be expected in the following years.

Yet central bank independence seems to be an important condition for the long-term success of monetary policy, in particular in EMDEs that have adopted IT. While generally IT central banks are at the forefront of transparency in the world community of central banks, most IT central banks face two key challenges to upgrade significantly their transparency: regular publication of their future policy rate forecasts and of key unobservable variables: potential GDP (and the output gap), the natural rate of unemployment, the neutral policy rate, and the equilibrium exchange rate.

Strengthening flexible IT. Compared to NIT central banks, the evidence shows that the weight on inflation is larger under IT. This result and the additional fact that the Phillips curve has flattened since the 1990s leads some observers to conclude that the inflation weight is sub-optimally high under IT, and therefore output should be weighted more heavily in the conduct or policy or that IT should be replaced by a dual mandate over inflation and unemployment like the one adopted by the US Federal Reserve. There are several ways to address this concern within the IT framework. The key one is flexible IT, as defined above, which distances itself strongly from rigid IT by acknowledging the weight attached to output volatility and the tolerance to temporary deviations from targets. Reinforcing this line of argument, it is sometimes argued that IT central banks should communicate more explicitly their concern for output stabilization (Woodford 2003, Svensson 2006), without stating an unemployment target like the Federal Reserve does. Another way to reflect more concern for output variability is by lengthening the monetary policy horizon beyond the standard two years (Mishkin 2008, Gillitzer and Simon 2015). However, this option should be carefully evaluated against the potential cost of weakening policy credibility and un-anchoring inflation expectations when adopting a looser monetary policy stance consistent with a longer policy horizon.

Price-level targeting. There is some discussion on the optimality of targeting inflation compared to targeting the CPI price level. Svensson (1999) and Vestin (2006) were the first in evaluating the relative benefits of adopting price-level targeting (PLT). Its main advantage over IT is that inflation deviations from targets (from the targeted path of the price level) are not bygones, as they are under IT. In order to put the price level back on its target path, an inflation deviation has to be followed, through appropriate policy actions, by future inflation deviations of the opposite sign. This strength of PLT is particularly relevant under conditions of very low inflation or even deflation, such as those observed in several European countries since the Great Financial Crisis and in Japan since the early 1990s. As forward-looking agents anticipate monetary action that brings the price level back to its target path, and hence future inflation that compensates for current low inflation, the likelihood of deflation is lower under PLT than under IT and, when it occurs, the likelihood of getting sooner out of it is higher.[10] Therefore PLT could emerge as a variation of IT that could improve efficiency of the policy conduct and its macroeconomic outcome.

[10] Walsh (2009) reports counter-factual simulation results for the stabilizing effects of PLT on U.S. inflation expectations, if the Federal Reserve had implemented a PLT regime since the start of the Great Financial Crisis.

5.3 Inflation Targeting in Emerging-Market/Developing Economies

Against these odds, many central banks in EMDEs have successfully adopted IT since the 1990s. Although their policy transparency tends to be lower and their inflation deviations from targets are higher than in AEs (Figures 10 and 9, respectively), they have been able to upgrade their policy framework and improved their inflation performance before and after adopting IT. It is encouraging that recent IT adopters include several low and middle-income EMDEs countries such as Albania (in 2009), Moldova (in 2010), Uganda (in 2012), Paraguay (in 2013), and India (in 2015).

6. Concluding Remarks

Inflation targeting (IT) was started by New Zealand in 1990 and has since spread to 35 other advanced and emerging/developing countries to date. Drawing from existing and new research, this paper has taken stock of IT's past performance, its current strengths and limitations, and its main challenges to remain the monetary regime of choice in the future.

Adopting and developing IT took many different forms but central banks gradually converged to a common policy framework after adopting IT. This framework itself continues evolving over time. Theoretical pre-conditions for IT were not in place when most central banks adopted IT but they have proven to be *de facto* post-conditions required for strengthening the IT framework over time. Empirical evidence points toward institutional and macroeconomic variables that raise the likelihood for countries to adopt IT and maintain this regime over time. Several EMDE ITers started with partial IT and at higher target and inflation levels, to converge only gradually to stationary-target fully-fledged IT. The IT framework itself has evolved since its inception 25 years ago: today its transparency is much more developed, internal technical capacity at central banks has been developed, and strict IT has given way to flexible inflation targeting.

A selective review of the large evidence of macroeconomic and policy performance reveals key findings about the world's IT experience. Many of these findings apply more forcefully to EMDEs, which are 25 of the world's current 36 IT countries. IT central banks do not differ on average from NITers regarding overall independence – but they are world record holders regarding central bank transparency and accountability. Inflation target levels vary across ITers but, in the medium term, when stationary target levels are attained, the range of target levels is very narrow. Average inflation deviations from targets also vary across ITers and tend to be higher in EMDEs. IT central banks tend to be more hawkish: their policy actions reveal larger weights on inflation variability than those of NIT central banks. However, their commitment to flexible IT is reflected in tolerance bands around inflation target mid-points and to policy horizons that average 2 years into the future. Long-term inflation is not generally lower in IT countries, and similar results apply to other macroeconomic outcomes, including inflation volatility, output

growth, and output volatility. Most evidence on inflation expectations points toward a better anchoring of expectations under IT than under other monetary arrangements. Monetary policy efficiency has improved under IT but the best-performing IT central banks do not dominate the best-performing NIT central banks.

The last decade presented the greatest challenges to IT: the commodity price shock of 2007-08 and the Global Financial Crisis and its aftermath. Evidence shows that policy and macroeconomic performance has been better under IT. Other evidence also suggests that IT central banks react not only to inflation and output but also to financial variables – and to a similar degree as NIT central banks do – and this has been observed both before and after the Global Financial Crisis.

IT is significantly more challenging for central banks in EMDEs – and particularly in lower-income EMDEs – than in AEs. However, against the odds, since 2002 half of the new adopters of IT belong to the group of low and lower middle-income countries.

EMDEs, and lower income countries in particular, face several challenges when adopting IT. EMDEs that are considering IT adoption have to evaluate if they satisfy minimum standards of conditions in four broad categories for successful IT: central bank institutional independence, central bank technical infrastructure, economic structure, and financial development and health. If conditions are rather poorly satisfied at the start of IT, central banks should commit to a feasible program of upgrading conditions over the medium term. Prospective IT adopters or countries that started IT recently have to show a strong commitment to inflation as their dominant policy objective. Countries that are on a convergence path toward lower inflation and/or are partial ITers should keep their transition periods toward full-fledged IT and stationary targets as possible. During their transition period they should avoid accommodation of positive inflation shocks by raising inflation target levels.

Beyond these challenges faced by IT EMDEs, all IT countries – both EMDEs and AEs – face three additional challenges to strengthen their IT framework in the future: improving central bank independence, transparency, and accountability; strengthening flexible IT without giving up low inflation as the key policy mandate; and evaluating seriously adoption of price-level targeting.

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Table 1
Likelihood of having an inflation-targeting regime in place

Dependent variable: dummy variable for having an IT regime in place (1=yes; 0=no)
Estimation methods: Discrete-choice logit panel-data models
Sample: 1975-2005 (annual data 1975-2005)

	Fixed effects Logit		Random effects Logit					
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Inflation	-130.026 ***	-117.311 ***	-35.392 ***	-36.295 ***	-43.349 ***	-36.421 ***	-39.508 ***	-33.487 ***
	(2.95)	(3.18)	(5.10)	(5.46)	(6.13)	(5.88)	(6.63)	(6.46)
Government budget balance	-25.066	-	19.307 **	20.685 **	15.040 **	17.909 **	-	-
	(1.45)	-	(2.07)	(2.31)	(1.98)	(2.53)	-	-
Financial development	19.872 ***	16.881 ***	0.775	-	3.299 ***	3.186 ***	2.633 ***	2.677 ***
	(3.07)	(3.39)	(0.55)	-	(3.19)	(3.40)	(2.99)	(3.22)
Exchange rate regime	-20.320 ***	-17.824 ***	-4.958 ***	-5.068 ***	-4.978 ***	-4.464 ***	-3.990 ***	-3.655 ***
	(3.03)	(3.22)	(5.27)	(5.54)	(7.04)	(7.20)	(7.74)	(7.49)
GDP per capita	104.027 ***	90.130 ***	5.042 ***	5.249 ***	4.605 ***	3.478 ***	4.822 ***	3.829 ***
	(3.19)	(3.56)	(4.78)	(5.29)	(5.08)	(3.49)	(5.90)	(4.19)
Trade openness	46.763 ***	42.343 ***	1.156	-	2.289 **	0.837	3.185 ***	2.134 **
	(2.83)	(3.03)	(0.82)	-	(2.06)	(0.68)	(4.01)	(2.53)
Money growth volatility	-	-	-0.142	-0.126	-	-	-	-
	-	-	(0.44)	(0.39)	-	-	-	-
Terms of trade volatility	-	-	1.760	0.959	-	-	-	-
	-	-	(0.28)	(0.15)	-	-	-	-
Dummy LAC	-	-	6.986 ***	6.741 ***	7.789 ***	-	7.433 ***	-
	-	-	(3.84)	(4.11)	(4.63)		(4.85)	-
Constant	-	-	-45.403 ***	-45.517 ***	-43.798 ***	-30.343 ***	-47.961 ***	-36.263 ***
	-	-	(5.01)	(5.27)	(5.68)	(3.44)	(7.01)	(4.57)
Observations	491	554	1143	1163	1854	1854	2305	2305
Number of countries	19	24	71	71	76	76	98	98
Countries with the IT regime	19	24	19	19	19	19	24	24
Countries without the IT regime (control group)	0	0	52	52	57	57	74	74
LR statistic	450.19	499.19	76.03	75.10	126.91	126.90	177.77	161.95
p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Absolute value of z statistics in parentheses
** significant at 10%; ** significant at 5%; *** significant at 1%*

Source: Calderón and Schmidt-Hebbel (2008).

Table 2
Selective Features of the Inflation-Targeting Framework in 36 IT Countries, 2015

Country	IT Adoption Year	Transparency: Publication of Minutes	Accountability: Parliamentary Hearings	2015 Inflation Target	Target Horizon
Albania	2009	Yes	Yes	3% ± 1 pp	Medium term
Armenia	2006	Yes	Yes	4% ± 1.5 pp	Medium term
Australia	1993	Yes	Yes	2%-3%	Medium term
Brazil	1999	Yes	Yes	4.5% ± 2pp	Yearly target
Canada	1991	No	Yes	2% (mid-point of 1%-3%)	Six-eight quarters
Chile	1991	Yes	Yes	3% ± 1pp	Around two years
Colombia	1999	Yes	Yes	2%-4%	Medium term
Czech Republic	1997	Yes	No	2% ± 1pp	Medium term
Dominican Republic	2011	Yes	Yes	4% ± 1pp	Medium term
Georgia	2009	Yes	Yes	5%	Medium term
Ghana	2007	No	No	8% ± 2pp	18-24 months
Guatemala	2005	Yes	Yes	4% ± 1pp	End of year
Hungary	2001	Yes	Yes	3% ± 1pp	Medium term
Iceland	2001	Yes	Yes	2.50%	On average
India	2015	Yes	Yes	8%	Medium term
Indonesia	2005	No	No	4% ± 1pp	Medium term
Israel	1997	Yes	Yes	1%-3%	Within two years
Japan	2013	Yes	Yes	2%	Approx. 2 years as soon as possible
Korea	1998	Yes	Yes	3% ± 0.5pp	Three years
Mexico	2001	Yes	Yes	3% ± 1pp	Medium term
Moldova	2010	Yes	Yes	5% ± 1.5pp	Medium term
New Zealand	1990	No	Yes	2% ± 1pp	Medium term
Norway	2001	No	Yes	2.5%	Medium term
Paraguay	2013	Yes	Yes	4.5%	Medium term
Peru	2002	No	Yes	2% ± 1pp	At all times
Philippines	2002	Yes	No	4% ± 1pp	Medium term
Poland	1999	Yes	No	2.5% ± 1pp	Medium term
Romania	2005	No	No	3% ± 1pp	Medium term
Russia	2014	Yes	Yes	4%	Medium term
Serbia	2006	No	No	4% ± 1.5pp	Medium term

South Africa	2000	No	Yes	3%-6%	On a continuous basis
Sweden	1995	Yes	Yes	2%	Normally two years
Thailand	2000	Yes	No	2.5% ± 1.5 pp	Eight quarters
Turkey	2006	Yes	Yes	5% ± 2pp	Multiyear
Uganda	2012	Yes	Yes	5% ± 2pp	Medium term
United Kingdom	1992	Yes	Yes	2%	At all times

Sources and note: information in Hammond (2012) updated to more countries and to current information published in central bank webpages.

Table 3
Ranking of Central Bank Independence and Transparency of IT Countries in World Ranking, 2010

Country	Transparency Ranking	Independence Ranking
Sweden	1	8
New Zealand	2	72
Hungary	3	9
CzechRepublic	4	24
UnitedKingdom	4	79
Israel	6	40
Canada	7	50
Australia	7	83
Iceland	11	14
Japan	11	62
Norway	14	46
Philippines	14	68
Turkey	14	29
Indonesia	17	11
Poland	17	58
Thailand	17	74
Armenia	21	7
Brazil	21	nd
Chile	21	16
Korea	21	65
Peru	21	32
SouthAfrica	21	86

Moldova	27	17
Albania	27	27
Romania	30	5
Georgia	30	36
Colombia	34	69
Ghana	34	nd
Guatemala	34	nd
Mexico	43	26
Russia	80	28
Uganda	80	70
India	80	89
Dominican Republic	nd	nd
Paraguay	nd	nd
Serbia	nd	nd

Source: Dincer and Eichengreen (2014): Table 8, CBIW measure for independence; Table 1 for transparency.
Note: Dincer and Eichengreen's rankings of independence are for 89 countries and of transparency for 120 countries.

Table 4

Monetary Policy in Inflation and Non-Inflation Targeting Countries, 1994-2011 and 2002-2011

Dependent variable: Monetary Policy Rate

Estimation methods: Instrumental-Variable Fixed Effects

Sample: 1994-2011 (monthly data)

	(1)	(2)	(3)	(4)
	IT Countries		**Non-IT Countries**	
Sample	1994-2011	2002-2011	1994-2011	2002-2011
Dependent Variable	mpr_t			
Variables				
mpr_{t-1}	0.953***	0.956***	0.964***	0.944***
	(0.006)	(0.007)	(0.008)	(0.013)
$Inflation_{t-3,t-1}$	0.018***	0.013***	0.005*	0.003
	(0.003)	(0.003)	(0.003)	(0.002)
$Unemployment_{t-4,t-2}$	-0.024***	-0.024***	-0.005	-0.004
	(0.006)	(0.008)	(0.004)	(0.004)
Inflation $Forec._{t,t+11}$	0.023**	0.050***	0.034**	0.035**
	(0.009)	(0.013)	(0.016)	(0.017)
GDP Growth $Forec._{t,t+11}$	0.001	-0.006	0.029***	0.034***
	(0.009)	(0.010)	(0.010)	(0.011)
Observations	2,668	2,153	1,275	895
Number of Countries	20	20	8	8
Country Fe	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes

We instrument the lag of monetary policy with two lags of monetary policy rate, quarterly inflation, and unemployment.
Heteroscedastic and autocorrelated (AR-1) robust standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Source: Muñoz and Schmidt-Hebbel (2013).

Table 5

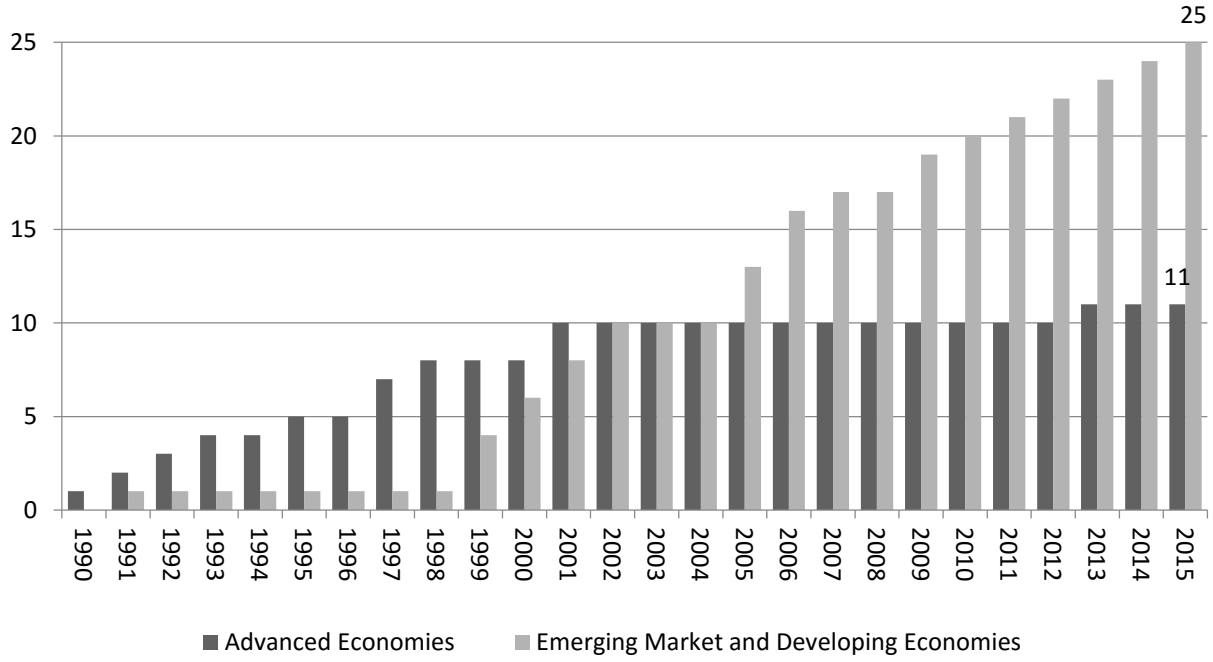
Effects of Inflation Targeting on Long-term Inflation Levels in Different Country Groups, 9 Studies

Authors	Sample: Treatment Group; Control Group	EstimationMethod	Difference in Long-Term Inflation Rate
Ball and Sheridan (2005)	AEs: 7 IT; 13 NIT	Cross-section OLS	Zero
Vega and Winkelried (2005)	World: 23 IT; 86 NIT	Propensity score matching	--2.6% to -4.8%
IMF (2005)	EMDEs: 13 IT; 22 NIT	Cross-section OLS	-4.8%
Mishkin and Schmidt-Hebbel (2007)	21 IT; 13 NIT AEs	Cross-section OLS	+1.20%
	21 IT; 13 NIT AEs	IV Panel	Zero

	21 post-IT; 21 pre-IT	IV Panel	-5.0%
	Stationary IT; 13 NIT AEs	IV Panel	Zero
Batini and Laxton (2007)	21 IT; 29 NIT	Cross-section OLS	-4.8%
Lin and Ye (2007)	AEs: 7 IT	Propensity score matching	Zero
Gemayel et al. (2011)	EMDEs: 10 IT; 29 NIT	Cross-section OLS Various panels	-3% -2% to -3%
Calderón and Schmidt-Hebbel (2010)	World: 24 IT; 73 NIT	Multi-variate structural inflation model; Panel Models: Fixed Effects, Random Effects, and System GMM	-3% to -6%
Samarina, Terpstra and de Han (2014)	25 AEs and 59 EMDEs	Propensity score matching	Zero for AEs and negative for EMDEs

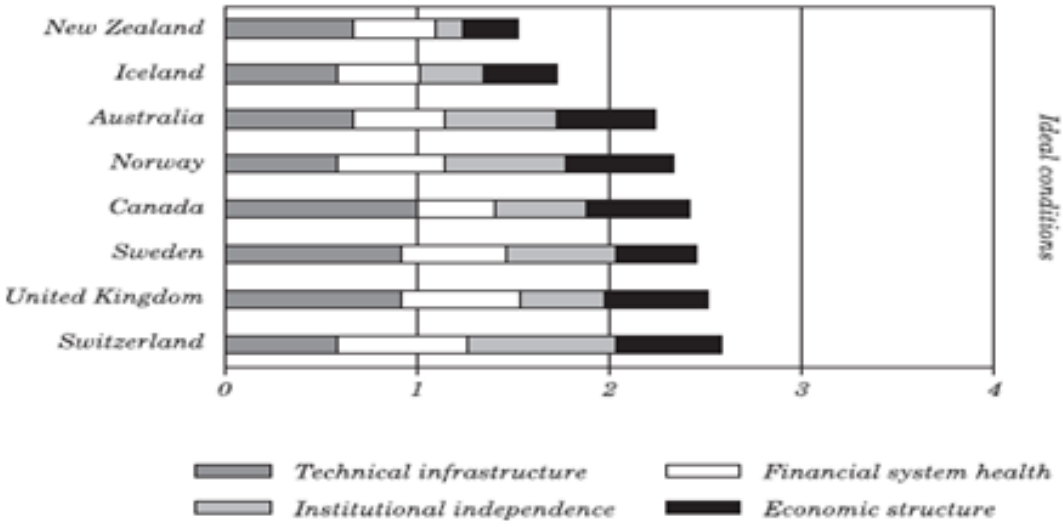
Notes: The second column identifies the number of countries in the treatment group comprised by inflation targeting (IT) countries and in the control group comprised by either non-inflation targeting (NIT) or IT countries. The column also identifies the full or partial samples as corresponding to the world, advanced economies (AE) or emerging/developing economies (EMDE). The last column reports the long-term inflation rate differences are those of the treatment groups compared to the control groups; values are statistically different from zero, and zero means statistically not different from zero.

Figure 1
Number of IT countries, 1989-2015



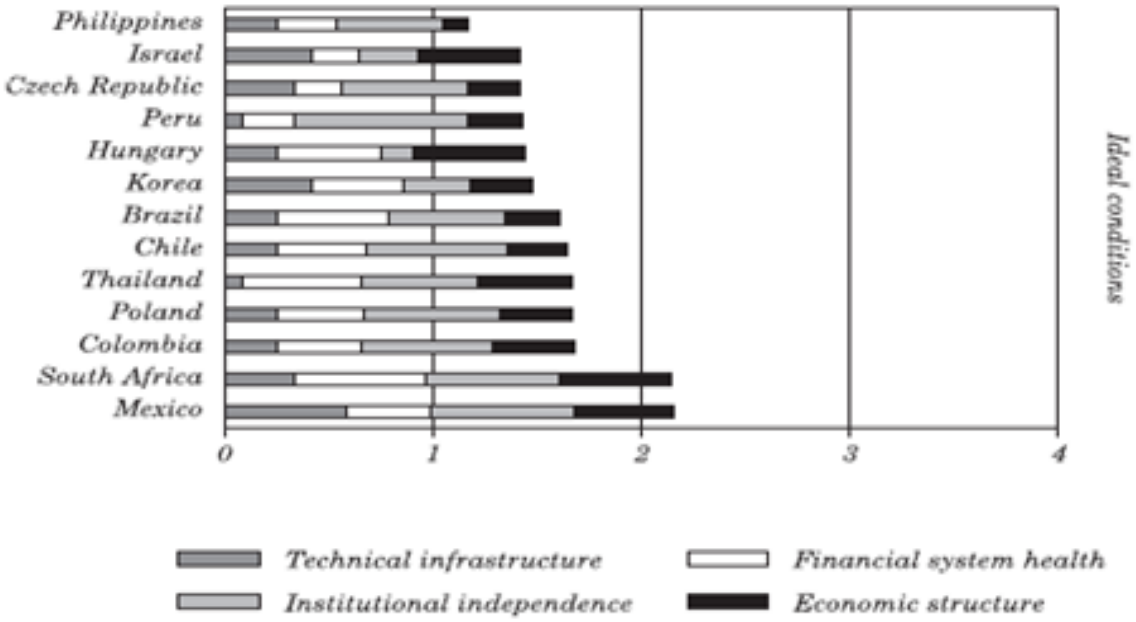
Source: Hammond (2012) and central banks webpages.

Figure 2
Preconditions at the Time of Inflation Targeting Adoption in Advanced Economies



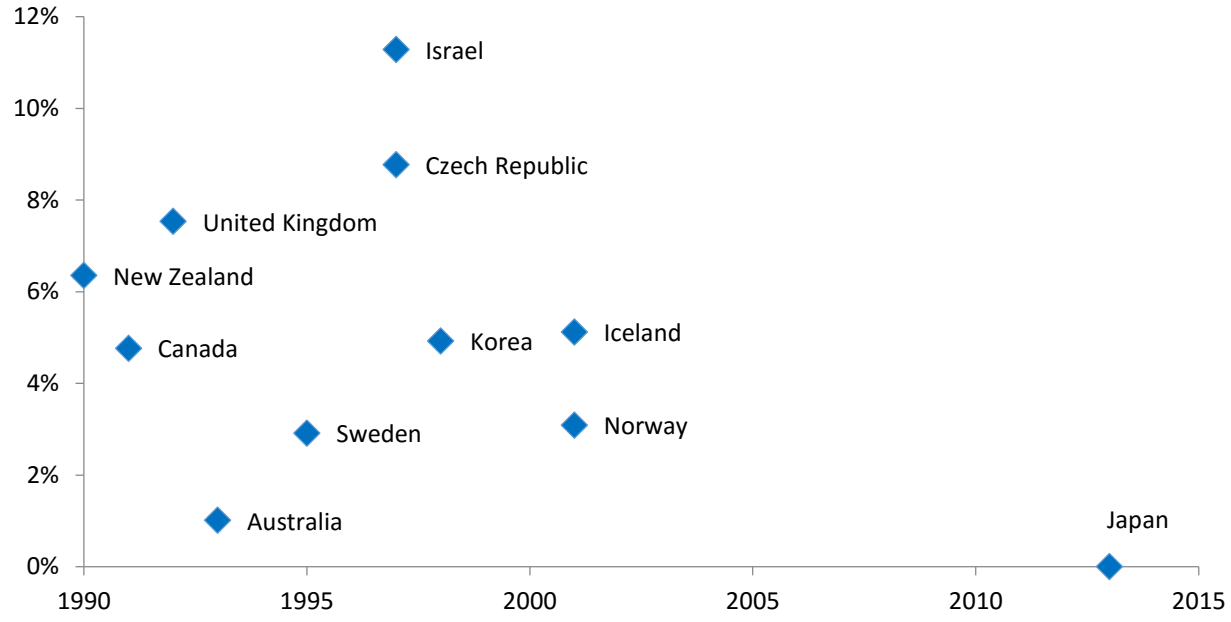
Source: Batini and Laxton (2007).

Figure 3
Preconditions at the Time of Inflation Targeting Adoption in Emerging-Market and Developing Countries



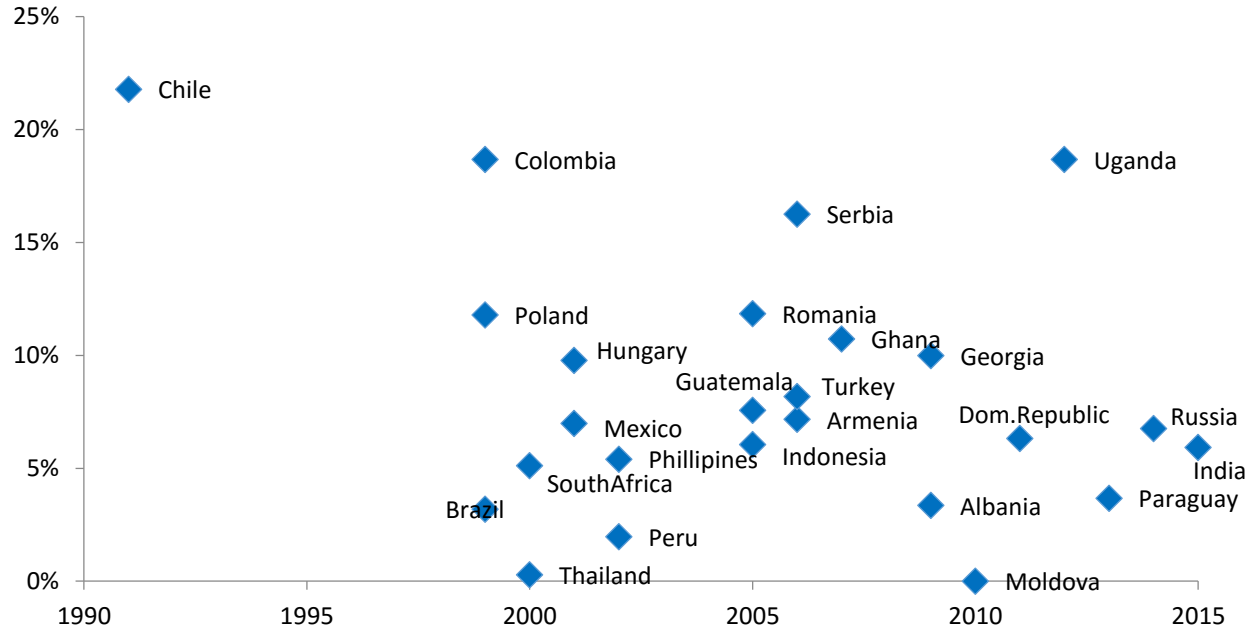
Source: Batini and Laxton (2007).

Figure 4
Initial Inflation Levels and Inflation-Targeting Adoption Years in 11 Advanced Economies



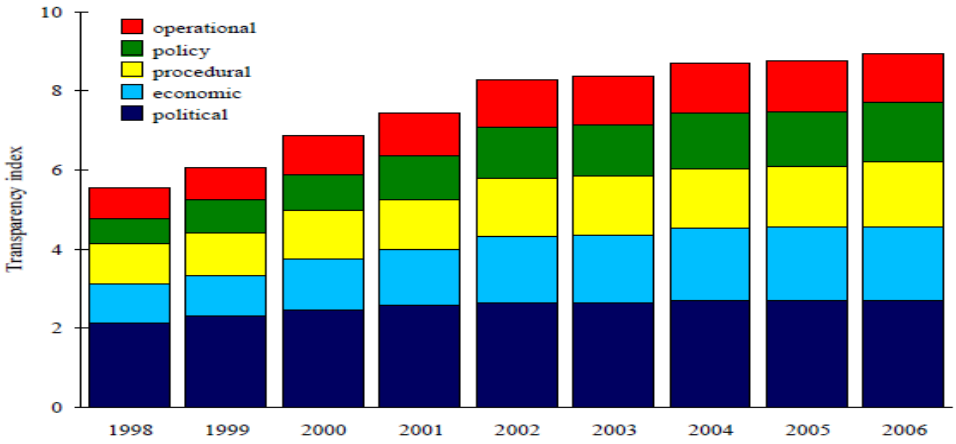
Source: Hammond (2012) and central banks webpages.

Figure 5
Initial Inflation Levels and Inflation-Targeting Adoption Years in 25 Emerging-Market and Developing Countries



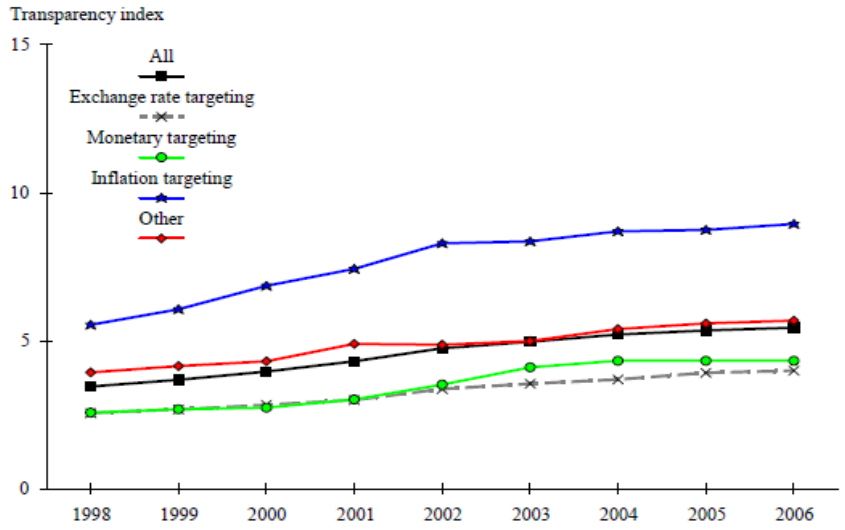
Source: Hammond (2012) and central banks webpages.

Figure 6
Average Transparency of Inflation-Targeting Central Banks, 1998-2006



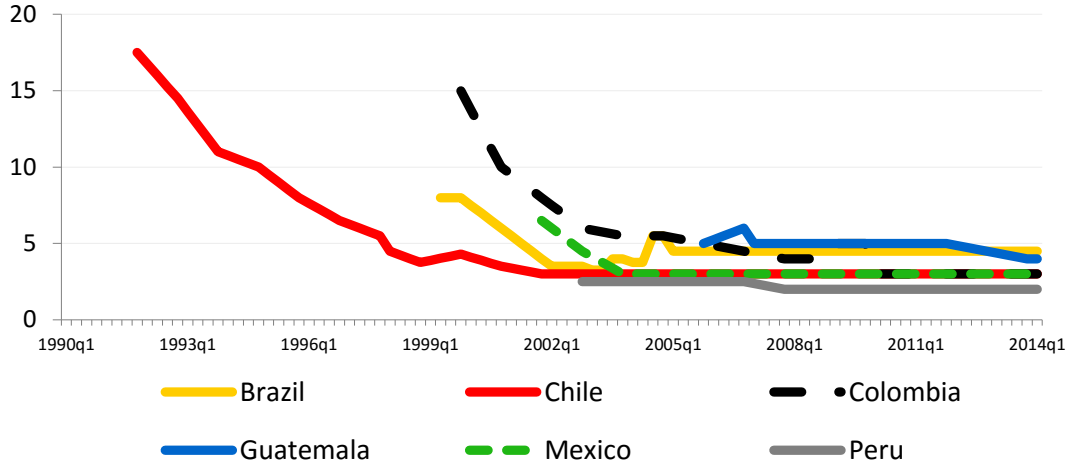
Note: the aggregate central-bank transparency index comprises five dimensions of transparency: political, economic, procedural, policy, and operational.
Source: Geraats, P. (2009)

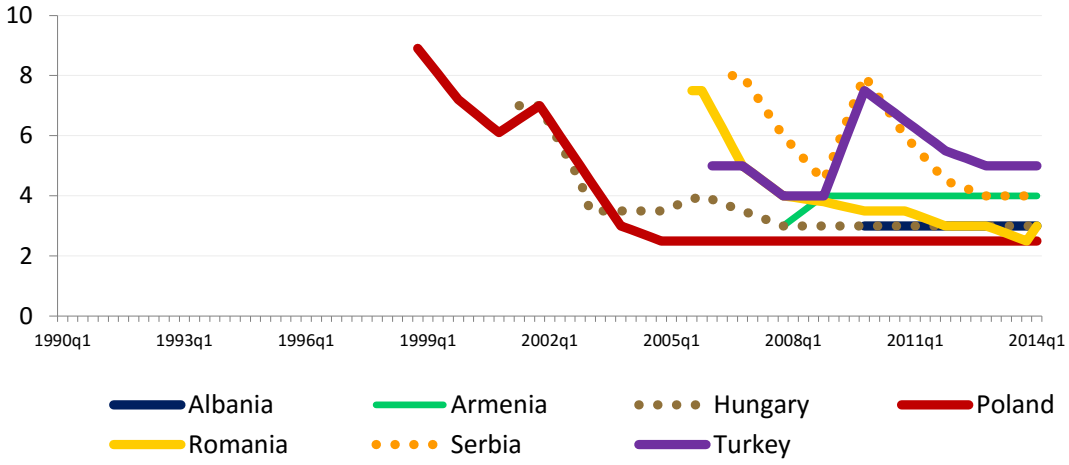
Figure 7
Average Central Bank Transparency by Monetary Policy Regimes, 1998-2006

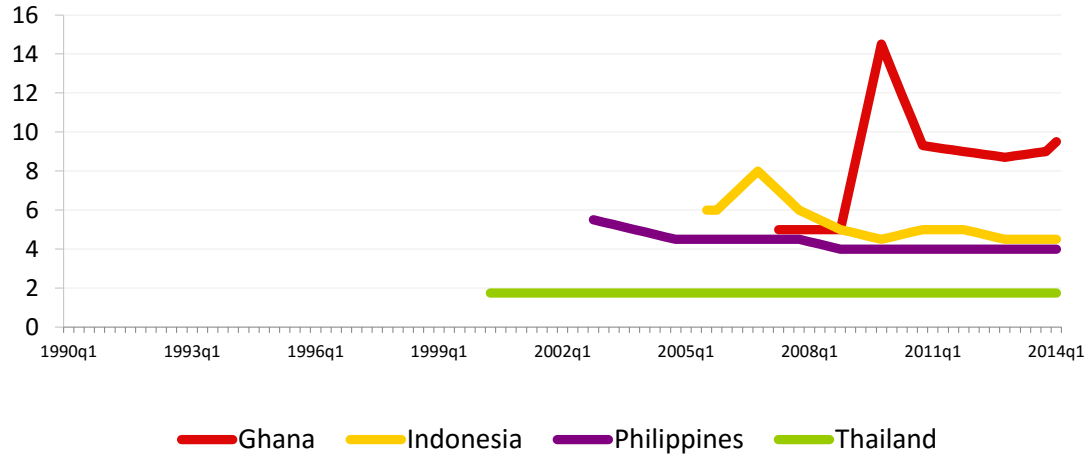


Note: central banks are classified according to their monetary policy regimes: exchange-rate targeting, monetary targeting, inflation targeting, and other.
Source: Geraats, P. (2009)

Figure 8
History of Inflation Targets in 17 IT Emerging and Developing Economies, from IT Start to 2014

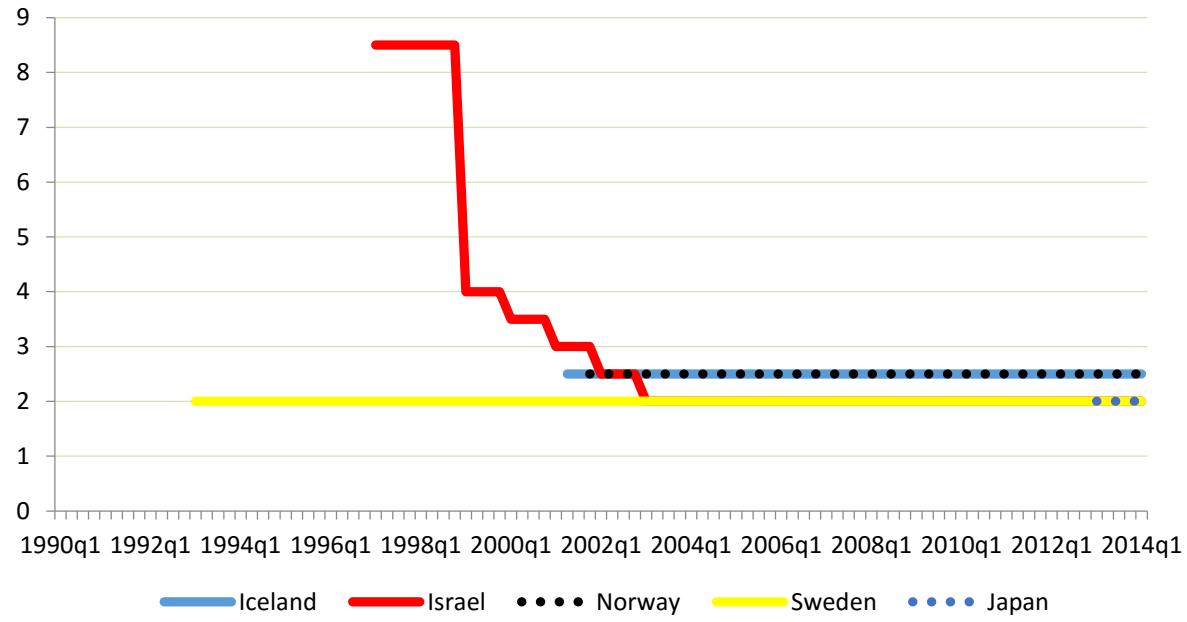


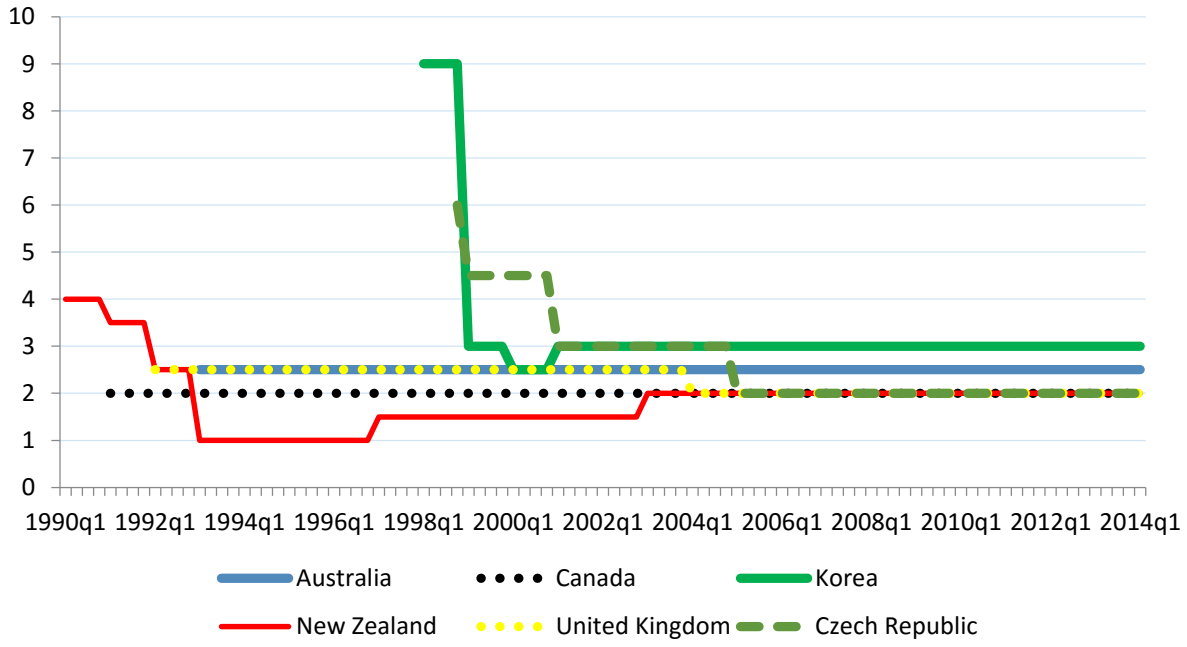




Source: Authors' calculations.

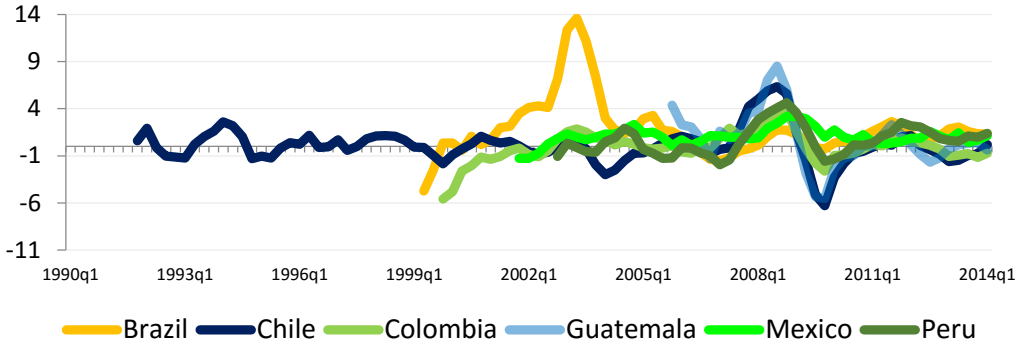
Figure 9
History of Inflation Targets in 11 IT Advanced Economies, from IT Start to 2014

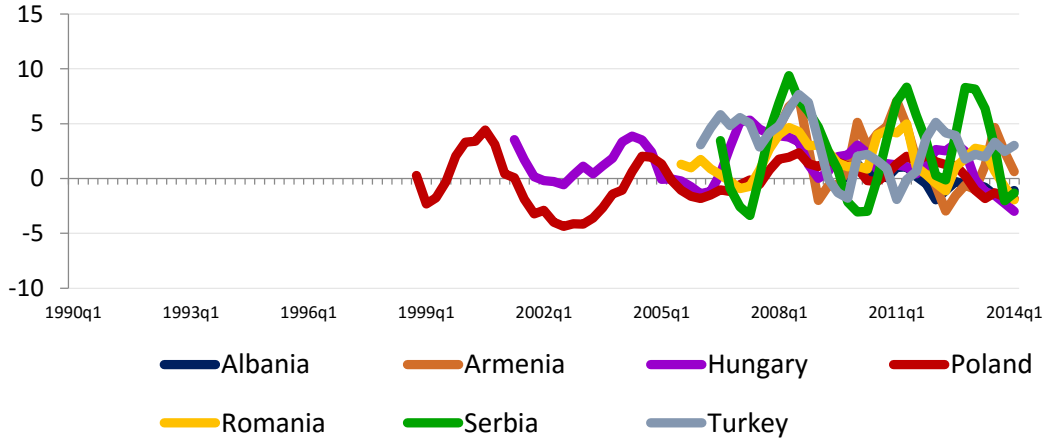


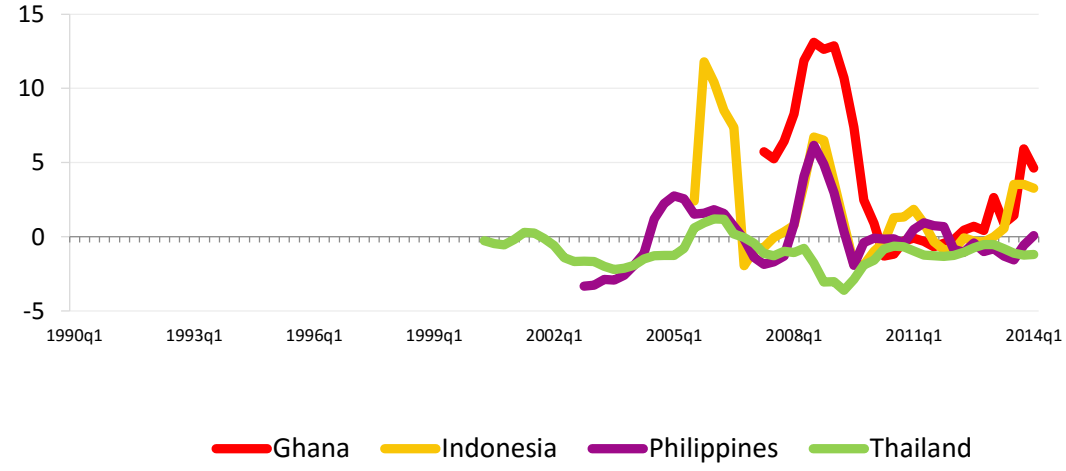


Source: Authors' calculations.

Figure 10
History of Inflation Deviations from Targets in 17 IT Emerging and Developing Economies, from IT Start to 2014

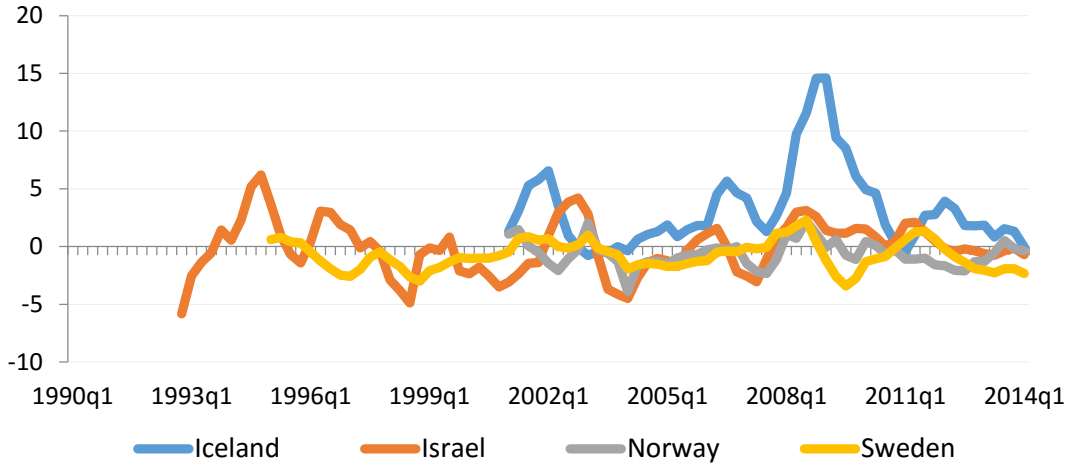


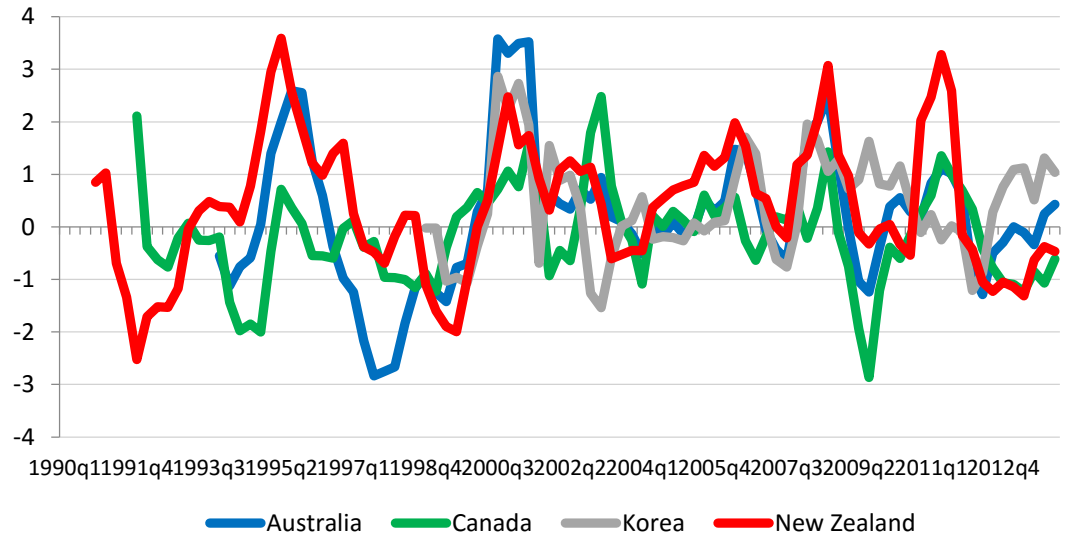




Source: Authors' calculations.

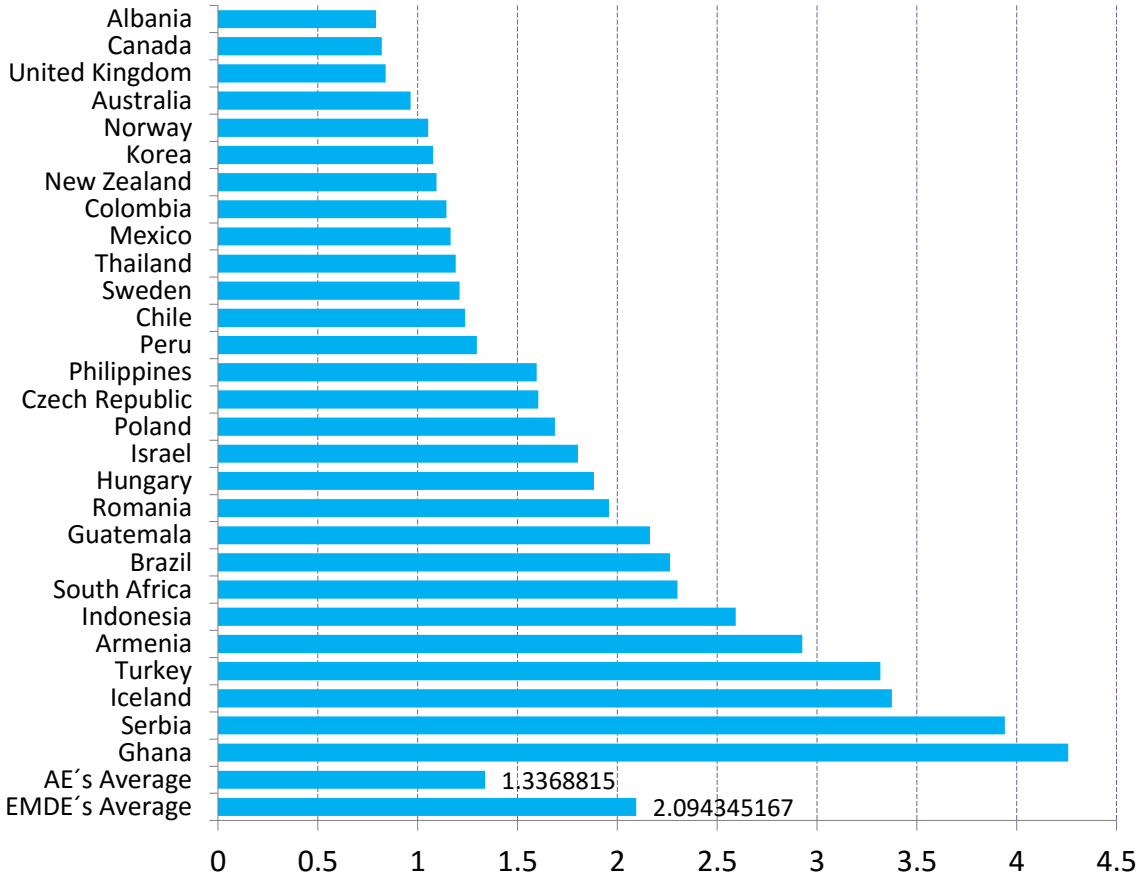
Figure 11
History of Inflation Deviations from Targets in 8 IT Advanced Economies, from IT Start to 2014





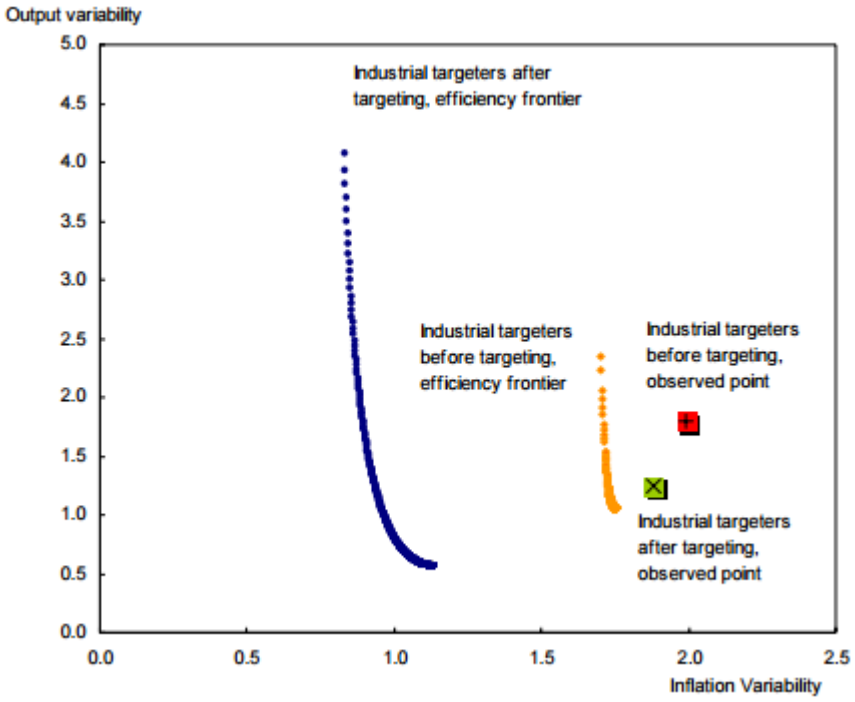
Source: Authors' calculations.

Figure 12
Average Absolute Inflation Deviations from Targets in 28 Inflation-Targeting Countries, from IT Start to 2013



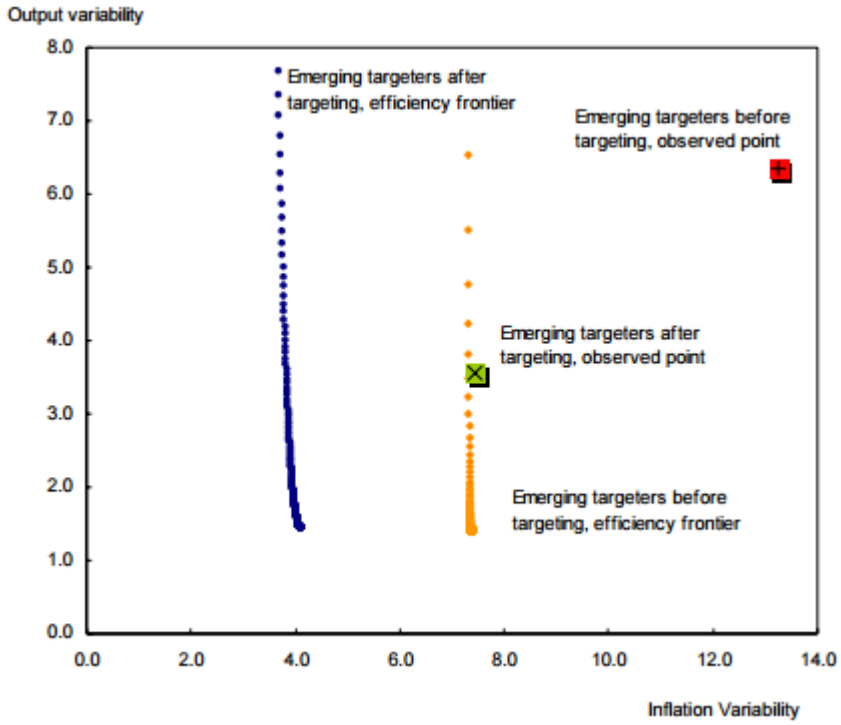
Source: Authors' calculations.

Figure 13
Monetary Policy Efficiency Frontiers and Observed Macroeconomic Performance Points in AE Targeters before IT and since starting IT until 2004



Source: Mishkin and Schmidt-Hebbel (2007).

Figure 14
Monetary Policy Efficiency Frontiers and Observed Macroeconomic Performance Points in EMDE Targeters before IT and since starting IT until 2004



Source: Mishkin and Schmidt-Hebbel (2007).