Inflation Targeting and Anchored Inflation Expectations: The Role of Central Bank Credibility*

SWATI SINGH†

Preliminary work, kindly do not circulate.

Abstract

This paper assesses the effect of Inflation Targeting (IT) in anchoring expectations through both empirical and theoretical approaches, focusing on differences between advanced and emerging-market economies. The empirical analysis examines IT's impact on inflation, expectations, and the role of credibility in enhancing anchoring. Results show that expectations are better anchored in emerging economies and that credibility strengthens this anchoring, particularly in these economies. Heterogeneity across target types and economies is also observed. The theoretical analysis employs a New Keynesian (NK) model with non-rational expectations and an imperfect-credibility NK Phillips curve to further investigate these relationships. Higher credibility reduces inflation and nominal interest rates while inducing a smaller reduction in the output gap. The endogenous credibility results highlight a negative relationship between credibility and inflation. Anchored expectations, serving as the transmission channel, help absorb shocks to inflation, enhancing economic stability. These findings underscore the importance of credibility and expectations in the effectiveness of IT, especially in emerging economies.

Keywords: Inflation, Inflation Targeting, Inflation Expectations, Credibility
JEL classification: D84, E42, E52, E58

*I would like to thank Kei-Mu Yi, David Papell, and Bent Sørensen for their guidance and helpful comments. I thank the workshop participants at UH economics student workshops and brown-bag at Hobby School of Public Policy (UH) for their comments and suggestions.

†Department of Economics, University of Houston. Email: ssingh63@uh.edu

1. INTRODUCTION

At the core of any central bank conducting monetary policy is the issue of price stability. Central banks have adopted different monetary policy frameworks over the decades to achieve this and provide a nominal anchor for the economy. However, for a variety of reasons, these frameworks often underperformed and failed to achieve their objectives.[3] This led many countries to switch to a new monetary policy framework: inflation targeting (IT), 1990s onward. As a result, IT emerged as the dominant and most popular monetary policy framework in recent decades.

When a central bank adopts IT as a monetary framework, it publicly announces a target for inflation; achieving this becomes the central bank's main objective.[4] One of the other objectives of adopting IT is to anchor the inflation expectations of economic agents to this target level.[5] The main benefit of IT is thus its impact on inflation expectations, and consequently, on inflation and other macroeconomic variables.

Despite the importance of anchored inflation expectations and their impact on inflation, there is limited evidence on whether expectations have become well-anchored following the adoption of IT across economies. Moreover, little consensus exists on the driving forces of better-anchored inflation expectations. Even within an IT framework, many factors influence the anchoring of expectations and, eventually, inflation. Among these, the central banks' credibility has been identified as a key factor in regaining anchoring inflation expectations across economies which is the focus of this paper.[6] The literature defines the anchoring of expectations in different ways.[7] In line with one definition in the literature, this paper defines anchoring as the deviation of the expectations from the target.[8]

This paper aims to assess the relationship between IT and anchoring inflation expectations, and it seeks to answer the following questions. First, does the adoption of IT lead to anchored expectations? If so, what are the channels through which this effect operates? Finally, what factors help in improving anchoring? The paper addresses these questions

[3] As a few examples of previous frameworks, the currency peg was not favored as it meant high dependency on the monetary policy of the country to which the currency was pegged. On the other hand, monetary targeting was not successful as money became unstable.

[4] Some central banks have a single objective or mandate, which is to target inflation, while others have a dual objective where they also focus on maximizing employment generation in the economy along with price stability.

[5] As discussed in Bernanke et al. (1998), among others.

[6] See Goodfriend and King (2005) for example.

[7] Some papers look at it through the response of long-term expectations to shocks to short-term expectations. See Buono and Formai (2016) for example.

[8] A similar approach is used in Kumar et al. (2015), Moessner and Takáts (2020), Bems et al. (2021), etc.

by comparing advanced economies (AEs) with emerging-market economies (EMEs).

I answer the proposed question using both empirical and theoretical approaches. The empirical approach examines the impact of IT on inflation and expectations and assesses its effect on anchoring across economies using panel data. However, these estimates do not provide insights into the dynamics of inflation or inflation expectations in response to various shocks or economic situations. I use a theoretical approach to address these issues, employing a New Keynesian (NK) model with non-rational expectations and incorporating credibility. This model helps to understand the behavior of expectations and inflation, offering insights into the dynamics for economies that have already adopted IT and those that are planning or are shifting to adopt IT in the future.

On the empirical side, the literature on IT and its impact on inflation and expectations does not decisively compare the effects across AE and EME. I use event study estimates to assess the short-run impact of IT adoption on inflation and expectations, finding that IT has had a more pronounced effect in reducing both inflation and expectations in EMEs as compared to AEs.[9] Additionally, I evaluate the long-run effects of IT shock on these macro variables. The Impulse Response Functions (IRFs) from local projection estimations indicate that expectations decrease more rapidly in EMEs and remain lower even in the long run following an IT adoption shock, compared to AEs.

I also find that expectations are anchored to the target in IT-adopting EMEs and AEs. However, expectations are better anchored in EMEs. This difference may be due to the stickiness of expectations in AEs, where agents tend to rely more on past inflation rather than the target. For example, some AEs, such as Japan and Switzerland, are aiming to increase inflation from low levels. This can be puzzling to the agents who believe lower inflation is preferable, leading them to base their forecast on past inflation rather than the target level of 2%. As a result, expectations may be less anchored in these AEs.[10] In contrast, EMEs exhibit a stronger alignment with the target.

The paper examines whether the credibility of the central bank plays a crucial role in anchoring expectations. The credibility measure used, adopted from Alichi et al. (2009), reflects the extent to which agents observe a 'low' inflation scenario. In such a scenario, credibility is considered close to perfect as inflation aligns with the target level. I find that higher credibility enhances the anchoring of expectations in EMEs but has no effect on AEs. This disparity arises because credibility has markedly improved EMEs over the

[9] Capistrán and Ramos-Francia (2010) is one of the papers that also find this.

[10] Some papers in the literature also find similar results where expectations have de-anchored in the case of developed economies. See Ehrmann (2014), Kumar et al. (2015) for example.

past two decades, while it has not significantly changed in AEs. Consequently, increases in credibility do not alter expectations in AEs, as agents' forecasts remain similar to those they held previously. In contrast, improved credibility in EMEs has led to greater trust in the central bank, resulting in expectations more aligned with the target and thus better anchored.

Along with several robustness checks, the paper also examines the impact of anchoring under various target types. Since there is heterogeneity in the type of target (point, range, or point-tolerance) a central bank chooses, there might be varying effects on the anchoring of expectations. The results support heterogeneity in the anchoring level across target types and economies. The EMEs show better anchoring in the presence of point targets rather than range. Whereas, AEs have significant anchoring only for the case of point targets. Various target types perform differently under the case with credibility across economies.

It is crucial to understand the pace at which inflation and expectations converge to the target inflation in an IT economy after an economic shock. Additionally, examining how different levels of credibility affect this process in EMEs and AEs is essential for understanding the impact of IT on anchoring expectations. The empirical analysis alone did not address this, so I use a theoretical approach. I incorporate credibility into the expectation formation process within a NK model framework. The model is solved for both exogenous and endogenous credibility.

In the model with exogenous credibility, the analysis reveals that the economy reacts differently to varying levels of credibility. The results show that with increasing credibility, the output gap responds less aggressively to both TFP and monetary policy shocks. A similar pattern is observed for inflation, nominal, and real interest rates with the latter increasing less as a response to a monetary policy shock with increasing credibility.

The model with endogenous credibility indicates the anchoring of expectations and this varies depending upon the shock the economy faces. Additionally, there is a negative relationship between credibility and inflation is evident across different shocks. The model also includes an additional shock- the stock of credibility shock. An increase in the stock of credibility results in higher current-period credibility, which influences expectations and results in lower inflation. This shock also lowers nominal and real interest rates. However, increased credibility in the economy, which signals a strong commitment by the central bank to controlling inflation, leads to expectations of tighter monetary policy. This anticipation reduces current spending and consequently lowers output in the economy.

The empirical estimates highlight differences between EMEs and AEs in terms of the degree of anchoring. They also examine how credibility impacts this anchoring. On the other hand, the quantitative model helps understand how anchored expectations translate into lower inflation and underscores the importance of credibility in facilitating this process. This paper addresses whether IT leads to anchored expectations and explores the different channels through which this occurs across EMEs and AEs. It also finds that credibility plays a crucial role in the entire process.

2. LITERATURE REVIEW

The paper contributes to the extensive literature focused on the macroeconomic implications of IT on macro variables, for example, Ball and Sheridan (2004), Walsh (2009), Gonçalves and Salles (2008) by emphasizing expectations anchoring. Apart from this, the paper also contributes to three other strands of literature.

First, it adds to the empirical literature on inflation expectations and IT such as Levin et al. (2004), Capistrán and Ramos-Francia (2010), Gürkaynak et al. (2010), Ball and Mazumder (2011), Davis (2012), Davis (2014), Buono and Formai (2016), Strohsal et al. (2016), Mehrotra and Yetman (2018), Kose et al. (2019), Ehrmann (2021), Grosse-Steffen (2021), Carvalho et al. (2023), etc. These papers either do not explore anchoring in the context of IT adoption or if they do, they do not explore the comparison across AEs and EMEs with the specific role of credibility. This paper explores the anchoring of expectations through deviations of expectations from the target in the context of IT adopting AEs and EMEs.

Additionally, the paper looks at the role of credibility in improving anchoring which has been relatively under-researched, and thus the paper contributes to this area. The paper furthers the literature on credibility such as Cukierman and Meltzer (1986), Erceg and Levin (2003), Alichi et al. (2009), Binder (2017), Bordo and Siklos (2017), Neuenkirch and Tillmann (2014), de Mendonça (2018), Unsal et al. (2022), Kalemli-Özcan and Unsal (2024). Some of these papers focus on developing a new index for credibility while others use the existing indexes. This paper follows Alichi et al. (2009) for the credibility measure and uses that for empirical estimations and the model. de Mendonça (2018) is the closest paper and looks at the credibility and inflation expectations but only examines the relation empirically for seven emerging economies. Thus, I add to the literature by measuring the influence of credibility in anchoring expectations across different types of economies and incorporating it into the model.

Lastly, the paper adds to the literature on theoretical explanations of the behavior of

anchoring expectations under the IT economy and the impact of credibility on this. To examine this, the paper uses non-rational expectations in NK models and adds to the existing literature. Some papers that deviate from rational expectations are Evans and Honkapohja (2001), Erceg and Levin (2003), Alichi et al. (2009), Ascari and Ropele (2009), Ascari et al. (2017). The paper also contributes to the literature on expectation formation such as Mankiw et al. (2003), Blinder et al. (2008), Coibion and Gorodnichenko (2015), Kumar et al. (2015). This paper relates closely to two papers, Ascari et al. (2017) which as discussed earlier examines anchoring and transparency, whereas, Alichi et al. (2009) which examines a model for IT under imperfect credibility. This paper differs from the latter in terms of modeling expectations formation by the agent and assessing exogenous credibility explicitly. Additionally. this paper examines the model for representative AE and EME to address the importance of different levels of credibility for the two types of economies and the structures of different mandates in the respective economies.

The rest of the paper is organized as follows. Section 3 discusses the data and methodology used for empirical analysis. Section 4 discusses the results of these empirical analyses. Section 5 presents some robustness checks. Section 6 introduces the model and section 7 discusses the quantitative results from the model. Lastly, Section 8 presents the conclusion.

3. DATA & METHODOLOGY

In this section, I document the differences in expectations and inflation after IT adoption across EMEs and AEs. I also examine the effect on the anchoring of expectations after IT adoption and explore credibility as one of the factors enhancing this anchoring across economies. The fact that central banks adopt varying target types is also accounted for while assessing the level of anchoring. In the empirical analysis, the results do not make causal claims about the anchoring and importance of credibility. For this, I model the credibility in a NK model with non-rational expectations described in Section 6.

Data: The empirical estimation is conducted for 12 AE and 16 EMEs that have adopted IT.[11] The data spans 1990-2019 and is at a quarterly frequency. Inflation expectations data are from the Ifo World Economic Survey (WES), a survey of professional forecasters, which collects qualitative responses converted to numerical estimates for each period. This paper uses these numbers for estimation. The data for inflation is taken from the IMF (IFS) database. Inflation targets, types of targets and IT adoption dates are taken from the respective central bank websites, IMF, and some literature.[12]

[11] The list of countries with inflation levels, implementation dates, target type, and current target levels are given in Appendix A.

[12] For some economies, the IT dates have also been taken from IMF. Ehrmann (2021) and Grosse-Steffen (2021) were referred for some target type dates.

3.1 Impact of inflation targeting

The empirical exercise is conducted in three stages. In the first stage, I assess the impact of IT adoption on inflation and expectations across AE and EMEs. I use an event study specification of the following form for this:

$$y_{it} = \sum_{j=2}^{J} \beta_j * Lag(j)_{it} + \sum_{k=0}^{K} \gamma_k * Lead(k)_{it} + \mu_i + \lambda_t + \epsilon_{it} \tag{1}$$

where y_{it} is the outcome of interest i.e inflation and inflation expectations here, μ_i and λ_t are country and time fixed effects, and ϵ_{it} is the error term. *Lag(j)* is the dummy indicating that a given country was j quarters away from adopting IT and *Lead(k)* similarly. The reference period here is taken as 1 quarter before IT adoption i.e. the first lag (j=1). The estimation window considered in this paper is such that *J=8* and *K=16*.
This is a staggered event study estimation and only includes countries that have adopted IT; thus, there are no never-treated units. In this case, the control group comprises all the countries that have not yet adopted IT (the non-yet-treated group).

Next, to assess the long-term effect of IT adoption as a shock, I use the Jordà local projections Jordà (2005) to estimate and infer impulse responses. Since the adoption dates of inflation-targeting economies are available, I create a dummy variable equal to 1 at the time of IT adoption and 0 otherwise for each country, which acts as the policy shock. This local projections approach involves running the regression of the outcome variable on the independent and control variables at different horizons after time t. I use the following specification of the regression for various values of the horizon:

$$y_{i,t+h} = \beta^h IT_{it} + \sum_{k=1}^{K} \lambda_k^h IT_{i,t-k} + \sum_{k=1}^{K} \theta_k^h y_{i,t-k} + \alpha_i^h + \gamma_t^h + \varepsilon_{i,t}^h \tag{2}$$

where y_{it} is the outcome of interest i.e inflation and inflation expectations here, IT is the dummy variable for the dates of IT adoption, α_i and γ_t are country and time fixed effects, and ε_{it} is the error term. The coefficient for the dummy i.e. β for the various horizons is the estimate for the response of inflation or inflation expectations to the realization of the adoption of IT as a framework.

The underlying assumption here is that the main thing the central banks consider while introducing IT is past inflation and nothing else. The easiest way to control for that is through the θ coefficient that captures the estimate for the lagged values of the dependent variable. Apart from these lagged values, any effects from the anticipation of the IT introduction itself or any future inflation/ inflation expectations are captured by the lags

of the shock itself. These are captured by the λ coefficient for each horizon. The country and time-fixed effects are also included to capture variations across countries and other global effects. I have used a value of 4 for the K in each lag. I estimate the regression for each horizon from 0 to 20 quarters ahead to examine the response of inflation and expectations up to 5 years after the adoption of the framework for both AE and EMEs.

3.2 Anchoring of inflation expectations

As the final step of empirical estimations, I assess the effect on the anchoring of inflation expectations after IT adoption. As discussed earlier, anchoring inflation expectations has been one of the objectives for some IT-adopting central banks. Well-anchored expectations indicate that the agents in the economy believe in the central banks' motive of bringing inflation close to the target and thus form expectations close to the target themselves. Though there are different ways in which anchoring has been discussed, I assess the anchoring of inflation expectations through the deviations of expectations from the inflation target.[13] The regression captures the effect of past inflation deviation from the target on the deviation of expected inflation from the target. The deviations are considered in absolute terms as I am not focusing on any symmetries arising from overshooting and undershooting of the target.[14] This regression is as follows and is estimated for both AE and EMEs:

$$|\pi^{e}_{it} - \pi^{tar}_{it}| = \beta * |\pi_{it-1} - \pi^{tar}_{it}| + \alpha_i + \gamma_t + \varepsilon_{it} \tag{3}$$

Here, π^e is inflation expectations, π^{tar} is the target inflation announced by the central bank and π is inflation. The regression captures the anchoring through β which is a coefficient on the deviation of the past inflation from the inflation target.[15] Well-anchored expectations i.e. expectations close to the target would mean that the β should be close to zero.[16] I include country and time-fixed effects to control for unobserved country heterogeneity and capture all potential time-varying global effects respectively. I also run another regression to capture the anchoring of expectations in level form rather than in the form of deviations from the target. This regression is discussed in detail in Appendix B.

The anchoring is examined further closely under the varying degrees of credibility and

[13] Strohsal et al. (2016) use this form in a TVP model estimation, Moessner and Takáts (2020) also use deviations of long-term expectations from the target as the dependent variable and deviations of short-term expectations from the target as the independent variable with some lags.

[14] The latter might help understand the dynamics of countries that undershoot the inflation target, for eg. Japan

[15] I have also tested the same regression for just the absolute deviation of expectations or past inflation from the target. The squared deviations are used to avoid problems with the inversion (differentiable) of the matrices for estimating β.

[16] β would be zero when expectations are perfectly anchored.

various target types in the next sub-sections.

3.2.1 Credibility measure and it's effect

Furthermore, to examine if some factors help in better anchoring expectations, I introduce a measure for the central bank's credibility in the above regressions. Credibility is one of the major differentiating factors across advanced and EMEs and is considered an important factor in the policy-making of any economy. To assess whether credibility affects this measure of anchoring, I use a regression with demeaned interaction term as suggested by Balli and Sørensen (2013).[17] The interaction term coefficient (β_3) captures the effect of deviation of past inflation from the target on the deviation of expectations from the target with increasing credibility. The β_1 coefficient captures the effect of past inflation deviation from the target on the deviation of expected inflation from the target when the credibility of each country at time t is equivalent to the mean across all observations (here, all EMEs and AEs) i.e. $cred_{it} = \overline{cred}$. The coefficient of the *cred* variable i.e. β_2 captures the effect of credibility on the deviation of inflation expectations from the target inflation when $|\pi_{it-1} - \pi_{it}^{tar}| = \overline{|\pi_{t-1} - \pi^{tar}|}$. All the other terms are similar to that of Equation 3.

The regression equation I estimate is as follows:

$$|\pi_{it}^{e} - \pi_{it}^{tar}| = \beta_1 * |\pi_{it-1} - \pi_{it}^{tar}| + \beta_2 * cred_{it} + \beta_3 * (cred_{it} - \overline{cred}) * (|\pi_{it-1} - \pi_{it}^{tar}| - \overline{|\pi_{t-1} - \pi^{tar}|}) + \varepsilon_{it} \tag{4}$$

The hypothesis here is for the $\beta_1 > 0$ and $\beta_3 < 0$ which would thus mean that with credibility increasing on average, the deviation of past inflation from the target has a lower impact on the deviation of expectations from the target i.e anchoring of expectations improves with an increase in average credibility.

The credibility measure is calculated for all the countries in the sample and follows from Alichi et al. (2009). To define the credibility (flow) measure, the paper presumes that the agents see the possibility of two inflation scenarios- 'high' and 'low'. The *'cred'* parameter indicates the extent to which the 'low' inflation scenario is observed. In the 'low' inflation case, inflation converges to the target, and the second term in the denominator becomes zero. Thus, the *cred* term converges to 1. However, in the 'high' inflation scenario, there are doubts or suspicions amongst the agents that there might be a very high inflation rate and will be higher than the target meaning that the *cred* term converges to 0. Here, π^{low} is the inflation target the central bank announces or the long-term inflation target (2%)

[17] The coefficient of the interaction term from this regression and the one without demeaned terms will give the same value. See Balli and Sørensen (2013) for more details.

for some advanced economies. Whereas, π^{high} is an assumed higher level of inflation for the particular economy. [18] The θ parameter indicates the convergence rate to the steady state (high persistence implies a longer time to converge). The θ value varies across the two inflation scenarios.

$$cred_t = \frac{(\pi_t^{high} - \pi_t)^2}{(\pi_t^{high} - \pi_t)^2 + (\pi_t^{low} - \pi_t)^2} \tag{5}$$

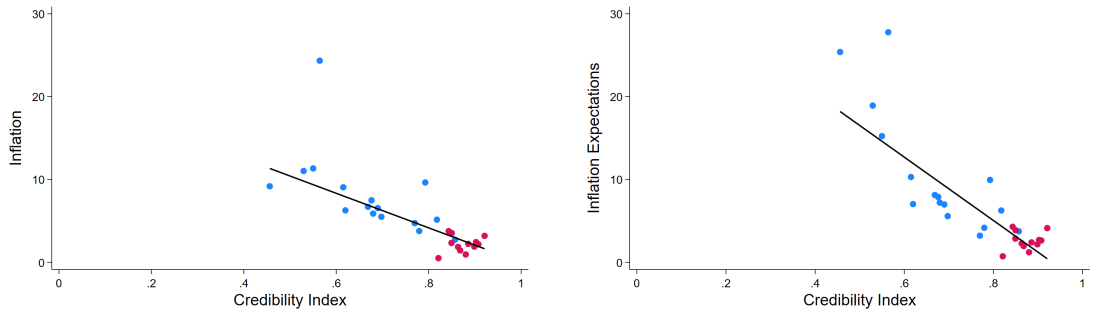
and,

$$\pi_t^{high} = \theta_h * \pi_{t-1} + (1 - \theta_h) * \pi^{high}$$

$$\pi_t^{low} = \theta_l * \pi_{t-1} + (1 - \theta_l) * \pi^{low}$$

This credibility measure is negatively correlated with inflation and inflation expectations. For eg., a 0.1 increase in credibility leads to an 'x' percent decrease in inflation or inflation expectations for a particular country. As we can see from Figure 1, a negative slope indicating higher credibility and lower inflation or inflation expectations is mostly driven by EMEs.

Figure 1: Inflation and Inflation Expectations



(a) Inflation (b) Inflation Expectations

Note: The scatter plot shows the regression coefficient of inflation and inflation expectations on the credibility index. The blue dots are for EMEs and the red dots are for AEs. The coefficients are plotted against the average credibility over time. The regression period for Brazil, Peru, Türkiye, Ukraine, and Uruguay have been selected to exclude hyperinflation episodes.

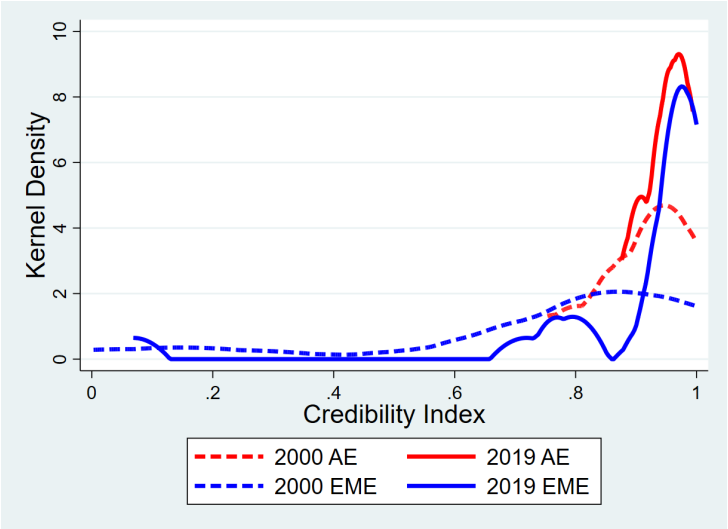
Figure 2 on the other hand shows the distribution of credibility for 2000 and 2019.[19] As we can see, the mass has shifted to the right, for both EMEs and AEs indicating higher average credibility across countries. EMEs had a higher variance of credibility over both periods and AEs on the other hand had a narrower distribution. It is also evident that although for AEs not a lot changed over time, for EMEs, we can see most of the mass towards higher credibility. [20]

[18] It is taken as 5 pp higher than the highest inflation in the particular country for the EME group and 2 pp higher for the AEs group.

[19] Year 2000 has been selected instead of 1991 to avoid the high inflation episodes in some EMEs.

[20] These results are similar to what Kalemli-Özcan and Unsal (2024) also find using the IAPOC index.

Figure 2: Credibility Distribution



Note: The plot shows the distribution of credibility index for EMEs and AEs in 2000 and 2019.

3.2.2 Influence of various target types

As mentioned earlier, when a central bank adopts IT, it announces a target. However, there is significant heterogeneity in the types of targets across time and countries. Broadly these targets can be categorized into three types: point target, point with tolerance, and range target. Most EMEs initially adopted point targets with tolerance, whereas AE began with point targets.[21] Over time, these countries have adjusted their target types in response to evolving economic conditions and shifts in their monetary policy stance. Figure 10 in Appendix C illustrates the distribution of the mean for different target types across sub-samples for EMEs and AEs, highlighting the heterogeneity of target type over time and between the two groups of economies. The data show that point targets with tolerance have become significantly more prevalent in EMEs, while point targets have gained popularity in AEs. In contrast, range targets have experienced a rise and subsequent decline in both groups over the sub-samples.

These differences in target types across time and economies lead to varying monetary policy decisions, reactions, and differences in how economic agents perceive inflation. They also highlight the target-related risks that each economy may face. Many EMEs, with their history of high inflation, higher targets, and lower credibility, may prefer a more moderate approach to setting targets, such as point targets with tolerance. This approach allows them to avoid committing to precise point targets while mitigating the risk of exceeding a specified range. In contrast, AEs, characterized by greater credibility, and much more stable inflation, favor point targets.

[21] See Table 8 for details.

These differences in target types may influence the degree of inflation expectations anchoring. This question has been very scarcely addressed in the literature. For example Castelnuovo et al. (2003) examined industrial economies and found that adopting a quantitative target improves anchoring but did not find any differences among the target types. Similarly, Grosse-Steffen (2021) explored the impact of different target formulations on expectations anchoring using a panel of 29 countries. Their paper, which focuses on long-term expectations and uses a smaller sample size, differs from this paper. They find that point and hybrid target formulations better anchor expectations and find consistency with models interpreting range targets as zones of less active monetary policy.

Ehrmann (2021), which distinguishes between point targets with and without tolerance and range targets is the closest study to this paper. They employ a different measure of anchoring expectations, focusing on the pass-through of past inflation to expectations, and find that the pass-through is weaker for range or tolerance band targeters. While their study is similar in using shorter forecast horizons and covering a larger period, this paper differs in several aspects. It adopts a distinct definition of expectation anchoring and, incorporates the role of credibility to examine the interaction between credibility and target types and assess how credibility influences expectations anchoring under different targeting frameworks.

This paper tests for anchoring across target types and the effect of credibility in enhancing anchoring across these target types. The first regression estimated differentiates anchoring across target types as follows:

$$|\pi_{it}^{e} - \pi_{it}^{tar}| = \beta * |\pi_{it-1} - \pi_{it}^{tar}| + \gamma * D_{it}^{type} + \delta * |\pi_{it-1} - \pi_{it}^{tar}| * D_{it}^{type} + \alpha_i + \gamma_t + \varepsilon_{it} \quad (6)$$

where D_{it}^{type} is the dummy, taking the value one for each quarter for a certain target type and zero otherwise. Thus, there are three dummies, one for each target type. The category for point target is treated as the baseline category for the regression.

The following regression captures the effect of anchoring under credibility and target types and is given as:

$$\begin{aligned} |\pi_{it}^{e} - \pi_{it}^{tar}| = \beta_1 * |\pi_{it-1} - \pi_{it}^{tar}| + \beta_2 * cred_{it} + \beta_3 * D_{it}^{type} + \\ \beta_4 * (cred_{it} - \overline{cred}) * (|\pi_{it-1} - \pi_{it}^{tar}| - \overline{|\pi_{t-1} - \pi^{tar}|}) * D_{it}^{type} + \varepsilon_{it} \end{aligned} \quad (7)$$

The coefficients of interest are β_1 and β_4, and the hypothesis is for the $\beta_1 > 0$ and $\beta_4 < 0$ which would mean that under various target types, anchoring of expectations improves with an increase in average credibility. All the other variables are as described before.

4. RESULTS & DISCUSSION

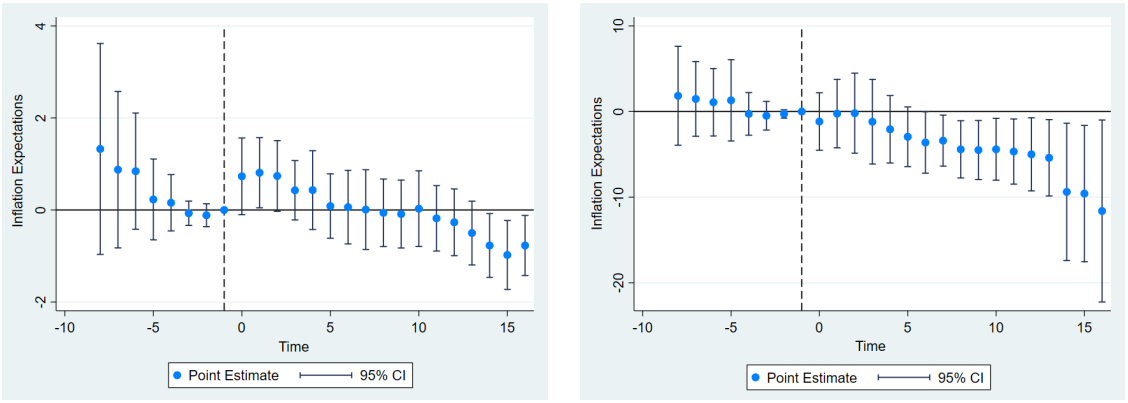
This section presents the results from the empirical exercises discussed above. The main findings are that there are differences in the reaction to inflation and expectations after the adoption of IT across AE and EMEs. The effect on anchored expectations also varies across the two types of economies. The results indicate that EMEs have better anchored expectations, and the central banks' credibility helps to improve this anchoring. Moreover, anchoring under target types and across the two sets of economies is heterogeneous.

The results from event study estimations are shown in Figure 3, where the *'Time'* axis is the event time, with each number representing a quarter, and '0' here indicates the event time (IT adoption time). The dotted vertical line one period before the event date denotes the reference period used in event study estimation. The pre-trends assumption is not violated in either of the cases. The results indicate that, after IT adoption, inflation expectations decrease persistently in EMEs after about 7 quarters (almost 2 years) of adoption. In advanced economies, there is a slight increase in inflation expectations in the second quarter post-adoption however this increase is weakly significant and does not strongly support the case.[22] Reducing inflation expectations in advanced economies takes more time (more than 3 years) compared to EMEs. Results for inflation responses around IT adoption, as shown in Appendix C Figure 11, display similar trends. Thus, inflation and inflation expectations decrease more quickly and significantly in EMEs than in AEs. The full sample (all countries) results also indicate that inflation expectations and inflation generally fall within about a year, with significant reductions observable even after 4 years. In contrast, inflation did not show a notable decrease (see Appendix C, Figure 12).

Next, I use a local projections approach to assess the long-run impact of IT adoption on expectations. The IRFs shown in Figure 4 display the response of inflation expectations to an IT adoption shock for advanced and EMEs respectively. There is evidence that expectations remained negative throughout all periods following the shock in the case of EMEs and began to exhibit an upward trend around 14 quarters later. The maximum observed is a reduction of 2 percentage points after about three years. The estimated impact is significant at several horizons, though not at all. On the other hand for AEs, expectations initially rise but then start to decline. They experience a significant decrease after about 2.5 years, reaching 0.4 percentage points below the baseline level. However, this response is only significant for a few horizons, which makes it challenging to draw a strong conclusion about the overall impact in AEs.

[22] This result is consistent with Capistrán and Ramos-Francia (2010) where they find that IT affects the dispersion of expectations only in EMEs.

Figure 3: Impact of IT adoption on inflation expectations

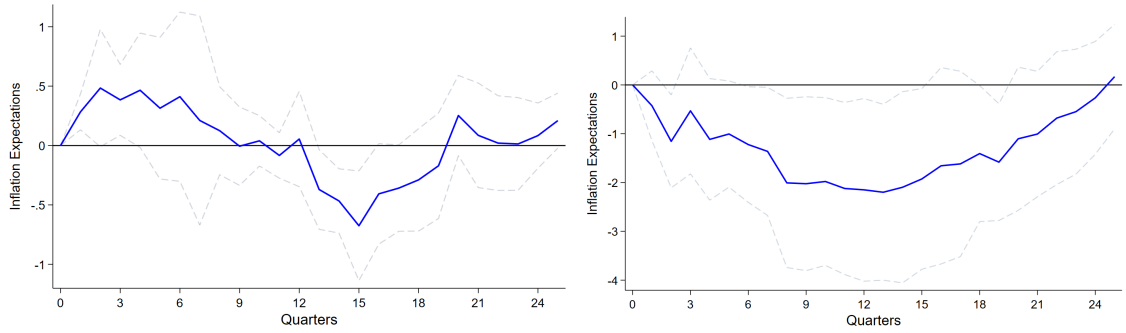


(a) Advanced Economies (b) Emerging-market Economies

Note: The blue dots are the event study coefficients from Equation 1 for inflation expectations as the outcome variable. Estimates are relative to a quarter before adopting IT indicated by the dotted vertical line. The bars around each estimate indicate a 95% confidence interval.

The same exercise was also done with inflation as the outcome variable in Equation 2, and the IRFs are shown in Appendix C Figure 17. The IRFs for inflation are similar to those from expectations. Inflation remains negative for all the horizons in the case of EMEs and is significantly different from the baseline case for most of the horizons, with the maximum impact being a fall of about 3.5 percentage points in about two years. For AEs, the effect on inflation is not statistically significantly different from zero for most of the horizons and remains significantly negative after 3 years for about a year.

Figure 4: Response of inflation expectations to an IT adoption shock



(a) Advanced Economies (b) Emerging-market Economies

Note: The solid blue line is the estimate from Equation 2 and inflation expectations as the outcome variable for horizons 0 to 24. The dotted lines are the 95% confidence interval.

The next step is to make conclusions about the anchoring of expectations in the presence of an IT framework. Using panel data regressions, the results from Equation 3 are presented in Table 1. As discussed in Section 2, we expect the coefficient on β to be close to zero (zero would mean perfect anchoring, as target inflation would equal expectations). The results

from the regression favor anchoring in both EMEs and AEs.[23] However, the results indicate that expectations are better anchored in the case of EMEs, as the coefficient is smaller than that for AEs. This result can be supported by the fact that in AEs, expectations have more stickiness to past inflation than to the target. These results are estimated from regressing the variables in level terms i.e. regression expectations on a weighted average of past inflation and the target, as Equation 27 in Appendix B.[24]

Table 1: Anchored Expectations

	EME	AE
$\lvert\pi_{it-1}$ - $\pi_{it}^{tar}\rvert$	.336***	.411***
	(.121)	(.051)
N	1177	877
R^2	0.75	0.69
Country FE	Y	Y
Time FE	Y	Y

Note: Clustered SE in parenthesis. ***p<0.01, **p<0.05, *p<0.1. F-value: 5.88. The dependent variable is absolute deviation of expectations from the target. The regression results are for Equation 3.

Table 2: Anchored Expectations and Credibility

	EME	AE
$\lvert\pi_{it-1} - \pi_{it}^{tar}\rvert$	.396**	.375**
	(.059)	(.021)
$cred_{it}$	-1.41***	-.434***
	(.461)	(.158)
Interaction (β_3)	-.226**	.027
	(.092)	(.078)
N	1177	877
R^2	0.79	0.70
Country FE	Y	Y
Time FE	Y	Y

Note: Clustered SE in parenthesis. ***p<0.01, **p<0.05, *p<0.1. The dependent variable is the absolute deviation of expectations from the target. The regression results are for Equation 4.

Now that there is evidence of anchored expectations in an IT economy, I assess whether the credibility of the central bank helps in improving anchoring across economies and use Equation 4 for this purpose. The results of the regression are presented in Table 2. The

[23] Davis (2014) also find that IT reduces the response of expectations to shocks in oil and inflation, Mehrotra and Yetman (2018) find expectations become more anchored across all IT adopting economies.

[24] These results are also present in Appendix B.

coefficient for *'cred'* is negative in both cases, which means that with increasing credibility, the absolute deviation of expectations from the target reduces when the absolute deviation of past inflation of the target is equal to its mean value. This supports that with increasing credibility, the expectations are closer to the target.

The coefficient on the interaction term is also negative, which means that with increasing credibility, the effect of the deviation of past inflation from the target on the deviation of expectations from the target becomes much smaller. In other words, the agents now give less weight to past inflation and forecast expectations close to the target, thus improving anchoring. This result holds only for EMEs and that can be seen because credibility didn't change much for AEs over time. Therefore, any additional increase in credibility doesn't help improve anchoring across AEs. However, as seen from Figure 2, credibility has shifted drastically for EMEs and thus, it affects the anchoring of expectations. The result aligns with the theory: as credibility increases, meaning economic agents have more trust or belief in the central bank, they expect the target to be met. Consequently, they align their expectations closer to the target.[25]

As discussed earlier, different target types might have various levels of impact on the anchoring of expectations. Tables 3 and 4, present results from regressions 6 and 7 respectively. The data used is the same as for previous regressions; the point target type is the baseline category for these regressions.

The results indicate heterogeneity in the effect of target type on anchoring expectations. Table 3 shows range and point-tolerance being statistically significant only in the case of EMEs. Point targets perform the best followed by point-tolerance type and range types anchor expectations the least in the case of EMEs.[26] The results are in line with the flexibility hypothesis as discussed in Ehrmann (2021). The results mean that more flexibility in terms of the target is not perceived as good and rather definite targets even with some tolerance bands provide better anchoring.[27] The results for AEs indicate that only the point-target type is statistically significant. Range and point-tolerance have no significant effect on anchoring in the case of AEs. The higher credibility and lower adoption of range or point-tolerance target types for AEs might be the reason for these results.
Table 4 presents results for anchoring in the presence of credibility and target types. These results also indicate heterogeneity in target type affecting anchoring at different levels across countries and types. The increase in credibility reduces deviation of expectations from the target i.e. increases anchoring. For EMEs, under range target type and with

[25] de Mendonça (2018), Güler (2021) also find similar results.
[26] The coefficients are also significantly different from each other according to the F-test.
[27] Though, their paper finds support in favor of the credibility hypothesis. Whereas, Grosse-Steffen (2021) finds better anchoring with point targets.

Table 3: Anchoring under Target Types

	EME	AE
$\lvert\pi_{it-1} - \pi_{it}^{tar}\rvert$	0.284***	0.345***
	(0.067)	(0.080)
range	-0.835	0.179
	(0.543)	(0.208)
point tolerance	-1.032***	-0.084
	(0.299)	(0.176)
range $\times$ $\lvert\pi_{it-1} - \pi_{it}^{tar}\rvert$	0.501***	0.069
	(0.128)	(0.148)
point tolerance $\times$ $\lvert\pi_{it-1} - \pi_{it}^{tar}\rvert$	0.396***	0.014
	(0.109)	(0.096)
N	1176	762
R^2	0.827	0.678
Country FE	Yes	Yes
Time FE	Yes	Yes

Note: Clustered Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The dependent variable is the absolute deviation of expectations from the target.
The regression results are for Equation 6

increasing credibility on average, the effect of deviation of past inflation from the target on the deviation of expectations from the target is much smaller i.e anchoring is stronger (-.623) compared to point tolerance type (-.034). Whereas, point target type with increasing credibility on average, worsens anchoring. For AEs, the results are the opposite; with increasing credibility on average, point target type improves anchoring whereas, range or point tolerance types worsen anchoring. These results indicate that as AEs have more credibility, any increase in credibility would improve anchoring under point-targets than others as the central banks have more credibility in achieving the point target rather than having range or tolerance around the point target. However, for EMEs, as there is less credibility built up, any increase in credibility only improves anchoring for range or point-tolerance cases rather than point target types. This is because agents do not believe the central bank is meeting the point target; rather agents believe they falling somewhere in a safe net of range or tolerance band.

Table 4: Anchoring and credibility under target types

	EME	AE
$\lvert\pi_{it-1} - \pi_{it}^{tar}\rvert$	0.376***	0.378***
	(0.054)	(0.053)
cred_{it}	-1.456***	-0.382**
	(0.319)	(0.146)
range	-0.339	0.221
	(0.322)	(0.176)
point tolerance	-0.565**	-0.077
	(0.214)	(0.093)
Interaction	0.254*	-1.299***
	(0.145)	(0.382)
range × Interaction	-0.999***	1.426*
	(0.200)	(0.428)
point tolerance × Interaction	-0.410**	1.312**
	(0.175)	(0.399)
Observations	1176	762
R^2	0.873	0.695
Country FE	Yes	Yes
Time FE	Yes	Yes

Note: Clustered Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The dependent variable is the absolute deviation of expectations from the target. The regression results are for Equation 7

5. ROBUSTNESS CHECKS

I ran some robustness checks for the empirical estimations discussed in the previous sections. In particular, I focus on the effect of any anticipation that the agents might have of adopting IT, the impact of central bank independence on the policy implications of adopting IT, and lastly some robustness checks related to the regression for anchoring.

5.1 Anticipation of IT adoption

One of the things to check for the correct identification of the impact of IT adoption is to assess the effect of any anticipation of the adoption being done in the future. Since the expectations used in the estimation are from professional forecasters (well-informed agents in the economy), there might be a possibility of them being aware of such a policy being adopted in the future which will impact their expectations today. To account for this, I also test for the event study using announcement dates for the adoption of IT. The dates for the announcements are collected from respective central banks (explicit public announcements or future monetary policy framework change hints in the meetings).[28]

The results from the event study exercises using announcement dates are presented in Appendix C Figures 13 and 14. They indicate no anticipation effect in the two types of economies as neither inflation nor expectations have any statistical impact. One would not expect inflation to decrease immediately after the announcement as the policy has not been implemented and thus the results made sense. However, one might expect inflation expectations to react. No reaction of the latter can be due to two reasons; either there wasn't much duration between announcement and implementation or the agents did not believe the central bank and thus made no changes to the expectations.

5.2 Central Bank independence and IT

There can be doubts about the response of inflation or expectations after IT adoption from the event study results because of other policies that intervened with IT adoption. One of the most discussed policies that might affect the central banks' monetary policy stance and thus inflation levels is the independence of the central banks. To examine this, I analyze the results from the event study for inflation and inflation expectations around the time the central banks gained independence.

None of the AEs in my sample had an episode of the central banks becoming independent

[28] For countries with no explicit announcements or hints of any future change found, I have assumed that the announcement was made in the quarter preceding the adoption implementation.

post-IT adoption. On the other hand, about six EMEs had independent central banks post IT adoption.[29] I use the time of central bank independence as event time and the results from event study estimations are shown in Figure 15 and Figure 16 in Appendix C. The results for AE have no change even after using the independence timing. The response for inflation is insignificant for all quarters and expectations rise after six quarters. There is also no response to central bank independence for inflation and inflation expectations for EMEs. Thus, these results do not affect those for IT adoption in either AEs or EMEs.

5.3 Weighted regression variables

Next, I use squared deviations for both dependent and independent variables which put a large weight on large deviations.

$$|\pi^e_{it} - \pi^{tar}_{it}|^2 = \beta * |\pi_{it-1} - \pi^{tar}_{it}|^2 + \alpha_i + \gamma_t + \varepsilon_{it} \tag{8}$$

Table 5: Anchored Expectations

	EME	AE
$\lvert\pi_{it-1} - \pi^{tar}_{it}\rvert$	.268**	.320***
	(.085)	(.083)
N	1177	877
R^2	0.56	0.58
Country FE	Y	Y
Time FE	Y	Y

Note: Clustered SE in parenthesis. ***p<0.01, **p<0.05, *p<0.1. F-value: 5.88. The dependent variable is absolute deviation of expectations from the target. The regression results are for Equation 8.

The results from weighted regression are also similar to that for Equation 3 which indicate that both the economies have anchored expectations but EMEs have better anchoring.

The same analysis was also done for the regression with credibility and the following regression was estimated for which the results are shown in Table 6.

$$|\pi^e_{it}-\pi^{tar}_{it}|^2 = \beta_1*|\pi_{it-1}-\pi^{tar}_{it}|^2+\beta_2*cred_{it}+\beta_3*(cred_{it}-\overline{cred})*(|\pi_{it-1}-\pi^{tar}_{it}|^2-\overline{|\pi_{t-1}-\pi^{tar}|^2})+\varepsilon_{it} \tag{9}$$

The results from Table 6 are consistent with those from Table 2. The interaction term is

[29] These are Brazil, Chile, Mexico, Paraguay, Peru, Philippines. Thailand and Uruguay do not have an independent central bank.

negative only for EMEs indicating that increasing credibility improves anchoring of expectations only in EMEs and has no effect in AEs. The credibility coefficient is negative which means that as credibility increases, the squared deviation of expectations from the target reduces when the squared deviation of past inflation from the target equals its mean. In other words, with increasing credibility, even the squared expectations are closer to the squared target value.

Table 6: Anchored Expectations and Credibility

	EME	AE
$\lvert\pi_{it-1} - \pi_{it}^{tar}\rvert^2$	.284**	.268***
	(.143)	(.027)
cred_{it}	-5.31***	-1.09***
	(1.25)	(.262)
Interaction (β_3)	-1.06**	.077
	(.053)	(.073)
N	1177	877
R^2	0.72	0.69
Country FE	Y	Y
Time FE	Y	Y

Note: Clustered SE in parenthesis. ***p<0.01, **p<0.05, *p<0.1. The dependent variable is the absolute deviation of expectations from the target. The regression results are for Equation 9.

These robustness checks support the claim made in the paper that the adoption of IT had a greater effect on expectations and inflation in EMEs compared to AEs. The timing of adoption does not significantly affect the results, as the anticipation of adoption has a negligible impact. Additionally, the independence of the central bank does not alter these findings. The results for the anchoring of expectations, obtained from the weighted regression variables, are consistent with the main results of the study.

6. MODEL

In this section, I discuss the model I use to address the questions that the empirical estimates could not fully assess. Understanding the pace of inflation and expectations is crucial for converging to the target inflation in an IT-adopting economy after any shock. Additionally, examining the effect of different levels of credibility and scenarios in EMEs and AEs is vital for understanding the impact of IT on anchoring expectations. This analysis will also help to explore the channels through which expectations are anchored.[30]

[30]The channels here mean whether expectations are 'shock' or 'level' anchored. For details on the two kinds of anchoring, see Ball and Mazumder (2011) among others.

I use the NK model with non-rational expectations and imperfect credibility for an IT-adopting economy to assess the behavior of anchored expectations in such an economy. In the baseline model, I build upon the work of Alichi et al. (2009) by using different expectation formation processes. In the extended model, I introduce the signaling problem for target inflation as in Ascari et al. (2017). The three shocks in the economy-TFP, Moenatry policy, and credibility-have different implications for inflation and output. I demonstrate how a credibility shock affects expectations and, consequently, inflation. Additionally, I extend the model to include countries without an IT regime, comparing the response of economies with dual vs those with a single mandate for monetary policy.

6.1 Households

A representative infinitely lived household whose utility is given as:

$$E_0 = \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \frac{N_t^{1+\theta}}{1+\theta} \right] \tag{10}$$

where C_t is the consumption, N_t denotes hours worked. Parameter $\beta \in (0,1)$ is the discount factor, $\sigma \geq 0$ is the curvature of the utility of consumption and $\theta \geq 0$ is the curvature of the dis-utility of labor or the Frisch labor supply elasticity. E is the expectational operator and for simplicity, I assume that households have full information.
C_t is the consumption index and is a Dixit-Stiglitz aggregator given by:

$$C_t = \left(\int_0^1 C_t(i)^{1-\frac{1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}}$$

where C_{it} is the consumption of each variety i in period t and $\epsilon > 1$ is the elasticity of substitution between varieties. The households are subject to the following budget constraint:

$$P_t C_t + (1+i_t)^{-1} B_t \leq B_{t-1} + W_t N_t + D_t \tag{11}$$

where P_t is the price of the consumption good, W_t is the nominal hourly wage. B_t is the quantity of one-period nominal risk-less discount bond purchased in period t for the nominal interest rate of i_t. D_t represents the dividends, conditional on the households of the firms' owners.

In addition to the consumption, labor, and savings decisions, the household has to decide how to allocate consumption across different goods. The latter is done by maximizing the consumption bundle C_t subject to the consumption budget. The demand equation for each variety i is given as:

$$C_{it} = \left(\frac{P_{it}}{P_t}\right)^{-\epsilon} C_t \tag{12}$$

for all $i \in [0,1]$, where $P_t = \left(\int_0^1 P_t(i)^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}}$ is an aggregator price index.

6.2 Firms

The final good Y_t is produced with a continuum of intermediates goods $Y_t(i)$ indexed by i ∈ [0,1] and is given by:

$$Y_t = \left(\int_0^1 Y_t(i)^{\frac{\epsilon-1}{\epsilon}} di\right)^{\frac{\epsilon}{\epsilon-1}}$$

Intermediate inputs $Y_t(i)$ are produced using labor adnd technology:

$$Y_t(i) = N_t(i) \tag{13}$$

where technology, $lnA_t = a_t$, is an exogenous productivity shock which follows and AR(1) process:

$$a_t = \rho_a a_{t-1} + \sigma_a \epsilon_{a,t} \tag{14}$$

Following Rotemberg (1982), the model assumes that a monopolistic firm faces a quadratic cost of adjusting nominal prices, measured in terms of final good, given as:

$$\frac{\psi}{2}\left(\frac{P_{i,t}}{P_{i,t-1}} - 1\right)^2 Y_t \tag{15}$$

where ψ determines the degree of nominal price rigidity that accounts for the negative effects of price changes. These effects increase with the size of price change and with Y_t.

Thus, the firm maximizes the problem given as :

$$\max_{P_t^*|_0^\infty} E_t x_{t,t+j}\left(\left(\frac{P_{i,t}}{P_{i,t-1}} - \mathcal{C}_{t+j}\right) Y_{t,t+j} - \frac{\psi}{2}\left(\frac{P_{i,t}}{P_{i,t-1}} - 1\right)^2 Y_{t+j}\right) \tag{16}$$

s.t:

$$Y_{i,t+j} = \left(\frac{P_{i,t}}{P_{i,t-1}} - 1\right)^{-\varepsilon} Y_{t+j} \tag{17}$$

where, $x_{t,t+j}$ is the stochastic discount factor and $\mathcal{C}_{t+j}$ is the real marginal cost of the firm. Firms can change their prices each period, subject to payment of adjustment costs. Thus,

all firms face the same problem i.e. choosing the same price, thus producing the same quantity.
The rest of the optimization conditions are shown in Appendix D.

6.3 Expectations and credibility

As we saw from the empirical analysis the central banks' credibility plays an important role in an economy with IT. This makes it critical to examine how agents form expectations. For this reason, I deviate from rational expectations, assuming that agents have limitations and that they use simple rules (heuristics) to forecast the future.[31] There are many options in the non-rational expectations model however, I choose the ones explained below. The agents in the model choose from two rules, model consistent expectations or the lagged inflation expectations (naive expectations).

$$\tilde{E_{1,t}}\pi_{t+1} = E_t^M \pi_{t+1}$$

$$\tilde{E_{2,t}}\pi_{t+1} = \pi_{t-1}$$

The first rule sets expected inflation equal to the model-consistent expectations (forward-looking component) whereas, the second rule is the last period inflation (backward-looking component) that the agents have already observed. These different predictors make it possible for the agent to switch/choose and this switching generates changes in how shocks are propagated in the model.

The market expectations are a weighted average of these expectations and the weight is a measure of the stock of credibility. Thus,

$$E_t\pi_{t+1} = \mu_t * E_t^M \pi_{t+1} + (1 - \mu_t) * \pi_{t-1} \tag{18}$$

This credibility stock in the model evolves in a way where it depends on the last period's credibility stock and the credibility flow today and is given as:

$$\mu_t = \rho\mu_{t-1} + (1 - \rho)cred_t + \varepsilon_{\mu,t} \tag{19}$$

An increase in $cred_t$ which means that credibility is increasing, is a situation when the agents will believe in the central bank's ability to bring inflation down and thus result in a rise in the weight of the forward-looking component. Hence, the weight on the first term. On the other hand, when credibility is low, agents will lack faith in the monetary policies' ability to match the inflation target. Consequently, agents will forecast expectations based on the previous inflation rather than model-consistent expectations.

[31] Similar cases are discussed in De Grauwe (2012), Brazier et al. (2018) amongst others.

Substituting these expectations back into the NKPC gives us the imperfect credibility NKPC :

$$\pi_t = \beta(\mu_t * E_t^M \pi_{t+1} + (1 - \mu_t) * \pi_{t-1}) + \kappa \tilde{y}_t \tag{20}$$

Under perfect credibility, Equation 20 becomes the rational expectations NKPC (given by Equation 40 in the appendix).

The equivalent imperfect credibility IS curve would be:

$$\tilde{y}_t = -\frac{1}{\sigma}(i_t - (\mu_t * E_t^M \pi_{t+1} + (1 - \mu_t) * \pi_{t-1}) + r_t^n) + E_t \tilde{y}_{t+1} \tag{21}$$

6.4 Closing the model

The model is closed by the monetary policy rule set by the monetary authority which will have the following type of reaction function:

$$i_t = \bar{i}(\pi_t/\bar{\pi})^{\phi_\pi}(Y_t/\bar{Y})^{\phi_Y}\eta_t \tag{22}$$

I assume that the monetary policy shock and the credibility shock, like productivity shock, follow AR(1) processes:

$$ln\eta_t = \rho_\eta ln\eta_{t-1} + \sigma_\eta \epsilon_{\eta,t} \tag{23}$$

$$ln\mu_t = \rho_\mu ln\mu_{t-1} + \sigma_\mu \epsilon_{\mu,t} \tag{24}$$

The goods and labor market equilibrium conditions are described below. The goods market equilibrium for each variety is:

$$Y_t(i) = C_t(i) \tag{25}$$

Labor market clearing requires:

$$N_t = \int_0^1 N_t(i)di = \int_0^1 \left(\frac{y_t(i)}{A_t}\right)^{\frac{1}{1-\alpha}} di \tag{26}$$

The equations comprising the non-linear model used in the analysis are listed in Table 11 of Appendix E.

7. QUANTITATIVE ANALYSIS

In this section, I simulate the model to generate the responses of various macro variables under different scenarios, distinguishing between different credibility levels across a representative economy. I examine the model under both exogenous and endogenous credibility scenarios. The parameters used are borrowed from the literature and are listed in Appendix E.

7.1 Exogenous credibility

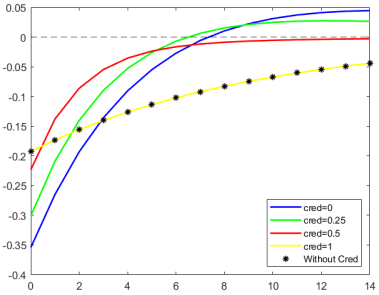
As a first step in quantifying the model, I consider constant exogenous credibility. Varying levels of credibility, ranging from 0 to 1, are examined to assess the economy's response to an expansionary TFP shock and a contractionary monetary policy shock. The results discussed below pertain to a representative economy.

Figure 5 shows the response to a one percent increase in technology. The black dots represent the economy without credibility, while the yellow line represents the IRFs for the full credibility case. As discussed above, in the full credibility scenario, the imperfect-credibility NKPC aligns with the standard NKPC, and the model converges to the standard NK model. The responses from the two cases overlap because Equations 20 and 21 converge to the standard NKPC and IS curve, respectively, under full credibility. In these cases, a positive TFP shock reduces both inflation and the output gap. Although output increases with a positive TFP shock, the output gap decreases because the natural level of output also rises. The nominal interest rate decreases due to reduced inflation, affecting the central bank's response to the shock. The real rate also declines as a result of lower inflation and the reduced nominal rate.

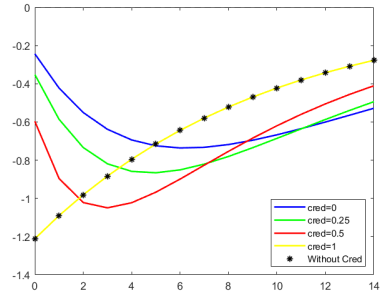
The responses for credibility levels less than one are represented by red (0.5 credibility), green (0.25 credibility), and blue (no/least credibility) respectively. There is a hump/inverted-U shape for these cases due to the spillover from the lagged inflation term in the expectations formation process that feeds into the imperfect credibility NKPC and the IS curves respectively. The overall response of the shock is the same as the standard model for these three cases, with slight changes. In the case of 50% credibility (red line), a positive TFP shock reduces the output gap; however, the output gap reduces more than the full credibility case. The convergence of the output gap to the potential is not as smooth; it increases in the short run and stays constant afterward. Inflation falls less as compared to the full credibility case in the first period but experiences a persistent reduction in the short run. Once the spillover from past inflation is negligible, inflation experiences a persistent increase. A similar pattern is observed for the nominal rate which reduces after

the shock as inflation falls.

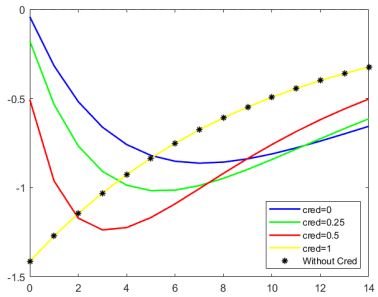
Figure 5: Response to a positive TFP shock



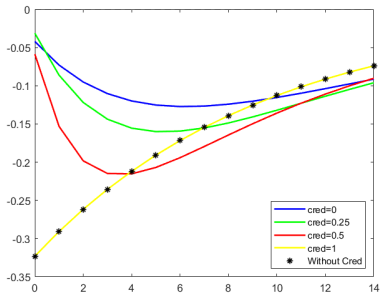
(a) Output Gap



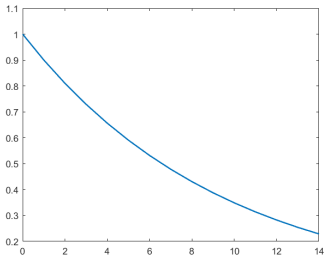
(b) Inflation



(c) Nominal Interest Rate



(d) Real Interest Rate



(e) TFP

Note: The impulse responses shown here are for different levels of credibility to a positive TFP shock. All graphs shown are in terms of percentage points. The responses of inflation, nominal, and real rates are in annualized terms.

In the two cases with less than 0.5 credibility, the impacts are much smaller. The response of the output gap to the shock results in a smaller reduction than in the 0.5 credibility case, but as the shock fades, the output gap increases, even resulting in an overshoot. This is due to the lagged inflation spillover from the expectations formation process. The initial response of inflation when the shock hits is minimal due to the spillover from the lagged inflation; however, in the long run, inflation persistently falls, as indicated by green and blue lines. The scenario with the least credibility (blue line) reflects a situation where expectations are influenced by naive forecasters and thus determined solely by past infla-

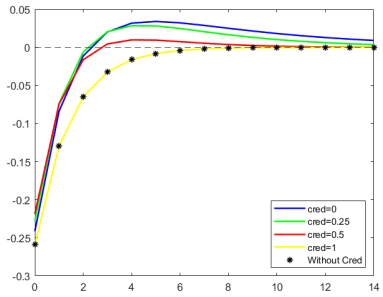
tion. In this case, the output gap decreases the most in the first period and overshoots the most in the long run, indicating excess output in low credibility scenarios. Inflation in this case doesn't decrease much initially but shows the most significant reduction in the long run. Thus, with increasing credibility, the output gap falls less, and although inflation decreases more in the short run, it rises more quickly and persistently in the long run. Nominal and real rates follow a similar pattern to inflation.

The response to a contractionary monetary policy shock (an increase of 25 basis points in the ϵ_ν) is shown in Figure 6. The response of inflation, nominal rates, and real rates are expressed in annualized terms. The responses from the case with full credibility overlap with those of the standard NK model, even for the monetary policy shock. In both cases, the shock leads to a decrease in inflation and the output gap. The nominal rate increases by less than the shock due to downward adjustment from inflation and the output gap. The real rate increases more than the nominal rate due to reduced inflation and rising nominal rate. As mentioned earlier, the responses overlap because Equation 20 and Equation 21 converge to the standard NKPC and IS, respectively, in the case of full credibility.

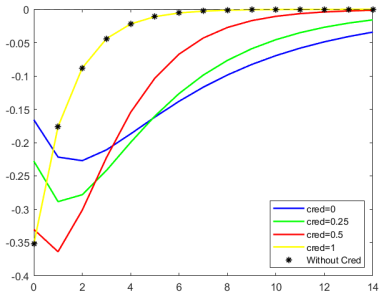
The responses in cases where credibility is less than one show slight differences. This variation arises due to the spillover from the lagged inflation term in the expectations formation process, which influences the other model equations. In the case of 50% credibility (red line), a contractionary monetary policy shock reduces the output gap less than in the full credibility case in the same period as the shock. However, the output gap eventually increases, becomes positive in the medium run, and converges to its potential in the long run. The response of inflation is negative and slightly higher than the standard model case. It continues to decline due to the influence of lagged inflation but experiences a persistent increase afterward. The nominal interest rate initially rises more than in the case of full credibility and dips below zero for some periods due to downward pressure from decreasing inflation. It eventually rises as inflation starts to increase and converges to zero. The real rate increases more than the nominal as inflation falls, similar to the full credibility case.

The cases with 0.25 and 0 credibility show much higher responses for inflation in the first period. As the effect of the shock persists, inflation increases but remains negative even in the long run. The output gap initially falls but becomes positive in the long run, indicating that with lower credibility, there is more output production in the economy. With the output gap increasing and falling inflation, the nominal rate decreases. There is a persistent decrease, with the rate even becoming negative due to output gap overshooting and falling inflation in the short run. The real rate increases in both cases, rising the most for the case with zero credibility.

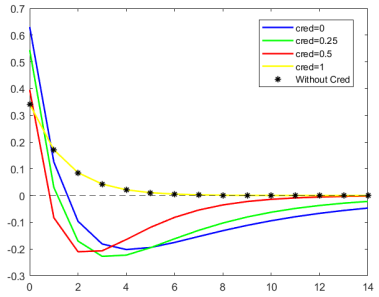
Figure 6: Response to a contractionary monetary policy shock



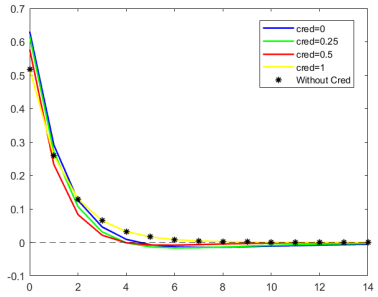
(a) Output Gap



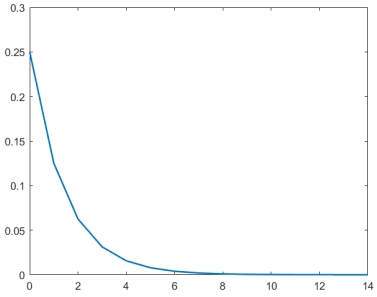
(b) Inflation



(c) Nominal Interest Rate



(d) Real Interest Rate



(e) ν

Note: The impulse responses shown here are for different levels of credibility to a positive TFP shock. All graphs shown are in terms of percentage points. The responses of inflation, nominal, and real rates are in annualized terms.

In summary, as credibility increases, the output gap decreases more, reducing or eliminating the overproduction of output in the economy. Inflation falls sharply in the first period and continues to decline in the short run, but it rises more rapidly later. As the credibility decreases, the nominal rate increases more in the first period, eventually falling and turning negative when credibility is less than one. Conversely, the real rate rises as credibility decreases.

These results support the claim that central bank credibility is crucial for an economy, as evidenced by the responses under different levels of credibility. The responses would be different between AE and EME due to their distinct initial conditions for various variables.

7.2 Endogenous credibility

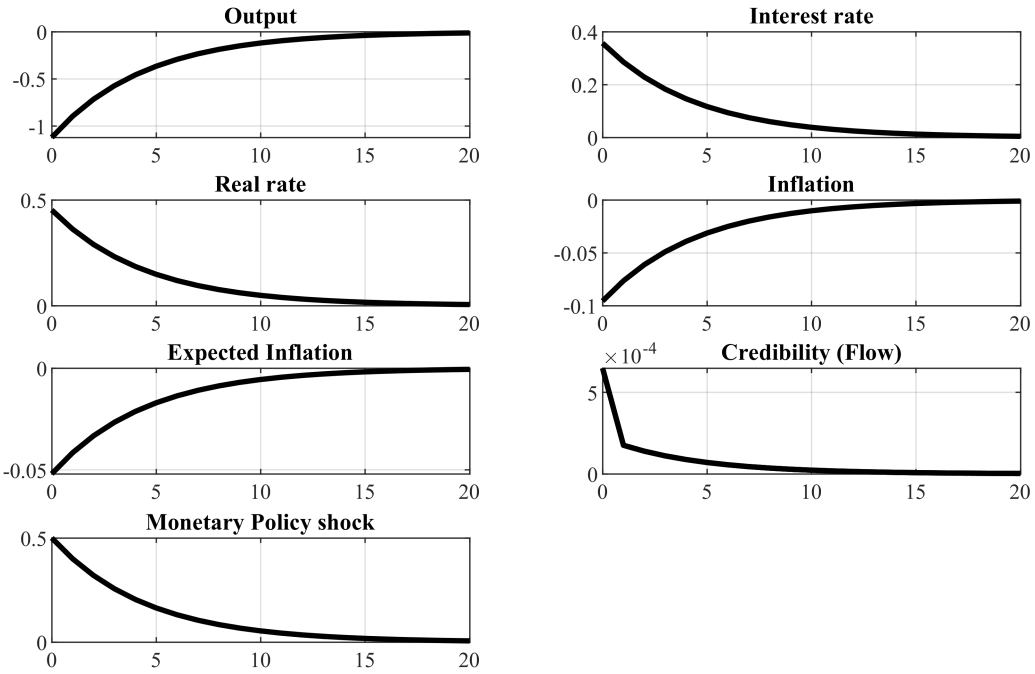
Next, I endogenize the credibility process and solve the model to track the responses of inflation expectations, the credibility parameter, and other variables to different shocks. In addition to the TFP and monetary policy shock, a shock to the credibility stock is also included in the model with endogenous credibility. The results discussed below pertain to a representative economy, with the parameter values specific to the credibility parameter and credibility stock drawn from the literature and listed in Appendix E.

Figure 7 shows the response to contractionary MP shock (50 basis points increase in ϵ_ν). In response to the shock, the credibility flow in the current period increases, reflecting agents' belief in the central banks' ability to bring down inflation. This is evident from the negative relationship between inflation and credibility. As credibility rises, expected inflation decreases, leading to a decline in actual inflation. It falls less than the actual inflation due to the lagged effect of expectation formation and also due to speculation effects about the policy. With inflation and output decreasing after the shock, there is downward pressure on the nominal interest rate, which rises less than the shock itself. The real interest rate rises more than the nominal rate as inflation decreases and the nominal rate increases. Both inflation and output return to baseline levels rather quickly, indicating the models' ability to offset the unfavorable monetary policy with relatively little difficulty. This is the result of the agents' inflation expectations being reasonably anchored to the target, as can be inferred from the response of expected inflation to the shock.

The responses to a positive technology shock are also consistent with the theory, as shown in Figure 8. The shock increases output and decreases inflation expectations and inflation. The nominal interest rates decrease due to reduced inflation. Lower inflation and nominal interest rates also lead to a decline in the real rate. In response to the positive technology shock, the credibility flow increases slightly, reflecting agents' belief in the central banks' ability to boost growth in the economy without bringing in slackness through higher inflation. Expected inflation falls as credibility in the economy increases with the shock. However, the expectations anchoring is lower than in the case of MP shock, as the model does not offset the response of inflation and output as quickly. This is because agents take time to anchor their expectations to the target as seen from the response of expected inflation.

The responses to a 50 basis point increase in the stock of credibility are shown in Figure 9. Expected inflation in the model falls as the stock of credibility increases, but the increase

Figure 7: Response to a contractionary MP shock

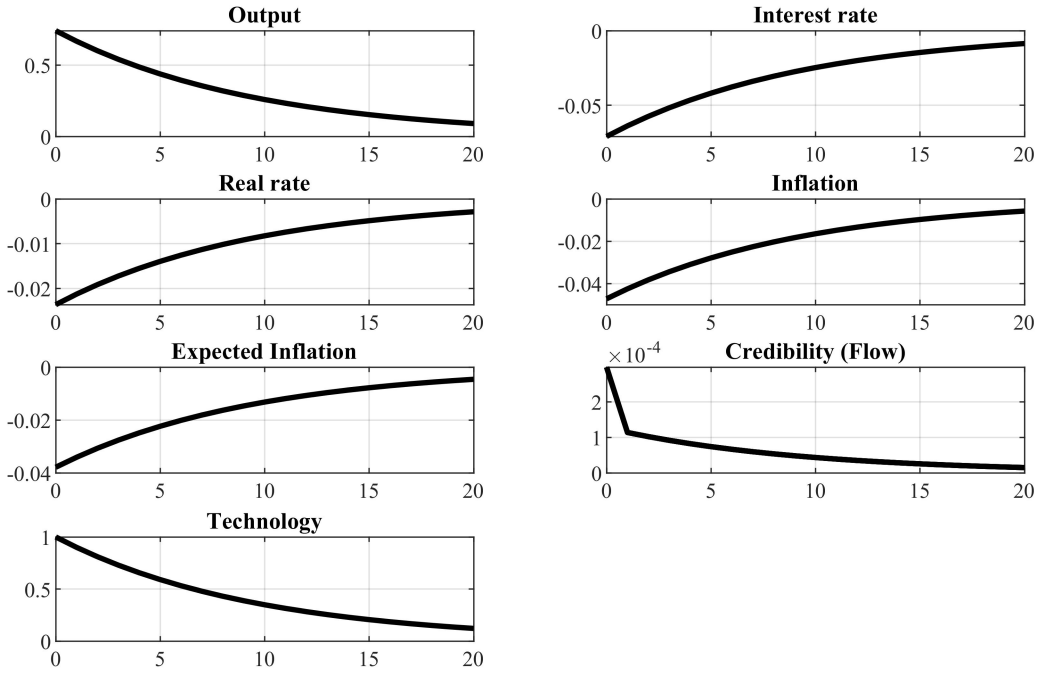


Note: The impulse responses shown here are from the model with endogenous credibility for a contractionary MP shock. All graphs shown are in terms of percentage points.

is smaller than the shock itself due to the influence of past inflation. With a higher stock of credibility in the economy, agents' expectations are most strongly anchored to the target, and thus inflation and output return to baseline levels rather quickly. This indicates the ease with which an economy with higher credibility to offset the impact of the shock. Inflation decreases in response to the shock, leading to a decrease in the nominal interest rate. This also reflects that with a higher stock of credibility in the economy, central banks do not need to raise nominal interest rates to maintain stable inflation. As both inflation and the nominal rate fall, the real interest rate also declines. As inflation falls, agents' belief in the central bank's intentions is strengthened, resulting in an increase in credibility in the current period. The inverse relationship between credibility and inflation is observed even with this shock. An increase in the stock of credibility suggests a strong image of the central bank and thus the trust in them to control inflation. The lower inflation and inflation expectations lead agents to speculate lower nominal wage growth in the future, thus reducing spending today to save more. This leads to less demand and thus the output in the economy falls.

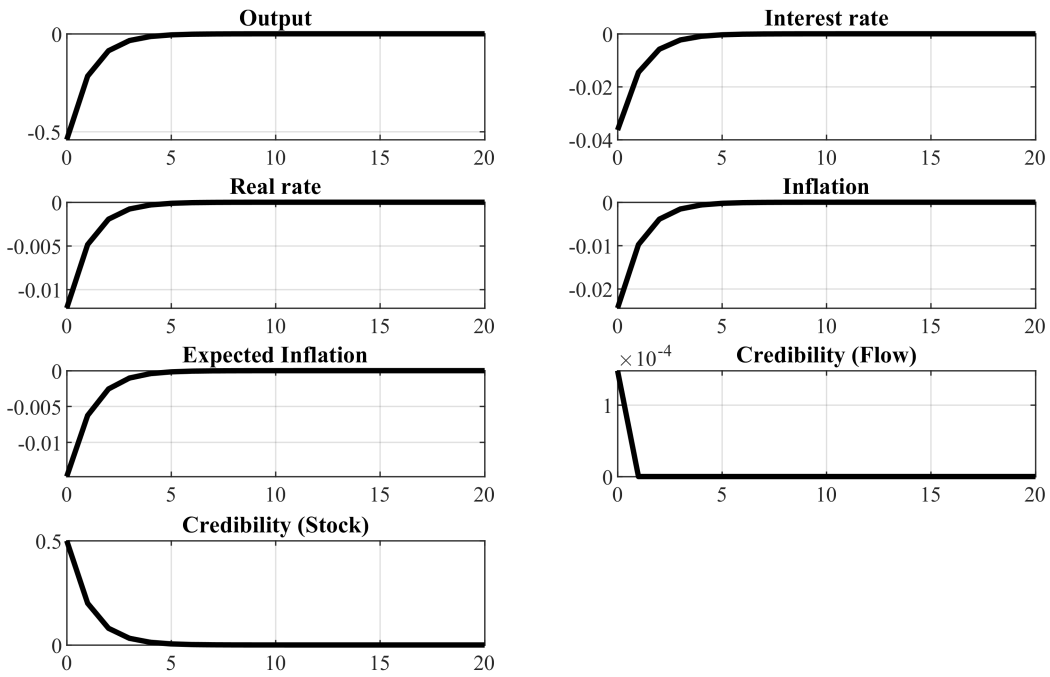
"This sub-section is incomplete. There are more things to be added."

Figure 8: Response to a positive TFP shock



Note: The impulse responses shown here are from the model with endogenous credibility for a positive TFP shock. All graphs shown are in terms of percentage points.

Figure 9: Response to a positive credibility shock



Note: The impulse responses shown here are from the model with endogenous credibility for a positive credibility shock. All graphs shown are in terms of percentage points.

8. CONCLUSION

This paper investigates the effect of IT on anchoring of expectations and addresses the question of whether IT has effectively helped in anchoring expectations along with understanding the role of central bank credibility in enhancing the anchoring. The paper finds that IT has been effective in lowering expectations in EMEs but has had a less significant impact on AEs. The anchoring of expectations to the target is also stronger in EMEs than in AEs. Additionally, improved central bank credibility enhances the anchoring of expectations more effectively in EMEs but does not affect AEs. The paper finds heterogeneous effects of target types on the level of anchoring even with credibility across economies. The model also indicates that different levels of credibility elicit different reactions to the same shock. Moreover, there is a negative relationship between credibility and inflation, highlighting the crucial role of central bank credibility in bringing down inflation. The effect is transmitted through the inflation expectations, which, as seen from the IRFs, are anchored to the target. The results emphasize that to stabilize inflation, expectations must be closely anchored, and these expectations are influenced by credibility.

Therefore, central banks in the EMEs implementing this framework need to improve their credibility to better anchor expectations, which will help stabilize inflation. However, agents in AEs tend to rely more on past inflation levels than on the target level when forecasting expectations. Central banks in AEs need to focus on convincing agents of the importance of the target inflation, and this objective needs to be communicated clearly.

As for the next steps, I am analyzing the model under different parameters to differentiate between AE and EME. I am also working on the model to assess economies without an IT regime to understand the requirements for transitioning to an IT framework. Additionally, the model will be used to compare the economy's response under a single mandate versus a dual mandate. This model could thus serve as a tool for quantitative research on economies that are either planning to adopt IT or have already done so.

References

Alichi, A., Chen, H., Clinton, K., Freedman, C., Kamenik, O., Kisinbay, T., and Laxton, D. (2009). Inflation targeting under imperfect policy credibility. *IMF Working Paper*.

Ascari, G., Florio, A., and Gobbi, A. (2017). Transparency, expectations anchoring and inflation target. *European Economic Review*, 91:261–273.

Ascari, G. and Ropele, T. (2009). Trend inflation, taylor principle, and indeterminacy. *Journal of Money, Credit and Banking*, 41(8):1557–1584.

Ball, L. M. and Mazumder, S. (2011). Inflation dynamics and the great recession. Technical report, National Bureau of Economic Research.

Ball, L. M. and Sheridan, N. (2004). Does inflation targeting matter? In *The inflation-targeting debate*, pages 249–282. University of Chicago Press.

Balli, H. O. and Sørensen, B. E. (2013). Interaction effects in econometrics. *Empirical Economics*, 45:583–603.

Bems, R., Caselli, F., and Grigoli, F. (2021). Expectations' anchoring and inflation persistence. *Journal of International Economics*, 32:1–22.

Bernanke, Posen, A. S. V., Laubach, T., and Mishkin, F. S. (1998). *Inflation targeting: lessons from the international experience*. Princeton University Press.

Binder, C. (2017). Fed speak on main street: Central bank communication and household expectations. *Journal of Macroeconomics*, 52:238–251.

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

Bomfim, A. N. and Rudebusch, G. D. (2000). Opportunistic and deliberate disinflation under imperfect credibility. *Journal of Money, Credit and Banking*, pages 707–721.

Bordo, M. D. and Siklos, P. L. (2017). Central bank credibility before and after the crisis. *Open Economies Review*, 28:19–45.

Brazier, A., Harrison, R., King, M., and Yates, T. (2018). The danger of inflating expectations of macroeconomic stability: Heuristic switching in an overlapping-generations monetary model. *Thirteenth issue (June 2008) of the International Journal of Central Banking*.

Buono, I. and Formai, S. (2016). The evolution of the anchoring of inflation expectations. *Bank of Italy Occasional Paper*, (321).

Capistrán, C. and Ramos-Francia, M. (2010). Does inflation targeting affect the dispersion of inflation expectations? *Journal of Money, Credit and Banking*, 42(1):113–134.

Carvalho, C., Eusepi, S., Moench, E., and Preston, B. (2023). Anchored inflation expectations. *American Economic Journal: Macroeconomics*, 15(1):1–47.

Castelnuovo, E., Nicoletti Altimari, S., and Rodriguez-Palenzuela, D. (2003). Definition of price stability, range and point inflation targets: The anchoring of long-term inflation expectations. *Range and Point Inflation Targets: The Anchoring of Long-Term Inflation Expectations (September 2003)*.

Coibion, O. and Gorodnichenko, Y. (2015). Information rigidity and the expectations formation process: A simple framework and new facts. *American Economic Review*, 105(8):2644–2678.

Cukierman, A. and Meltzer, A. H. (1986). A theory of ambiguity, credibility, and inflation under discretion and asymmetric information. *Econometrica: journal of the econometric society*, pages 1099–1128.

Davis, J. S. (2012). Inflation expectations have become more anchored over time. *Economic Letter*, 7.

Davis, J. S. (2014). *Inflation targeting and the anchoring of inflation expectations: Cross-country evidence from consensus forecasts*, volume 174. Federal Reserve Bank of Dallas Dallas, TX.

De Grauwe, P. (2012). *Lectures on behavioral macroeconomics*. Princeton University Press.

de Mendonça, H. F. (2018). Credibility and inflation expectations: What we can tell from seven emerging economies? *Journal of Policy Modeling*, 40(6):1165–1181.

Ehrmann, M. (2014). Targeting inflation from below-how do inflation expectations behave? Technical report, Bank of Canada Working Paper.

Ehrmann, M. (2021). Point targets, tolerance bands or target ranges? inflation target types and the anchoring of inflation expectations. *Journal of International Economics*, 132:103514.

Erceg, C. J. and Levin, A. T. (2003). Imperfect credibility and inflation persistence. *Journal of monetary economics*, 50(4):915–944.

Evans, G. W. and Honkapohja, S. (2001). *Learning and expectations in macroeconomics*. Princeton University Press.

Gonçalves, C. E. S. and Salles, J. M. (2008). Inflation targeting in emerging economies: What do the data say? *Journal of Development Economics*, 85(1-2):312–318.

Goodfriend, M. and King, R. G. (2005). The incredible volcker disinflation. *Journal of Monetary Economics*, 52(5):981–1015.

Grosse-Steffen, C. (2021). Anchoring of inflation expectations: Do inflation target formulations matter?

Güler, A. (2021). Does monetary policy credibility help in anchoring inflation expectations? evidence from six inflation targeting emerging economies. *Journal of Central Banking Theory and Practice*, 10(1):93–111.

Gürkaynak, R. S., Levin, A., and Swanson, E. (2010). Does inflation targeting anchor long-run inflation expectations? evidence from the us, uk, and sweden. *Journal of the European Economic Association*, 8(6):1208–1242.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American economic review*, 95(1):161–182.

Kalemli-Özcan, nd Unsal, F. D. (2024). Global transmission of fed hikes: The role of policy credibility and balance sheets. Technical report, National Bureau of Economic Research.

Kose, M. A., Matsuoka, H., Panizza, U., and Vorisek, D. (2019). Inflation expectations: review and evidence.

Kumar, S., Afrouzi, H., Coibion, O., and Gorodnichenko, Y. (2015). Inflation targeting does not anchor inflation expectations: Evidence from firms in new zealand. *Brookings Papers on Economic Activity*, 2015(2):151–225.

Levin, A. T., Natalucci, F. M., Piger, J. M., et al. (2004). The macroeconomic effects of inflation targeting. *Review-Federal Reserve Bank of Saint Louis*, 86(4):51–8.

Łyziak, T. and Paloviita, M. (2017). Anchoring of inflation expectations in the euro area: recent evidence based on survey data. *European Journal of Political Economy*, 46:52–73.

Mankiw, N. G., Reis, R., and Wolfers, J. (2003). Disagreement about inflation expectations. *NBER macroeconomics annual*, 18:209–248.

Mehrotra, A. and Yetman, J. (2018). Decaying expectations: What inflation forecasts tell us about the anchoring of inflation expectations. *56th issue (December 2018) of the International Journal of Central Banking*.

Moessner, R. and Takáts, E. (2020). How well-anchored are long-term inflation expectations?

Neuenkirch, M. and Tillmann, P. (2014). Inflation targeting, credibility, and non-linear taylor rules. *Journal of International Money and Finance*, 41:30–45.

Rotemberg, J. J. (1982). Sticky prices in the united states. *Journal of political economy*, 90(6):1187–1211.

Strohsal, T., Melnick, R., and Nautz, D. (2016). The time-varying degree of inflation expectations anchoring. *Journal of Macroeconomics*, 48:62–71.

Unsal, D. F., Papageorgiou, C., and Garbers, H. (2022). Monetary policy frameworks: an index and new evidence.

Walsh, C. E. (2009). Inflation targeting: what have we learned? *International Finance*, 12(2):195–233.

A: Data

Table 7: Countries and data description

Country	Implementation year	Inflation 3 years before IT adoption	Inflation 1 year before IT adoption	Inflation 1 year after IT adoption	Inflation 3 years after IT adoption
Advanced Economies					
Australia	April 1993	7.73	1.84	1.18	3.09
Canada	February 1991	4.08	5.42	1.58	0.54
Czech Republic	January 1998	9.32	7.16	3.07	4.04
Israel	January 1992	20.66	18.34	11.09	13.10
Japan	January 2013	-0.85	0.31	1.52	0.03
New Zealand	March 1990	18.29	4.01	4.52	0.96
Norway	March 2001	2.15	2.89	1.03	-1.42
South Korea	January 1998	4.75	4.69	0.70	3.69
Sweden	January 1995	3.38	1.64	1.44	0.54
Switzerland	January 2000	0.73	0.27	1.01	1.01
United Kingdom	October 1992	5.82	6.44	2.52	3.01
United States	January 2012	-0.04	2.14	1.68	-0.06
Emerging Market Economies					
Brazil	June 1999	17.61	3.73	6.58	7.80
Chile	January 1991	18.96	23.41	18.67	13.35
Colombia	September 1999	21.09	19.00	9.19	6.03
Hungary	June 2001	15.30	9.16	5.47	7.33
India	October 2016	10.57	5.33	4.55	5.86
Mexico	January 2001	15.29	10.54	4.74	4.32
Paraguay	May 2011	12.28	4.77	3.67	6.58
Peru	January 2002	7.74	3.68	2.82	2.91
Philippines	January 2002	7.39	5.83	2.10	7.24
Poland	January 1999	20.57	13.57	10.06	3.56
Russia	January 2015	3.86	6.38	8.34	2.25
South Africa	February 2000	9.61	8.46	7.42	8.28
Thailand	April 2000	4.29	-0.44	2.48	1.67
Türkiye	January 2001	99.27	68.82	70.32	26.53
Ukraine	January 2016	-0.47	36.35	13.93	8.86
Uruguay	June 2007	29.22	6.44	7.57	6.87

Note: Full Period - 1980Q1: 2023Q2. Classification of countries is done according to the IMF.
Source: IMF and Central Bank websites.

Table 8: Countries, Targets and Target Types

Country	Target Type	Point Target	Lower Band	Upper Band
Advanced Economies				
Australia	Range		2	3
Canada	Point Tolerance	2	1	3
Czech Republic	Point Tolerance	2	1	3
Israel	Range		1	3
Japan	Point	2		
New Zealand	Range		1	3
Norway	Point	2		
South Korea	Point	2		
Sweden	Point	2		
Switzerland	Range		-	2
United Kingdom	Point	2		
United States	Point	2		
Emerging Market Economies				
Brazil	Point Tolerance	4.25	2.75	5.75
Chile	Point	3		
Colombia	Point Tolerance	3	2	4
Hungary	Point Tolerance	3	2	4
India	Point Tolerance	4	2	6
Mexico	Point Tolerance	3	2	4
Paraguay	Point Tolerance	4	2	6
Peru	Point Tolerance	2	1	3
Philippines	Point Tolerance	3	2	4
Poland	Point Tolerance	2.5	1.5	3.5
Russia	Point	4		
South Africa	Point Tolerance	4.5	3	6
Thailand	Range		1	3
Türkiye	Point Tolerance	5	3	7
Ukraine	Point	5		
Uruguay	Point Tolerance	5	3	7

Note: Classification of countries is done according to the IMF. The target is from the first implementation period. Source: IMF, Central Bank websites, Ehrmann (2021) and Grosse-Steffen (2021).

B: Anchoring in level terms

I also test for anchored inflation expectations in levels using Equation 27. Here, I follow Bomfim and Rudebusch (2000) approach, in which expectations are modeled as a weighted average of lagged inflation and the target. This differs from Equation 3, as the latter captures anchoring in deviations from the target, while the former does so in level terms. The β coefficient in Equation 3 indicates the anchoring effect, while the corresponding coefficient is α in Equation 27.

$$\pi^{e}_{it} = \alpha * (\pi^{Tar}_{it}) + (1 - \alpha) * \pi_{it-1} + \alpha_i + \gamma_t + \varepsilon_{it} \tag{27}$$

Here, π^e is inflation expectations, π^{tar} is the target inflation announced by the central bank and π is inflation. The country and time-fixed effects are also included and are similar to those in Equation 3. The regression results from the analysis of anchoring expectations in level terms are given in Table 9. These results indicate that the forecasters judge their expectations based on central bank targets and are less affected by the backward-looking component in the case of EME. [32] A higher weight assigned to the inflation target suggests that agents in EME are more concerned about matching the target than past inflation, leading them to form expectations closer to the target. However, in the case of AE, the agents have more stickiness to the past inflation than that for the target inflation. This supports the results found in Table 1. Results from both tables point towards better anchoring in EMEs compared to AEs.

Table 9: Regression in Level Terms

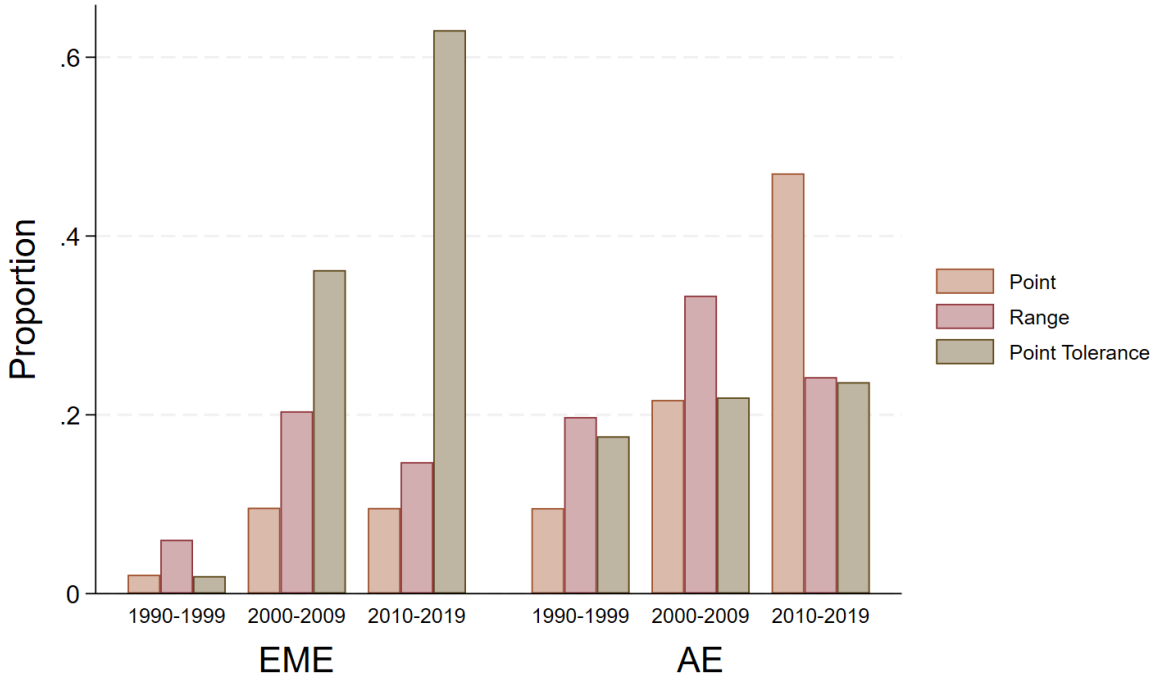
	EME	AE
π^{Tar}_t	0.54***	0.44***
	(0.06)	(0.03)
π_{t-1}	0.45**	0.55***
	(.06)	(.03)
N	1244	873
R-squared	0.75	0.76
Country FE	Y	Y
Time FE	Y	Y

Note: Country-level clustered SE in parentheses; ***p<0.01, **p<0.05, *p<0.1

[32] Łyziak and Paloviita (2017) find a similar result for the Euro Area.

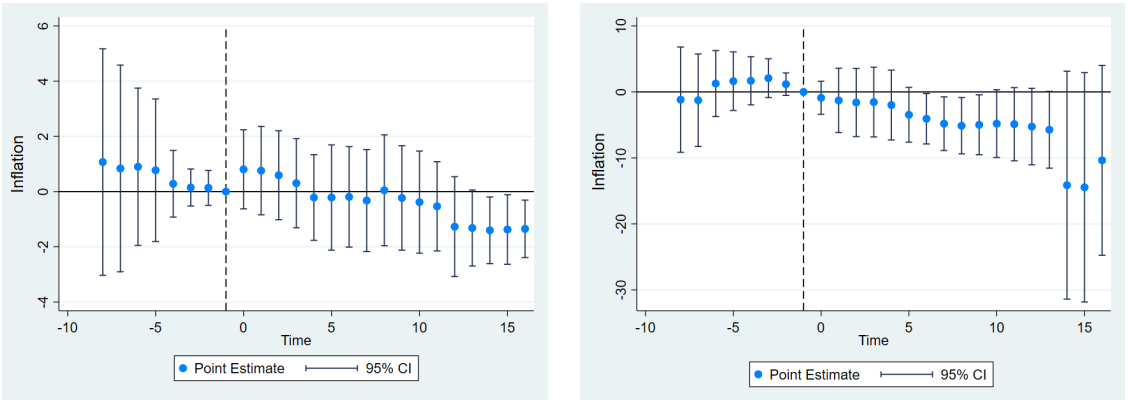
C: Figures

Figure 10: Target Types Across Time for EME and AE



Note: The graph shows the mean of the target types across time and countries for the two sets of economies. Source: IMF, Central Bank websites, Ehrmann (2021) and Grosse-Steffen (2021).

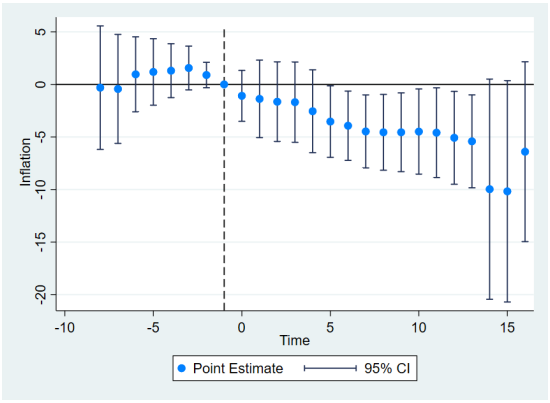
Figure 11: Impact of IT adoption on inflation



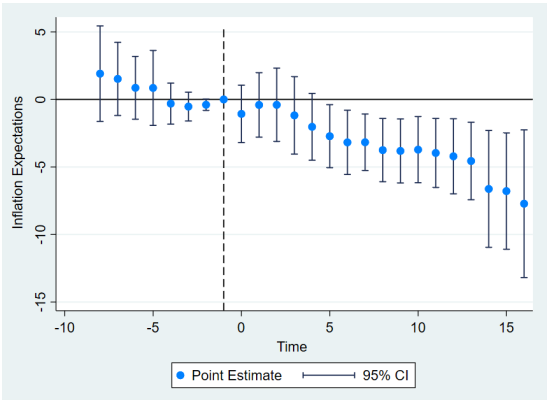
(a) Advanced Economies (b) Emerging-market Economies

Note: The blue dots are the event study coefficients from Equation 1 for inflation as the outcome variable. Estimates are relative to a quarter before adopting IT indicated by the dotted vertical line. The bars around each estimate indicate a 95% confidence interval.

Figure 12: Impact of IT adoption for all countries



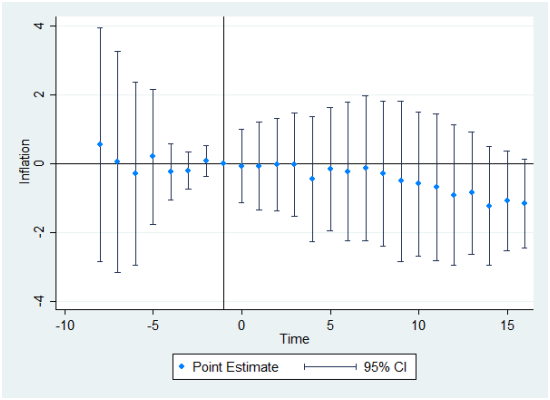
(a) Inflation



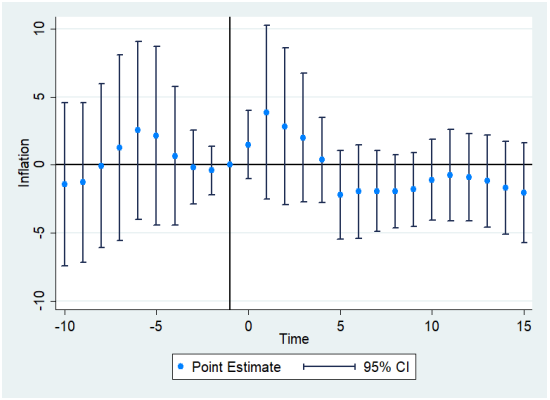
(b) Inflation Expectations

Note: The blue dots are the event study coefficients from Equation 1 for (a) inflation and (b) inflation expectations as the outcome variable. Estimates are relative to a quarter before adopting IT indicated by the dotted vertical line. The bars around each estimate indicate a 95% confidence interval.

Figure 13: Impact of IT announcement on inflation



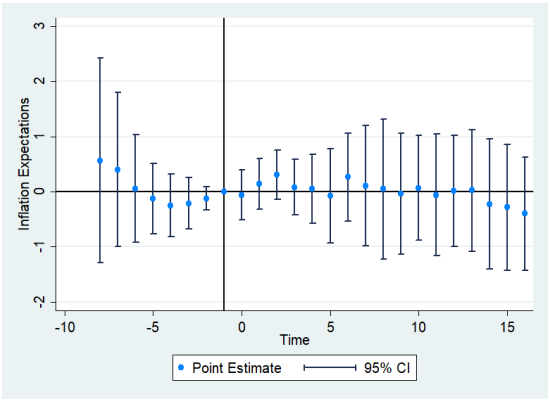
(a) Advanced Economies



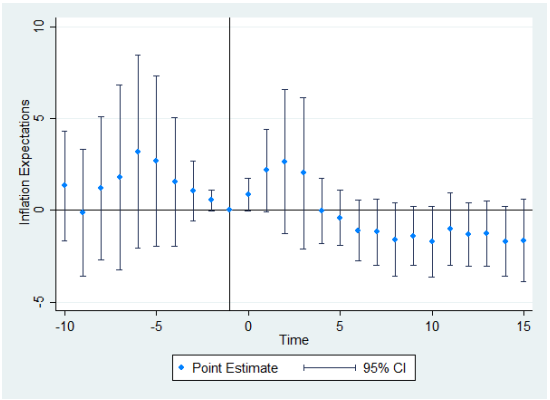
(b) Emerging-market Economies

Note: The blue dots are the event study coefficients estimated from an event study for the impact of IT announcement on inflation. Estimates are relative to a quarter before announcing IT indicated by the solid vertical line. The bars around each estimate indicate a 95% confidence interval.

Figure 14: Impact of IT announcement on inflation expectations



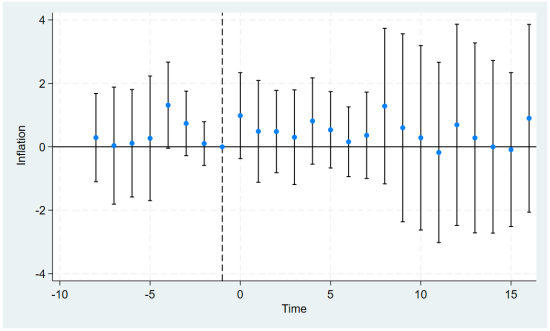
(a) Advanced Economies



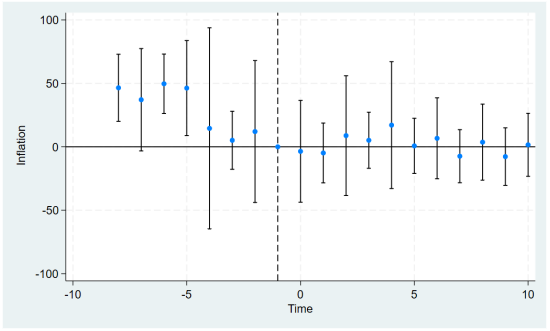
(b) Emerging-market Economies

Note: The blue dots are the event study coefficients estimated from an event study for the impact of IT announcement on inflation expectations. Estimates are relative to a quarter before announcing IT indicated by the solid vertical line. The bars around each estimate indicate a 95% confidence interval.

Figure 15: Impact of central bank independence on inflation



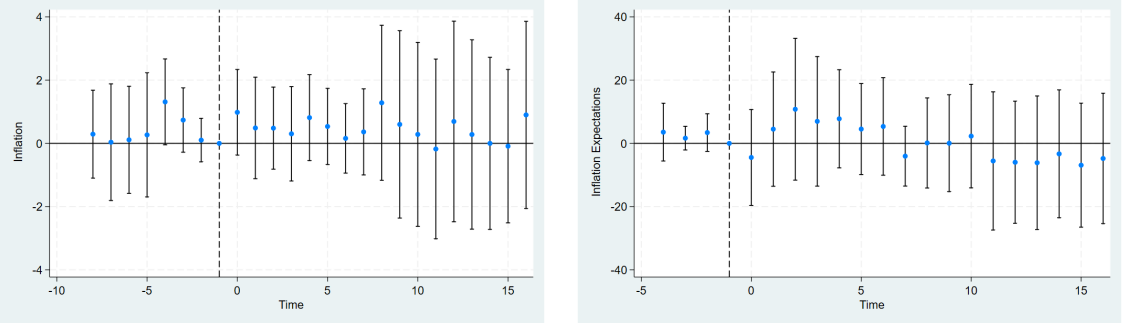
(a) Advanced Economies



(b) Emerging-market Economies

Note: The blue dots are the event study coefficients estimated from an event study for the impact of central bank independence timing on inflation. Estimates are relative to a quarter before independence was attained indicated by the solid vertical line. The bars around each estimate indicate a 95% confidence interval.

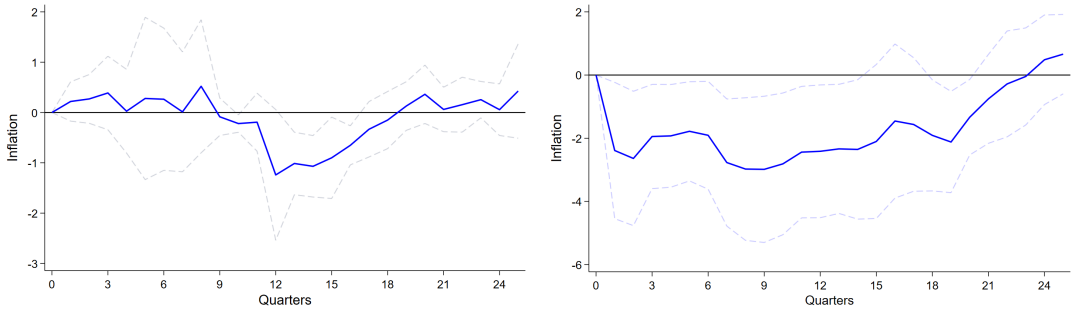
Figure 16: Impact of central bank independence on inflation expectations



(a) Advanced Economies (b) Emerging-market Economies

Note: The blue dots are the event study coefficients estimated from an event study for the impact of central bank independence timing on inflation expectations. Estimates are relative to a quarter before independence was attained indicated by the solid vertical line. The bars around each estimate indicate a 95% confidence interval.

Figure 17: Response of Inflation to an IT Adoption Shock



(a) Advanced Economies (b) Emerging-market Economies

Note: The solid blue line is the estimate from Equation 2 and inflation as the outcome variable for horizons 0 to 24. The dotted lines are the 95% confidence interval.

D: Model Equations

On the household side, the FOCs are given as:

$$1 = \beta E_t \left[\left(\frac{U'_{c,t+1}}{U'_{c,t}} \right) * \frac{P_t}{P_{t+1}} (1 + i_t) \right]$$

$$\left(\frac{U'_C}{U'_N} \right) = \frac{P_t}{W_t}$$

The log-linearised version of these FOCs is then given as:

$$\hat{C}_t = E_t(\hat{C}_{t+1}) - \frac{1}{\sigma}(i_t - E_t(\hat{\pi}_{t+1})) \tag{28}$$

$$\hat{W}_t - \hat{P}_t = \sigma\hat{C}_t + \theta\hat{N}_t \tag{29}$$

The firm FOC after imposing the symmetric equilibrium gives the optimality condition as:

$$\psi\left(\hat{\pi}_t - 1\right)\hat{\pi}_t = (1-\varepsilon) + \varepsilon\hat{\mathcal{C}}_t + \psi E_t\left[\hat{x}_{t+1}\left(\hat{\pi}_{t+1} - 1\right)\frac{\hat{Y}_{t+1}}{\hat{Y}_t}\left(\hat{\pi}_{t+1}\right)\right] \tag{30}$$

The aggregate production function is given by

$$Y_t = A_t N_t$$

The log-linearized form is:

$$\hat{Y}_t = \hat{N}_t + \hat{A}_t \tag{31}$$

The aggregate resource constraint takes adjustment cost into account such that:

$$Y_t = C_t + \frac{\psi}{2}(\pi_t - 1)^2 Y_t, \tag{32}$$

$$C_t = (1 - \frac{\psi}{2}(\pi_t - 1)^2)Y_t$$

The log-linearization of the resource contraint is:

$$\hat{C}_t = \hat{Y}_t - \left(\frac{\psi(\bar{\pi}-1)\bar{\pi}}{1 - \frac{\psi}{2}(\bar{\pi}-1)^2}\right)\hat{\pi}_t \tag{33}$$

NKPC & IS curve

Combining Equations 33 and 31, we can re-write Equations 28 and 29 as:

$$\hat{Y}_t = E_t(\hat{Y}_{t+1}) - \left(\frac{\psi(\bar{\pi}-1)\bar{\pi}}{1 - \frac{\psi}{2}(\bar{\pi}-1)^2}\right)E_t(\Delta\hat{\pi}_{t+1}) - \frac{1}{\rho}E_t(i_t - E_t(\hat{\pi}_{t+1})) \tag{34}$$

$$\hat{W}_t = (\sigma + \psi)\hat{Y}_t - \theta A_t - \left(\frac{\sigma\psi(\bar{\pi}-1)\bar{\pi}}{1 - \frac{\psi}{2}(\bar{\pi}-1)^2}\right)\hat{\pi}_t \tag{35}$$

Equation 34 for the model with log-linearization around the zero trend inflation will result in the standard NK model IS curve:

$$\hat{Y}_t = E_t(\hat{Y}_{t+1}) - \frac{1}{\rho} E_t(i_t - \hat{\pi}_{t+1}) \tag{36}$$

The firms' marginal cost can be expressed as real wage divided by the marginal product of labor. In logs, we get:

$$\hat{W}_t = \hat{MC}_t + \hat{A}_t \tag{37}$$

Imposing labor market equilibrium, the log-linear real marginal costs' is given by:

$$\hat{MC}_t = (\sigma + \psi)\hat{Y}_t - (1 + \theta)A_t - \left(\frac{\sigma\psi(\bar{\pi} - 1)\bar{\pi}}{1 - \frac{\psi}{2}(\bar{\pi} - 1)^2} \right) \hat{\pi}_t \tag{38}$$

From Equation 33 and log-linearizing Equation 30. we get the following NKPC:

$$\hat{\pi}_t = \gamma_1 \beta E_t \hat{\pi}_{t+1} + \gamma_2 \beta (1 - \sigma) E_t \hat{\Delta Y}_{t+1} + \gamma_3 \hat{MC}_t \tag{39}$$

where,

$$\gamma_1 = \frac{(2\bar{\pi^2} - \bar{\pi})(C/Y) + [(\bar{\pi} - 1)\bar{\pi}]^2 \sigma\psi}{\chi}$$

$$\gamma_2 = \frac{(\bar{\pi^2} - \bar{\pi})(C/Y)}{\chi}$$

$$\gamma_3 = \frac{[\varepsilon - 1 + \psi(\bar{\pi^2} - \bar{\pi})(1 - \beta)](C/Y)}{\theta\chi}$$

$$\chi = (2\bar{\pi^2} - \bar{\pi})(C/Y) + [(\bar{\pi} - 1)\bar{\pi}]^2 \sigma\psi\psi$$

Equation 39 for the model with log-linearization around the zero trend inflation will result in the standard NK model PC curve:

$$\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} + \kappa \hat{MC}_t \tag{40}$$

where,

$$\kappa = \frac{(1 - \theta)(1 - \beta\theta)}{\theta}$$

E: Model Parameters

Table 10: Parameter Values

Variable	Parameter	Value
Discount Factor	β	0.99
Coefficient of risk aversion	σ	1
Frisch Elasticity	θ	6
Inflation feedback Taylor rule	ϕ_π	1.5
Output feedback Taylor rule	ϕ_y	0.125
Elasticity of money demand	η	1
Demand Elasticity	ε	9
Adjustment Cost	ψ	80
Convergence rate (high state)	θ_h	0.8
Convergence rate (low state)	θ_l	0.5
TFP shock	ρ_a	0.9
MP shock	ρ_ν	0.5
Credibility stock shock	ρ_μ	0.7

Table 11: Non-linear Equations of the model

$\text{cred}_t = \frac{(\pi_t - \pi_t^{high})^2}{(\pi_t - \pi_t^{high})^2 + (\pi_t - \pi_t^{low})^2}$
$\pi_t^{high} = \theta_h * \pi_{t-1} + (1-\theta_h) * \pi^{high}$
$\pi_t^{low} = \theta_l * \pi_{t-1} + (1-\theta_l) * \pi^{low}$
$\mu_t = \rho\mu_{t-1} + (1-\rho)cred_t + \varepsilon_{\mu,t}$
$\text{E}_t\pi_{t+1} = \mu_t E_t \pi_{t+1}^M + (1-\mu_t)\pi_{t-1}$
$\text{x}_{t+1} = \beta(c_t/c_{t+1})^\sigma$
$\text{w}_t = \chi n_t^\eta c_t^\sigma$
$1 = \text{E}_t\left(\frac{x_{t+1} r_t}{\pi_{t+1}}\right)$
$\text{c}_t = \left(1 - \frac{\psi}{2}\left(\frac{\pi_t}{\bar{\pi}} - 1\right)^\sigma\right) y_t$
$\text{y}_t = a_t n_t$
$\text{w}_t = a_t mc_t$
$\psi\left(\frac{\pi_t}{\bar{\pi}} - 1\right)\frac{\pi_t}{\bar{\pi}} = (1-\theta) + \theta mc_t + \psi E_t\left[x_{t+1}\left(\frac{\pi_{t+1}}{\bar{\pi}} - 1\right)\frac{y_{t+1}}{y_t}\left(\frac{\pi_{t+1}}{\bar{\pi}}\right)\right]$
$\text{r}_t = \bar{r}(\pi_t/\bar{\pi})^{\phi_\pi}(y_t/\bar{y})^{\phi_y}\nu_t$
$\ln\ \nu_t = \rho_\nu ln\nu_{t-1} + \sigma_\nu \varepsilon_{\nu,t}$
$\ln\ \text{a}_t = \rho_a ln a_{t-1} + \sigma_a \varepsilon_{a,t}$