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Monetary Policy and Inflation Expectations

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To Nana Uncle and Snoopy.

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Abstract

This dissertation consists of three chapters each discussing a different aspect of the interaction between the monetary policy stance and inflation expectations.

Chapter I answers the question, do inflation expectations respond to changes in monetary policy, namely, Inflation Targeting? Subjective expectations, a survey expectations of professional forecasters for 32 Inflation Targeting countries, and an event study methodology are used to find that countries with price stability as the single objective, have a reduction in short run forecast errors. Moreover, the reduction in forecast errors is the result of a change in inflation and not expectations. The key insight of the paper is that Inflation Targeting does not have a direct impact on short-run inflation expectations. In addition, the change in forecast errors but not expectations lends support to the idea that inflation leads expectations. Unsurprisingly, the reduction in inflation is led by economies who have single mandates.

Following the findings of Chapter I, chapter II investigates the responsiveness of agents' expectation variance to shifts in monetary policy, utilising subjective expectations to ascertain the speed of learning before and after the implementation of Inflation Targeting. The analysis quantifies the Kalman Gain and the weight agents assign to the inflation target. The findings indicate a sluggish adjustment of agents' expectations to monetary policy changes, suggesting a reliance on an extended inflation history for expectation formation. Additionally, a minor emphasis on the inflation target by agents is observed. Incorporating these insights into an optimal policy model reveals that, regardless of learning speed, a stronger weight placed on the inflation target by agents diminishes the necessity for aggressive central bank responses during high inflation periods. Furthermore, the central bank's response aligns more closely with the rational expectations equilibrium when agents allocate a weight of 10% to the inflation target relative to their beliefs.

Finally, chapter III which is joint work with Luis Rojas, examines the challenge faced by a government aiming to implement a gradual reduction in inflation by entrusting

monetary policy to an independent central bank with limited credibility. Expanding upon the framework established by Barro and Gordon (1983b), we demonstrate that an optimal policy for minimising the sacrifice ratio of disinflation involves a gradual disinflationary process coupled with the announcement of intermediate targets. The speed at which disinflation occurs strikes a balance between the objective of enhancing credibility and the associated costs of unexpected inflation. Our theoretical framework provides an explanation for the disinflationary experiences observed in Chile and Colombia during the 1990s, wherein these countries established new monetary institutions and steadily achieved single-digit inflation levels through the annual announcement of decreasing inflation targets. We argue that the use of intermediate targets played a pivotal role in their design, facilitating the establishment of credibility with lower output costs.

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Chapter 1

Targeting Inflation Expectations?

1 Introduction

An open question that has resurfaced during the Covid-19 outbreak and recent resurgence in inflation, is that of an appropriate monetary policy framework for central banks to achieve their objective of price stability.[1] Modern macroeconomic theory dictates that inflation expectations matter for the path of current and future inflation.[2] Several monetary policy frameworks such as Inflation Targeting (IT), Average Inflation Targeting (AIT), Price-Level Targeting (PLT) have the anchoring of inflation expectations as the main tenet. However, there is little consensus on how agents form expectations and whether agents' expectations adjust to changes in regimes and monetary policy frameworks. This paper aims to disentangle the effect of the introduction of a policy, namely, Inflation Targeting (IT) on inflation expectations.

Figures 2.1 - 2.2 provide preliminary evidence to motivate the research question. The blue line represents realised inflation while the red dashed line represents inflation expectations based on a survey of professional forecasters. The vertical yellow line marks the year of the adoption of Inflation Targeting. Figure 2.1 portrays the evidence for Colombia while figure 2.2 presents evidence for the United States. Upon comparing the two figures, it is difficult for one to conclusively ascertain the impact of a regime change on expectations.

Figure 2.1 suggests that inflation expectations adjust significantly when IT is implemented and expectations track inflation with gradual adjustments also taking

[1] For instance, the Federal Reserve shifted to Average Inflation Target in August 2020 only to reverse policy to Inflation Targeting in May 2022. One of the reasons for the reversals was to control the rise in expectations and prevent them from becoming unmoored (see Bullard et al. (2022))

[2] ‘a la Calvo (1983), amongst others

place in the period of the announcements. On the other hand, figure 2.2 shows no change in expectations following the announcement and implementation of the policy. The break in inflation and inflation expectations occurs at the time of the financial crisis, which has been documented in Gerko (2017). This evidence leads to the question regarding the direction of impact of the policy specifically, whether inflation expectations lead or lag realised inflation.

With this background in mind, this paper attempts to answer the following question. Does the mean of the prior of agents' inflation expectations adjust after the introduction of Inflation Targeting? In particular, is there a downward revision in expectations following the announcement of the policy.

There are several competing hypotheses describing the nature of expectations ranging from the rational expectations (RE) approach to the umbrella of deviations from RE. The paper uses the RE and adaptive learning framework as the theoretical basis to estimate the effect of IT on expectations. Data on six-month-ahead inflation expectations from professional forecasters for thirty countries is used to undertake the analysis.

Adaptive learning models are an attractive lens to understand inflation expectations. These models are able to match the properties of expectations and macroeconomic aggregates. Coibion and Gorodnichenko (2015a) document the fact that forecast errors are correlated with forecast revisions, a key feature of learning models. Additionally, Carvalho et al. (2021) develop a model with adaptive learning which has good out-of-sample properties[3].

The paper then proceeds with a test of the Rational Expectation Hypothesis (REH) on the data used which is followed by the use of an event study design. The specific method used is based on Borusyak et al. (2021) to elicit the impact of the change in policy on expectations and the forecast errors. The method suggested by Borusyak et al. (2021) allows one to use the full set of observations and also allows for heterogeneity in the treatment effects typically missing in the treatment effects literature.

[3]The experimental literature Anufriev and Hommes (2012) also show that simple learning rules provide the best fit in a lab setting.

FIGURE 1.1: Colombia: Inflation and Inflation Expectations

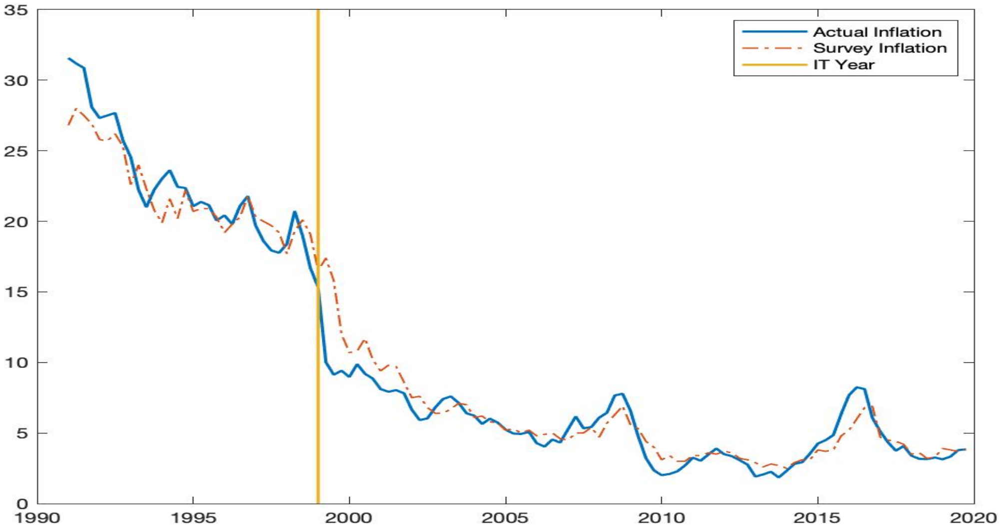
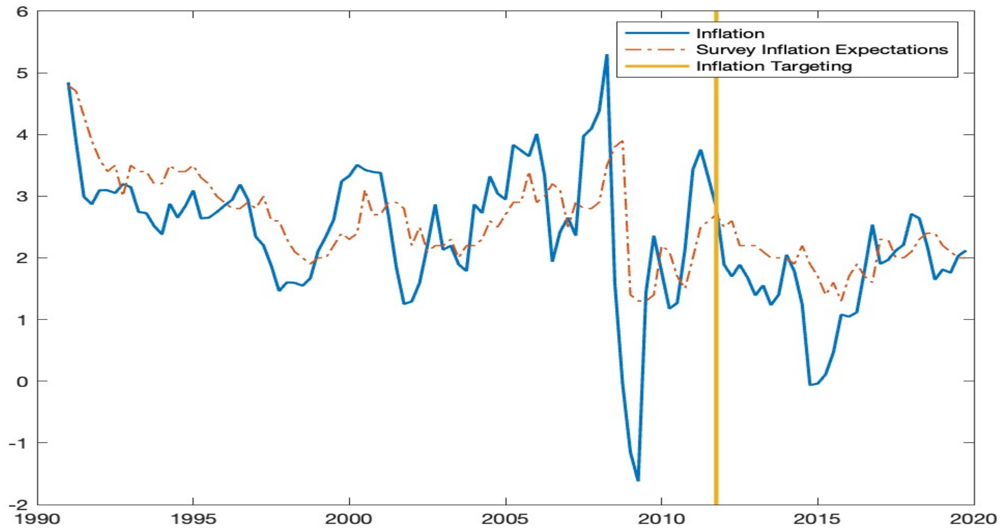


FIGURE 1.2: United States: Inflation and Inflation Expectations



I further develop on the question by distinguishing between the announcement and implementation dates. Therefore, allowing for any anticpatory effects to be considered when evaluating the expectations. This is one of the first papers to study the announcement and adoption of the policy as different events. Defining data on the announcement dates is particularly important since the study uses surveys of professional forecasters - agents who are well informed about the economy. The announcement is gleaned from the minutes of the monetary policy meetings from each country by checking the first time the there is a discussion of a new regime.

One of the key aspects of IT is the anchoring of expectations in the long run as opposed to the short run, which is the data this study uses. However, (Carvalho et al., 2021, p. 19) suggest that the degree of anchoring depends on the endogenous link between long-term and short-term inflation expectations and the strength of this depends on the recent forecasting performance and monetary policy. They show that short-term forecasts accurately predict long term forecasts.[4]. Moreover, Candia et al. (2023) show that there is high correlation between short and long-term forecasts.

Apart from confirming the deviations from rational expectations, the paper finds two key results. First, countries who have a single mandate, that is, they focus on price stability as their sole objective are able to adjust the short-run expectations with the adoption of inflation targeting. The mechanism is through a reduction in the forecast errors[5]. However, this reduction is the result of a change in inflation and not inflation expectations. For countries with dual mandates, there is increased volatility in forecast errors. This result holds despite the length of time period considered post the adoption of the policy. This result is different from the findings by Gürkaynak et al. (2010a) who suggest that IT leads to an anchoring of inflation expectations in the long run. However, this paper differs on two key dimensions. First, it uses a panel dataset of over 30 countries and modern econometric methods of event study analysis to produce the current findings. Second, Gürkaynak et al. (2010a) use a measure of forward interest rates and inflation compensation to elicit expectations. On the other hand, the current paper uses survey expectations from professional forecasters. While not a perfect measure, survey data provides a direct measure of expectations without the need to infer it from market information. This

[4](Coibion et al., 2020, p. 34) also show the importance of short-term expectations for the financial sector

[5]Please see section 4 for a discussion on the construction of the forecast errors.

paper also only finds an effect for countries with a single mandate as opposed to the focus on dual mandate economies by Gürkaynak et al. (2010a). This result also challenges the view of Coibion et al. (2018) who suggest no effect for the US and New Zealand (also based on individual country analysis) after the introduction of the policy.

Second is a small adjustment in inflation expectations two quarters after the announcement of the policy. However, by the third quarter after the announcement, this effect also disappears. Overall, supporting the fact that expectations do not adjust to IT.

Taken together, the results of the empirical estimation highlight two things. First and crucially, there is no direct impact of the policy on expectations but on inflation. That is, inflation leads inflation expectations. Second, the empirical evidence suggests that a single objective aids clarity of communication and facilitates the adjustment process even if not through the expected channel.

One of the main criticisms of using vastly different countries can be the credibility of the central bank. The paper uses data from Dincer and Eichengreen (2013) to run a robustness check by including information on central bank transparency. Despite controlling for "credibility", the results remain unchanged. Robustness checks are also based on different estimators such as those by Sun and Abraham (2021) and Callaway and Sant'Anna (2021) uphold the main results of the paper. There is no significant change in the response to new information when the policy is implemented. Although, with Callaway and Sant'Anna (2021), there is an increase in expectations after a few quarters. The significance of this result is not straightforward since the method requires grouping of the individual countries by date of adoption, reducing the sample size. Therefore, with the use of different estimators, the results remain robust. Additional results based on different splits of the data present results similar to those highlighted above.

Related Literature This paper lies at the intersection of and contributes to three strands of literature. First, assuming that agents behave like econometricians (as in Marcet and Sargent (1989b), Evans and Honkapohja (2012)) this paper studies how far expectations look back to the past to form expectations about the future before and after a change in the monetary policy framework. Thus, it is one of the only papers to tackle the impact of a policy change on expectations. This paper furthers the literature on inflation expectations such as Mankiw et al. (2003), Erceg and Levin (2003), Eusepi and Preston (2011), Coibion and Gorodnichenko (2015b), Coibion et al. (2018), and Bordalo et al. (2020), Carvalho et al. (2021), Gáti (2022). These papers document the deviation of the forecasts of the professional forecasters from the full information rational expectations (FIRE) framework. However, as stated above this literature has ignored the formation of expectations around a change in regime. Thus, beginning from the assumption that inflation expectations have always played a critical role in inflation. To the best of the author's knowledge, this is the first paper to address the question under adaptive learning.

A plethora of the literature has focused on the macroeconomic implications of IT on variables such as GDP and inflation, for example, Cecchetti and Ehrmann (1999), Ball and Sheridan (2004), and Levin et al. (2004). In addition, the effect of a policy change on expectations under RE has been relatively more researched for example, Castelnuovo et al. (2003), Gürkaynak et al. (2010b) Gürkaynak et al. (2010a), Beechey et al. (2011) there is limited work under deviations from RE. While Coibion et al. (2020) discuss the role that the introduction of Average Inflation Targeting plays on expectations of households, the evidence is limited on account of the policy application. To the best of the author's knowledge, this is the first paper to have a systematic and comprehensive comparison of surveys across a wide set of countries (advanced and developing), that differ substantially in their history of inflation and economic stability. Given the widespread implementation of IT as a monetary policy framework,[6], a rigorous study calls for using all available data.[7]

In addition, this paper distinguishes between the announcement and implementation of the policy. Thus, allowing the paper to focus on the transition

[6]Approximately 60 countries around the world have adopted Inflation Targeting as their Monetary Policy Framework.

[7]Most of the work pertaining to inflation expectations has been limited to the developed economies specifically, the United States

period of the policy and consider an anticipation effect of the policy. The literature on the other hand, has ignored the transitory period.[8]

Finally, the paper adds to the literature on the credibility of the central bank building on papers such as Kostadinov and Roldán (2020) and King et al. (2020). The previous two papers build models where the agents need to infer the type of policy maker based on the policies implemented after a change in policy makers. In addition, Duggal and Rojas (2022) also use an adaptive learning model to measure central bank credibility based on announcement of intermediate targets.[9] This paper differs from the previous literature by assuming the new regime is announced and known to all individuals in the economy. However, this paper supports the credibility literature as learning is due to a lack of credibility and over time, expectations should converge to the objective of the central bank.

Road map The paper is organised as follows. Section two discusses the model of expectations explored in the paper. Section three presents the empirical framework and results. Section four encompasses robustness checks using different definitions and estimators. Finally, section seven concludes with directions for further research.

2 Agents' Expectations

Before turning to the empirical and quantitative models, it is important to have a framework in mind, which can be used to interpret the results of the models. The paper specifically builds on two frameworks which are later tested. First, is the standard rational expectations framework. The second is adaptive learning based on Marcet and Sargent (1989a) and Evans et al. (2001).

[8]While there is a strand of literature that focuses on anticipation pioneered by Garmel et al. (2008), Schmitt-Grohé and Uribe (2012), and Maliar et al. (2015). However, the results in these papers relate to policies such as the introduction of the enlargement of the EU with eastern European countries, and anticipated shocks to output. Thus, anticipation has been limited to discussion of policies outside regime changes in the monetary framework.

[9]Early version working paper available here

2.1 Inflation

To understand the formation of expectations let us first understand the model for inflation.

Let inflation evolve according to a uni-variate unobserved component model. Where inflation π_t is the sum of an unobserved permanent (λ_t) and transitory component (ε) . Before IT is implemented the permanent component evolves according to a unit root process.

$$\pi_t = \lambda_t + \varepsilon_t \tag{1.1}$$

$$\lambda_t = \lambda_{t-1} + \vartheta_t \tag{1.2}$$

Now, let IT be introduced at time $t = IT^I$ such that for all periods after the implementation of IT inflation follows,

$$\pi_t = \lambda_t + \varepsilon_t \tag{1.3}$$

$$\lambda_t = \rho\lambda_{t-1} + (1-\rho)\pi^T + \vartheta_t \tag{1.4}$$

Where, the key difference between the pre and post-IT periods is the change in the process for the permanent component of inflation (λ_t). λ_t now evolves according to an AR(1) process where ρ measures the persistence of the permanent component and $(1 - rho)$ is the weight on the inflation target. Therefore, inflation is now a mean reverting process for $\rho < 1$.

The variance of the errors in inflation is time varying. The discussion of the relevance of the time varying error structure is postponed till section 5 of the paper.

2.2 Rational Expectations

The rational expectations approach assumes that the economic agents have complete of knowledge about the economy. Specifically, knowledge about the structure of the economy, the mapping between the fundamentals, the values of the parameters and the value of the shocks. Agents therefore, fully know the path of inflation, output and other macroeconomic variables in an economy. This implies that forecasts under RE will always be given as per[10],

$$\mathbb{E}_t \pi_{t+h} = \pi_t \tag{1.5}$$

Under the Rational Expectations Equilibrium (REE), the perceived law of motion of the agents (PLM) and the actual law of motion (ALM) of the variable, coincide. Moreover, that the shocks to the economy are *independent and identically distributed*. This is because the REE imposes a consistency condition that each agent's choice is the best response to the choices of others.

In the pre inflation targeting period, the agents would have perfect knowledge about the underlying process for inflation. Therefore, they are able to predict inflation correctly. A well know example of this is referred to as the inflation bias as termed by Barro and Gordon (1983b), where agents have rational expectations and they are able to anticipate how the government will respond to shocks and correctly forecast future inflation. For details on the Barro and Gordon (1983b) model, please see appendix D.

Similarly, in the post-inflation targeting period, the agents know the central bank's inflation target, π^T for all t. This inflation target can also be interpreted as the long run mean of inflation or the inflation drift. Thus, under rational expectations and a credible inflation target, the expectations of the agents will coincide with the inflation target.

[10] While the variance of the forecast and the forecast error will be given by (if assuming an underlying model of stochastic volatility),

$$\begin{aligned} Var(E_t \pi_{t+h}) &= \sum_{k=1}^{h} E_t \sigma^2_{\varepsilon_{t+k}} + E_t \sigma^2_{\vartheta_{t+k}} \\ &= \sigma^2_{\varepsilon_t} \sum_{k=1}^{h} exp^{-0.5\gamma} + \sigma^2_{\vartheta_t} exp^{-0.5\gamma} \end{aligned}$$

$$\mathbb{E}_t \pi_{t+h} = \pi^T$$

This implies that under RE, the history of the policy, inflation or any other variable does not matter. Every period, agents know perfectly how all the changes in the economy will take place.

While, the agents considered in this paper are relatively more informed agents (professional forecasters) about the economy, they are not endowed with full information about the structure of the economy. Thus, they must behave as econometricians to forecast future prices. This implies that the second framework being considered in this paper is that of adaptive learning.

2.3 Subjective Expectations

There is sufficient literature which discusses that inflation expectations deviate from rational expectations[11]. Therefore, one can now use a model of adaptive learning specifically, constant gain learning to underpin the empirical framework discussed in section four. They implication of using learning models (independent of the fundamental being addressed) is the fact that agents form expectations based on the history of the variables of economy. Moreover, they are unaware of the interaction between the structural variables.

The assumption the paper makes is that agents use a constant gain model to predict future inflation with the updating equation given by,

$$\tilde{\beta}_t = \tilde{\beta}_{t-1} + \kappa_t(\pi_t - \tilde{\beta}_{t-1}) \tag{1.6}$$

$\tilde{\beta}$ represent the underlying inflation expectations which impact inflation and are the result of the standard Kalman Filter.

[11]For instance, Branch and Evans (2006), Eusepi and Preston (2011), Coibion and Gorodnichenko (2015a), Branch and Evans (2017)

As suggested before, let inflation targeting be announced at $t = IT^I$ such that there are two possibilities for the formation of expectations,

$$\tilde{\beta}_t = \tilde{\beta}_{t-1} + \kappa(\pi_t - \tilde{\beta}_{t-1}) \tag{1.7}$$

Where, κ gives the strength at which agents update their beliefs and with a constant κ. That is, agents do not adjust the way they change their expectations.

The second alternative is that for $t \geq IT^I$,

$$\tilde{\beta}_{IT} < \tilde{\beta}_{IT-1} + \kappa(\pi_{IT} - \tilde{\beta}_{IT-1})$$

Intuitively, 2.3 refers to the idea of the jump in expectations. That is, the paper aims to check whether the announcement or the introduction of the policy makes people reduce their inflation expectations or they must see it to believe it. Under equations (1.7) and (2.3) the assumption is of a constant variance of priors and a constant Kalman gain (κ). Section 5 relaxes this assumption to check if maybe the variance of the priors and therefore the Kalman Gain adjust after the introduction of inflation targeting.

As discussed in the introduction, the paper uses short-run inflation forecasts to answer the research question. Appendix E provides a small explanation regarding how expectation of short-run inflation matters for economic decisions. Moreover, long-run expectations are the infinite sum of long-run expectations. Thus, making the study of the effect of a policy change on short-run expectations, relevant.

3 The Role of Inflation Targeting

3.1 Empirical Framework

To estimate the treatment effect as described in (1.7), the paper uses the event study methodology based on Borusyak et al. (2021). Specifically, the regression is of the form

$$\beta_{it} = \underbrace{\delta_i}_{0} + \beta_{it-1} + \kappa(\pi_{it} - \beta_{it-1}) + \gamma_1 t + \gamma_2 \bar{\pi}_t + \epsilon_{it} \tag{1.8}$$

Where, β_{it} are the inflation expectations as taken from the surveys of professional forecasters, y_{it} is the annualised inflation rate, t captures a time trend and $\bar{\pi}_t$ represents the world inflation with $\epsilon_{it} \sim N(0, \sigma_\epsilon^2)$ and is orthogonal to all previous information. The paper also uses a complementary regression to understand the impact on inflation through expectations namely,

$$\pi_{it} = \beta_{it-1} + \kappa(\pi_{it} - \beta_{it-1}) + \gamma_1 t + \gamma_2 \bar{\pi}_t + \epsilon_{it} \tag{1.9}$$

One way to interpret both equations 1.8 and 1.9 is to think of constant gain learning akin to the normal returns in the Finance literature[12]. Thus, $(\beta_{it} - \hat{\beta}_{it-1})$ and $(y_{it} - \hat{\beta}_{it-1})$ represent the "abnormal" expectations and inflation, allowing the measurement of the effect of the treatment.

In order to compute the effect of the change in the policy, the estimation needs to be done in three stages. Before describing the details, let us work through some notational details. Let $\{it : D_{it} = 1 \in \Omega_1\}$ be the set of observations that receive treatment (those periods where Inflation Targeting is active) and $\{it : D_{it} = 0 \in \Omega_0\}$ be the untreated observations (periods where Inflation Targeting is not active). Let τ_{it} be the effect of the policy on the variable of interest (β_{it}) and $\beta_{it}(0)$ be the potential outcome if the observations were not treated. In addition, let w_{it} be the weights attached to each unit in the computation of the treatment effect. Then, the treatment effect is computed based on the following,

1. For all untreated observations in Ω_0, compute β_{it} by OLS. Thus, for this paper the regression is given by equation 1.8 to estimate $\hat{\kappa}, \hat{\gamma}_1, \hat{\gamma}_2$.

[12] For instance, Fama et al. (1969)

2. For all the treated observations in Ω_1 and $w_{it} \neq 0$ compute $\beta_{it}(0) = \beta_{it-1} + \hat{\kappa}(\pi_{it} - \beta_{it-1}) + \hat{\gamma}_1 t + \hat{\gamma}_2 \bar{\pi}_t + \epsilon_{it}$.

3. Compute, $\beta_{it} - \beta_{it}(0) = \tau_{it}$ which gives us the treatment effect.

4. Finally, the effect for each period after the treatment is computed as per $w_{ih} = \frac{1}{\Omega_{1,h}}$ where $\Omega_{1,h} = \{it : h = t - IT\}$ which is the relative time since the adoption of the policy.

5. Finally, $\tau_h = w_{ih}\tau_{ih}$ is the estimand based on τ_{it} for the different horizons ($h = \{1, 2, 3, 4, 5, 6, 7, 8\}$).

To complement the estimation procedure above consider the following example. Let there be two economies $n1$ and $n2$ such that $n1$ is treated at time $IT = 2$ and $n2$ is treated at time $IT = 4$. Then, the average treatment effect τ for each period is given by,

$$\tau = \begin{bmatrix} 0 \\ \tau_{n1,2} \\ \vdots \\ \tau_{n1,T} \\ 0 \\ \vdots \\ \tau_{n2,4} \\ \tau_{n2,5} \\ \vdots \\ \tau_{n2,T} \end{bmatrix}$$

Therefore, the effect at each horizon (h) is computed according to the following,

$$\tau_h = \frac{1}{\Omega_{1,h}} \sum_{i=1}^{N \in \Omega_{1,h}} \tau_{ih}$$

Where, $\Omega_{1,h}$ is all the observations such that inflation targeting is implemented in period $h = t - IT^I$ after the introduction of IT and $h = \{0, 1, 2, 3, \dots\}$. Finally, this implies that $\tau_1 = \frac{1}{2}(\tau_{n1,3} + \tau_{n2,5})$. Thus, this methodology doesn't require a normalisation period since we are able to compute the effect on impact as well ($h = 0$).

3.1.1 A note on Identification

Having defined the procedure and formal regression which has been used to estimate the treatment effect, let us turn to the identification procedure. Specifically, checking if the assumptions such as *non-anticipation* of the policy and *parallel trends* before the introduction of IT, holds for the study.

Anticipation: This is the main threat to identification for the study. In order to circumvent the anticipation effect, the paper uses the announcement date. The announcement (anticipation) date is constructed based on the minutes of the meetings of the monetary policy committees. The date is drafted based on the first time a change in monetary regime to either a Taylor type rule or Inflation Targeting is explicitly discussed. For some countries, there were also studies which were conducted before shifting to Inflation Targeting. For these countries, the paper uses the dates of the study. Addressing the question of anticipation is particularly important since the underlying data is that of Professional forecasters - agents who are well informed about the economy. By using the date of the first discussion of a change in regime one is able to capture the anticipation effect.

Unobserved Heterogeneity (Unit Fixed effects): The study assumes that the unobserved heterogeneity is constant across all the countries. Moreover, this unobserved heterogeneity is zero ($\delta_i = 0$). While a strong assumption, making this assumption is not unreasonable. With a constant gain model having unobserved heterogeneity, would imply that agents would always make mistakes. These mistakes would then have a mean value around which they osciallate, making it difficult to reach the Rational Expectation Equilibrium (which is the inflation target).

Reverse Causality: Second, the treatment effect literature often worries about issues relating to reverse causality (anticipation is a special case). However, the implementation of the policy in most countries was a response to high inflation or high inflation volatility with the objective of anchoring inflation expectations. Prior to the adoption of IT, most countries did not keep track of inflation expectations and did expectations were not a part of monetary policy. Therefore, it is unclear how expectations would have an impact on the introduction of the policy.

Control Group: The study only has data on countries which are treated, resultantly, missing a control group to compute the treatment effect as in the *difference-in-difference* literature. However, this is resolved by using the *not-yet-treated* group as the control for those treated. This implies for a country treated in say, 1999Q1, will have a companion country which is treated in 2010Q3 thus allowing the pre-trends to hold for the country treated in 1999Q1. Since the data set in the paper has countries whose announcement and implementation date range from 1995Q3 to 2016Q3, the study is able to build a credible control group.

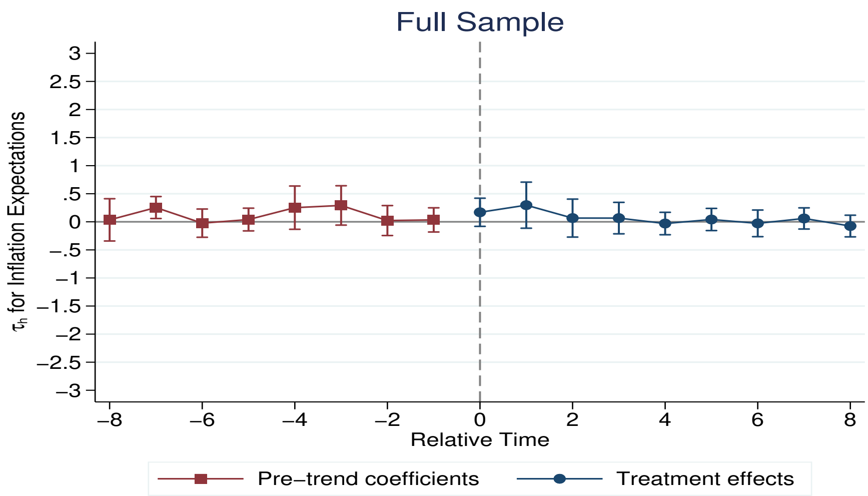
Finally, there are a few important *limitations* to address before discussing the results and stylised facts of the paper. First, the data is low frequency data, since the survey is a quarterly survey. This means there could be changes that could occur during a quarter which would could manipulate expectations, limiting the effect of the policy. Second, the data used is a survey. As with any survey, there will be a degree of measurement error. One redeeming factor of the survey is that it is based on professional forecasters. Therefore, given forecasters have a stake in how well their expectations perform, the contribution of the error should be minimal. Finally, given the data is from professional forecasters there is an open debate in the literature on whose expectations to consider while thinking about the monetary policy framework. This paper is unable to answer this question owing to data availability. Let us now turn to the stylised facts derived from the study and their implications.

3.2 Implementation

Figure 1.3 and 1.4 present the first set of findings. The red dots and confidence interval lines represent the period before IT while the blue dots and lines portray the post targeting period or the treatment period. First, the pretrends assumption is not violated since the confidence intervals cross zero. Second, after the introduction of IT there is no change in the level of inflation expectations. The magnitude remains similar to before IT and the results are insignificant.

Fact 1: *Inflation expectations do not respond to the implementation of the policy.*

FIGURE 1.3: Inflation Expectations Around Implementation



Fact 2: *There is a significant but small change in the forecast errors around the implementation.*

Figure 1.4: Forecast Errors Around Implementation

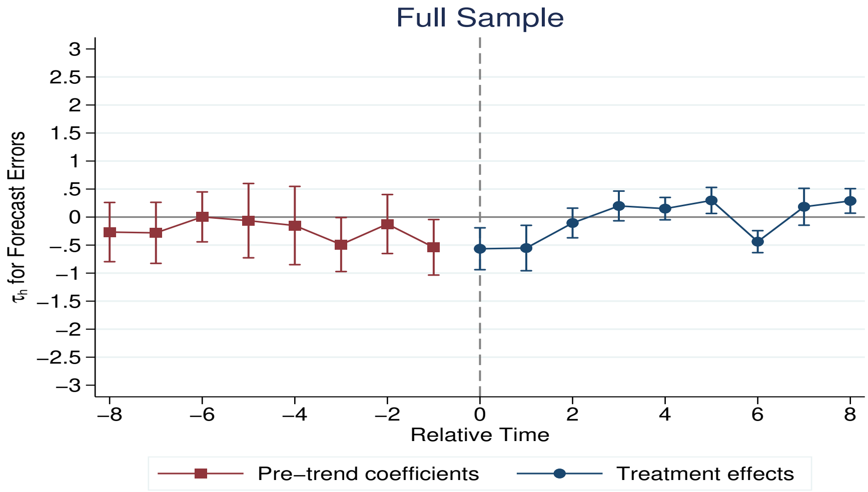
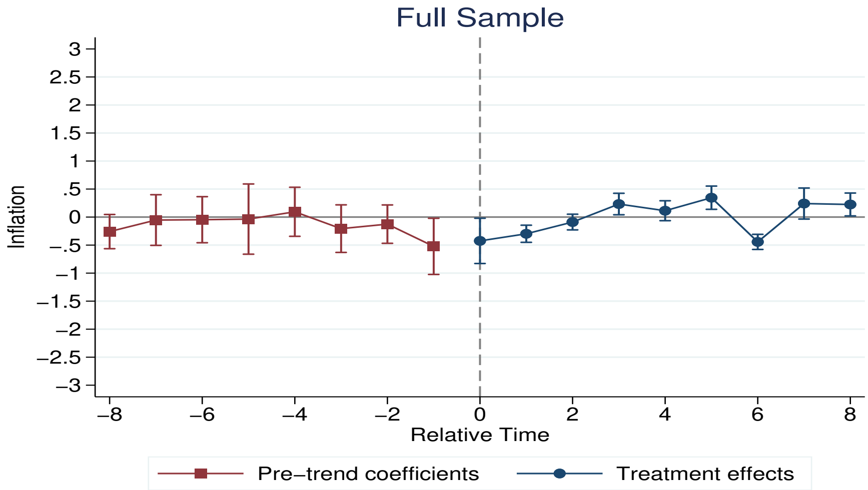


Figure 1.4 provides support to fact 1 with forecast errors adjusting after the implementation of the policy. In order to decompose this effect, note that forecast errors are defined as realised inflation − inflation forecasts. Therefore, a negative (positive) forecast error implies agents are over predicting (under predicting) inflation. Systematic changes of forecast errors is predictive of two things. First, agents do not form expectations according to the REH. In addition, it enables us to distinguish between changes in expectations that may occur due to inflation as opposed to inflation expectations. Figure 1.11 represents the path of inflation after the introduction of the policy. The results suggest that inflation declined after the policy was adopted however expectations did not change. As a result, the forecast errors increased with agents overpredicting inflation. This implies, inflation leads inflation expectations as opposed to inflation expectations leading inflation.

Figure 1.5: Inflation Around Implementation

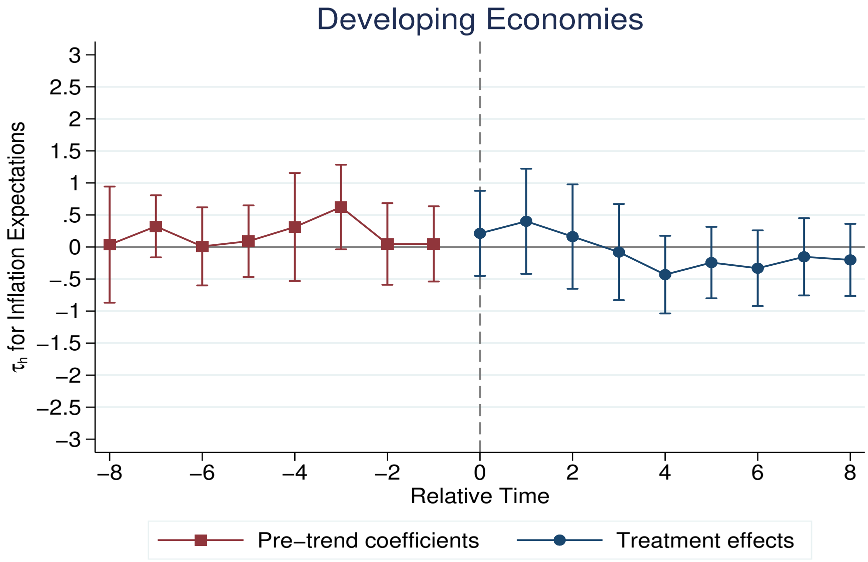


Inflation Targeting is often credited with success in developing economies. This paper tries to test this hypothesis as well. A decrease in the level of expectations for developing economies is to be expected since on average, these economies had higher inflation before the policy was adopted. Figure 1.6 presents the results from this hypothesis and are similar to those found previously. While there is a decline in expectations, the results are insignificant at the 95% level. Moreover, agents overpredict inflation in these economies (figure 1.12) upon implementation before the forecast errors return to around zero after roughly one year.

These results suggest two things. First, inflation targeting does not have a direct impact on inflation expectations. However, if countries have a single mandate after about a year of adopting the policy, expectations adjust.

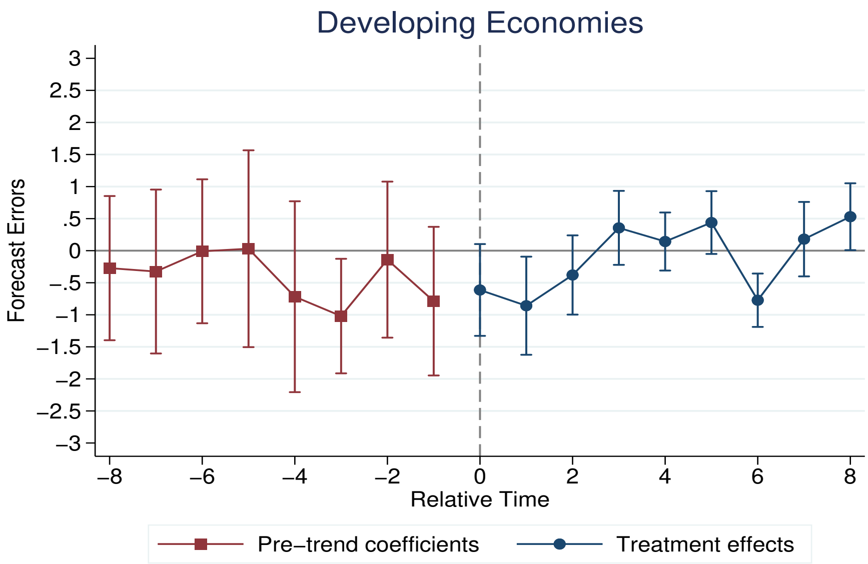
Fact 3: *Any change in expectations is insignificant in developing economies.*

Figure 1.6: Inflation Expectations Around Implementation



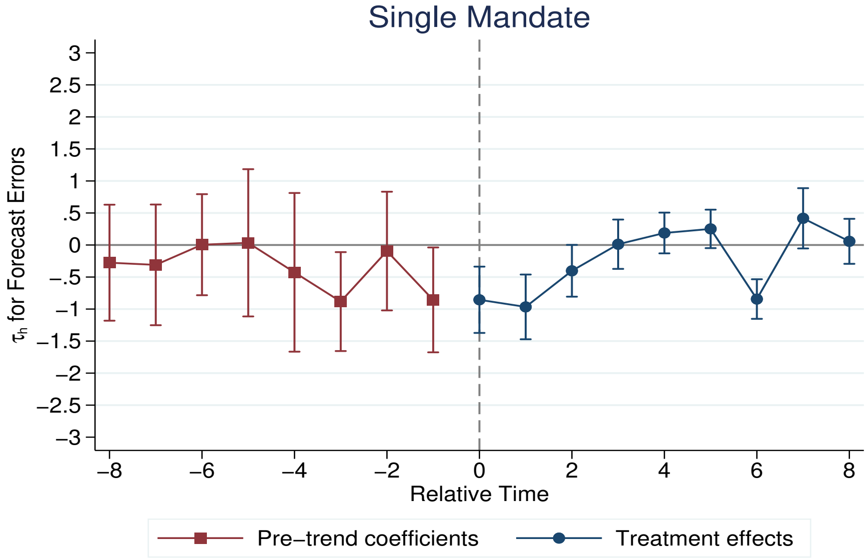
Fact 3a: *Significant but small change in forecast errors in developing economies.*

Figure 1.7: Forecast Errors



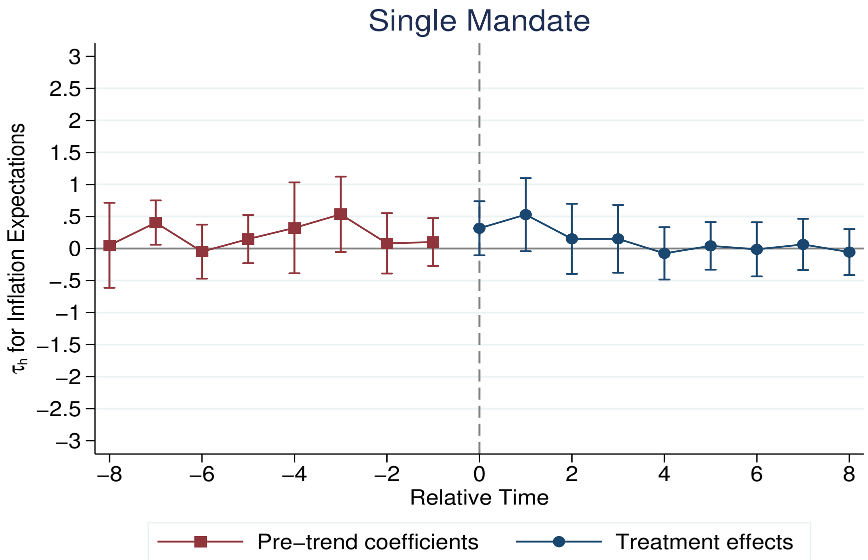
Fact 4: *Forecast errors for those countries whose central banks have single mandates are close to zero a few quarters after implementation.*

FIGURE 1.8: Forecast Errors Around Implementation



Fact 4a: *Inflation expectations for countries with single mandates do not adjust significantly after implementation.*

FIGURE 1.9: Forecast Errors Around Implementation



3.3 Announcement (Anticipation)

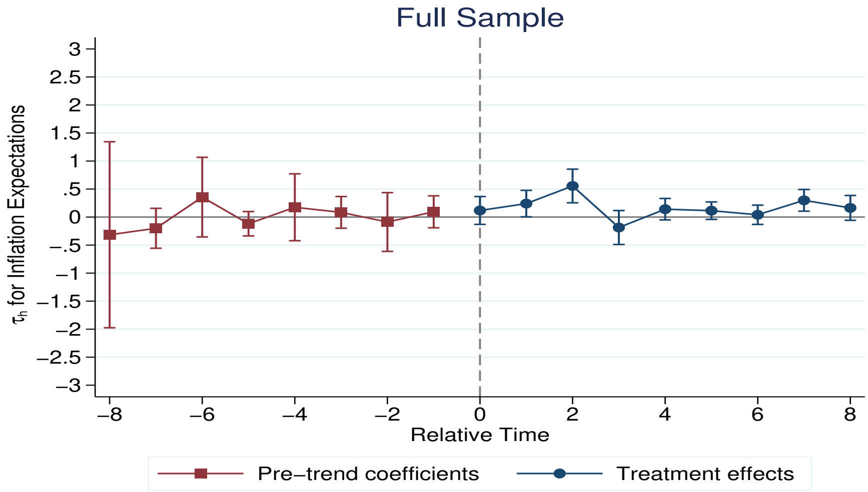
As discussed above the anticipation of the policy is a concern for determining causality (or lack thereof). Thus, let us now observe the findings from using the announcement dates as the date for agents becoming aware of the new policy. The results based on the date of the announcement are not very different to that of implementation. There is a small and statistically significant uptick in inflation expectations based after two quarters of the announcement. However, soon after, the changes become insignificant. There is however not a clearly distinguishable causal effect of the policy announcement on inflation expectations. This is because several countries preferred to make the announcement to switch to Inflation Targeting when inflation was lower than average[13]. Thus, the exogenous state of the economy dictated the introduction of the policy itself. Thus, this result is in line with the result around implementation of the policy.

Forecast errors around the announcement have the same behaviour as around the implementation, for the full sample. However, the behaviour of the forecast errors for single mandate economies differs slightly from before. On average, figure 1.13 suggests that agents continue to over predict inflation after the announcement of the policy. The mechanism behind this remains a decline in inflation as opposed to a rise in inflation expectations except for the small uptick in quarter 2.

Fact 1: *There is minimal change in inflation expectations upon announcement.*

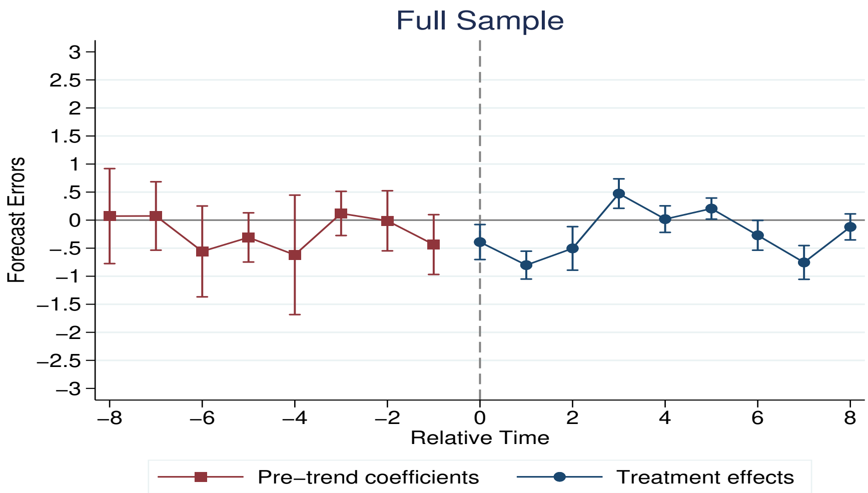
[13] For more details, please see Hammond et al. (2012)

Figure 1.10: Inflation Expectations Around Announcement



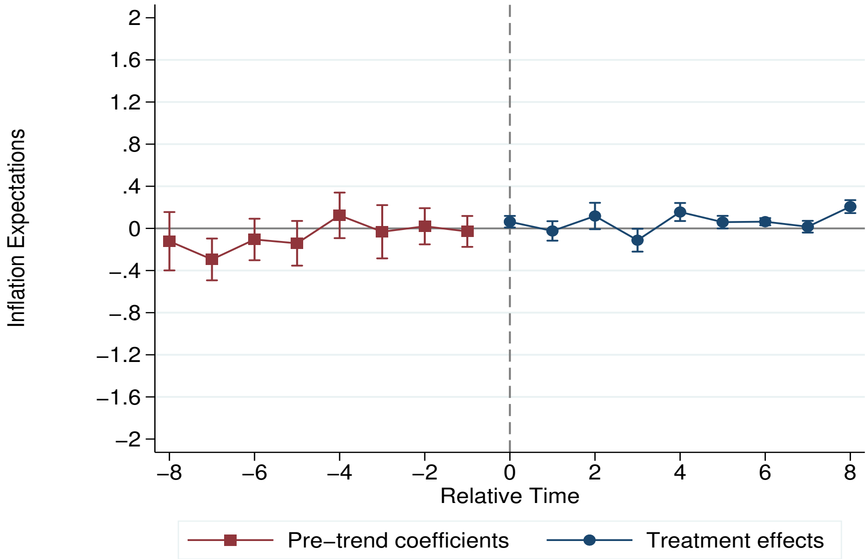
Fact 2: *Forecast errors decline after the announcement of IT.*

Figure 1.11: Forecast Errors Around Announcement



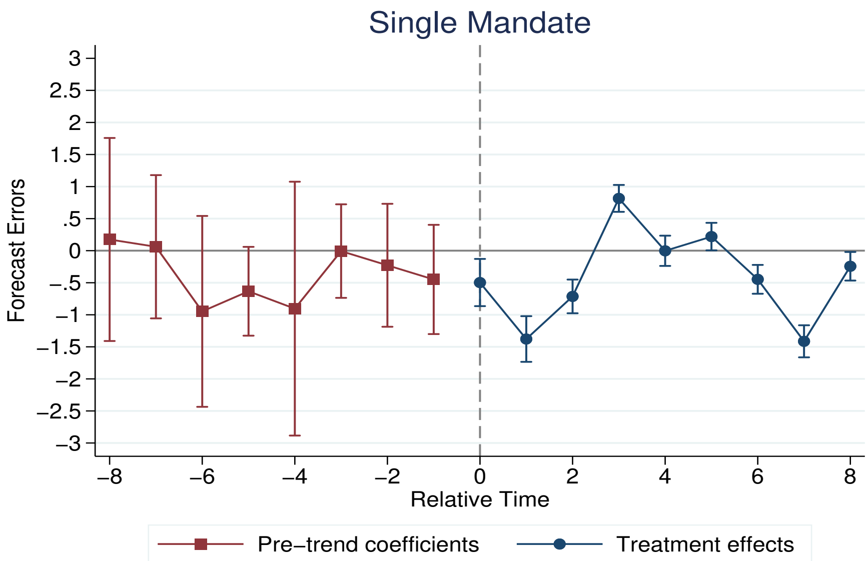
Fact 3: *No change in the advanced economies even after 8 quarters of the announcement.*

FIGURE 1.12: Inflation Expectations Around Announcement



Fact 4: *Forecast errors for single mandate countries decline after 3 quarters.*

FIGURE 1.13: Forecast Errors Around Announcement



The above stated facts are the key findings of the paper. However, appendix H and I provide a detailed breakdown of each variable observed around the change in policy. In addition, it provides graphs which look at the impact up to five years after the implementation and announcement of the policy. The results remain largely unchanged. One interesting fact arises from looking at the results five years ahead, though. There appears to be some form of cyclicality in inflation and inflation expectations roughly about every two years. This is an aspect that is left for further investigation as this could be influenced by individual countries and their varying adoption dates.

4 Robustness Checks

The main finding of the paper is surprising and not encouraging for central banks. Therefore, performing robustness tests becomes more critical. The following section provides details on the different robustness exercises that the paper undertakes. There are two main categories. The first set of checks uses different definitions of rational expectations to check for changes in the policy. Second, different estimators are used as a way to ensure that the results are not in fact driven by the methods used.

4.1 Forecast Revisions and Forecast Errors

Adapted from the FIRE framework and in line with adaptive learning, it is possible to run the following regression by a re-write of 1.8 in the following way,

$$\underbrace{\beta_{it} - \beta_{it-1}}_{\text{Forecast Revision}} = \bar{\alpha} + \kappa\underbrace{(y_{it} - \beta_{it-1})}_{\text{Forecast Errors}} + \gamma_1 t + \gamma_2 \bar{\pi}_t + \epsilon_{it} \tag{1.10}$$

Writing (1.10) allows one to measure the gain directly by using a form of the Huber-Robust regressions as suggested by Coibion et al. (2020) to control for any outliers in the data. The regression is adjusted in the following way to compute the gain parameter.

$$\underbrace{\beta_{it} - \beta_{it-1}}_{\text{Forecast Revision}} = \bar{\alpha} + \bar{\alpha}\mathbb{1}_{t\geq t^*} + \kappa\underbrace{(y_{it} - \beta_{it-1})}_{\text{Forecast Errors}} + \underbrace{\kappa_{IT}(y_{it} - \beta_{it-1})\mathbb{1}_{t\geq t^*}}_{\text{Forecast Errors after IT}} + \gamma_1 t + \gamma_2 \bar{\pi}_t + \epsilon_{it} \tag{1.11}$$

Using the break point as the announcement and implementation date for each country. The key finding is that for most countries the changes after the implementation or announcement are insignificant. There are some countries which find an increase in the estimated gain after IT is announced and implemented. Thus, this result supports the finding that there is no change with either implementation of announcement of the policy. The table below presents the results for a select few countries where there are some significant changes.

Tables 1.1 and 1.2 report the findings of regression (1.11) for Colombia and the US. It can be seen that the gain parameter (κ - coefficient on the forecast errors) does not have a significant change after the policy introduction. The same is also true when using the anticipation dates of IT. Thus, the results are robust to this new definition.

4.1.1 Volatility of Expectations

Apart from anchoring expectations around the inflation target the goal of IT is to reduce the volatility of inflation expectations. To measure the change in volatility of expectations, this paper follows a regression similar to Gürkaynak et al. (2010a). The previous paper suggests regressing a change in inflation compensation on the surprise component of macroeconomic data and policy announcements. Formally, the regression is of the form,

$$\Delta\beta_t = \bar{\alpha} + \gamma_1(y_t - \beta_{t-1}) + \gamma_2\mathbb{1}_{t\geq t^*} + \epsilon_t \tag{1.12}$$

Here, γ_1 and γ_2 are the parameters of interest. Since these capture the effect of inflation surprises on the volatility of expectations. Note, if one were to re-write equation 1.12, it would lead to equation 1.10. And as shown before, this regression leads to the result of no significant change in the level of volatility of expectations after the implementation or adoption of the policy.

Table 1.1: Forecast Revisions on Forecast Errors: Colombia

(a) Implementation

VARIABLES	1	2
Forecast Errors	0.213***	0.413
	(0.0584)	(0.334)
Cons$*\mathbb{1}_{t\geq t^*}$		0.715**
		(0.310)
FE$*\mathbb{1}_{t\geq t^*}$		-0.361
		(0.111)
Constant	0.0217	0.0429
	(0.0855)	(0.0898)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Forecast Errors	0.213***	0.292***
	(0.0584)	(0.0183)
Cons$*\mathbb{1}_{t\geq t^*}$		0.728***
		(0.0724)
FE$*\mathbb{1}_{t\geq t^*}$		-0.0759
		(0.0533)
Constant	0.0217	0.616***
	(0.0855)	(0.0775)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.2: Forecast Revisions on Forecast Errors: United States

(a) Implementation

VARIABLES	1	2
Forecast Errors	0.0722**	0.0687**
	(0.0311)	(0.0339)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.0451
		(0.0486)
FE$*\mathbb{1}_{t\geq t^*}$		0.00428
		(0.0497)
Constant	-0.0153	0.222***
	(0.0220)	(0.0276)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Forecast Errors	0.0722**	0.0706*
	(0.0311)	(0.0366)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.00952
		(0.0463)
FE$*\mathbb{1}_{t\geq t^*}$		9.36e-05
		(0.0704)
Constant	-0.0153	0.224***
	(0.0220)	(0.0274)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2 FIRE Framework

In addition to the regression in the previous section above, one can check the coefficients of the *Full Information Rational Expectations (FIRE)* framework.

Following, Coibion and Gorodnichenko (2015a), Bordalo et al. (2020) the following test is run.

$$\underbrace{y_{it} - \beta_{it-1}}_{\text{Forecast Errors}} = \bar{\alpha} + \bar{\alpha}\mathbb{1}_{t\geq t^*} + \gamma_\kappa \underbrace{(\beta_{it} - \beta_{it-1})}_{\text{Forecast Revision}} + \underbrace{\gamma_{\kappa_{IT}}(\beta_{it} - \beta_{it-1})\mathbb{1}_{t\geq t^*}}_{\text{Forecast Revision after IT}} + \gamma_1 t + \gamma_2 \bar{\pi}_t + \epsilon_{it} \tag{1.13}$$

The regression above is based on the idea that forecast errors should not be predictable by the forecast revisions. One can run the test for each country to check if there have been changes in the predictability of forecast errors. This would capture any changes that might have occurred post the announcement and adoption of IT and therefore an impact of the policy.

Similar to the findings in section (6.1) there is no pattern in the way there are changes in the predictability of forecast errors. However, for some countries such as Colombia and the US, forecast errors have become more predictable after IT compared to before the announcement. The tables below (1.3 and 1.4) present the results for Colombia and the US. The results do not alter significantly if using the date of intervention as the announcement or the implementation of the policy.

Table 1.3: Forecast Revisions on Forecast Errors: Colombia

(a) Implementation

VARIABLES	1	2
Forecast Errors	0.0699	-0.356
	(0.185)	(0.436)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.204
		(0.540)
FE$*\mathbb{1}_{t\geq t^*}$		1.073**
		(0.468)
Constant	-0.283**	-0.0297
	(0.128)	(0.988)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Forecast Errors	0.0699	1.545***
	(0.185)	(0.235)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.559***
		(0.279)
FE$*\mathbb{1}_{t\geq t^*}$		-1.459***
		(0.307)
Constant	-0.283**	1.225***
	(0.128)	(0.171)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1.4: Forecast Revisions on Forecast Errors: United States

(a) Implementation

VARIABLES	1	2
Forecast Errors	0.742***	0.844***
	(0.227)	(0.156)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.0957
		(0.214)
FE$*\mathbb{1}_{t\geq t^*}$		-1.395***
		(0.495)
Constant	-0.176**	0.756***
	(0.0846)	(0.0839)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Forecast Errors	0.742***	0.563
	(0.227)	(0.410)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.155
		(0.171)
FE$*\mathbb{1}_{t\geq t^*}$		0.226
		(0.464)
Constant	-0.0525	-0.344**
	(0.0719)	(0.155)
Observations	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3 New versus Old Targeters

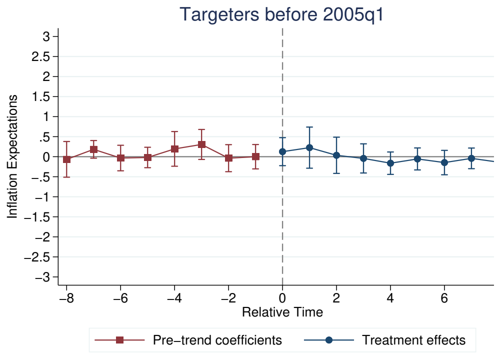
One of the features that is exploited in the event study is the different start dates of the policy. The different dates allow for the construction of the hypothetical which considers how the economies would respond if the policy was not implemented. However, there is one big factor that plays a role in these days. Some of the countries adopted IT after the financial crisis while others in the late 90s and early 2000s. The nature of global shocks was different at both these times. In addition, countries which adopted targeting later had evidence from previous adopters on how implementation. Therefore, this paper now tests whether new adopters of the policy had an advantage and if they were able to capitalise on it.

The data set is now split as per countries which adopted targeting before and after 2005Q1 (as per the announcement date). 2005Q1 is roughly the middle date of the sample period and allows the econometric methodology to still hold with a variety of adoption dates.

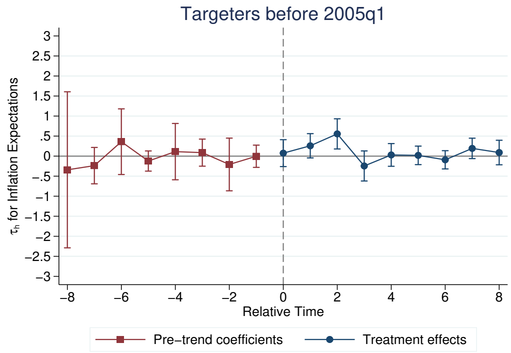
Figure 1.14 presents the findings upon dividing the sample between those who adopted targeting prior to and post 2005q1. An additional variable that controls for the Great Financial Crisis (GFC) is used to capture any effects of the time effects

FIGURE 1.14: Old and New Targeters: Inflation Expectations

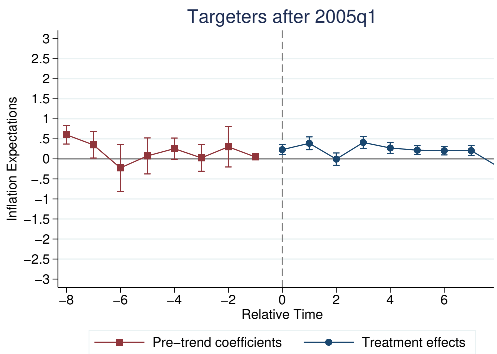
(A) Implementation: Old



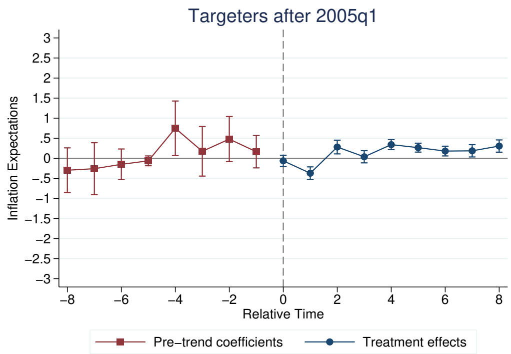
(B) Announcement: Old



(C) Implementation: New



(D) Announcement: New



of the crisis. The results remain the same as those found previously. There is no significant change in inflation expectations on announcement or implementation of the policy. One interesting feature of this study however is the increased volatility of expectations for the countries which adopt IT after 2005q1.

4.4 Central Bank Transparency

Credibility is an important factor for inflation expectations. A simple example of this is the experience of the Latin American economies prior to the independence of the central bank. While monetary policy was still under the government's control, monetary policy had a credibility crisis and there were hyper inflationary cycles. However, after the independence of the central bank many of these countries have seen a steady decline in inflation[14].

While there are no direct measures available for the credibility of the central bank, there is an index of transparency and independence created by Dincer and Eichengreen (2013). This paper uses the index as a proxy for central bank credibility. The more transparent and independent the central bank, the higher the control it has on monetary policy and the ability to reach its objective, thus, making this variable a good proxy. Formally, the following regression is run,

$$\beta_{it} = \bar{\alpha} + \beta_{it-1} + \kappa(y_{it} - \beta_{it-1}) + \gamma_1 t + \gamma_2 \bar{\pi}_t + \gamma_3 TR + \epsilon_{it} \tag{1.14}$$

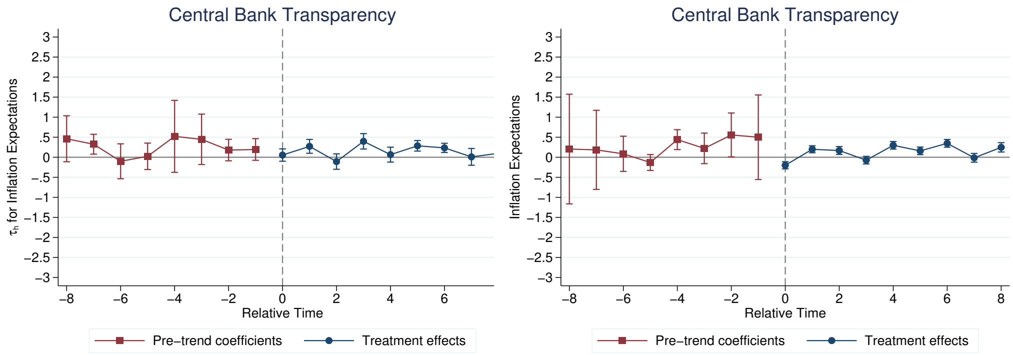
Where, the variables except TR which, measures the transparency of the central bank, are the same as before. The data is available from the period 1998-2019 and is available for all countries except those which are part of the European Monetary Union (EMU), Paraguay, and Uruguay. There is a combined index available for the EMU. However, given the countries announced the implementation of IT in different years, this paper does not include the data for the EMU. Moreover, given the index for central bank transparency is available for a shorter period, the regression is based on a shorter set of countries. The countries used for this analysis are Hungary, India, Japan, Korea, Mexico, Norway, Philippines, South Africa, Switzerland, Thailand, and the United States. An important caveat to highlight here is that the data being used is not weighted by the country GDP or population. The weighted data is not as freely available and is left for further research.

Figure 1.15 show the findings of the paper when central bank transparency is controlled for in the regression. The result for the implementation date remains unchanged. There is no significant change in expectations when the policy is introduced. On the other hand, there is a significant decline in expectations when the policy is announced. However, this decline is not sustained and overturns the following quarter albeit, at a lower level then prior to the announcement.

[14] Duggal and Rojas (2022) show how credible announcements led to a decline in expectations.

FIGURE 1.15: Inflation Expectations After controlling for Transparency

(A) Implementation (B) Announcement



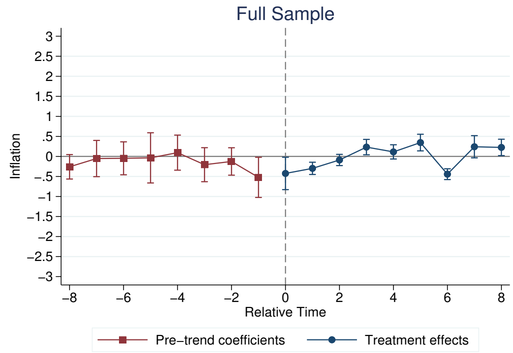
It is key to note here that the sample is significantly reduced making it difficult to draw convincing conclusions of the effect of central bank transparency. Therefore, the paper very cautiously amidst that there is a decline in the level of expectations.

4.5 Controlling for past inflation

One of the big differences across the different countries in my dataset is their experience with inflation. On the one hand, I have countries such as Colombia which have experienced periods of hyperinflation while on the other I have the United States where inflation has been stable in the single digits. Therefore, to account for the variability in the past inflation experiences, I run a robustness check accounting for previous inflation when computing the impact on inflation of the policy.

Figure 1.16 portrays the result from control for previous inflation. As can be seen, controlling for previous inflation results in no change to the key result. There is a decline in inflation following the introduction of Inflation Targeting but inflation expectations do not respond to IT even after controlling for past inflation.

Figure 1.16: Controlling for Past Inflation



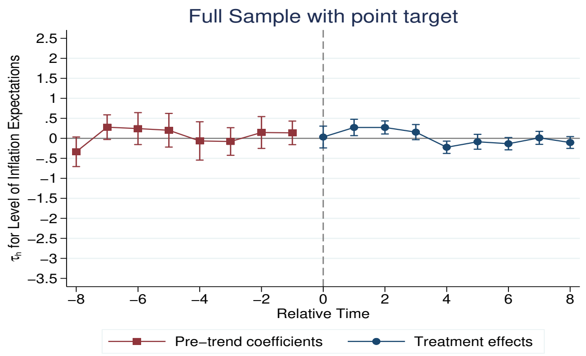
4.6 Expected Changes in Interest Rates

One important factor that aids in the determination of expectations is the future course of monetary policy. One of the variables that is available in the Ifo World Economic Survey is that of future short run intrest rates. The variable for 6 months ahead interest rates is a qualitative measure. It is computed based on 3 possible values: Higher (+), same (=) or lower (-). The balance (difference between the positive (+) and negative (-) shares) is then computed as follows:

$$B_{it} = \left(\frac{(+_{it}) - (-_{it})}{n_{it}}\right)100 \tag{1.15}$$

Where n_{it} is the total number of respondents for each country. Therefore, the measure represents if on average interest rates are expected to increase or decrease in any given period. While the balance is not a perfect measure of future policy it provides an indication as to whether agents expect a tightening or loosening of policy. Thus, providing a measure for how they might adjust expectations before and after the policy is introduced.

FIGURE 1.17: Inflation Expectations Around Implementation: Short-Run Interest Rate



One final note to consider is whether interest rates a reliable measure of computing the counterfactual, given that prior to IT, interest rates were not used as a policy measure. It is always possible to write an interest rule that mimics the money supply rule followed by many countries. Therefore, I continue using the balance as an imperfect measure of future policy.

As figure 1.17, controlling for the future path of monetary policy does not change the results. The response of inflation expectations remains flat upon the introduction of Inflation targeting. This is not surprising given the key result of the paper, where changes in expectations track the changes in inflation. Given that interest rates are aimed at changing realised inflation, it will be difficult to reconcile any changes to inflation expectations after controlling for interest rates.

4.7 Limited Information Robustness Checks

The following section portrays some other checks I have undertaken. However, the results are not very reliable since they have limited/missing information. This implies that producing the counterfactual for these checks would produce large standard errors making inference difficult. I list the checks I undertake with the limited data but highlight the unreliability of the measures.

4.7.1 Point Targets versus Target Ranges

One common difference in how Inflation Targeting is practised across the world is in economies which have point targets versus those which have tolerance bands around the inflation target. Figures 1.18 - 1.21 present the results for these two groups. For the countries with point targets, the results remain robust however for those with target ranges the results vary. However, as mentioned above, the results for economies with target ranges are not reliable given the small sample size.

FIGURE 1.18: Inflation Expectations Around Implementation: Point Targets

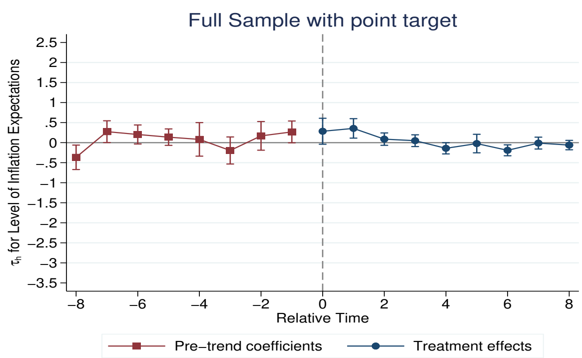


FIGURE 1.19: Inflation Expectations Around Implementation: Target Range

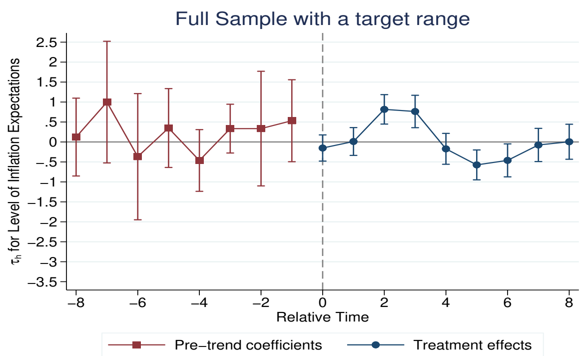


FIGURE 1.20: Forecast Errors Around Implementation: Point Targets

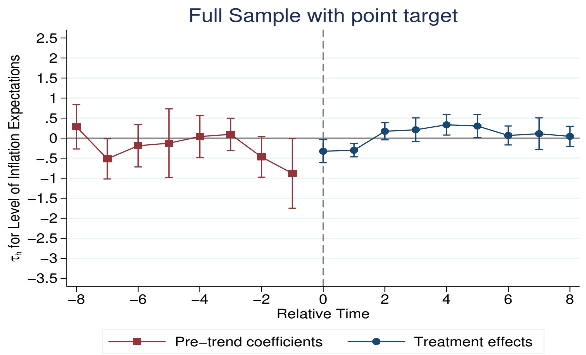
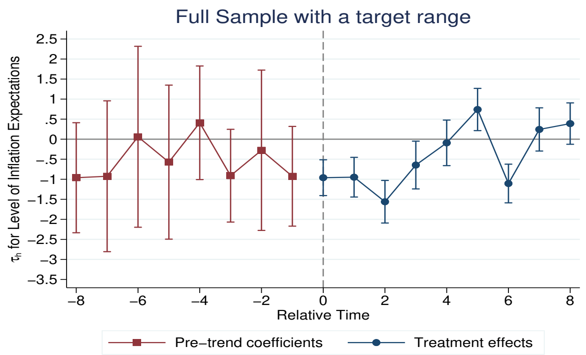


FIGURE 1.21: Forecast Errors Around Implementation: Target Range



4.7.2 Including the Hyperinflationary Economies

As you might recall, in the baseline version of the analysis, I remove economies who have had experience of inflation greater than 50%. This is because the impact of the announcement of a new policy in countries with hyperinflations is unclear. I now run the analysis bringing these countries back into the dataset but only removing the periods where there way hyperinflation. In doing so, I introduce several missing observations in the pre-IT period, resulting in an inaccurate counterfactual computation. Therefore, I do not show the results here.

4.7.3 Controlling for Fiscal Policy stance

Along with the changes in monetary policy, several economies used fiscal policy tightening in conjuction to be able to reduce inflation and make the transition to IT easier. In order to take this into consideration, use the the $\frac{Debt}{GDP}$ ratio as a control for fiscal policy. However, there is a lot of missing data for most economies. I am unable to find series for most of the 1990s for all of the countries. Resultantly, the computation of the series if the policy was not introduced (the counterfactual) is not credible.

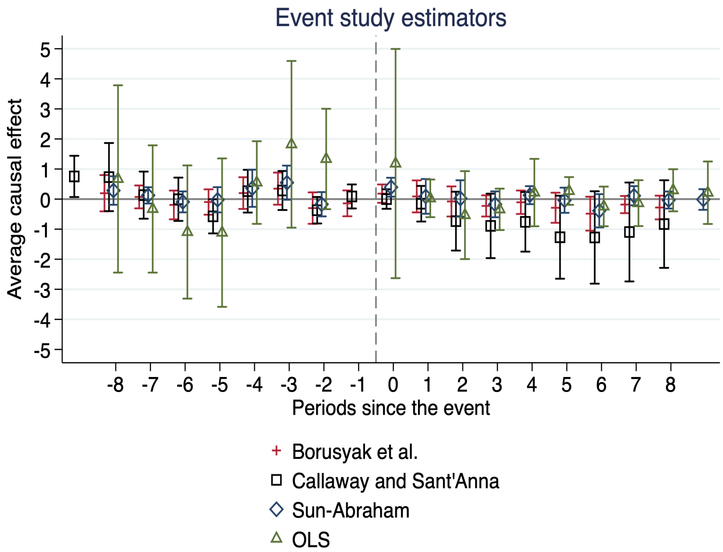
4.8 Other Estimators

The last couple of years have seen a burgeoning literature on the Two Way Fixed Effect literature with an effort to correct the bias in event studies. Two such studies are those of Sun and Abraham (2021) (SA) and Callaway and Sant'Anna (2021) (CS). One key difference between Borusyak et al. (2021) and SA, CS is how the data is used to construct the control group.

First, both CS and SA are group based estimators. That is, the data is grouped according to the year the policy is implemented. Given that the panel data being used in this study is small, this is a limitation to use the estimators. Second, both estimators aim to balance data in event time. This leads to a loss of further information for this study. This can lead to two problems, larger standard errors and inconsistent estimates. Since the imputation strategy in Borusyak et al. (2021) requires one to regress the treatment group to build the control group from all the periods before implementation, the estimator is more robust for this study.

Nonetheless, figure 1.22 presents findings based on 4 different estimators those by OLS, Sun and Abraham (2021), Callaway and Sant'Anna (2021) and Borusyak et al. (2021). As expected, OLS has the worst performance in terms of the estimates and the standard errors. While all estimators provide no evidence of a change in expectations it is important to rely on the estimator which enables the use of the most data.

Figure 1.22: Treatment Effect of Implementation



5 Conclusion

Employing an adaptive learning model and the event study methodology, the paper studies the response of inflation expectations to a change in the monetary policy regime. Specifically, it studies whether agents discount the distant past information in favour of the commitment made by the central bank on keeping inflation low.

The paper finds that countries with a single mandate are able to adjust short-run forecast errors. However, this change in forecast errors is a result of an adjustment in inflation and not inflation expectations. Therefore, the paper delineates that Inflation Targeting does not directly impact short-run expectations. Several robustness checks carried out on the bases of different estimators and definitions also further consolidate this result. Using a simple

While striking there are some limitations of the results. First and foremost, the data used is for a short-run horizon as opposed to long-run data. This is an important drawback since the purpose of Inflation Targeting is to anchor long-run expectations. However, as Carvalho et al. (2021) comment, short run expectations have a direct impact on how anchored on unanchored inflation expectations are.

In addition, at the moment the paper is assuming a constant kalman gain. While convenient, it is a potential channel through which adjustment might be taking place and therefore leading to the result which suggests expectations are not the channel impacting inflation. Resolving these issues are left for further research. Finally, further research aims to build a model that can exploit a change in inflation but not expectations.

Chapter 2

Evolution of Expectations and Optimal Policy

1 Introduction

The introduction of Inflation Targeting (IT) in 1990, ushered a new era in the conduct of Monetary Policy. Increasingly, developed and developing countries alike[1] have adopted the policy. The policy, derived on the basis of a purely-forward looking New-Keynesian Phillips Curve (NKPC), describes that inflation evolves according to the expected evolution of inflation. Thus, central bankers continuously emphasise the critical role of anchoring inflation expectations for effective monetary policy transmission and achieving low and stable inflation. Measures of inflation expectations are therefore important in assessing the credibility of the monetary authority in meeting its objective.

This chapter builds on the question raised in Chapter 1 by assessing whether the *variance*[2] of the agents' expectations respond to the introduction of Inflation Targeting (IT) as the monetary policy framework. In order to account for the transition to the IT regime, I propose two ways in which agents can form expectations, and compute the *speed of learning* of agents prior to and post the introduction of the policy. Finally, based on the measurement of inflation expectations given by surveys, I proceed with the formulation of optimal policy and computation of the welfare costs.

One theme that emerges from figure 2.1 and 2.2 is the overprediction of inflation following the introduction of Inflation Targeting. The graphs above represent

[1] Please refer to Appendix A for a list of IT countries.

[2] In Duggal (2023) I find that the mean of inflation expectations does not respond to the introduction of IT.

realised inflation (solid blue line), survey inflation expectations (red dashed line) and the date of implementation of Inflation Targeting (yellow vertical line) for Colombia and the US. The consistent overprediction suggests that agents use a recursive updating to generate their forecasts. Therefore, the paper attempts to extend the literature in two ways. First, I aim to capture the evolution of inflation expectations where there is a regime shift using a constant gain learning model. Any changes in expectations following the regime shift will be captured by the gain parameter.

Figure 2.1: Colombia: Inflation and Inflation Expectations

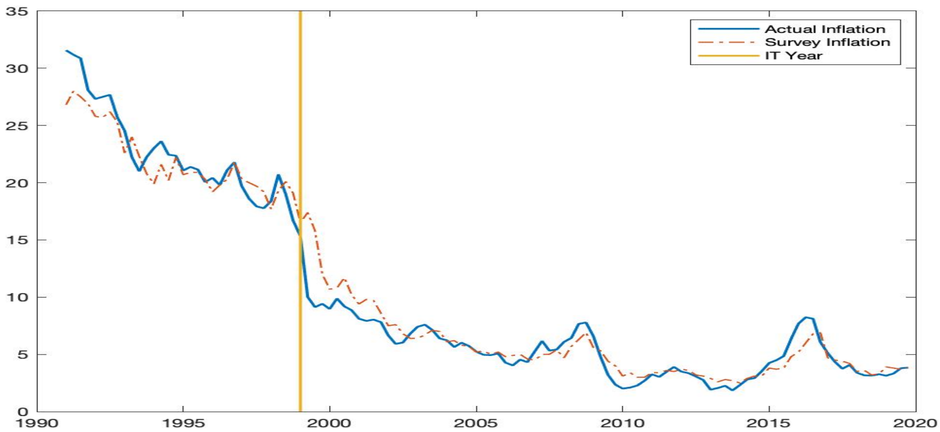
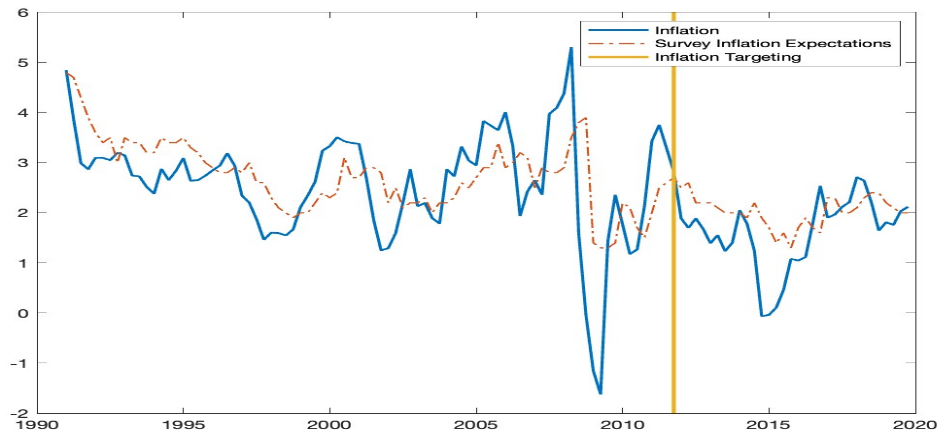


Figure 2.2: United States: Inflation and Inflation Expectations



Second, using the results obtained from extracting the learning process from survey evidence, I attempt to compute optimal policy. I assume that the central bank is rational and knows how agents form their expectations, taking them into account when solving the welfare loss function. The model I use is the workhorse New Keynesian (NK) model with forward looking expectations, allowing for a comparison to previous literature.

The primary finding is that agents don't immediately adjust their expectations to the new regime. The speed of learning remains stable around 0.01 prior to and after the introduction of IT. In addition, taking a long-term horizon view the speed of learning remains largely unchanged. This result is contrary to what intuition would dictate should happen when there are changes to monetary policy frameworks since the speed of learning indicates the weight that agents attach to forecast errors. The lower values of the Kalman gain indicate high persistence in inflation expectations and lower sensitivity to new information[3]. This result provides credence to the results in Chapter 1 which dictates that inflation expectations lag realised inflation.

Second, computing optimal policy using the stochastic algorithm for the post inflation targeting period, I find that the central bank faces an intertemporal trade-off in addtion to the well known intratemporal trade-off similar to the results found by Gaspar et al. (2006), Orphanides and Williams (2007) and Molnár and Santoro (2014). The numerical analysis suggests that incorporating the intertemporal trade-off has substantial welfare gains. However, the more noteworthy characteristic of the model is that with a slight deviation from rational expectations, the coefficients on the reaction functions of the central bank are close to the ones found under RE. This suggests that while the central bank needs to emphasise the stabilisation of inflation expectations by acting aggresively, the scale of the response is smaller than the one suggsted by Molnár and Santoro (2014). Specifically, a small weight on the inflation target ($\approx$ 10%) in the agents' beliefs enables the central bank response function to be close to the first best rational

[3]Central Banks hope to achieve targeting by lowering the the gain over time after IT in a periods of three to five years within the framework for "flexible" inflation targeting (Bernanke and Woodford, 2007).

expectations equilibrium. The response is predominantly driven by the weight the agents attach to the target and less by the speed at which agents learn.

To summarise, I find that for a small deviation from rational expectations and a relatively low weight on the inflation target, there are large gains that can be made. Therefore, an optimally behaving monetary authority should aim to anchor inflation expectations as suggested by Coibion et al. (2018). Moreover, there should be clear communication about the target which helps agents more compared to when they are uncertain about the target as also suggested by Orphanides and Williams (2004).

Related Literature This paper builds on two strands of literature within monetary policy namely, inflation expectation formation and optimal monetary policy under learning. First, it relates to discussions about inflation expectations and their formation. Several authors such as Mankiw et al. (2003), Branch (2004) and Del Negro and Eusepi (2011) have emphasised how existing models which rely on the rational expectations assumption have not been successful in explaining survey evidence for inflation expectations. They rely on various empirical analyses to evidence the deviation of survey expectations from rational expectations. In particular, Mankiw et al. (2003), Carroll (2003), Cavallo et al. (2017), and Coibion et al. (2018) show that professional forecasters, households and firms do not follow the rational expectation hypothesis. They find that even with inflation data availability agents use less accurate sources of information such as their own memory, to forecast inflation. Similarly, they suggest that inflation expectations of households do not respond to monetary policy at low interest rate levels and question the use of anchoring of inflation expectations as a tool for monetary policy.

In a seminal paper, Erceg and Levin (2003) show under inflation targeting, households and firms use an optimal filtering algorithm to disentangle persistent and transitory shifts in the monetary policy for the Volcker disinflation period. They in turn find that this leads to increased persistence in inflation which further feeds into agents under/over-predicting the expected future path of inflation. In addition, using a medium scale DSGE model, Ormeño and Molnár (2015) also suggest that allowing agents small deviations from rational expectations fits survey expectations better.

Incorporating the information above, immense literature has examined the robustness of Taylor-type rules in light of learning. For instance, Bullard and Mitra (2002), Bullard and Mitra (2007), Evans and Honkapohja (2008) and Cogley et al. (2015). They find that the rules that guarantee stability under rational expectations are often unstable when agents are learning. Orphanides and Williams (2004), Orphanides and Williams (2007) posit that the misconception of private agents calls for greater policy inertia, a more aggressive response to inflation and a smaller response to the uneployment gap. On the other hand, limited literature has attempted to answer the question of optimal monetary policy and the importance of the central bank's effective communication and credibility.

This paper builds on this strand on literature to compute optimal policy closely related to Gaspar et al. (2010) and Molnár and Santoro (2014). Gaspar et al. (2010) suggest that the loss under learning is close to the loss under committment. Furthermore, they find that the ability of the central bank to adapt to cost-push shocks, depending on the state of the economy, is only of second-order importance relative to reducing the persistence in inflation. Molnár and Santoro (2014) reinforce this finding by analytically deriving optimal policy in an NK model when agents are learning. They use a constant gain as well as a decreasing gain learning to portray that the central bank faces an inter-temporal trade-off and that the central bank should act aggressively to stabilise inflation expectations.

This paper attempts to bridge the gap between these two strands of literature by focusing on how agents form expectations with inflation targeting and subsequently suggesting the optimal policy rule the central bank should follow.

Roadmap This paper is organised as follows. Section 2 presents a model for agents' expectations. Section 3 discusses the computation of the speed of learning and presents the results. Section 4 builds a model for optimal policy. Finally, section 5 concludes with directions for further research.

2 Theoretical Framework

2.1 Model Description

Before identifying the process for inflation expectations around the policy change, it is important to first and foremost understand the variation in true inflation during the same period. Thus, allowing for the closest approximation of expectations given the inflation dynamics in a specific country.

Consider an economy, with inflation evolving according to a uni-variate unobserved component model, based on Stock and Watson (2007) and Stock and Watson (2016). Specifically, let inflation be the sum of two unobserved components, a trend given by τ_t and a transitory component, ε_t, where the variances of the two disturbances change over time.

$$\pi_t = \tau_t + \varepsilon_t, \text{ where, } \varepsilon_t = \sigma_{\varepsilon,t}\zeta_{\varepsilon,t} \tag{2.1}$$

$$\tau_t = \tau_{t-1} + \vartheta_t, \text{ where, } \vartheta_t = \sigma_{\vartheta,t}\zeta_{\vartheta,t} \tag{2.2}$$

$$\ln \sigma^2_{\varepsilon,t} = \ln \sigma^2_{\varepsilon,t-1} + \nu_{\varepsilon,t} \tag{2.3}$$

$$\ln \sigma^2_{\vartheta,t} = \ln \sigma^2_{\vartheta,t-1} + \nu_{\vartheta,t} \tag{2.4}$$

$\zeta_t = (\zeta_{\varepsilon,t}, \zeta_{\vartheta,t}) \sim iid(0, I_2)$ and $\nu_t = (\zeta_{\nu,t}, \zeta_{\nu,t}) \sim iid(0, \gamma I_2)$. Moreover, $Cov(\zeta_t, \nu_t) = 0$. Where, γ is a smoothing parameter for the stochastic volatility process.

The choice of a stochastic volatility model for inflation is based on Stock and Watson (2007). The authors argue that post the 1980s a lower order auto regressive process became a less accurate approximation of the inflation process. In addition, they suggest that the changing nature of the processes for inflation requires a time varying process. The paper assumes that the process for inflation in the pre and post inflation targeting period remains the same. This is because the choice of a stochastic volatility model allows for accounting for a regime shift without imposing one. Specifically, a regime shift would imply, that subject to well anchored inflation expectations, the variance to the trend (or) permanent component of inflation (ϑ_t), will decrease over time.

Thus, given the properties of an unobserved components process to map inflation, this paper assumes the same for the model economy. Let us now turn to the timing in the model and the formation of beliefs.

FIGURE 2.3: Timing of the model

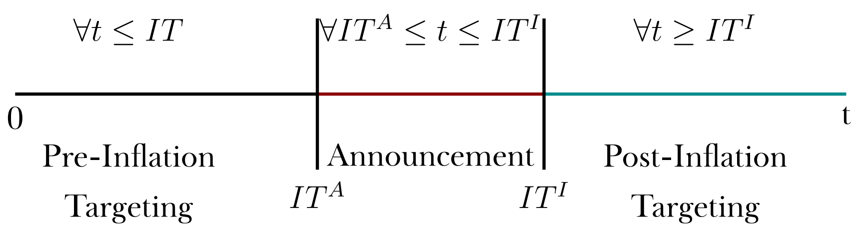


Figure 2.3 summaries the timing of the model. There are three distinct intervals $0 < t < IT^A$, $IT^A < t < IT^I$ and $t > IT^I$ which represent the pre-IT, announcement and post-IT period. Once IT has been adopted in the economy it can no longer change the monetary policy framework. Let us now turn to how agents form expectations in this economy.

2.2 Belief Formation

Given that the rational expectations hypothesis does not hold with the survey data, I assume a more flexible information structure for the agents. That is, agents have subjective expectations about the evolution of the aggregate price level in the economy and form expectations using an unobserved component model[4].

[4]This model is similar to the statistical IMA model introduced by Stock and Watson (2007)

Agents must learn in this economy because they do not know the true underlying process for inflation which is given by the stochastic volatility model in equations (2.1) to (2.4). Therefore, they must behave as econometricians to forecast future inflation given by $\mathbb{E}^P \pi_{t+1} = \tilde{\beta}_t$.

2.2.1 Pre-Inflation Targeting

Consider agents who think that the process for inflation is the sum of a persistent component β_t and a transitory component ϵ_t.

$$\pi_t = \beta_t + \epsilon_t \tag{2.5}$$

$$\beta_t = \beta_{t-1} + \eta_t \tag{2.6}$$

Equations (1) and (2) represent the Perceived Law of Motion (PLM) for the agents, $\epsilon_t \sim ii\mathcal{N}(0, \sigma_\epsilon^2)$ and $\eta_t \sim ii\mathcal{N}(0, \sigma_\eta^2)$ are independent of each other and jointly iid. This implies that $E[(\epsilon_t, \eta_t)|I_{t-1}] = 0$, where I_{t-1} includes all the variables in the agents' information set up to $t-1$. Assume that agents' prior beliefs are given by,

$$\tilde{\beta}_0 \sim N(\bar{\beta}_{-1}, \sigma^2_{\tilde{\beta},0})$$

The priors here are computed using a training sample of realised inflation. Regressing inflation on a presample period allows one to avoid over sensitivity of the data to the current temporary shocks. Since agents behave as econometricians, optimal updating implies,

$$\tilde{\beta}_t = \tilde{\beta}_{t-1} + \gamma(\pi_t - \tilde{\beta}_{t-1}) \tag{2.7}$$

$$\gamma = \frac{\tilde{\sigma}^2_{\tilde{\beta},0} + \sigma^2_\eta}{\tilde{\sigma}^2_{\tilde{\beta},0} + \sigma^2_\epsilon + \sigma^2_\eta} \tag{2.8}$$

Where, κ gives the strength at which agents update their beliefs. That is, the speed at which agents adjust to new information in the economy.

The choice of using a constant gain learning algorithm to model expectations is in line with the literature. It is commonly noted that a constant gain parameter can track structural changes better than a decreasing gain parameter. However, this comes at an additional cost of increased asymptotic variability. Given that the paper is considering a change in policy regime. It is therefore reasonable to use a constant-gain algorithm. Furthermore, agents in this model only use past inflation and their forecast error to form expectations about inflation. The paper abstracts from using other variables as part of the PLM since with inflation data the PLM does well in capturing the formation of expectations.

Equation (2.7) reflects the model agents use to forecast inflation until period $t < IT^I$. At $t = IT^I$, targeting is implemented with an announced inflation target given by π^T which is known by the agents.

2.2.2 Post Inflation Targeting

Given the change in policy $\forall t \geq IT^I$, the agents can adjust their beliefs in two possible ways. Similar to the assumption in Duggal (2023), the agents may or not believe that there is a change in inflation following the change in policy. Therefore, if the agents don't believe that the introduction of IT will change inflation, they continue to use the same PLM.

The second possibility is that agents now believe that inflation is a weighted average of their beliefs yesterday and the inflation target. That is,

$$\beta_t = (1-\nu)(\beta_{t-1} + \gamma(\pi_{t-1} - \beta_{t-1})) + \nu\pi^T \tag{2.9}$$

The key difference in the model between equations 2.7 and 2.9 is that now the inflation target is an additional source of information that the agents use to form their expectations. There are a few reasons to include this change in the PLM. First, there was an explicit adoption of the new policy regime with amendments to the objectives of the central bank. Second, the agents being modelled are professional forecasters who have extensive knowledge of the economy. In addition, the aim of IT is the anchoring of inflation expectations. Specifically, reducing the mean and variance of expectations. Third, the inclusion of the inflation target in the PLM is indicative of some credence being paid to the announcement by the central bank. If the agents do not use the inflation target as an additional source of information in their PLMs, it would imply that the expectation channel of monetary policy may not be as strong as it is thought to be and brings to the forefront a potential credibility problem.

Notice however, that equation 2.9 entails the two extremes of whether agents adjust their expectations and fully adjust to the introduction of the inflation target ($\nu = 1$) or if they do not believe the change and continue to form expectations as before ($\nu = 0$).

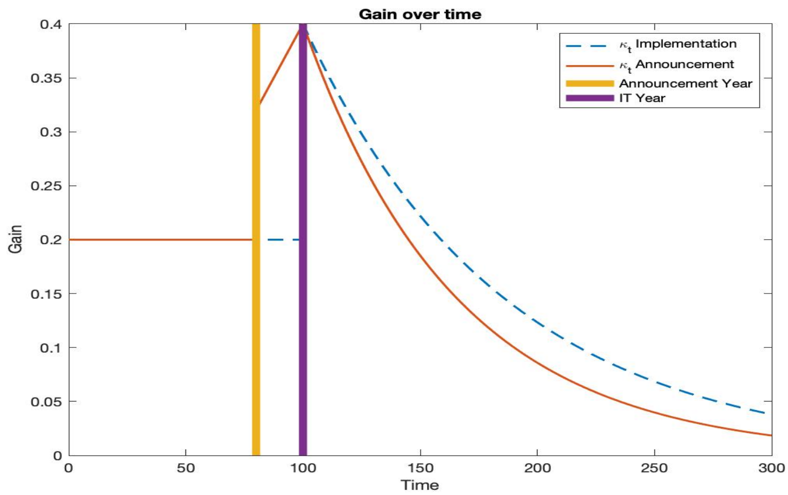
Let us now turn to the key hypothesis for the paper which is highlight using the gain parameter or speed of learning, γ. The Gain represents how much agents respond to new information. That is, how quickly they take into account the previous prediction error. The higher the value of the Kalamn Gain, the more weight the agents attach to the recent past. Therefore, $\gamma \approx 1$ would imply agents update their information immediately in every period and discount all previous information. On the other hand, $\gamma \approx 0$ would imply that agents take into account all the information from all the previous periods available to them. This would then imply that agents use a decreasing gain algorithm as opposed to a constant gain algorithm.

Based on the constant gain learning model, figure 2.4 provides some intuition regarding the change in expectations. The yellow and purple lines represent the date when the change in policy is announced and the date of implementation of the policy, respectively. The dashed blue line and the solid red line represent the potential path of the Kalman gain after the change in policy. Assuming that the Kalman Gain is at steady state prior to the announcement and implementation of Inflation Targeting[5].

[5]This is not an unreasonable assumption. Since the period prior to Inflation Targeting witnessed high inflation volatility, one can assume that agents discounted information almost at a constant rate since agents would not necessarily expect policy changes to sustain.

One caveat needs to be highlighted here. The hypothesis assumes a time varying gain. Given the limitations in the number of data points availble to compute the Kalman Gain, I will have to compute the steady state Kalman Gain at different points in time. However, the key idea of how the transition works should be reflected in the steady state values at different points in time. This is a limitation which can be dealt with if I were to have access to monthly data, for example.

FIGURE 2.4: Hypothesis: Gain over time



As can be seen, there are two possibilities for how inflation expectations adjust (γ) based on past experiences. Under constant gain learning, when agents notice that there has been a change in the policy on implementation and the policy is credible, agents will immediately discount the distant past and adjust expectations quickly. This is what the constant gain ($0 < \gamma < 1$) will capture. The higher (lower) the value of the gain ($\gamma \approx 1$), the more (less) the agents discount the distant (recent) past and use the recent (distant) history to forecast future inflation. Therefore, as central banks continue to build credibility - defined as inflation being at or near its target - after the introduction of Inflation Targeting, agents would become less sensitive to external shocks implying that the constant gain model would eventually become a decreasing gain model.

The other alternative is that agents believe the announcement as soon as it is made (before the implementation of the policy). Consequently, the constant gain (γ) adjusts before the policy is implemented and then steadily declines as the central bank delivers on its targets and mandate. Notice, there can be two jumps after the announcement. It could be that at the time of the announcement, agents partially believe the change and therefore discount some information. They further adjust expectations once there has been full implementation of the policy has occurred.

This paper therefore exploits two properties of the agents' beliefs. First, introducing the inflation target to the PLM of the agents and therefore a change in the priors. Second, the Kalman gain specifically, the weight that agents attach to the inflation surprise agents witnessed in the previous period. Given it can be a measure of elasticity of information. That is, how much agents respond to new information on observing inflation and perceived permanent and temporary shocks.

2.3 Quantitative Performance of the Model

Whether the simulated model reflects reality from the perspective of the agents' is something that needs to be tested. Following Adam et al. (2016), Adam et al. (2017) and Duffie and Singleton (1993) this paper uses the Method of Simulated Moments (MSM) to estimate and test the model. Using this method, allows us to focus on the ability of the model to explain specific moments of the data.

One of the objectives of Inflation Targeting as a policy is to reduce the mean, volatility, and persistence of inflation expectations. As discussed in the introduction, several economies tend to overpredic inflation following the introduction of the policy. Therefore, I also test the ability of the model to explain the ability the forecast errors. Depending how agents interpret the change in policy (as a temporary or permanent shock), agents could have higher or lower forecast errors.

Therefore, the moments that the paper uses to measure the performance of the model are given by,

$$\hat{\theta}_{pre} = \{\gamma\},\ M_{pre} = \left(E(\hat{\pi^e}), \sigma_{\hat{\pi^e}}, \rho_{\hat{\pi^e}}, E(\pi \hat{-} \pi^e), \sigma_{\pi \hat{-} \pi^e}, \rho_{\pi \hat{-} \pi^e}\right)$$
$$\hat{\theta}_{post} = \{\gamma, \nu\},\ M_{post} = \left(E(\hat{\pi^e}), \sigma_{\hat{\pi^e}}, \rho_{\hat{\pi^e}}, E(\pi \hat{-} \pi^e), \sigma_{\pi \hat{-} \pi^e}, \rho_{\pi \hat{-} \pi^e}\right)$$

Accounting for the model above, the only free parameter is the Kalman gain (γ). In the post-IT period an additional parameter is free, which is the weight that agents attach to the inflation target (ν). While, the variance of the permanent, transitory shocks and the variance of the priors are also free parameters, the Kalman Gain summaries their variances. Moreover, allowing only two parameters to match the moments allows for superior performance since the criteria becomes stricter. Let us now turn to the details regarding the computation of the moments.

Let $\hat{S}_N \in R^s$ denote the sample moments that will be matched in the estimation with N denoting the sample size and $s \leq 6$. Furthermore, let $\tilde{S}(\theta)$ denote the moments implied by the model for some parameter θ. The MSM parameter estimate $\hat{\theta}_N$ is defined as,

$$\hat{\theta}_N = \arg\min_{\hat{\theta}}[\hat{S}_N - \tilde{S}(\theta)]'\hat{\Sigma}^{-1}_{S,N}[\hat{S}_N - \tilde{S}(\theta)] \tag{2.10}$$

The estimate of $\hat{\theta}$ chooses the model parameter such that that the model moments $\tilde{S}(\theta)$ fit the observed moments $\hat{S}_N$ as closely as possible in terms of a quadratic form with a weighting matrix $\hat{\Sigma}^{-1}_{S,N}$.

The variance-covariance matrix given by $\hat{\Sigma}_{S,N}$ is an estimate of the variance-covariance of the sample moments $\hat{S}_N$. The Newey West estimator is used to compute the matrix of moments of the sample. The variance of the for the sample statistics is given by the following,

$$\hat{\Sigma}_{S,N} \equiv \frac{\partial S(M_N)}{\partial M'}\hat{S}_{w,N}\frac{\partial S(M_N)'}{\partial M} \tag{2.11}$$

Where, M_N contains the sample moments and $\hat{S}_N$ contains any functions of these moments. For example, M_N would contain the $\hat{v}ar(\pi_t^e)$ and $\hat{S}_N$ contains the serial correlation of inflation.

This approach also provides an overall test for the model. Under the null hypothesis that the model is correct, we have

$$\hat{W}_N \equiv N[\hat{S}_N - \tilde{S}(\hat{\theta}_N)]'\hat{\Sigma}_{S,N}^{-1}[\hat{S}_N - \tilde{S}(\hat{\theta}_N)] \rightarrow \chi^2_{s-4} \text{ as } N \rightarrow \infty \tag{2.12}$$

It is important to note that for the method of simulated moments, one requires the property of geometric ergodicity to be satisfied. This paper uses the results from Adam et al. (2016) and Duffie and Singleton (1993) to allow for an asymptotic distribution for constant gain models.

Table 2.1 portrays how well the model captures inflation expectations and the forecast error, pre and post targeting for the United States. The assumed model for expectations is able to capture the mean and autocorrelation of the inflation expectations and forecast errors but underpredicts the volatility of expectations. This however, can be easily fixed with adding some variance to the beliefs of the agents.

TABLE 2.1: Moments: United States

	Pre-IT		Post-IT	
Moment	Model	Data	Model	Data
$\widehat{E(\pi_t^e)}$	2.02	2.69	2.22	2.05
$\widehat{\sigma_{\pi_t^e}}$	1.92	7.91	0.71	4.37
$\widehat{\rho_{\pi_t^e}}$	0.166	0.201	0.27	0.34
$\widehat{E(\pi_t - \pi_t^e)}$	-0.045	-0.095	-0.021	-0.471
$\widehat{\sigma_{\pi_t-\pi_t^e}}$	1.033	2.11	1.01	0.707
$\widehat{\rho_{\pi_t-\pi_t^e}}$	-0.057	-0.005	0.031	0.033

Let us now turn to the key parameters of interest the speed of learning and the weight that agents attach to the inflation target.

2.4 Discussion

As noted in section 2.2.2, the hypothesis is that the introduction of inflation target should induce a higher weight (Kalman Gain) on the forecast error and then a gradual reduction in the weight that agents attach to the forecast errors. Table ?? provides the results of the Kalman Gain for the, pre and post Inflation Targeting periods for the United States[6].

TABLE 2.2: Parameters

Parameters	Pre-IT	Post-IT	
		5 Years	Full Sample
κ^C	0.016	0.015	0.020
α^C	-	0.0001	0.09
κ^{US}	0.0058	-	0.004
α^{US}	-	-	0.03

Contrary to what the hypothesis in Figure 2.4 suggests, I find the Kalman Gain is time invariant. That is, agents are not reactive to a change in the monetary policy stance. This could be possible for two reasons. First, given the US has experienced relatively low volatility of inflation in the years preceding the introduction of the new monetary policy framework, the change in policy is not a significant change for the agents. Second, as has been posited by Bracha and Tang (2022) agents in low inflation environments pay less attention to changes and policies. The results of the Kalman Gain contradict the recent evidence presented by Cavallo et al. (2017) who suggest that economies in low inflation environments have a lower weight on the priors. The value of the Kalman Gain suggests that agents' beliefs are persistent.

The surprising element of the results presented above is the low weight attached to the inflation target in the agents' beliefs. This is because the agents being considered in the survey are professional forecasters. It is not unreasonable to posit that well informed agents of the economy would incorporate all available information while forming their beliefs. However, the results suggest that the inflation target is not

[6] Due to the fact that the number of periods post inflation targeting are limited, I am unable to split the sample further.

informative for the formation of the beliefs. Taken together, the results reinforce the finding in Duggal (2023) that is, inflation expectations lag behind inflation and are persistent.

Finally, using the value of α^{US}, it is possible to compute the time horizon which would allow central banks to gain limited credibility surrounding the inflation target. Given the data has a horion of six months ahead inflation forecasts, it is easy to determine that in 5 years time, the weight that agents will attach to the target will be close to 30%. As will be demonstrated in the next section, even a weight of 30% on the inflation target can ease the job of the central bank and can bring the economy closer to the rational expectations equilibrium.

3 Optimal Policy

Given the findings in Section 2 about the the way agents form expectations, I would now like to understand how that can inform monetary policy. Particularly, I derive the reaction function of the central bank taking into account how agents form expectations for the post inflation targeting period.

3.1 Model

I employ the standard New Keynesian (NK) model in reduced form, derived by Galí (2015)[7] and follow the approach of Evans and Honkapohja (2008) and Cogley et al. (2015) to build the model. That is, the behaviour of the private sector is characterised by the following two equations. The NK Phillips Curve (NKPC)[8], which is given by,

$$\pi_t = \kappa x_t + \beta \mathbb{E}_t^{\mathcal{P}} \pi_{t+1} + u_t \tag{2.13}$$

[7] Which is based on a non-linear framework of of representative consumer and continuum of firms producing differentiated goods under monopolistic competition.

[8] Here I assume that $\tilde{E}_t \pi^T = \pi^T$, therefore it can be take out of the expectations since it is a constant.

where π_t is inflation, x_t is output gap and $\tilde{E}$ represent the private agents' expectations, which may not be rational and $0 < \beta < 1$, $\kappa > 0$[9]. The second equation is the Investment-Saving (IS) curve derived from the Euler equation of the consumer optimisation problem and given by,

$$x_t = \mathbb{E}_t{}^{\mathcal{P}} x_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t^{\mathcal{P}} \pi_{t+1}) \tag{2.14}$$

where i_t is the interest rate set by the central bank and $\sigma > 0$. We assume that $u_t \sim N(0, \sigma^2)$ is a white noise cost-push shock. Milani (2006) in an empirical study supports the use of an *iid* cost-push shock when agents are learning. Since, learning endogenously generates persistence in inflation data.

Finally, the loss function of the Central Bank (CB) is given by,

$$E_0 = \sum_{t=0}^{\infty} \beta^t ((\pi_t - \pi^T)^2 + \alpha x_t^2) \tag{2.15}$$

where α is the relative weight the CB attaches to the objective of output stabilisation. We assume that the CB has RE. It is reasonable assumption since in general the CB has more information about the economy when compared to the agents. While allowing for complete knowledge is a strong assumption, it is necessary to keep the model tractable and arrive at useful insights.

I assume that agents estimate inflation and output using the following rules,

$$\mathbb{E}_t^{\mathcal{P}} \pi_{t+1} = (1 - \nu)(a_{t-1} + \gamma_t(\pi_{t-1} - a_{t-1})) + \nu \pi^T \tag{2.16}$$

$$\mathbb{E}_t^{\mathcal{P}} x_{t+1} = b_{t-1} + \gamma_t(x_{t-1} - b_{t-1}) \tag{2.17}$$

Following Evans and Honkapohja (2003) (EH from here on) and Molnár and Santoro (2014) (MS from here on) I solve for optimal policy. Using this framework as the benchmark I assume, as termed by Kreps (1998) that the central bank is an anticipated utility maximiser.

[9] As highlighted in Preston (2003) when departing from RE the NK model should also include forecasts many periods into the future. However, for tractability and ease of comparison, I use the one period ahead Euler equation to solve for optimal policy.

3.2 Benchmark Optimal Policy (RE and Learning)

Clarida et al. (1999) show that the policy problem the central bank faces is to minimise the social welfare loss subject to the IS cure, NKPC and agent's expectations (discretionary monetary policy),

$$\min_{\{\pi_t, x_t, i_t\}} E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \alpha x_t^2) \tag{2.18}$$

given,

$$x_t = \mathbb{E}_t^{\mathcal{P}} x_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t^{\mathcal{P}} \pi_{t+1})$$
$$\pi_t = \kappa x_t + \beta \mathbb{E}_t^{\mathcal{P}} \pi_{t+1} + u_t$$
$$\mathbb{E}_t^{\mathcal{P}} \pi_{t+1}, \mathbb{E}_t^{\mathcal{P}} x_{t+1}$$

They find the optimality condition (at time t) under rational expectations and a zero percent target rate of inflation for this problem to be,

$$\frac{\kappa}{\alpha}\pi_t + x_t = 0 \tag{2.19}$$

Evans and Honkapohja (2003) and Molnár and Santoro (2014) also deviate from the framework by introducing learning. Specifically, the learning process used in our model is also given by a constant gain stochastic algorithm as in Molnár and Santoro (2014). The key difference between Molnár and Santoro (2014) and this paper is the updating rule that is used by the agents for inflation. Particularly, I derive a stochastic algorithm using empirical evidence on household inflation expectations. Moreover, this paper takes into account the regime shift using initial conditions and the inflation target, which has not been considered in MS. In the following section, I present a model which derives the actual law of motion for inflation, output and interest rate based on the learning algorithm computed in section 2. Additionally, I compute the welfare loss arising from the optimal policy.

3.3 Optimal Policy under Learning

This paper posits that by considering a different algorithm than the ones suggested by EH or MS, the monetary authority can do better in terms of welfare loss. I assume that private agent's expectations are formed according to adaptive learning. Agents do not know the exact process followed by the endogenous variables but recursively estimate a perceived law of motion (PLM) consistent with the law of motion the central bank implements[10]. I solve the optimal policy problem for a discretionary monetary policy for comparability and tractability.

Let us define, $\mathbb{E}_t^{\mathcal{P}}\pi_{t+1} \equiv a_t$ and $\mathbb{E}_t^{\mathcal{P}}x_{t+1} \equiv b_t$. Therefore, we can now write the following optimisation problem for the central bank.

$$\min_{\{\pi_t, x_t, i_t, a_{t+1}, b_{t+1}\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} \beta^t ((\pi_t - \pi^T)^2 + \alpha x_t^2) \tag{2.20}$$

given,

$$\begin{aligned}
x_t &= \mathbb{E}_t^{\mathcal{P}} x_{t+1} - \frac{1}{\sigma}(i_t - \mathbb{E}_t^{\mathcal{P}}\pi_{t+1}) \\
\pi_t &= \kappa x_t + \beta \mathbb{E}_t^{\mathcal{P}}\pi_{t+1} + u_t \\
a_t &= (1-\nu)(a_{t-1} + \gamma_t(\pi_{t-1} - a_{t-1})) + \nu\pi^T \\
b_t &= b_{t-1} + \gamma_t(x_{t-1} - b_{t-1})
\end{aligned}$$

It is important to highlight that agents in this model follow two different processes when forming inflation and output expectations. This is not an unreasonable assumption since usually, central banks have the exclusive responsibility of price stability, which induces the target on inflation. However, some central banks also focus on output stability as a secondary mandate. Nonetheless, this paper focuses on the inflation target.

[10] Please see the discussion in Marcet and Sargent (1989a) who are the first to apply the stochastic approximation techniques to study the convergence of learning algorithms

Let us write the Lagrangian for this problem,

$$
\begin{aligned}
\mathcal{L} = E_0 \sum_{t=0}^{\infty} \beta^t (\pi_t^2 + \alpha x_t^2) \\
+ \lambda_{1t}[x_t - \mathbb{E}_t^{\mathcal{P}} x_{t+1} + \frac{1}{\sigma}(i_t + \mathbb{E}_t^{\mathcal{P}} \pi_{t+1})] \\
+ \lambda_{2t}[\pi_t - \kappa x_t - \beta \mathbb{E}_t^{\mathcal{P}} \pi_{t+1} - u_t] \\
+ \lambda_{3t}[a_t - (1-\nu)(a_{t-1} - \gamma_t(\pi_{t-1} - a_{t-1})) - \nu \pi^T] \\
+ \lambda_{4t}[b_t - b_{t-1} - \gamma_t(x_{t-1} + b_{t-1})]
\end{aligned}
$$

Here, λ_{it}, $i_t = 1, ..., 4$ denote the Lagrange Multipliers associated with the constraints. The first order conditions, structural equations (IS curve and NKPC) and the law of motion of the agents' beliefs are the necessary conditions for an optimum. Given that now beliefs depart from rationality and follow a law of motion, they become state variables in the optimisation problem of the CB.

The first order conditions at $t \geq 0$,

$$\{i_t\} : \lambda_{1t} = 0 \tag{2.21}$$

$$\{x_t\} : 2\alpha x_t + \lambda_{1t} - \kappa \lambda_{2t} - \gamma_{t+1} \lambda_{4t} = 0 \tag{2.22}$$

$$\{\pi_t\} : 2(\pi_t - \pi^T) + \lambda_{2t} - \gamma_{t+1} \lambda_{3t} = 0 \tag{2.23}$$

$$\{a_{t+1}\} : E_t\Big[\frac{\beta}{\sigma}\lambda_{1t+1} + \beta^2 \lambda_{2t+1} + \beta(1-\nu)(1-\gamma_{t+2})\lambda_{3t+1}\Big] = \lambda_{3t} \tag{2.24}$$

$$\{b_{t+1}\} : E_t[\beta \lambda_{1t+1} + \beta(1-\gamma_{t+2})\lambda_{4t+1}] = \lambda_{4t} \tag{2.25}$$

The optimality conditions here are not time invariant. However, γ_t is exogenous and deterministic. Therefore, the policy function that solves the optimality conditions does not depend on the period when the CB optimises. Additionally, since we are assuming a constant gain algorithm, we have a time invariant optimal condition.

Using (2.21) and (2.25) we find that for a bounded solution, $\lambda_{4t} = 0$. Together, (2.21) and $\lambda_{4t} = 0$, imply that the Lagragnge Multipliers associated with the IS

Curve and the law of motion of the output gap beliefs are zero along the equilibrium path, we find that those constraints are irrelevant (as in Molnár and Santoro (2014)).

Using all the first order conditions and the fact that $\lambda_{4t} = 0$ the optimality condition for inflation is given by[11]

$$2\pi_t - 2\pi^T + 2\frac{\alpha x_t}{\kappa} = \gamma_{t+1}\lambda_{3t} \tag{2.26}$$

Here λ_{3t} is the Lagrange Multiplier on inflation expectations. When $\gamma_{t+1} = 0$, we will have constant expectations implying the CB cannot manipulate expectations (discretionary policy) and have the optimality condition,

$$\pi_t + \frac{\alpha x_t}{\kappa} = \pi^T \tag{2.27}$$

This is the optimality condition under RE. If the inflation target is zero as has been considered in almost the entire literature surrounding New Keynesian models, we would have the same result as equation 2.19. Equation (2.26) delineates two important trade-offs that the CB faces[12]. First, the optimal conditions present the usual *intratemporal trade-off* between output stabilisation and inflation at time t. This is due to the shock present in the NKPC. Second, with learning when $\gamma_{t+1} > 0$, monetary authority is confronted by an *intertemporal trade-off* between optimal behaviour in period t and in the future. They must now take into account how reacting to inflation today will impact expectations tomorrow which will further impact how inflation evolves in the future. Since a change in inflation will impact expectations by a factor of γ_{t+1}, which in turn will impact the welfare by a factor of λ_{3t}. Whether the impact on welfare from the expectations is positive or negative will depend on current inflation expectations. Since there exists a non-zero inflation target, how far expectations are from the target will drive the impact on the welfare loss. A symmetric loss function implies that over or under-predicting inflation would negatively impact welfare loss.

[11] Details of the computation are given in Appendix M.

[12] Our findings are similar to those of Molnár and Santoro (2014)

Given that the central bank now faces an intertemporal trade-off apart from the well known intratemporal trade-off, we can derive optimal policy under the constant gain algorithm given by 2.9. To this effect, we can characterise the actual law of motion (ALM) under this process. The actual law of motion maps the agents' expectations or the perceived law of motion (PLM) to the stochastic process that inflation follows given by the Phillips Curve.

Proposition 3.1. *There exists a solution to the problem in* (17) *with constant gain learning and the policy function for inflation is given by:*

$$\pi_t = a_\pi \pi^T + c_\pi a_t + d_\pi u_t$$

The coefficients are given by (for the parameters considered),

$$\begin{aligned} c_\pi &\in (0,1) \\ d_\pi &= \frac{\alpha}{(\gamma c_\pi - A_{11})\alpha\beta(\beta\gamma + (1-\nu)(1-\gamma)) + \kappa^2\beta(1-\nu)(1-\gamma)} \\ a_\pi &= \frac{P2 - \nu(1-\gamma)c_\pi}{\gamma c_\pi + 1 - A_{11}} \end{aligned}$$

Where, P_2 *and* A_{11} *are given in Appendix M.*

I find that for the specific parameters in the model, $c_\pi^{MS} < c_\pi < c_\pi^{EH} = \alpha\beta/(\alpha+\kappa^2)$. For a fixed ν, which is the weight agents attach to the inflation target in the learning algorithm, γ can have two effects on inflation. A high γ can imply that the impact of current inflation is high on future expectations. On the other hand, it could also mean that current expectations do not impact future expectations. Given the empirical evidence, where the highest value of the gain parameter is 0.005. I find that the first effect dominates. This implies that agents' expectations are tracking previous inflation and are persistent.

This result has two implications. First, since the value of γ is small, the central bank will allow expectations to pass through to inflation. However, this also implies that the more persistent the expectations and further the agents' beliefs from the inflation target, the harder will be the job of the central bankers to achieve price stability. Therefore, the central bank must generate a higher contraction in the output, in order to keep future expectations close to the steady state level.

FIGURE 2.5: Parameters in the ALM as a function of γ and $\nu = 0.1$, $\pi^T = 2\%$

c_π d_π

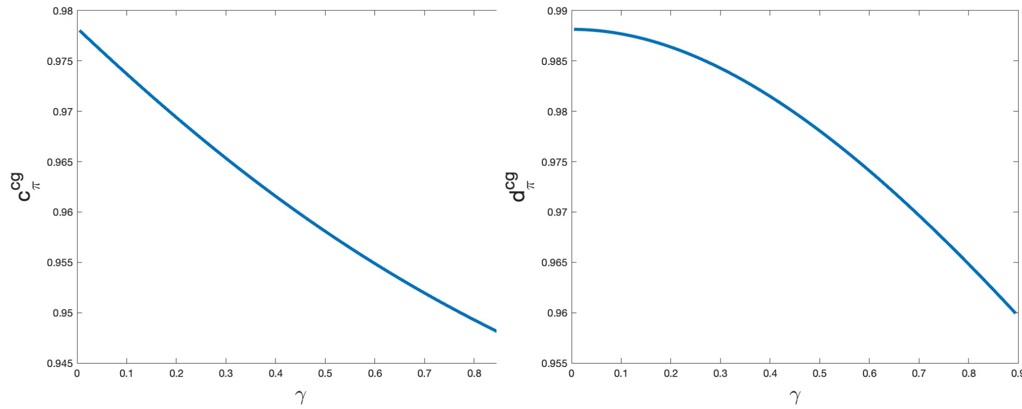
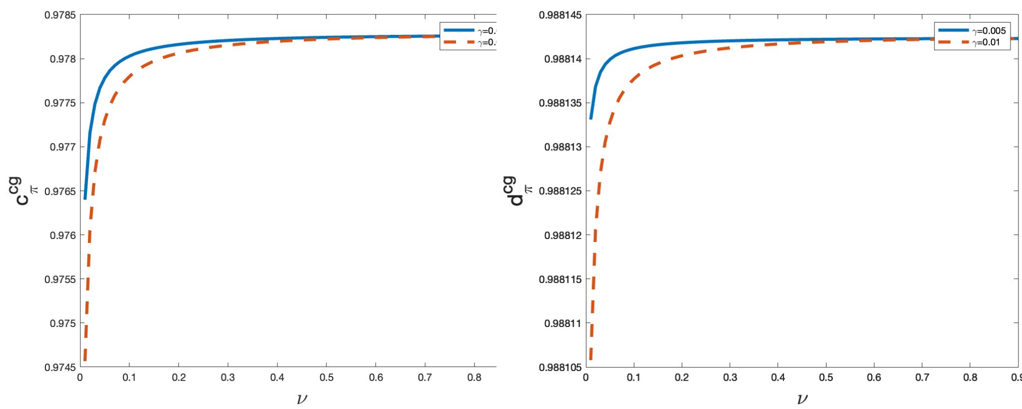


Figure 2.6, describes the evolution of the parameters in the actual law of motion for inflation as a function of ν, the weight attached on the inflation target

FIGURE 2.6: Parameters in the ALM as a function of ν and $\gamma = 0.005$, $\pi^T = 2\%$

c_π d_π



As expected, we find that c_π is an increasing function of the weight agents attach to the inflation target. This implies that closer the inflation expectations are to the inflation target, the more the central bank allows them to pass through to actual inflation, enabling a reversion to steady state. In addition, a closer look suggests that our rule produces coefficients which are closer to rational expectations than the ones described in Molnár and Santoro (2014), since $\nu = 0$ is the case where agents do not believe the target. Whereas, with an explicit target, agents are able to forecast better. Therefore, we find that the reaction of the CB can be more measured than in the case with no targeting involved. This is depicted in detail in figure 2.7. Moreover, the higher value of γ, the less the central bank allows for expectations to feed through to inflation.

Using the NKPC and the IS curve, we can now derive the optimal allocation of the output gap as well as the optimal interest rate rule.

$$\begin{aligned} x_t &= \frac{c_\pi - \beta}{\kappa} a_t + \frac{d_\pi - 1}{\kappa} u_t + \frac{a_\pi}{\kappa} \pi^T \\ x_t &= c_x a_t + d_x u_t + a_x \pi^T \end{aligned} \tag{2.28}$$

As we can see from figure 2.5 and 2.6, the value of $c_\pi < \beta = 0.99$ and $d_\pi < 1$. This implies that the coefficients on the inflation expectation term and the cost-push shock in the law of motion for the output gap are negative. Suggesting that the central bank will need to generate a higher contraction in output to stabilise inflation. A result that is similar to the one found in Mele et al. (2015). The policy maker is able to do this as agents require information to update their beliefs. Moreover, a low γ[13] is indicative of the fact that as new data arrives agents discount the past less. This is all while, the CB is able to reduce inflation in the current period due to output contraction. This is different from the case of rational expectations since agents will adjust expectations immediately and therefore will believe that the CB is deviating from its policy.

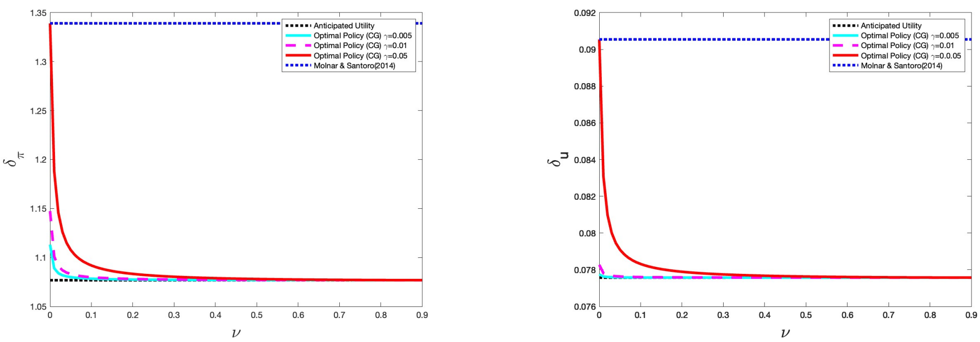
The optimal interest rate rule is given by,

[13] As noted in section 3

$$i_t = \delta_\pi a_t + \delta_x b_t + \delta_u u_t + \delta_a \pi^T \tag{2.29}$$
$$\delta_\pi = \left[1 + \sigma \frac{\beta - c_\pi}{\kappa}\right],\ \delta_x = \sigma,\ \delta_u = \sigma \frac{1 - d_\pi}{\kappa},\ \delta_a = \frac{-\sigma a_\pi}{\kappa}$$

Since we are looking for deviations from the inflation target, the coefficient on the target in equation 2.29 is negative. Given that we have that $c_\pi < \beta$ (as discussed above), we find that the coefficient on inflation expectations in the interest rule is greater than 1. Reinforcing the fact the Taylor principle holds Clarida et al. (1999). Finally, this suggests that when the central bank takes into account inflation expectations while solving for optimal policy, it prefers to anchor future expectations more than it would under EH but less than MS. This is an important implication because it implies that the central bank is trying to avoid expectations from being de-anchored, even though it employs discretionary monetary policy. A result that echoes the findings of Gaspar et al. (2010). The response to a positive cost-push shock is similar. The CB will raise interest rates to induce an output-contraction. However, the contraction will be less severe than the one observed in Molnár and Santoro (2014).

FIGURE 2.7: Parameters in the interest rate rule as a function of ν and $\gamma = 0.005, 0.01, 0.05$



(A) δ_π as a function of ν (B) δ_u as a function of ν

As can be seen in figure 2.7, the response to an increase in inflation expectations and a cost-push shock depends on the value of ν. The anticpated utility model which is the model that ensures convergence to RE, has the lowest coefficient values. Whereas, the CB reacts the most when agents do not believe the inflation target at all. I find that with our baseline value of $\nu = 0.3$, the response of the CB is higher than would be with optimal policy under RE yet very close to those parameters. This underscores the need for the agents to receive effective communication about and believe the inflation target. If the CB explicitly sets an inflation target, agents are able to forecast better. Moreover, this allows the central bank flexibility in responding to the shocks compared to the case where agents do not believe the target.

Figure 2.7 also iterates that central banks will need to respond much more to deviations of inflation from the inflation target when the Kalman gain is high. With stable beliefs the central bank requires smaller adjustments to inflation but will have a longer time frame which will allow for the return to a welfare loss close to the rational expectations benchmark as the level at which inflation expectations settle will matter for the response.

3.4 Welfare Loss Analysis

No optimal policy discussion is complete without a welfare loss analysis. Using the learning structure described above, we can compute the welfare loss. Since it is hard to interpret welfare loss in terms of utility, we follow Adam and Billi (2007) and Mele et al. (2015) to compute the consumption equivalent welfare loss. To do so, we first compute the utility losses and then convert them into percentage equivalents of steady state consumption.

To compute the welfare loss, we use parameter values that are commonly accepted in the literature as well as calibrated values[14]. Table 3 (below) lists the parameters and their value. We use a monte carlo simulation of length 10000. The cost push shocks are derived from a normal distribution with mean zero and variance 0.1.

[14] Source: Woodford (1999)

TABLE 2.3: Parameter Values for the economy

Parameter	Description	Parameter Value
β	Discount Factor	0.99
σ	Risk aversion	0.157
κ	Weight on Output Gap in the NKPC	0.024
α	Weight on Output Gap in the Welfare Function	0.48
ν	Weight on the Inflation Target	0.3
$target$	Inflation Target	0%

We use 0% inflation as the target rate to allow for comparability between the three models since the steady state inflation level in Evans and Honkapohja (2003) and Molnár and Santoro (2014) is zero.

We also perform a sensitivity analysis for these parameters. The parameters we use are from Clarida et al. (1999). Qualitatively our results do not change. However, the consumption loss is higher with the parameters from Clarida et al. (1999) compared to Woodford (1999) for all three models.

Table 2.4 presents the results from the welfare analysis. It compares the consumption equivalents under optimal policy, loss under Molnár and Santoro (2014) (MS) and (Evans and Honkapohja, 2003) (EH) for three different tracking parameters $\gamma = [0.1, 0.3, 0.5]$ and different initial conditions $a_0 = [0, 0.5, 1, 2]$. We find that for a small weight on the inflation target, our model out performs MS and EH, with significant gains for higher inititial conditions and high tracking parameter values. However, one would expect to see consumption equivalents at high γ values since a high constant gain parameter implies that there is higher variance in inflation and output.

Consider the case where $a_0 = 0$ and $\gamma = 0.1$, we find that the gain from using the optimal rule is 46% over MS. This suggests that if agents form expectations out of equilibrium, it is advisable to react to them strongly as this would lead to a lower welfare loss, even if in the short run the cost is higher. Another take away from our model is the increased performance at higher levels of the gain parameter. MS and EH suggest significantly higher welfare losses for values of the tracking parameter that are close to the ones found empirically.

I would also like to highlight the fact that the learning rule used in MS is the rule we use for our pre-inflation targeting period. This implies that the adoption of a Taylor-type rule is effective in reducing welfare costs. However, given our empirically findings regarding the evolution of the beliefs, it may take a few years before countries like Japan and India shall realise the gains of such a policy.

TABLE 2.4: Welfare Loss Comparison

γ	Loss under Optimal Policy (c^{OP})	Loss under MS (c^{MS})
	$a_0 = 0$	
0.1	0.0128	0.0188
0.3	0.0137	0.0369
0.5	0.0155	0.0551
	$a_0 = 0.5$	
0.1	0.0131	0.0342
0.3	0.0140	0.0435
0.5	0.0158	0.0592
	$a_0 = 1$	
0.1	0.0139	0.0803
0.3	0.0148	0.0631
0.5	0.0166	0.0714
	$a_0 = 2$	
0.1	0.0175	0.2644
0.3	0.0183	0.1417
0.5	0.0200	0.1198

Based on the parameter values in Table 2.3

4 Conclusion

This paper presents a model for the formation of inflation expectations. It develops on the existing literature by assuming an adaptive learning model contrary to the previous literature focusing on inflation targeting. I model the transition between the two periods (pre and post IT) using different initial conditions. I find that agents continue to form expectations based on their previous forecasts. This is particularly true for the period immediately following the adoption of IT.

Based on the learning algorithm found from the empirical evidence, I compute optimal policy as well as welfare loss. We find that the Taylor principle is still valid under learning and that the CB will react to high inflation expectations by contracting output more than under RE. The same is true in the case of a cost-push shock. I also find that the further away initial expectations are from the inflation target, the more persistent is the cost-push shock. This is contrary to what RE predicts where no matter what agents belive, a cost-push shock dies out immediately[15]. Furthermore, the constant gain model predicts significant welfare gains compared to those found previously in the literature. I find that even with a discretionary monetary policy, CB is able to influence inflation expectations a result that is absent from the RE literature. Finally, I find that the response of the CB is closer to the one found under RE compared to Molnár and Santoro (2014). This suggests tha the CB should work on gaining credibility about the inflation target. Since even with a reasonbly small weight, the economy could witness major gains.

[15] Please see the Appendix N

Chapter 3

Optimal Disinflation with Delegation and Limited Credibility

1 Introduction

Chile and Colombia grappled with persistently high and volatile inflation for several decades until constitutional reforms in the early 1990s led to the establishment of independent central banks. Subsequently, a decade-long period of gradual disinflation unfolded, witnessing a decline in inflation from levels above 20% to single-digit figures. This achievement remained sustainable, maintaining relatively stable inflation rates from 2000 to 2020.

The newly established central banks adopted a standard statutory configuration, encompassing a primary mandate to "preserve the value of the currency." They were led by a head and a board of directors whose terms extended beyond the presidential or congressional election cycles, enjoying autonomy in their decision-making regarding monetary instruments. Two forward guidance tools were implemented: 1) a long-term inflation objective and 2) a one-year inflation target. Even before officially adopting an inflation targeting regime, these countries began announcing the one-year targets annually. Initially set at 22% in Colombia, they gradually decreased in subsequent years, ultimately reaching single-digit levels by the early 2000s.

Given the history of high and volatile inflation in these economies, the promise of a central bank tasked with controlling and reducing inflation to single-digit levels did not immediately command full credibility. Moreover, this commitment relied on a newly established institutional framework, leaving people with limited information about its likelihood of success. We argue that the one-year ahead inflation targets served as a tool to enhance credibility while minimising the associated output costs.

We substantiate our argument through a theoretical model that builds upon the Barro and Gordon (1983b) framework, wherein a government lacking commitment is enticed to generate inflation surprises, leading to an inflation bias in equilibrium. Our model extends this setup by introducing the delegation of monetary policy to an independent central bank. The policy design includes the government's ability to provide the central bank with a sequence of publicly announced loss functions represented by inflation targets. However, the private sector may not fully believe in the credibility of this reform, forming a prior expectation regarding the central bank's commitment to the announced targets and updating this expectation based on observed inflation outcomes.

Our primary finding suggests that when credibility is limited, it is optimal for the government to announce a gradual decrease in inflation targets. The pace at which disinflation occurs strikes a delicate balance between enhancing credibility and mitigating the costs associated with unexpected inflation. Conversely, in a scenario where credibility is fully established, intermediate targets become redundant, and the government would create a central bank aimed at achieving the long-run optimal inflation level immediately.[1].

The underlying result hinges on the fact that the central bank does not have perfect control over inflation, resulting in inflation outcomes that do not fully reveal the central bank's intended objectives. In this scenario, economic agents face an inference problem and employ optimal strategies that lead to a revision of their prior beliefs regarding the credibility of the central bank. Specifically, the closer realised inflation is to the inflation target, the greater the revision of priors regarding central bank credibility. Consequently, lower inflation targets are associated with

[1]In our analysis, we adopt a highly stylised setup devoid of output persistence and without accounting for the costs associated with output volatility. This deliberate simplification enables us to sharpen the comparison of policies. However, the effects of alternative setups and their implications are deferred to the discussion section

larger expected disinflation surprises. The benefit of such surprises is enhanced credibility, but it comes at the cost of a decline in output. The optimal policy strikes a balance between these factors and yields a gradual disinflation process.

The optimal speed of the disinflation process relies on two crucial factors: the credibility of the central bank and its limited control over inflation. Credibility encompasses two key dimensions: the mean and the variance of the prior distribution held by economic agents concerning the importance given by the central bank to the inflation target. The mean represents people's expectations of the central bank's actions, while the variance reflects the level of uncertainty they harbour. Consequently, the mean determines the expected inflation, and the variance determines the extent to which prior beliefs are revised in response to inflation surprises. When people have confidence that the newly appointed central bank places little emphasis on the inflation target, a slower disinflation process becomes optimal.

The limited control of inflation pertains to the discrepancy between realized inflation and the central bank's desired inflation level. A higher variance indicates that inflation offers less insight into the central bank's objectives, resulting in a slower development of credibility. In extreme cases where the reform's credibility is expected to be severely limited or the central bank's ability to control inflation is low, it may be optimal to maintain the current system and forgo the establishment of an independent central bank.

Our contribution is to propose a new notion of credibility that is dynamic and costly to build over time into the literature of monetary policy, particularly suited for understanding disinflation processes in developing economies and rationalising the use of intermediate targets. Most existing literature treats credibility as a static concept when discussing disinflation. Credible disinflation plans are typically described as situations where the government has no incentives to deviate due to the high costs associated with deviation. These costs are often modeled as trigger strategies that revert the economy to the inflation bias (as seen in Barro and Gordon

(1983b)) or to a delegation arrangement (such as Herrendorf and Lockwood (1997), Jensen (1997)). Another static notion of credibility is credible delegation, which refers to the government's ability to renounce the independence of the central bank and intervene (Lohmann 1992, Herrendorf (1998)). In such cases, the government can choose to intervene in the central bank's decisions at a cost, and the higher the cost, the more credible the delegation arrangement becomes. In contrast, our dynamic approach would be akin to consider the possibility that agents learn over time about this unobserved cost.

Discussion of the Literature This paper speaks to four strands of literature. First, we build on the literature on optimal monetary policy rules and time inconsistency models by Kydland and Prescott (1977), Barro and Gordon (1983a), Barro and Gordon (1983b), and Barro (1986). As noted before, specifically building on Barro and Gordon (1983b). This paper also refers to the Inflation Bias which was first established in Kydland and Prescott (1977) (and later in Barro and Gordon (1983b)), which is the systematic difference between actual (realised) inflation and optimal inflation. We deviate from both papers by introducing an independent monetary authority which does not face a trade off between inflation and output. Therefore, agents must distinguish between the two institutions.

The paper also adds to the discussion of optimal monetary policy when there is delegation. For instance, Herrendorf and Lockwood (1996) take into account a central bank who is weight restricted.That is, central banks are unable to respond to the information of the wage setters and thus end up with an equilibrium with a stochastic inflation bias. Contrary to that, in our set up, the central bank is aware of how agents form expectations and know they are Bayesian. Therefore, they are able to respond to private information of the agents. Similarly, Al-Nowaihi and Levine (1994) consider a model where agents are able to rest prices and wages where a zero inflation outcome is sustained through a coordination game amongst agents. Our paper on the other hand, deviates by allowing the central bank to respond to expectations without any punishment required from agents' coordination.

Second, this paper inserts self at the intersection of the the literature of disinflation and the literature on subjective expectations. Kostadinov and Roldán (2020) comes closest to the model we present in the subsequent sections however with some key deviations. The authors present a model where the government faces a trade-off between inflation and output but announces a sequence of inflation targets and the model is set up as a principal-agent model. In their paper, after the announcement of the targets, agents set expectations using Bayes's rule. Subsequently, the government then chooses inflation depending on the behavioural type it is. Therefore, agents must now distinguish whether the government is rational or of a behavioural type. On the other hand, the uncertainty in our paper is about the policy rather than the type of the agent. That is, from the perspective of the agents both the central bank and government are rational but they do not know the policy that is being followed by the new institution. Other papers which also build on type preferences of the government are Lu (2013) and Lu et al. (2016).

This paper also closely relates to Cukierman and Meltzer (1986) specifically the mechanism which prescribes that monetary surprises may lead to future higher inflation expectations. However, their paper assumes that agents are rational but have limited information about the monetary procedures. Moreover, they develop a model with discretionary policy. Our paper assumes that agents are Bayesian learners where they forecast the future taking into consideration all past information. Furthermore, the announcement of the future policy path acts as a commitment device which the central bank cannot renege on.

Ascari and Ropele (2012), Lamla and Vinogradov (2019) and Lamla et al. (2019) also ascertain the cost of disinflation and credibility. They do not do so from the context of the Latin American economies or the introduction of announcements of the policy. Using a model where agents lose trust in the announcements of the monetary authority, Lamla et al. (2019) show that it is possible to have an inflationary and deflationary bias. On the other hand, Lamla and Vinogradov (2019) looks at how central bank announcements effects consumers' beliefs using Micro data and 12 FOMC announcements. Ascari and Ropele (2012) employ money supply and interest based rules to test the different speeds at which disinflation can take place through a New Keynesian model.

Third, our paper ties into the literature on adaptive learning. Specifically, Marcet and Nicolini (2003) and Sargent et al. (2009). Both the above mentioned papers focus on the case of the South American context using bounded rationality. However, both papers study the hyperinflationary phases in these economies. Specifically, they explain how a combination of beliefs and debt dynamics were responsible for the hyperinflation experienced in these economies. That is, both papers are able to explain the behaviour of prices based on deviations from rationality. However, none of the papers focus on disinflation in the economies. Moreover, the period of analysis is a decade apart from our paper.

Finally, our paper adds to the discussion surrounding the Delphic and Odyssean view of forward guidance, see for instance Bassetto (2019). The Odyssean view refers to the announcement of a future course of action by the central bank. On the other hand, under the Delphic view, the central bank signals some private information about the state of the economy. Our set up, while closely related to the Odyssean view, adds an additional layer. The paper depicts that announced policy changes can help build credibility if the policy is delivered ex-post. This is true when ex-ante the participants in the economy do not believe the policy.

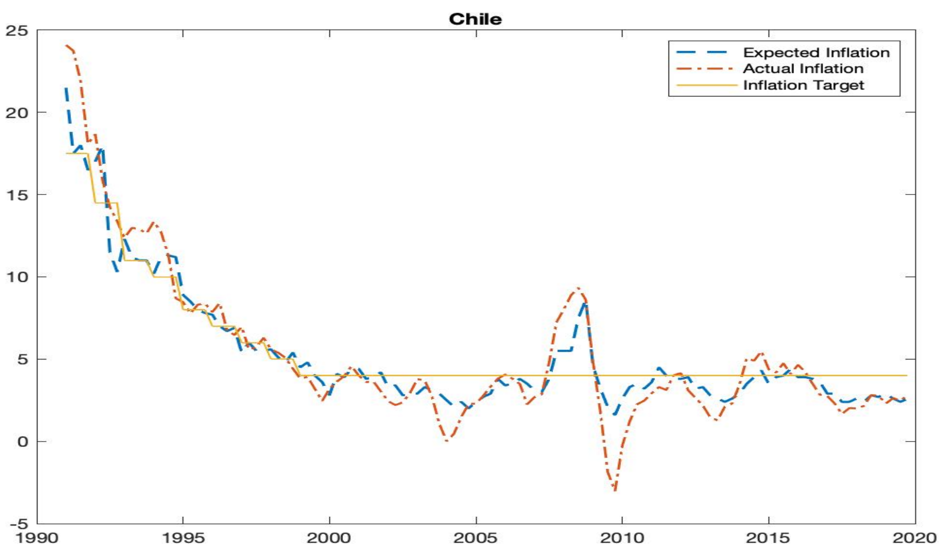
Road map The remainder of this paper is divided as follows. Section 2 presents a description of the institutional setup of disinflations in Latin America, Section 3 presents the model . Section 4 discusses the results with model simulations, detailing the welfare gains from the policy interventions and the role of inflation surprises. Finally, the paper concludes in section 4.

2 Delegation and disinflation in Latin America

To motivate our research question, we present time series evidence from three Latin American economies namely, Brazil[2], Chile and Colombia. We focus on these three economies for two main reasons. First, all three countries adopted similar measures to disinflate and stabilise inflation. Second, all three economies experienced similar shocks during the same period, restricting the feasible set of shocks we need to consider when modelling the disinflationary process.

Figures 3.1 - 3.2 delineate the evolution of inflation (blue solid line), inflation expectations[3] (red dotted line). The series cover the period ranging from January 1990 - January 2020 with. All three countries unanimously, witness a decline in inflation until 1999, when they adopt inflation targeting as the monetary policy. Specifically, the decline was from hyperinflationary states to around 3% over the course of the decade through the use of intermediate inflation targets.

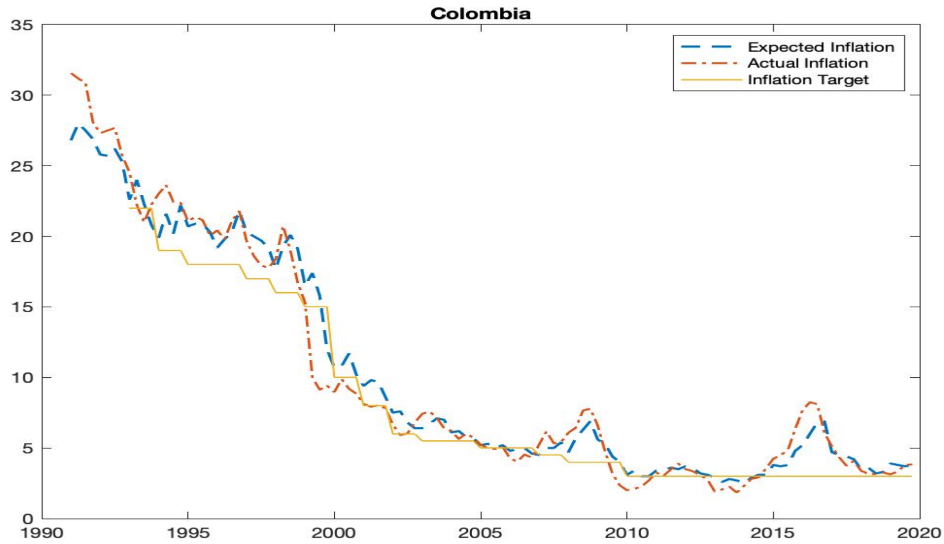
FIGURE 3.1: Inflation Target, Inflation and Inflation Expectations: Chile



[2]Information about Brazil can be found in Appendix A

[3]The figures do not include a measure of inflation expectations prior to 1999, since most central banks only started tracking expectations post the adoption of inflation targeting.

FIGURE 3.2: Inflation Target, Inflation and Inflation Expectations: Colombia



Two aspects of these countries' experiences are worth drawing attention to. First, all three countries after experiencing turbulent inflation in the late 1980s and early 1990s, introduced amendments in the constitution for the central bank. Table ?? lists the dates for the constitutional amendments. The figures present information immediately following the amendments. The amendments introduced a board of governors for the central bank which would have a few members appointed by the incumbent government but any new government would not have influence over. The amendment also led to central banks having full control over monetary, credit and foreign exchange matters[4].

Second, and crucially, the period prior to 1999, is the period where the three countries adopted what is referred to as intermediate inflation targets before assigning a medium to long term target associated with low and stable inflation. The reason to introduce an intermediate inflation target is to build credibility for the central bank in order to meet the ultimate objective of price stability. Moreover, as Svensson (1999) notes, targets allow the monetary authority degrees of constrained discretion through a target horizon, escape clause, price index and range.

[4]For example, there was a constitutional amendment in Colombia in 1991

Concretely, focus on Figure 3.1, the experience of Chile. It announced an annual inflation target of 20% in September 1990 which was close to the average inflation rate during the 1980s[5]. The adoption of the target coincided with the independence of the central bank. From 1991-1999, the inflation target was linked to the current annual inflation forecast[6] of the central bank. This is known as the period where Chile was a soft inflation targeter. Colombia shares its experience with Chile in the process of disinflation. Colombia[7] also introduced a sequence of intermediate inflation targets in 1991 with a constitutional redesign of central bank which involved the central bank to be responsible for monetary, exchange, and credit policies. However, during the period of 1992-1999, there was significant deviation of inflation from the target. Therefore, during this period the central bank had low credibility.

The experience of Chile and Colombia highlight the essence of the paper. A sustained commitment and decline in inflation following the independence of the central bank and announcement of the intermediate targets led to a decline in inflation expectations.

We thus hypothesise that a significant reduction in inflation came from using announced intermediate targets as a way to manage inflation expectations. Prior to the existence of an independent central bank and targets, the agents were familiar with what is commonly referred to as the Inflation Bias. However, the introduction of the new institution and policy objectives means the agents need to learn about a new policy environment. Moreover, if there is limited credibility in the institution with respect to the new policy, agents are consistently learning and therefore, forced to adjust expectations.

[5]Based on Morandé (2002)

[6]The targets prior to 1999 are approximated based on Céspedes and Soto (2006)

[7]See also Gómez et al. (2002), Echavarría et al. (2013)

3 Model

This section presents a model based on Barro and Gordon (1983) that incorporates the delegation of monetary policy to a "conservative" central banker with limited credibility. We explore how the introduction of intermediate targets can increase welfare. We illustrate numerically the properties of the optimal delegation arrangement in the presence of limited credibility.

3.1 Status-quo: The Inflation Bias

The government aims to maximise social welfare, approximated by an instantaneous social welfare loss function:

$$L_t^G = \pi_t^2 - a\tilde{y}_t \tag{3.1}$$

Here, $\tilde{y}_t$ represents the output gap, which is weighted by parameter a, and π_t denotes the current inflation level.

The output gap is determined by inflation surprises:

$$\tilde{y}_t = 2c(\pi_t - \pi_t^e) \tag{3.2}$$

where π_t^e represents expected inflation, π_t is realised inflation, and c is a parameter.

The government has limited control over inflation. Realized inflation is equal to the target inflation set by the government, denoted as $\bar{\pi}_t$, plus a shock that is unobserved. Thus, inflation is given by:

$$\pi_t = \bar{\pi}_t + \epsilon_t \tag{3.3}$$

Here, ϵ_t follows a normal distribution with mean 0 and variance $\tilde{\sigma}_\epsilon^2$, representing the component of inflation that the government cannot control and is independent of $\bar{\pi}_t$.

Since the government lacks commitment, its problem can be considered static. The government's objective is to maximize:

$$V = \max_{\bar{\pi}_t} E\left(\bar{\pi}_t + \epsilon_t\right)^2 - ac\left(\bar{\pi}_t + \epsilon_t - \pi_t^e\right) \tag{3.4}$$

The solution to this maximization problem yields the target inflation:

$$\bar{\pi}_t = ac \tag{3.5}$$

Consequently, in equilibrium, under rational expectations, the inflation, inflation expectations, and the output gap are given by:

$$\pi_t = ac + \epsilon_t; \quad \pi_t^e = ac; \quad \tilde{y}_t = 2c\epsilon_t \tag{3.6}$$

This result demonstrates the classical inflation bias. Due to the government's lack of commitment and its temptation to stimulate output through inflation surprises, an equilibrium is established with positive average inflation but no gain in output. A commitment solution would result in an average inflation and output gap of zero.

The expected discounted value in this case is given by:

$$\mathcal{L}^G = \sum_{t=0}^{\infty} \beta^t E_0 L_t^G = \frac{1}{1-\beta}\left((ac)^2 + \tilde{\sigma}_\epsilon^2\right) \tag{3.7}$$

In contrast, the expected discounted value with commitment is $\frac{1}{1-\beta}\left(\tilde{\sigma}_\epsilon^2\right)$.

3.2 Rogoff's Conservative Banker with Limited Credibility

Now, we introduce the government's ability to delegate monetary policy to a central bank and assign a specific loss function that the central bank must minimize by independently determining its target inflation. If the reform is fully credible, the optimal policy is to select a "conservative" central banker who minimizes only inflation volatility, assigning no weight to output volatility:

$$L_t^{CB} = \pi_t^2 \tag{3.8}$$

This outcome is optimal in a setup where there is no concern for output volatility, supply shocks, or output persistence (see Svensson (1997)). In the case of full credibility, this solution aligns with the outcome of a commitment regime.

However, suppose the announced objective of the central bank to focus solely on inflation is not fully credible. People may question how strictly the central bank will adhere to this rule, considering the possibility of an intermediate objective between the government's preference and the announced objective. Alternatively, they may wonder to what extent the government can influence the central bank to deviate from the announced objective. In our notion of limited credibility, people's beliefs about the conservatism of the central banker's actions may differ from the announced reform. Individuals in the economy hold a prior belief about the weight a^{CB} that the central bank assigns to output.

Consequently, individuals perceive the loss function of the central bank as:

$$\widehat{L_t^{CB}} = \pi_t^2 - a^{CB}\tilde{y}_t \tag{3.9}$$

where the prior belief at $t = 0$ for a^{CB} is given by $\mathcal{N}(\tilde{a}_0, \tilde{\sigma}_0^2)$. Full credibility corresponds to the particular case where $\tilde{a}_0 = \sigma_0^2 = 0$.

Using a normal distribution to characterise beliefs has the advantage of capturing beliefs through the mean and variance, allowing us to straightforwardly represent the evolution of beliefs using the Kalman filter. Expected inflation depends solely on the mean of the prior and is given by:

$$\pi_t^e = \tilde{a}_{t-1}c \tag{3.10}$$

Beliefs are optimally updated as follows:

$$
\begin{aligned}
\tilde{a}_t &= \tilde{a}_{t-1} + K_t\left(\pi_t - \pi_t^e\right) \\
\tilde{\sigma}_t^2 &= \left(1 - K_t c\right)\tilde{\sigma}_{t-1}^2 \\
\text{where } K_t &= \left(\frac{c\tilde{\sigma}_{t-1}^2}{c^2\tilde{\sigma}_{t-1}^2 + \tilde{\sigma}_\epsilon^2}\right)
\end{aligned} \tag{3.11}
$$

Here, K_t represents the Kalman gain, which determines the optimal revision of the prior's location parameter in response to a unitary inflation surprise.

The system of equations given by equations 3.2, 3.10 and 3.11 forms the foundation of our analysis throughout the paper. A negative inflation surprise incurs output costs (equation 3.2) and leads to credibility gains (equations 3.11), resulting in lower expected inflation for the subsequent period (equation 3.10). Furthermore, credibility gains are larger when there is higher uncertainty in people's prior judgment of the central bank ($\tilde{\sigma}_{t-1}^2$) and in the central bank's ability to control inflation (inverse of $\tilde{\sigma}_\epsilon^2$).

The sequence of $\tilde{a}_t$ for Rogoff's conservative central bank decreases on average and converges to 0. Although $\tilde{a}_t$ is subject to inflation shocks, it converges almost surely to zero in the limit, representing full credibility. Therefore, in the limit, we obtain the result described by Rogoff (1985), where the conservative central banker implements the first-best outcome. However, limited credibility imposes output costs during the transition period.

To assess the welfare implications of the reform, we begin by characterizing the expected path of inflation expectations. This path is determined by the following equation:

$$
\begin{aligned}
E_0\left\{\pi_t^e\right\} &= \kappa_{t-1} E_0\left\{\pi_{t-1}^e\right\} \\
\text{where } \kappa_{t-1} &= \frac{\tilde{\sigma}_\epsilon^2}{\left(c^2\tilde{\sigma}_{t-2}^2 + \tilde{\sigma}_\epsilon^2\right)}
\end{aligned} \tag{3.12}
$$

Thus, expectations are expected to decrease over time at a rate determined by κ_t, which itself decreases over time. We interpret κ_t as the persistence in inflation expectations. By iterating backwards, we can characterize the entire sequence of expected inflation expectations as:

$$E_0\left\{\pi_t^e\right\} = \left(\prod_{j=1}^{t-1} \kappa_{t-j}\right)(\tilde{a}_0 c) \tag{3.13}$$

This expression establishes expectations as a function of the prior and the variance of inflation shocks.

Moving on, the expected discounted loss of implementing the reform is given by:

$$\mathcal{L}^R = a2\tilde{a}_0 c^2 \sum_{t=1}^{\infty} \beta^{t-1}\left(\prod_{j=1}^{t-1} \kappa_{t-j}\right) + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{3.14}$$

Here, $\mathcal{L}^R$ represents the loss incurred by Rogoff's central banker[8]. The terms highlighted in blue are the new components that arise in comparison to the inflation bias benchmark. The potential welfare gains from implementing the reform depend on the prior mean $\tilde{a}_0$ and the level of persistence in inflation expectations. Greater initial credibility (lower $\tilde{a}_0$) and lower persistence of inflation expectations (lower $\tilde{\sigma}_\epsilon^2$ or higher $\tilde{\sigma}_0^2$) lead to larger welfare gains with the conservative banker.

It is worth noting that since $\left(\prod_{j=1}^{t-1} \kappa_{t-j}\right)$ is bounded above by 1, a sufficient condition for the welfare improvement from the reform is that individuals believe the central bank to be at least as twice as conservative as the government ($2\tilde{a}_0 \leq a$).

Our main point is that there exists an optimal delegation arrangement[9]—a central bank designed to become progressively more conservative over time and to announce this specific path to the public from the outset. We explore this case further in the next section.

[8] A detailed derivation can be found in Appendix O

[9] Appendix P details the proof for the conditions under which a country would want to introduce a central bank.

3.3 Disinflation with Intermediate Targets

We now consider a scenario where the government assigns the central bank a time-varying loss function characterized by a sequence of inflation targets. The objective of the conservative central bank is to minimize the deviation of inflation from the specified targets, resulting in the following instantaneous loss function:

$$L^{CB*} = (\pi_t - \pi_t^*)^2 \tag{3.15}$$

Here, L^{CB*} represents the loss function with intermediate targets $\{\pi_t^*\}_{t=0}^{\infty}$. Consequently, the optimal inflation decision by the central bank is to set the target equal to the aimed inflation, i.e., $\bar{\pi}_t = \pi_t^*$.

However, individuals may not fully trust or consider this arrangement credible. They might believe that the central bank's loss function is a combination of the stated objective and the government's objective. This belief leads to the following expression for the perceived loss function of the central bank:

$$\widehat{L_t^{CB*}} = (1-\gamma)\left(\pi_t - \pi_t^*\right)^2 + \gamma\left((\pi_t)^2 - a\tilde{y}_t\right) \tag{3.16}$$

Here, γ represents the perceived weight assigned by the central bank to the inflation target. Individuals form a prior belief about γ given by $\mathcal{N}(\hat{\gamma}_0, \hat{\sigma}_0^2)$. The case of full credibility corresponds to $\hat{\gamma}_0 = \hat{\sigma}_0^2 = 0$. Notably, this setup is equivalent to the previously analysed case when all targets are set equal to zero.

At any time period t, given the beliefs at that point $\mathcal{N}(\hat{\gamma}_{t-1}, \hat{\sigma}_{t-1}^2)$, the expected inflation is given by:

$$\pi_t^e = (1-\gamma_{t-1})\pi_t^* + \gamma_{t-1}ac \tag{3.17}$$

Consequently, expected inflation becomes a weighted average between the inflation target and the inflation bias level. The belief updating system can be characterized by the following equations:

$$\begin{aligned}\hat{\gamma}_t &= \hat{\gamma}_{t-1} + K_t\left(\pi_t - \pi_t^* - \gamma_{t-1}\left(ac - \pi_t^*\right)\right)\\ \hat{\sigma}_t^2 &= \left(1 - K_t\left(ac - \pi_t^*\right)\right)\hat{\sigma}_{t-1}^2\\ \text{where } K_t &= \frac{\hat{\sigma}_{t-1}^2\left(ac - \pi_t^*\right)}{\hat{\sigma}_{t-1}^2\left(ac - \pi_t^*\right)^2 + \sigma_\epsilon^2}\end{aligned} \tag{3.18}$$

Consequently, the expected path of inflation expectations can be characterized as:

$$\begin{aligned}\pi_t^e - \pi_t^* &= \kappa_{t-1}\left(\pi_{t-1}^e - \pi_{t-1}^*\right)\\ \text{where } \kappa_{t-1} &= \frac{\sigma_\epsilon^2}{\hat{\sigma}_{t-2}^2\left(ac - \pi_{t-1}^*\right)^2 + \sigma_\epsilon^2}\end{aligned} \tag{3.19}$$

Here, κ_{t-1} represents the persistence of expectations and is determined by the prior variance and the variance of inflation shocks. Importantly, note that lower inflation targets lead to faster convergence of expectations, as larger surprises reveal more information about the central bank's loss function. This is not surprising, as the Rogoff banker generates faster learning. However, early on, this can also lead to substantial output costs due to large inflation surprises.

In this new setup, the government can balance the trade-off between output costs and gains in credibility by selecting a sequence of targets π_t^*. It is essential to understand that high credibility does not automatically imply inflation close to zero. It signifies inflation expectations close to the target, which may not necessarily be zero at any given point.

For a given sequence of targets π_t^*, the present value of the social welfare is given by:

$$\mathcal{L}^{G*} = \sum_{t=1}^{\infty} \beta^{t-1}\left(\pi_t^*\right)^2 + \left(ac - \pi_1^*\right)\hat{\gamma}_0 a2c \sum_{t=1}^{\infty} \beta^{t-1}\left(\prod_{j=1}^{t-1} \kappa_{t-1}\right) + \frac{\sigma_\epsilon^2}{1-\beta} \tag{3.20}$$

The first term captures the inflation costs associated with the intermediate targets above zero, the second term represents the output costs, and the last term accounts for the costs imposed by the inflation shock. Both the inflation bias case and the

Rogoff case are particular instances of this specification. The inflation bias case involves a sequence of targets equal to the inflation bias, resulting in the second term being zero. All costs emerge from inflation costs. On the other hand, the Rogoff banker sets all targets equal to zero, leading to the first term being zero, with all costs arising from the output costs. The use of intermediate targets allows the government to select a sequence that balances these costs and potentially increases welfare.

We now condier two scenarios when the central bank is disinflating using intermediate inflation targets. The first scenario involves the central bank using inflation targets without announcing them. Therefore, the agents are not aware of the policy of the independent central bank. The second scenario entails announcing the inflation targets to the households. The next two sections illustrate the differences in the welfare loss from announcing and not announcing the inflation targets.

3.4 No Announcement of Intermediate Targets

To illustrate the changes that take place when agents are aware of the inflation targets versus when they are not we start with the following assumption. We assume that agents do not know that the central bank is following any specific policy.

This implies that equation 3.18 will be augmented to $\pi_t^* = 0$. Under this assumption, the welfare loss[10] will be given by,

$$E\{\mathcal{L}_0\} = \frac{(ac)^2}{2}\left\{\sum_{t=0}^{\infty}\beta^t(\rho^{t-1}(\rho+1)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{3.21}$$

This implies that for the agents, their information set is no different between having an independent central bank and an independent central bank who has targets but are those which are not public information. One caveat worth highlighting here is

[10] Details of the computation are provided in Appendix Q

that we could set up the model in way where they have to learn the inflation targets but know that the central bank has intermediate targets. However, the case where the agents don't know the policy provides a lower bound on the speed at which agents learn and the welfare loss. Allowing for agents to learn the targets while knowing the policy would be the middle ground between full information and no information.

3.5 Announcements of Intermediate Targets

To illustrate the trade-off involved in deciding the speed of the disinflation process, let's consider a policy announcement where the target inflation is lowered by the same percentage each period, given by $\pi_t^* = \rho^t ac$. Here, ρ captures the persistence of the disinflation process. We can examine two extreme cases: when $\rho = 1$, we have the inflation bias case, and when $\rho = 0$, we have the Rogoff central banker case.

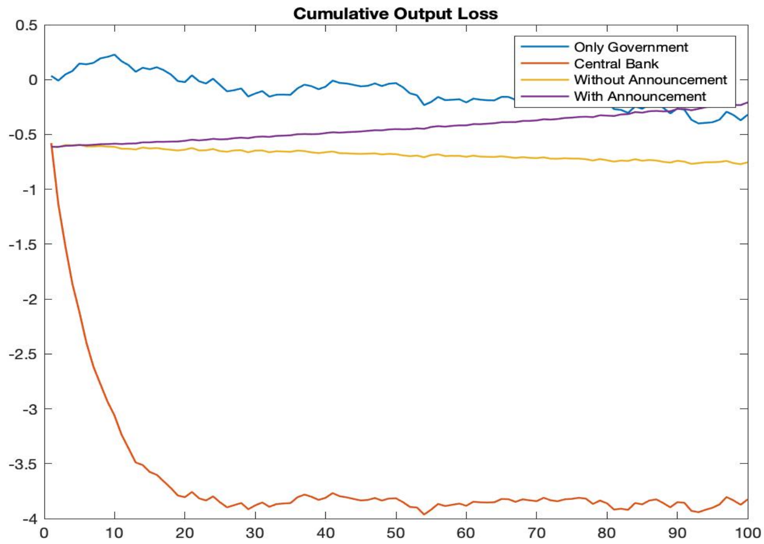
With this specific disinflation plan, social welfare can be expressed as follows:

$$\mathcal{L}^{G*} = \underbrace{\frac{\rho^2}{1-\beta\rho^2}ac}_{\text{Inflation cost}} + \underbrace{(1-\rho)\hat{\gamma}_0 2(ac)^2 \sum_{t=1}^{\infty} \beta^{t-1} \left(\prod_{j=1}^{t-1} \kappa_{t-1} \right)}_{\text{Output cost}} + \frac{\sigma_\epsilon^2}{1-\beta} \tag{3.22}$$

We observe that as ρ decreases and disinflation becomes faster, the costs associated with inflation decrease. However, a lower value of ρ also leads to higher output costs. It results in a larger initial surprise, although it lowers the persistence of expectations captured by κ. To gain further insight into the mechanisms at play, we conduct a numerical analysis in the next section to demonstrate how gradual disinflation can indeed increase welfare.[11]

[11] The details of the computation of the welfare loss are given in Appendix R.

FIGURE 3.3: Cumulative Output Loss



For a baseline calibration given in Table S.1, in the appendix S, figure 3.3 plots the cumulative output loss under the different regimes. The blue line presents the output loss under the inflation bias (only government) regime, the orange line presented the output loss under introducing a central bank, the yellow and purple lines represent the loss under the regime of intermediate inflation targets.

As measured by the output gap given by $\tilde{y}_t = c(\pi_t - \pi_t^e)$, the output loss from introducing the independent central bank is the highest followed by the loss from having intermediate targets. On the other hand, the loss from the government fluctuates around zero initially with a downward trend. Additionally, the volatility of the output gap is higher with the government. This suggests that in the regime where the government is respon- sible for monetary policy, they can manipulate prices such that they are able to satisfy their short term goals.

FIGURE 3.4: Cumulative Output Loss

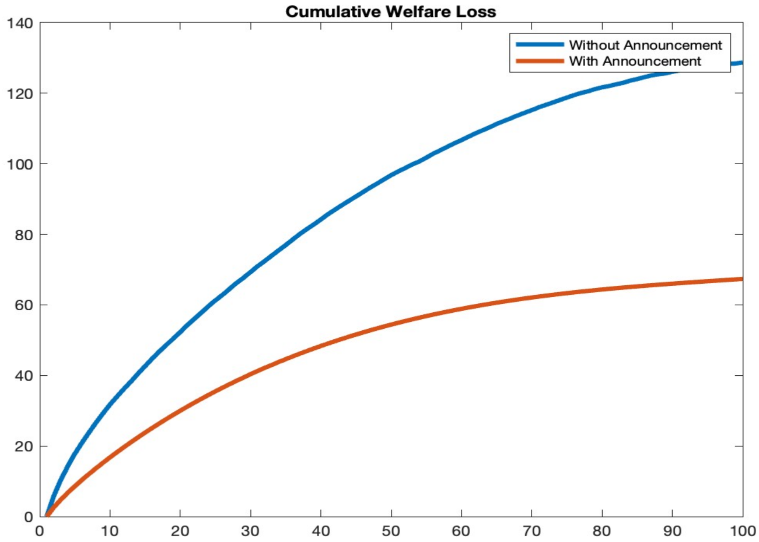


Figure 3.4 also portrays the cumulative welfare loss with announced and unannounced targets. The figure illustrates how over time, announcing inflation targets aids in the reduction of the welfare loss. This is because the agents are able to learn faster when they are aware of the policy the room for error is much smaller with announced inflation targets as opposed to unannounced inflation targets.

4 Numerical Illustration

In this section, we analyse the welfare implications of the three cases discussed earlier, using a simple calibration that involves specifying a single parameter, ρ, to characterise the speed of disinflation in a policy with intermediate targets. The calibration assumes an inflation level of 35% under the inflation bias regime ($a = 1, c = 0.35$) and a risk-free real rate of approximately 2% ($\beta = 0.98$). Additionally, the standard deviation of inflation shocks is set to 3% ($\sigma_\epsilon^2 = 0.03^2$), and the prior credibility of the central bank, $\tilde{\gamma}_0$, is set to 1, with a standard deviation of 0.1.

Figure 3.5 depicts the welfare function $\mathcal{L}^{G*}$ for the intermediate targets policy across various levels of the persistence of the targets path, $\rho \in [0,1]$. The two extremes correspond to the cases of the Rogoff central bank ($\rho = 0$) and the inflation bias ($\rho = 1$). In this calibration, the Rogoff central bank achieves a lower loss than the inflation bias case. The optimal policy corresponds to an interior solution with $\rho = 0.76$, representing a gradual disinflation process. At the optimum, a one percentage point inflation surprise in the first period results in a decrease of expectations of 0.7% relative to the target.

We decompose the welfare loss into inflation loss and output loss, as shown in equation 3.22, to illustrate the trade-off faced by the government when determining the speed of disinflation. Figure 3.6 demonstrates that a faster disinflation ($\rho \to 0$) reduces inflation costs at the expense of larger inflation surprises and, consequently, higher output costs. The optimal policy strikes a balance between the two.

FIGURE 3.5: Welfare loss with intermediate targets $\mathcal{L}^{G*}$

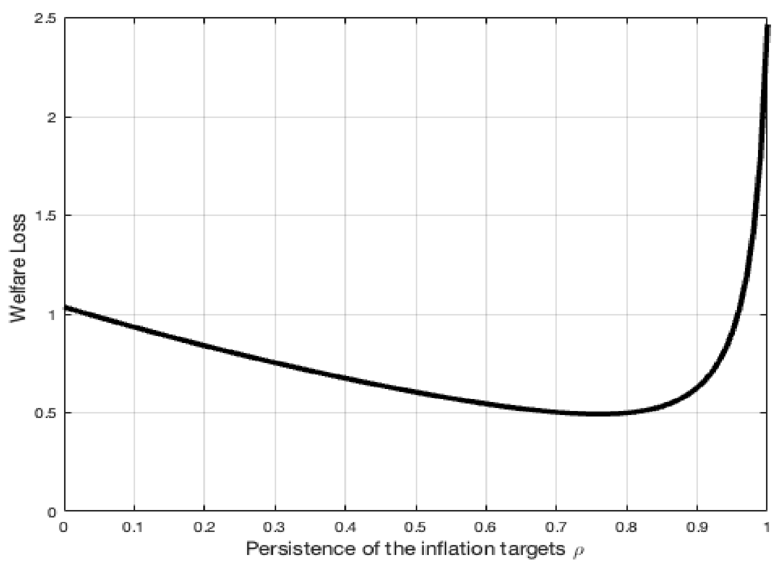
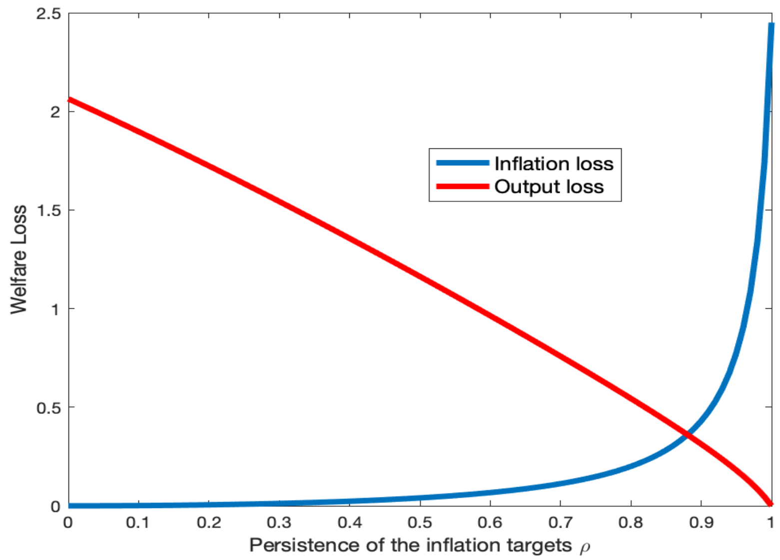
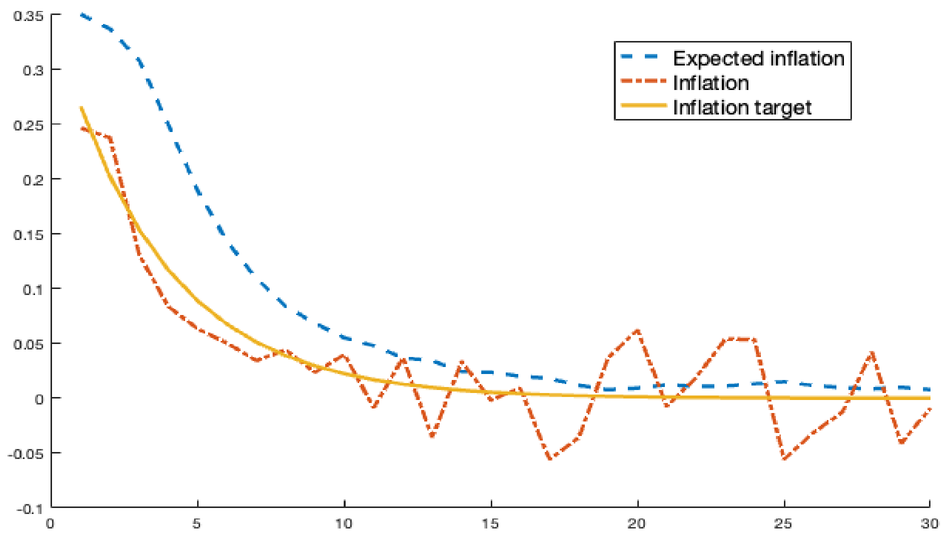


FIGURE 3.6: Decomposition of the welfare loss



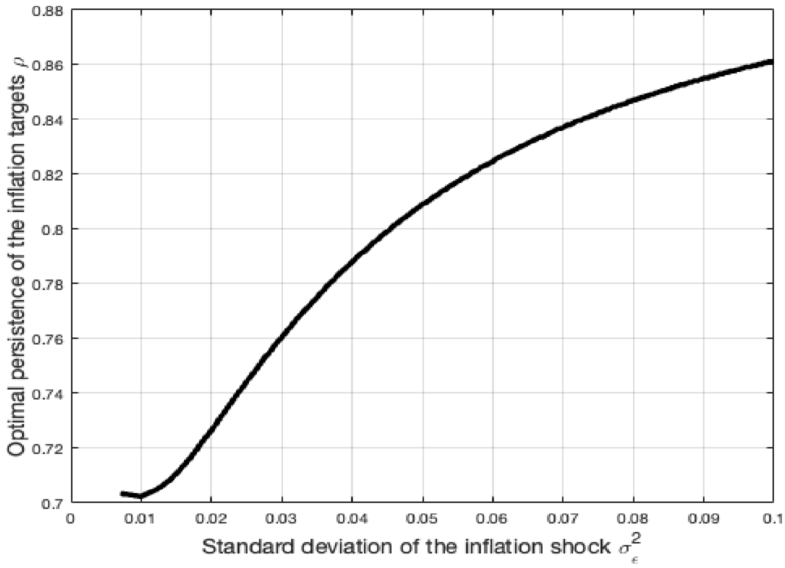
The optimal disinflation speed in our calibrated economy closely matches the disinflation processes observed in the Latin American countries discussed. It implies that within a decade, the economy practically converges to be within a 5% difference from the long-run target. Figure 3.7 plots a simulated disinflation path of the calibrated economy with the optimal disinflation path. Expectations start at the inflation bias and gradually converge to the inflation targets.

Figure 3.7: Inflation Target, Inflation and Inflation Expectations: Simulated model



Lastly, we highlight how the optimal speed of disinflation depends on the speed at which credibility can be built. The greater the volatility of inflation shocks, the more challenging it is to establish credibility, as agents may attribute negative inflation surprises to inflation shocks rather than the central bank's policy. Figure 3.8 illustrates how the optimal persistence of the targets varies with the standard deviation of inflation shocks. As the central bank has less control over inflation (higher variance), the disinflation path has a slower convergence to the long run objective.

Figure 3.8: Optimal disinflation for varying inflation volatility



5 Conclusion

The literature on optimal delegation of monetary policy has focused on setting up contracts between the government and the central banker to achieve the highest welfare. However, we argue that such contracts might lack credibility among the public due to potential hidden "side-payments" that could align the central bank with the government. Limited credibility affects the perceived welfare achievable through the contract. In such cases, we propose that contracts should consider limited credibility and balance the costs of gradual introduction with the benefits of credibility gains. The use of decreasing intermediate targets in the establishment of independent central banks in many Latin American countries can be viewed as an attempt to implement such a policy.

Appendix A

Appendix A List of IT Countries

0.1 List of IT Countries

TABLE A.1: List of IT countries

Name of Country	Start Year	Announcement Year	Target
Argentina	2016Q3	2015Q4	-
Austria	1999Q1	1998Q2	2%
Belgium	1999Q1	1996Q1	2%
Brazil	1999Q2	1995Q4	3% ± 1.5%
Chile	1999Q3	1990Q3	3%
Colombia	1999Q1	1993Q1	3% ± 1%
Czech Republic	1998Q1	1997Q4	2%
Finland	1995Q1	1993Q1	2%
Germany	1999Q1	1998Q1	2%
Hungary	2001Q3	2001Q2	3% ± 1%
India	2016Q3	2015Q1	4% ± 2%
Ireland	1999Q1	1997Q1	2%
Israel	1997Q2	1994Q3	1-3%
Italy	1999Q1	1998Q1	2%
Japan	2013Q1	2012Q1	2%
Korea	1999Q1	1998Q2	2%
Mexico	2001Q1	1998Q1	3%
Netherlands	1999Q1	1998Q1	2%
Norway	2001Q1	1999Q2	2%
Paraguay	2011Q2	2004Q2	4% ± 2%
Peru	2002Q1	1994Q1	2% ± 1%
Philippines	2002Q1	2001Q4	2-3%
Poland	1999Q1	1998Q1	2.5% ± 1%
Russia	2014Q1	2013Q3	4%
South Africa	2000Q1	1999Q2	3.5% ± 1.5%
Spain	1997Q1	1994Q4	2%
Switzerland	2000Q1	1999Q3	2%
Thailand	2000Q2	2000Q1	1-3%
Turkey	2002Q1	2001Q2	5%
Ukraine	2016Q1	2015Q3	5% ± 1%
United States	2012Q1	2008Q4	2%
Uruguay	2007Q3	2004Q4	5% ± 2%

Source: Central Bank websites and IMF. These are the countries used in this study.

Appendix B

Appendix B Inflation Targeting

A country is called an Inflation Targeter (Hammond et al. (2012)) when the following conditions are met.

1. Price stability is recognised as the explicit goal of monetary policy.
2. There is a public announcement of a quantitative target for inflation.
3. Monetary policy is based on a wide set of information, including an inflation forecast.
4. Transparency
5. Accountability mechanisms.

Appendix C

Country Classification

The following table details three different classifications for each country. First, whether each country is advanced or developing. Second, whether each country has a single or dual mandate. Third, whether the country has experienced an episode of hyperinflation.

The classification of a country as developing or advanced is based on the UN country classification. The distinction between countries who have single mandates and those with dual mandates (or flexible targets) is based on the mandates available on the central bank websites. A country has been classified as one with hyper inflationary episodes if it has ever had inflation greater than 50%, in the sample period.

Note: The final data used for the event study analysis excludes the countries that have had episodes of hyperinflation in the period covered by the data set.

TABLE C.1: List of IT countries

Name of Country	Development Status	Mandate	Hyper Inflation
Argentina	Developing	No-mandate	Yes
Austria	Advanced	Dual	No
Belgium	Advanced	Dual	No
Brazil	Developing	Single	Yes
Chile	Developing	Single	No
Colombia	Developing	Single	No
Czech Republic	Developing	Single	Yes
Finland	Advanced	Dual	No
Germany	Advanced	Dual	No
Hungary	Advanced	Single	No
India	Developing	Single	No
Ireland	Advanced	Dual	No
Israel	Developing	Single	No
Italy	Advanced	Dual	No
Japan	Advanced	Single	No
Korea	Developing	Single	No
Mexico	Developing	Single	No
Netherlands	Advanced	Dual	No
Norway	Advanced	Single	No
Paraguay	Developing	Single	No
Peru	Developing	Single	Yes
Philippines	Developing	Single	No
Poland	Advanced	Single	Yes
Russia	Developing	Single	Yes
South Africa	Developing	Single	No
Spain	Advanced	Dual	No
Switzerland	Advanced	Dual	No
Thailand	Developing	Single	No
Turkey	Developing	Single	Yes
Ukraine	Developing	Single	Yes
United States	Advanced	Dual	No
Uruguay	Developing	Single	Yes

Source: Central Bank websites, UN classification.

Appendix D

Barro and Gordon (1983b)

Let's assume the following simple model of the central bank with the loss function given by,

$$\mathcal{L}^{CB} = \max_{\pi_t} \frac{1}{2}\Big[(y_t - y^*)^2 + a(\pi_t - \pi_t^*)^2\Big] \tag{D.1}$$

Where, y_t and π_t are the current output and inflation levels. y^*, π^* are the potential output and inflation target. $\mathcal{L}^{CB}$ represents the loss function of the central bank subject to the following constraint,

$$y_t = b(\pi_t - \pi_t^e) \tag{D.2}$$

D.2 is the Phillips Curve, $a, b > 0$ and there is perfect foresight. Given there are rational expectations this would imply that $\pi_t^e = \pi_t$. That is, agents always know the optimal level of inflation from the central bank's loss function. Let us now consider the switch in regimes.

0.0.1 Pre-Inflation Targeting: No commitment

Let's solve for the optimal inflation when the central bank does not have full commitment which is assumed to be the case before Inflation Targeting. This is not an unreasonable assumption, since many economies faced high inflation prior to the adoption of targeting.

Take first order conditions and solve for optimal inflation with given inflation expectations and $\pi^* = 0$,

$$\pi_t = \frac{b(\pi_t^e + y^*)}{a+b} \tag{D.3}$$

$$\pi_t^e = \frac{(a+b)\pi_t - by^*}{b} \tag{D.4}$$

Given the central bank does not have commitment and agents have rational expectations, the inflation will follow (D.4) which is often referred to as the inflation bias level.

0.0.2 Post-Inflation Targeting: Full commitment

Let the central bank now announce the new credible policy of inflation targeting. Further, assume that the bank now has full commitment to bring reduce inflation to the target and let $\pi_t^* \geq 0$.

Then, following the same procedure as above we find the following,

$$\pi_t = \pi_t^* = \pi_t^e \tag{D.5}$$

Therefore, with rational expectations and full commitment by the central bank, inflation expectations will always be equal to the inflation target. Therefore, in accordance with the rational expectations hypothesis (REH) inflation should jump from (D.4) to (*D*.5) once inflation targeting is announced.

Appendix E

A note on Short-Run Expectations

The primary goal of Inflation Targeting is to anchor medium-long run expectations. Thus, it can be argued that IT should not matter for short run expectations. However, consider the Euler equation based on the Neoclassical Growth Model,

$$u'(c_t) = \beta \mathbb{E}_{\mathbb{t}} \Big[u'(c_{t+1}) \frac{(1+i_t)}{1+\pi_{t+1}} \Big] \tag{E.1}$$

Equation (E.1) explains how consumption today, adjusts to inflation expectations one-period ahead. Thus, adjustment to short run expectations leads to stimulation of consumption which further contributes to a rise in inflation. Moreover, since the objective of Inflation Targeting is respond to deviations in target irrespective of the length of time of deviations. Therefore, the central bank would also want to pay attention to short run expectations. In addition, the long run is derived by taking the sum of (E.1) to infinity. Therefore, indicating the importance of short run expectations.

The paper now turns to the data to analyse the effect of the introduction of Inflation Targeting on Inflation expectations. Before describing the empirical framework, the next section details the data used in this study along with some of the properties of the forecasts.

Appendix F

Summary Statistics and the Rational Expectations

Implementation

Hypothesis

Table F.1: Inflation Expectations: Full Sample around Implementation

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	19.27***	21.56	.815	28.23	8.27	.524
Austria	2.77***	.870	.980	1.87	.521	.804
Belgium	2.46***	.692	.963	1.88	.729	.777
Brazil	502.19***	679.26	.906	6.07	1.89	.808
Chile	9.81***	4.59	.944	3.45	1.07	.773
Colombia	22.03***	2.91	.915	5.65	3.05	.976
Czech Republic	14.20***	9.17	.834	3.11	2.15	.944
Finland	3.36***	.95	.793	1.718	.768	.843
Germany	2.79***	.984	.971	1.65	.540	.836
Hungary	19.50***	7.86	.960	4.24	2.00	.938
India	7.25***	2.44	.884	4.89	.501	.659
Ireland	2.66***	.436	.796	2.18	1.67	.920
Israel	10.48***	2.81	-.081	2.82	1.74	.903
Italy	4.46***	1.58	.963	1.875	.761	.914
Japan	.497***	.938	.926	.842	.548	.785
Korea	7.10***	1.78	.772	3.1	.979	.887
Mexico	17.77***	10.82	.864	4.68	.872	.893
Netherlands	2.62***	.513	.886	1.96	.762	.881
Norway	2.54***	.642	.802	2.11	.479	.669
Paraguay	11.15***	4.61	.675	4.79	1.07	.802
Peru	4.34***	1.02	.626	2.88	.695	.742
Philippines	8.84***	2.85	.845	4.43	1.50	.853
Poland	30.31***	19.98	.788	3.19	2.187	.957
Russia	125.09***	296.80	.893	7.75	3.35	.906
South Africa	9.82***	2.75	.942	6.13	1.42	.844
Spain	5.075***	1.21	.724	2.27	1.05	.897
Switzerland	2.10***	1.53	.974	.757	0.635	.896
Thailand	6.00***	1.96	.864	2.63	1.33	.794
Turkey	70.98***	18.64	.747	12.02	8.84	.968
Ukraine	13.69***	7.27	.895	11.23	2.01	.564
United States	2.75***	.701	.839	2.025	.304	.741
Uruguay	25.24***	22.81	.983	7.89	.855	.682

TABLE F.2: Inflation: Full Sample around Implementation

Country Name	$E(\pi_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi_{t,post})$	σ_{post}	ρ_{post}
Argentina	15.30	29.14	.9570	32.19	10.2649	.842
Austria	2.44	1.15	.937	1.87	.8031499	.849
Belgium	2.03	.714	.822	1.92	1.140096	.828
Brazil	715.42	1091.51	.879	6.34	2.663077	.888
Chile	10.03	5.24	.981	3.16	1.945892	.855
Colombia	22.21	3.92	.946	5.14	2.189618	.935
Czech Republic	11.29	4.63	.788	2.51	2.134448	.907
Finland	2.41	1.16	.883	1.39	1.148651	.898
Germany	2.70	1.65	.923	1.43	.6642704	.815
Hungary	19.33	7.75	.957	3.74	2.360664	.921
India	7.68	3.39	.859	4.95	2.304561	.748
Ireland	2.25	.74	.798	1.84	2.486491	.935
Israel	2.81	1.30	.272	.456	1.000285	.209
Italy	4.02	1.53	.969	1.70	1.043962	.927
Japan	.198	1.07	.864	.858	1.019516	.773
Korea	5.71	1.86	.661	2.34	1.242359	.887
Mexico	18.32	10.78	.906	4.27	1.017846	.836
Netherlands	2.43	.602	.853	1.87	.943258	.884
Norway	2.33	.679	.740	2.01	1.059178	.652
Paraguay	10.37	5.43	.864	3.79	1.373676	.734
Peru	91.54	412.78	.879	2.72	1.362741	.852
Philippines	7.76	3.80	.888	3.73	2.016421	.871
Poland	30.84	18.08	.983	2.76	2.55652	.949
Russia	76.71	183.58	.960	6.74	4.509322	.893
South Africa	9.09	3.53	.906	5.32	2.693829	.884
Spain	4.74	.981	.875	2.07	1.46061	.888
Switzerland	2.00	1.91	.973	.490	.8771129	.854
Thailand	4.64	2.42	.873	2.02	1.933139	.823
Turkey	75.04	18.01	.826	11.38	7.448558	.961
Ukraine	293.86	1130.55	.801	10.28	3.593149	.270
United States	2.59	1.08	.747	1.59	.7077859	.797
Uruguay	25.45	25.76	.992	7.95	1.077938	.791

TABLE F.3: Forecast Errors: Full Sample around Implementation

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	-3.96**	18.68295	.670***	3.96	8.650262	.707**
Austria	-0.327***	.4679931	.565***	0.001	.6910679	.730***
Belgium	-0.432***	.4195077	.455**	0.041	.9064904	.683***
Brazil	213.23***	499.1188	.622***	0.268	1.722025	.662***
Chile	0.218	1.665489	.403**	-0.285*	1.516027	.741***
Colombia	0.420	2.01485	.476**	-0.504**	1.734053	.855***
Czech Republic	-0.942***	3.760238	.54**	-0.603***	1.589391	.725***
Finland	-0.089	.796839	.598**	-0.320***	.80405	.730***
Germany	-0.170	.8298142	.748***	-0.214***	.51593	.551***
Hungary	0.429	2.878666	.521***	-0.490***	1.29543	.653***
India	-0.417***	2.850399	.738***	0.060	2.654569	.765***
Ireland	-7.938***	.6385225	.662***	-0.340**	1.475234	.823***
Israel	-.0437***	3.297099	.078	-2.36***	1.854971	.590***
Italy	-0.299***	.5861911	.732***	-0.169**	.6230933	.738***
Japan	-1.384***	.6225561	.549***	-0.751***	.7110261	.683***
Korea	0.545	1.839256	-0.453**		1.040202	.8157***
Mexico	-0.188**	3.251321	.392**	-0.085	.7393395	.561 ***
Netherlands	-0.213*	.492692	.673***	-0.095	.5500805	.532***
Norway	-1.18**	.7191434	.630***	-0.998***	1.042371	.517***
Paraguay	-1.751***	3.662622	0.422***	-0.162	1.138949	.426**
Peru	-1.08**	1.207112	0.618**	-0.694***	1.056194	.776***
Philippines	0.530	2.473918	.521***	-0.162**	1.628617	.741***
Poland	-23.43***	9.745684	.236	-694***	1.293753	.686***
Russia	-0.731**	81.00855	.703***	-0.428**	2.575003	.620***
South Africa	-0.327	1.994642	.624***	-1.01*	2.056672	.785***
Spain	-0.106	.7509802	.335	-0.805***	1.023761	.682***
Switzerland	-1.35***	.5722116	.764***	-0.209**	.5019372	.637***
Thailand	4.05**	2.42579	.816***	-0.615***	1.572284	.651***
Turkey	-0.007	12.03262	-.019	-0.640	3.690881	.597***
Ukraine	13.69403***	8.550081	.775***	-0.950	4.020822	.781***
United States	-0.158	.968073	.641***	-0.431***	.6205168	.609***
Uruguay	0.2156	5.417912	.620***	0.063	.9759901	.535***

TABLE F.4: Inflation Expectations: 5 years around Implementation

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	28.58***	4.80	.841***	32.14***	9.96	.665**
Austria	2.23***	.649	.965***	1.69***	.475	.772***
Belgium	2.06***	.446	.940***	1.80***	.366	.725***
Brazil	302.38**	632.32	.952***	7.71***	1.94	.511**
Chile	7.43***	2.16	.946***	3.41***	.791	.792***
Colombia	20.16***	1.04	.370***	9.24***	3.42	.963***
Czech Republic	11.18***	2.89***	.737	6.3***	2.94	.931***
Finland	1.80***	.552***	.592	1.79***	.673	.832***
Germany	2.13***	.550	.914***	1.57***	.448	.825***
Hungary	18.50***	6.40	.937***	6.704***	1.82	.912***
India	7.52***	.644	.537**	5.08***	.522	.683***
Ireland	2.49***	.359	.725***	3.60***	1.18	.847***
Israel	10.15***	2.14	-.069	4.833***	2.55	.879***
Italy	3.6***	1.31	.939***	2.366***	.376	.831***
Japan	.125	.724	.760***	.845***	.594	.787***
Korea	5.55***	1.87	.794***	3.53***	.353	.472**
Mexico	18.00***	6.74	.930***	4.941***	1.16	.966***
Netherlands	2.34***	.160	.398*	2.66***	.825	.778***
Norway	2.4***	.410	.544**	2.02***	.641	.800***
Paraguay	8.26***	2.02	.585**	5.27***	1.15	0.674***
Peru	4.34***	1.02	.626**	2.57***	.521	.630***
Philippines	7.28***	1.62	.349	5.32***	1.32	.858***
Poland	24.71***	7.12	.868***	6.60***	3.38	.969***
Russia	8.07***	.899	.714***	7.77***	3.68	.912***
South Africa	8.16***	1.45	.806***	6.26***	1.599	.893***
Spain	3.42***	1.04	.967***	2.91***	.505	.856***
Switzerland	1.07***	.539	.873***	1.12***	.353	.809***
Thailand	6.49***	2.25	.835***	2.53***	.763	.768***
Turkey	64.95***	18.81	.857***	17.25***	13.26	.977***
Ukraine	13.62***	9.83	.918***	11.23***	2.01	.564**
United States	2.39***	.807	.657***	1.97***	.323	.723***
Uruguay	11.95***	7.69	.840***	7.42***	.752	.378*

Table F.5: Inflation: 5 years around Implementation

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	14.22***	5.27	.836***	37.72***	12.30	.916***
Austria	1.72***	.801	.870***	1.90***	.765	.892***
Belgium	1.63***	.571	.686***	1.97***	.649	.694***
Brazil	462.15*	1165.37	.878***	8.30***	3.33	.823***
Chile	7.19***	2.19	.943***	2.78***	1.15	.819***
Colombia	19.96***	2.07	.824***	7.50***	1.45	.840***
Czech Republic	11.53***	4.95	.790***	4.99***	3.77	.900***
Finland	1.04***	.581	.679***	1.56***	1.07	.906***
Germany	1.60***	.678	.869***	1.41***	.495	.705***
Hungary	18.15***	7.08	.963***	6.22***	2.47	.933***
India	9.07***	2.07	.771***	5.17***	1.96	.718***
Ireland	2.09***	.515	.574***	3.76***	1.56	.876***
Israel	2.60***	.934	.045	.980***	1.35	.063
Italy	3.31***	1.44	.953***	2.41***	.382	.876***
Japan	-.28	1.01	.781***	.913***	1.09	.776***
Korea	3.94***	2.44	.771***	3.08***	.785	.684***
Mexico	17.58***	7.36	.964***	4.57***	.882	.863***
Netherlands	2.10***	.367	.774***	2.53***	.995	.926***
Norway	2.43***	.632	.804***	1.74***	1.15	.503**
Paraguay	7.44***	3.28	.775***	4.64***	2.12	.758***
Peru	4.46***	2.76	.959***	2.16***	1.24	.753***
Philippines	5.90***	2.19	.851***	4.22***	1.80	.894***
Poland	25.24***	8.51	.982***	5.62***	3.97	.957***
Russia	7.43***	2.59	.672***	6.04***	4.34	.954***
South Africa	7.00***	2.34	.762***	4.59***	4.12	.872***
Spain	3.19***	1.29	.951***	3.13***	.582	.512**
Switzerland	.791***	.646	.824***	.967***	.446	.639***
Thailand	4.91***	3.12	.874***	2.36***	1.56	.903***
Turkey	68.81***	16.84	.890***	14.80***	11.15	.982***
Ukraine	14.93***	19.48	.916***	10.28***	3.59	.270
United States	2.25***	1.78	.707***	1.42***	.708	.768***
Uruguay	10.94***	7.56	.836***	7.894	7.72***	.635***

Table F.6: Forecast Errors: 5 years around Implementation

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	-14.35***	4.12	.466**	5.58**	9.34	.616**
Austria	-.507***	.429	.383*	.208	.651	.782***
Belgium	-.426***	.445	.418*	.172	.621	.538**
Brazil	159.77	598.42	.611**	.592	2.95	.651***
Chile	-.236	1.14	.609**	-.626**	1.00	.572**
Colombia	-.194	2.00	.459**	-1.73***	2.33	.846***
Czech Republic	.351	4.04	.546**	-1.30**	2.39	.696***
Finland	-.763***	.826	.628**	-.232	.810	.697***
Germany	-.528***	.469	.683***	-.156*	.417	.425**
Hungary	-.353	2.66	.538**	-.477*	1.27	.647***
India	1.55**	2.25	.721***	.091	2.22	.733***
Ireland	-.398**	.515	.398*	.158	1.20	.709***
Israel	-7.54***	2.59	.091	-3.85***	2.76	.573**
Italy	-.288**	.624	.729***	.043	.352	.599***
Japan	-.409**	.789	.511**	.067	.753	.693***
Korea	-1.61**	2.16	.609**	-.451**	.767	.608***
Mexico	-.416	1.89	.568**	-.369**	.684	.651***
Netherlands	-.236**	.327	.693***	-.130	.583	.551**
Norway	.037	.698	.651***	-.281	1.26	.406**
Paraguay	-.818	2.88	.480**	-.623	1.90	.602***
Peru	-1.75***	1.20	.618**	-.406	1259	.748***
Philippines	-1.37**	1.84	.394*	-1.10**	1.59	.779***
Poland	.538	3.57	.360	-.988**	1.89	.683***
Russia	-.631	2.59	.729***	-1.72***	1.74	.670***
South Africa	-1.15**	2.13	.636**	-1.66**	3.18	.820***
Spain	-.228*	.538	.670***	.224	.595	.407**
Switzerland	-.278**	.375	.596**	-.161**	.351	.287
Thailand	-1.57**	3.15	.819***	-.166	1.12	.691***
Turkey	3.86**	7.85	.192	-2.45**	4.52	.579**
Ukraine	1.31	13.64	.769***	-.950	4.02	.781***
United States	-.139	1.63	.602**	-.550***	.633	.551**
Uruguay	-1.00	4.37	.438**	.299	0.902	.314

Announcement

TABLE F.7: Inflation Expectations: Full Sample around Announcement

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	18.95***	21.79	.813***	28.66***	7.30	.530**
Austria	2.91***	.783	.975***	1.85***	.520	.807***
Belgium	2.85***	.563	.925***	1.87***	.686	.777***
Brazil	864.80***	702.20	.836***	6.65***	3.37	.936***
Chile	26.52***	-	-	-	3.91	-
Colombia	14.36***	.937	.626	8.96***	6.80	.991***
Czech Republic	14.20357***	9.31	.832***	3.19***	2.25	.949***
Finland	3.92***	.734	.382	1.79***	.819	.869***
Germany	2.95***	.937	.969***	1.65***	.531	.831***
Hungary	19.76***	7.78	.958***	4.30***	2.06	.942***
India	7.36***	2.48	.883***	5.08***	.522	.683***
Ireland	2.74***	.394	.811***	2.20***	1.60	.918***
Israel	10.70***	3.37	-.303	3.62***	2.93	.918***
Italy	4.82***	1.34	.941***	1.87***	.744	.914***
Japan	.516***	.956	.925***	.75***	.570	.824***
Korea	6.93***	1.76	.754***	3.29***	1.42	.938***
Mexico	19.53***	12.49	.857***	5.90***	3.32	.981***
Netherlands	2.67***	.538	.881***	1.98***	.748	.882***
Norway	2.56***	.695	.828***	2.14***	.477	.665***
Paraguay	13.31***	4.38	.405**	6.04***	2.14	.859***
Peru	8.9***	-	-	-	.891	-
Philippines	33.01***	2.85	.842***	4.46***	1.51	.856***
Poland	127.74***	19.95	.752***	3.56***	2.74	.972***
Russia	10.13***	299.62	.892***	7.72***	3.22	.905***
South Africa	5.6***	2.66	.935***	6.14***	1.39	.842***
Spain	2.19***	1.22	.572**	2.45***	1.15	.920***
Switzerland	2.108333***	1.53	.973***	.756***	.627	.895***
Thailand	6.13***	1.83	.838***	2.62***	1.33	.795***
Turkey	71.50***	19.19	.761***	14.09***	13.43	.939***
Ukraine	12.94***	5.95	.890***	14.21***	8.87	.707***
United States	2.88***	.613	.899***	2.03***	.468	.593***
Uruguay	28.94***	23.29	.981***	7.68***	.996	.735***

TABLE F.8: Inflation: Full Sample around Announcement

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	14.84***	29.43	.961***	31.89***	9.24	.809***
Austria	2.62***	1.04	.917***	1.83***	.818	.857***
Belgium	2.36***	.574	.818***	1.87***	1.09	.823***
Brazil	1236.78***	1200.72	.816***	6.56***	3.37	.931***
Chile	-	-	-	3.45122	4.51	-
Colombia	27.86***	2.27	.843**	8.52***	6.69	.990***
Czech Republic	11.21***	4.71	.795***	2.63***	2.40	.909***
Finland	3.33***	.676	.898**	1.40***	1.12	.888***
Germany	2.99***	1.54	.904***	1.40***	.675	.817***
Hungary	19.59***	7.66	.956***	3.81***	2.41	.924***
India	7.80***	3.46	.859***	5.17***	1.96	.718***
Ireland	2.34***	.779	.830***	1.85***	2.38	.933***
Israel	3.13***	1.51	.252	.667***	1.16	.428***
Italy	4.34***	1.36	.956***	1.70***	1.02	.926***
Japan	.222**	1.09	.865***	.714***	1.03	.791***
Korea	5.83***	1.69	.773***	2.42***	1.38	.841***
Mexico	20.44***	12.07	.896***	5.51***	3.57	.977***
Netherlands	2.50***	.612	.852***	1.88***	.922	.882***
Norway	2.20***	.646	.705***	2.09***	1.05	.668***
Paraguay	12.15***	5.58	.842***	5.22***	2.79	.810***
Peru	-	769.01	-	-	4.15	-
Philippines	7.86***	3.77	.886***	3.73***	2.00	.869***
Poland	33.86***	17.29	.980***	3.08***	2.94	.957***
Russia	78.42***	185.49	.959***	6.71***	4.32	.893***
South Africa	9.67***	3.07	.897***	5.23***	2.69	.872***
Spain	5.23***	.741	.775***	2.23***	1.51	.901***
Switzerland	2.04***	1.96	.975***	.507***	.873	.853***
Thailand	4.73***	2.39	.868***	2.01***	1.92	.823***
Turkey	75.74***	18.42	.823***	13.54***	12.96	.959***
Ukraine	299.49**	1142.39	.800***	13.37***	9.93	.884***
United States	2.78***	.822	.665***	1.59***	1.06	.751***
Uruguay	29.30***	26.60	.991***	7.63***	1.33	.823***

Table F.9: Forecast Errors: Full Sample around Announcement

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	-4.10**	18.93	.672***	3.22	7.74	.713**
Austria	-.288**	.474	.539**	-.023	.691	.738***
Belgium	-.492***	.413	.530**	-.005	.868	.677***
Brazil	371.98**	616.58	.554**	-.089	1.87	.706***
Chile	-	-	-	-	1.57	-
Colombia	1.34**	1.74	.582	-.439**	1.78	.744***
Czech Republic	.288	3.78	.549**	-.557***	1.63	.714***
Finland	-.585**	.458	-.222	-.393***	.848	.753***
Germany	.040	.801	.699***	-.249***	.532	.588***
Hungary	-.169	2.91	.523***	-.486***	1.28	.648***
India	.446	2.93	.741***	.091	2.22	.733***
Ireland	-.396**	.631	.733***	-.353**	1.42	.817***
Israel	-8.03***	3.86	-.154	-2.95***	2.59	.727***
Italy	-.478***	.608	.722***	-.168**	.611	.737***
Japan	-.294***	.632	.550***	-.035	.687	.681***
Korea	-1.093***	1.56	.414**	-.870***	1.24	.766***
Mexico	.906	3.59	.320	-.388***	1.03	.645***
Netherlands	-.165	.516	.688***	-.097*	.542	.532***
Norway	-.359**	.673	.537***	-.047	1.01	.529***
Paraguay	-1.540**	4.057	.379**	-.820**	2.08	.500
Peru	-	-	-	-	1.19	-
Philippines	-1.03**	2.47	.519***	-.730***	1.64	.741***
Poland	.844	10.37	.230	-.484***	1.36	.668***
Russia	-23.98**	81.92	.702***	-1.00**	2.47	.618***
South Africa	-.460	1.85	.585***	-.910***	2.09	.782***
Spain	-.369	.872	.298	-.213**	.988	.677***
Switzerland	-.141	.569	.780***	-.249***	.509	.640***
Thailand	-1.40***	2.44	.817***	-.606***	1.56	.649***
Turkey	4.24**	12.44	-.010	-.553	3.65	.498***
Ukraine	-.009	8.57	.837***	-.837	4.61	.607**
United States	-.103	.773	.552***	-.438**	1.02	.694***
Uruguay	.366	5.87	.616***	-.046	1.22	.656***

Table F.10: Inflation Expectations: 5 years around Announcement

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	27.12***	5.07	.861***	31.78***	9.01	.647**
Austria	2.68***	.710	.967***	1.62***	.469	.791***
Belgium	2.85***	.563	.925***	1.81***	.374	.761***
Brazil	1019.68***	655.4	.841***	13.12***	11.53	.659***
Chile	-	-	-	-	-	-
Colombia	26.52***	.937	.626	20.53***	1.36	.644***
Czech Republic	11.18***	2.89	.737***	6.3***	2.94	.931***
Finland	3.92***	.734	.382	2.07***	.824	.830***
Germany	2.54***	.769	.958***	1.58***	.457	.823***
Hungary	14.89***	5.51	.965***	5.88***	1.78	.913***
India	7.52***	.644	.537**	5.08***	.522	.683***
Ireland	2.67***	.388	.823***	3.32***	1.21	.881***
Israel	11.16***	3.53	-.400	8.25***	2.99	.737***
Italy	4.27***	1.167	.918***	2.29***	.404	.880***
Japan	.195	.736	.769***	.704***	.653	.823***
Korea	5.87***	.625	.400**	4.62***	2.00	.852***
Mexico	21.25***	14.37	.853***	9.67***	4.50	.974***
Netherlands	2.41***	.235	.746***	2.75***	.739	.742***
Norway	2.27***	.481	.634**	2.31***	.587	.736***
Paraguay	11.81***	2.95	.542**	8.18***	1.87	.590**
Peru	-	-	-	-	-	-
Philippines	7.75***	1.61	.326	5.70***	1.20	.861***
Poland	24.71***	7.12	.868***	6.60***	3.38	.969***
Russia	10.18***	2.40	.910***	8.04***	3.21	.901***
South Africa	8.55***	1.24	.732***	6.66***	1.37	.835***
Spain	5.95***	1.11	.341	3.19***	1.08	.972***
Switzerland	1.22***	.563	.835***	1.05***	.383	.858***
Thailand	6.49***	2.25	.835***	2.53***	.763	.768***
Turkey	70.52***	18.82	.804***	25.20***	19.68	.915***
Ukraine	10.21***	3.89	.778***	14.92***	8.71	.706***
United States	2.67***	.384	.758***	2.27***	.723	.656***
Uruguay	10.97***	8.30	.867***	7.36***	1.14	.531**

TABLE F.11: Inflation: 5 years around Announcement

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	12.87***	4.80	.892***	33.67***	13.84	.937***
Austria	2.25***	.877	.892***	1.62***	.809	.914***
Belgium	2.36***	.574	.818***	1.83***	.735	.753***
Brazil	1460.50***	1179.76	.770***	12.06***	16.22	.960***
Chile	-	-	-	-	-	-
Colombia	27.86***	2.27	.843**	20.32***	2.07	.814***
Czech Republic	11.53***	4.95	.790***	4.99***	3.77	.900***
Finland	3.33***	.676	.898**	1.12***	.657	.732***
Germany	2.28***	1.04	.931***	1.21***	.553	.746***
Hungary	14.32***	4.90	.982***	5.47***	2.03	.847***
India	9.07***	2.07	.771***	5.17***	1.96	.718***
Ireland	2.11***	.628	.756***	3.58***	1.71	.913***
Israel	2.99***	1.59	.285	1.92***	1.52	.209
Italy	3.86***	1.26	.937***	2.35***	.448	.881***
Japan	-.158	1.06	.784***	.742**	1.18	.811***
Korea	5.19***	1.17	.422*	3.25***	1.88	.805***
Mexico	21.72***	13.93	.895***	9.21***	5.11	.977***
Netherlands	2.25***	.430	.810***	2.63***	.893	.906***
Norway	2.03***	.611	.641**	2.06***	1.29	.597**
Paraguay	9.23***	4.20	.646**	6.91***	3.29	.749***
Peru	-	769.01	-	2.884722	-	-
Philippines	6.30***	2.11	.853***	4.43***	1.78	.898***
Poland	25.24***	8.51	.982***	5.62***	3.97	.957***
Russia	8.948***	3.49	.915***	7.20***	4.29	.885***
South Africa	8.036***	1.58	.582**	4.88***	4.07	.848***
Spain	5.38***	.752	.741**	3.09***	1.20	.947***
Switzerland	.800***	.660	.798***	.906***	.470	.656***
Thailand	4.91***	3.12	.874***	2.367***	1.56	.903***
Turkey	72.38***	16.65	.932***	23.76***	20.79	.940***
Ukraine	7.21**	9.17	.905***	17.64***	16.19	.866***
United States	2.94***	.766	.593**	1.86***	1.53	.703***
Uruguay	9.83***	8.17	.861***	7.11***	1.49	.793***

TABLE F.12: Forecast Errors: 5 years around Announcement

Country Name	$E(\pi^e_{t,pre})$	σ_{pre}	ρ_{pre}	$E(\pi^e_{t,post})$	σ_{post}	ρ_{post}
Argentina	-14.25***	3.20	.439**	1.89	11.59	.806***
Austria	-.425***	.442	.435**	-.003	.688	.810***
Belgium	-.492***	.413	.530**	.013	.621	.519**
Brazil	440.82**	651.23	.512**	-1.06	8.31	-.941***
Chile	-	-	-	3.45122	2.05	-
Colombia	1.34*	1.740	.582	-.212	1.97	.402**
Czech Republic	.351	4.04	.546**	-1.30**	2.39	.696***
Finland	-.585**	.458	-.222	-.952***	.879	.661***
Germany	-.262**	.568	.711***	-.369***	.462	.524**
Hungary	-.562	1.95	.590**	-.403	1.48	.659***
India	1.55**	2.25	.721***	.091	2.22	.733***
Ireland	-.551***	.567	.655***	.255	1.06	.687***
Israel	-8.77***	3.87	-.390	-6.33***	3.05	.500**
Italy	-.402**	.666	.762***	.061	.343	.588**
Japan	-.353*	.819	.518**	.038	.770	.732***
Korea	-.671**	1.40	.372	-1.36***	1.91	.716***
Mexico	.477	4.01	.343	-.459	1.57	.723***
Netherlands	-.157*	.392	.678***	-.121	.571	.520**
Norway	-.235	.746	.522**	-.247	1.28	.435**
Paraguay	-2.57**	3.82	.506**	-1.26**	2.91	.482**
Peru	-	-	-	-	.888	-
Philippines	-1.45**	1.83	.392**	-1.27***	1.51	.811***
Poland	.538	3.57	.360	-.988**	1.89	.683***
Russia	-1.23**	2.41	.820***	-.831	2.55	.619***
South Africa	-.518	1.91	.598**	-1.77**	3.26	.805***
Spain	-.569**	.857	.041	-.103	.568	.723***
Switzerland	-.424***	.302	.394**	-.151*	.396	.324
Thailand	-1.57**	3.15	.819***	-.166	1.12	.691***
Turkey	1.86	9.01	.206	-1.44	6.80	.304
Ukraine	-2.99*	6.76	.769***	2.72	11.93	.765***
United States	.276	.672	.309	-.413	1.42	.613***
Uruguay	-1.14	4.23	.440**	-.250	1.55	.508**

0.1 *Rational Expectation Hypothesis*

If surveys about inflation expectations convey information about true expectations of future inflation, then it is possible to construct a test that verifies whether the Rational Expectation Equilibrium (REE) holds in the data. Under the Rational Expectation Hypothesis (REH) forecast errors must be orthogonal to all the information that is available and relevant to the agents at the moment of making the forecasts. However, if agents form beliefs about inflation according to adaptive expectations then, the forecasting errors may not necessarily be orthogonal to the information agents use to form their forecasts.

This paper follows Adam et al. (2017), Gerko (2017) and Kohlhas and Walther (2018) to perform the test for the rational expectation hypothesis. Let $E_t^{\mathcal{P}}$ and E_t denote the measure for subjective and rational expectations, respectively. Let $y_{t,t+h}$ denote the actual value of inflation in period $t+h$ and $E_t^{\mathcal{P}} y_{t,t+h}$ represent the forecast of inflation in period $t+h$, reported at time t. Therefore, the forecast error is given by $y_{t,t+h} - E_t^{\mathcal{P}} y_{t,t+h}$. Thus, a negative value of the difference would imply that agents are over-predicting inflation. Therefore, the test run to check the validity of the the hypothesis is the following,

$$y_{t,t+h} = \alpha_1 + \rho_1 y_{t-h,t} + \epsilon_t \tag{F.1}$$

$$E_t^{\mathcal{P}} y_{t,t+h} = \alpha_2 + \rho_2 y_{t-h,t} + \eta_t \tag{F.2}$$

Under the null of rational expectations, we would expect, $E_t^{\mathcal{P}} = E_t$. Thus, $H_0 : \rho_1 - \rho_2 = 0$. We can re-write equation (1) and (2) to perform a joint test for the REH. Thus the test is now augmented such that the null hypothesis is, $H_0 : \rho = 0$. Table F.13 presents the results for the REH test for the panel data. For both the pre and post IT period, the test is rejected.

TABLE F.13: REH Test, Panel Data

Variable	Pre-IT	Post-IT
Π_t	0.338***	0.142**
	(0.061)	(0.058)
Constant	-7.56***	-0.872***
	(1.77)	(0.167)

Note: The regression is of the forecast error in $t+h$ on inflation in period t. Newey West standard errors are reported in Parenthesis. The null hypothesis of $H_0 : \rho = 0$ is rejected for this sample. $*p < 0.10, **p < 0.05, ***p < 0.01$

Table F.14 provides the results for the REH test each country in the data set. It is unsurprising that the REH is rejected at the individual level for the expectations of professional forecasters. The Newey West standard errors are reported along with the coefficient on inflation (ρ). The coefficient for all countries in both the periods is significantly different from zero. Thus, it is possible to reject the test for almost all countries for the pre and post targeting period.

TABLE F.14: Rational Expectations Test

Country Name	Pre-IT	Post-IT
Argentina	.431***	.529***
	(.099)	(0.069)
Austria	.296***	.659***
	(.048)	(0.059)
Belgium	.202	.611***
	(.128)	(0.511)
Brazil	.410***	.455***
	(.046)	(0.077)
Chile	.167***	.650***
	(.041)	(0.055)
Colombia	.355***	-.162
	(.062)	(0.221)
Czech Republic	.654***	.269**
	(.134)	(.142)
Finland	.401**	.521***
	(.147)	(.057)
Germany	.448***	.470***
	(.038)	(0.070)
Hungary	.054	.290***
	(.072)	(0.080)
India	.592***	1.139***
	(.150)	(0.042)
Ireland	.695***	.449***
	(.095)	(0.082)
Israel	2.22**	0.693***
	(.0672)	(0.207)
Italy	.038	0.411***
	(.089)	(0.054)
Japan	.288**	.598***
	(.094)	(.081)
Korea	.526**	.539***
	(.211)	(.114)
Mexico	.041	.396**
	(.058)	(.135)
Netherlands	.467***	.343***
	(.130)	(.083)

TABLE F.14: Rational Expectations Test

Country Name	Pre-IT	Post-IT
Norway	.612**	.881***
	(.221)	(.059)
Paraguay	.343***	.535**
	(.086)	(.224)
Peru	.572***	.669***
	(.074)	(.067)
Philippines	.430***	.547***
	(.064)	(.107)
Poland	.034	.262***
	(.122)	(.059)
Russia	-.367***	.385***
	(.019)	(.102)
South Africa	.355***	.652***
	(.070)	(.098)
Spain	.025	.487***
	(.141)	(.052)
Switzerland	.225***	.401***
	(.049)	(.077)
Thailand	.673***	.592***
	(.145)	(.081)
Turkey	.187	-.082
	(.130)	(.080)
Ukraine	.564***	.968***
	(.089)	(.171)
United States	.689***	.791***
	(.094)	(.070)
Uruguay	.130**	.588***
	(.041)	(.105)

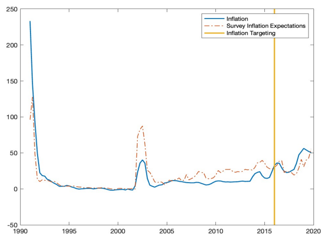
Note: Newey West standard errors in parenthesis.

Appendix G

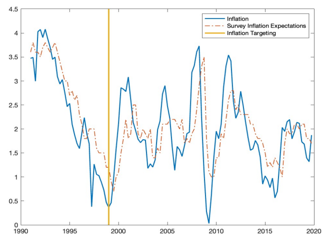
Time Series for all IT Countries

FIGURE G.1: Inflation and Inflation expectations

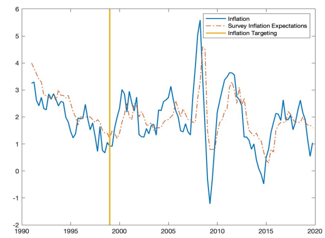
(A) Argentina



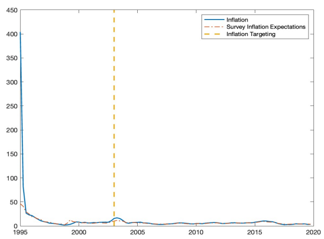
(B) Austria



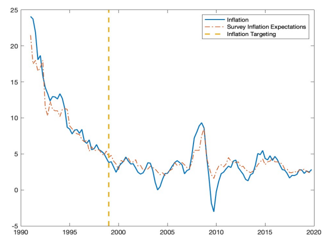
(C) Belgium



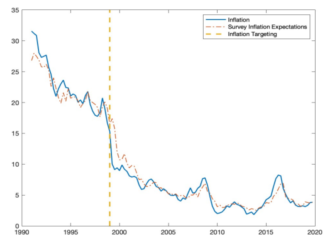
(D) Brazil



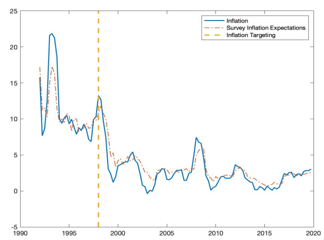
(E) Chile



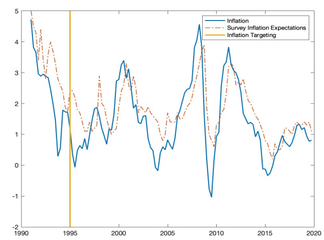
(F) Colombia



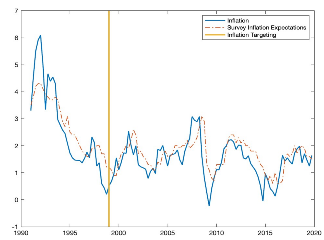
(G) Czech Republic



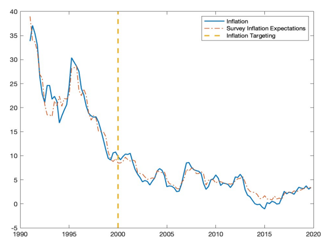
(H) Finland



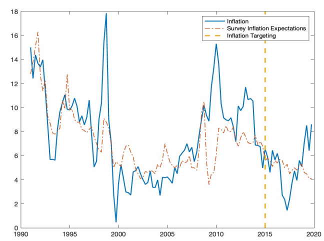
(I) Germany



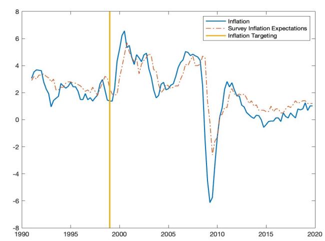
(J) Hungary



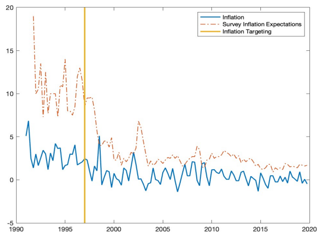
(K) India



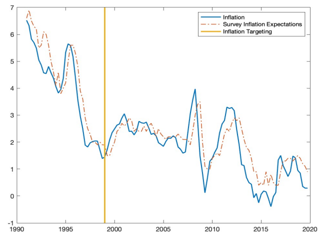
(L) Ireland



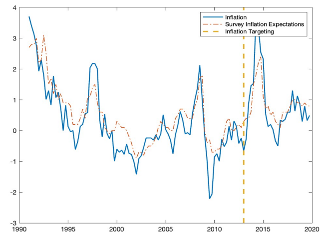
(M) Israel



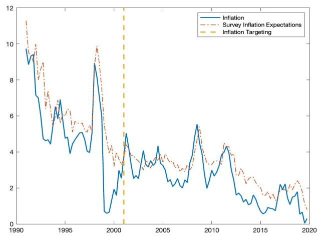
(N) Italy



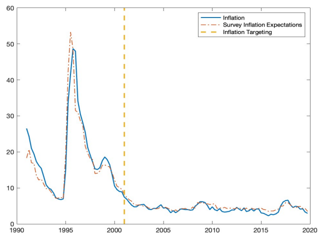
(O) Japan



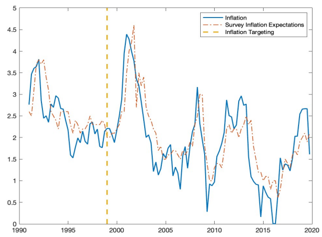
(P) Korea



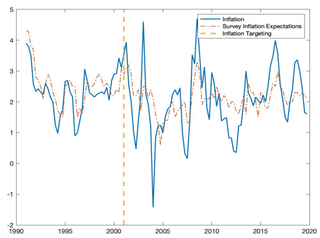
(Q) Mexico



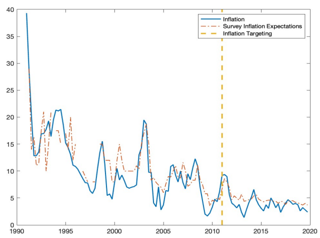
(R) Netherlands



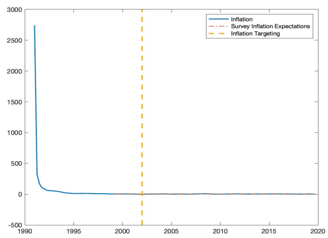
(S) Norway



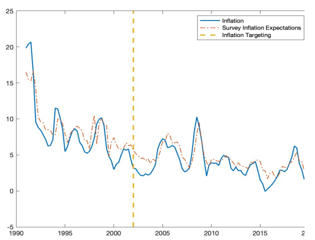
(T) Paraguay



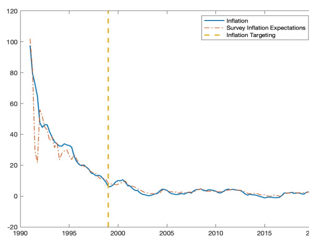
(U) Peru



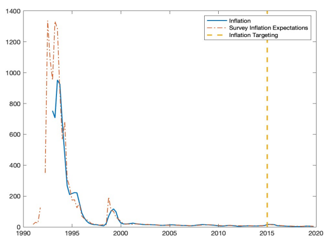
(V) Philippines



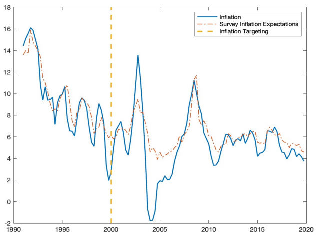
(W) Poland



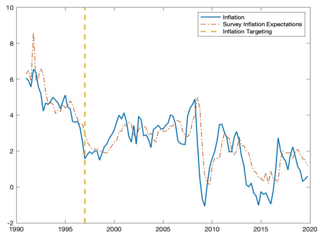
(X) Russia



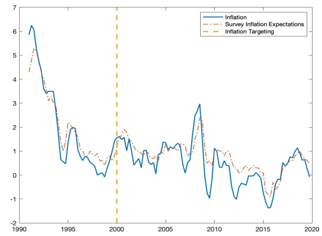
(Y) South Africa



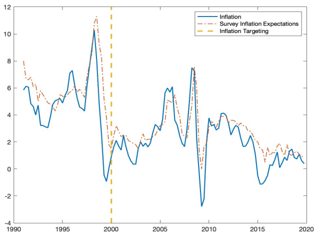
(Z) Spain



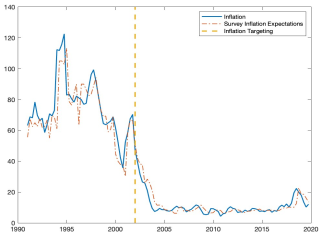
(AA) Switzerland



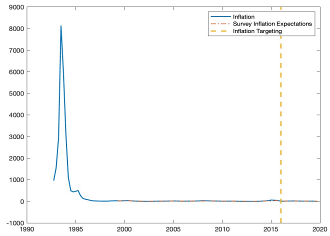
(AB) Thailand



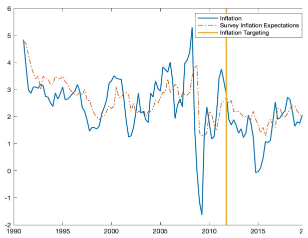
(AC) Turkey



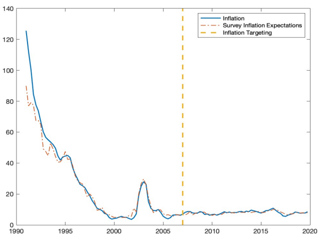
(AD) Ukraine



(AE) United States



(AF) Uruguay



Appendix H

Structural Break Tests

0.0.1 Inflation

TABLE H.1: Argentina

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.737***	0.635***
	(0.0733)	(0.0408)
Cons$*\mathbb{1}_{t\geq t^*}$		-5.030**
		(1.948)
Lag$*\mathbb{1}_{t\geq t^*}$		0.434***
		(0.0636)
Constant	2.990***	3.062***
	(0.834)	(0.476)
Observations	114	114
R-squared	0.853	0.910

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.737***	0.618***
	(0.0733)	(0.0350)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.708
		(2.243)
Lag$*\mathbb{1}_{t\geq t^*}$		0.412***
		(0.0658)
Constant	2.990***	2.865***
	(0.834)	(0.431)
Observations	114	114
R-squared	0.853	0.925

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.2: Austria

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.881***	0.679***
	(0.0423)	(0.0772)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.854***
		(0.222)
Lag$*\mathbb{1}_{t\geq t^*}$		0.412***
		(0.0769)
Constant	0.226**	0.693***
	(0.0923)	(0.221)
Observations	114	114
R-squared	0.794	0.847

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.881***	0.605***
	(0.0423)	(0.0831)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.105***
		(0.248)
Lag$*\mathbb{1}_{t\geq t^*}$		0.479***
		(0.0780)
Constant	0.226**	0.958***
	(0.0923)	(0.256)
Observations	114	114
R-squared	0.794	0.861

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.3: Belgium

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.822***	0.220***
	(0.0767)	(0.0605)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.575***
		(0.159)
Lag$*\mathbb{1}_{t\geq t^*}$		0.818***
		(0.0499)
Constant	0.328**	1.502***
	(0.150)	(0.173)
Observations	114	114
R-squared	0.681	0.915

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.822***	0.0917**
	(0.0767)	(0.0382)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.079***
		(0.162)
Lag$*\mathbb{1}_{t\geq t^*}$		0.925***
		(0.0311)
Constant	0.328**	2.047***
	(0.150)	(0.173)
Observations	114	114
R-squared	0.681	0.966

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.4: Brazil

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.909***	0.884***
	(0.166)	(0.180)
Cons$*\mathbb{1}_{t\geq t^*}$		-75.37
		(63.90)
Lag$*\mathbb{1}_{t\geq t^*}$		0.212
		(0.179)
Constant	15.69	74.76
	(13.64)	(63.99)
Observations	114	114
R-squared	0.826	0.828

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.909***	0.824***
	(0.166)	(0.211)
Cons$*\mathbb{1}_{t\geq t^*}$		-218.7
		(176.2)
Lag$*\mathbb{1}_{t\geq t^*}$		0.146
		(0.226)
Constant	15.69	218.7
	(13.64)	(176.2)
Observations	114	114
R-squared	0.826	0.832

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.5: Chile

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.896***	0.793***
	(0.0302)	(0.0487)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.808***
		(0.496)
Lag$*\mathbb{1}_{t\geq t^*}$		0.322***
		(0.0747)
Constant	0.365**	1.449***
	(0.164)	(0.453)
Observations	114	114
R-squared	0.936	0.950

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.896***	1.91e-08
	(0.0302)	(1.48e-08)
Cons$*\mathbb{1}_{t\geq t^*}$ = o,		-
Lag$*\mathbb{1}_{t\geq t^*}$		1.000***
		(1.70e-08)
Constant	0.365**	6.94e-09
	(0.164)	(2.33e-08)
Observations	114	114
R-squared	0.936	1.000

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.6: Colombia

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.963***	0.749***
	(0.0127)	(0.0774)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.958***
		(1.676)
Lag$*\mathbb{1}_{t\geq t^*}$		0.216***
		(0.0721)
Constant	0.122	5.034***
	(0.103)	(1.757)
Observations	114	114
R-squared	0.985	0.988

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.963***	0.0740
	(0.0127)	(0.0539)
Cons$*\mathbb{1}_{t\geq t^*}$		-24.76***
		(1.751)
Lag$*\mathbb{1}_{t\geq t^*}$		0.925***
		(0.0546)
Constant	0.122	24.75***
	(0.103)	(1.754)
Observations	114	114
R-squared	0.985	0.999

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.7: Czech Republic

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.934***	0.660***
	(0.0627)	(0.126)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.081***
		(1.203)
Lag$*\mathbb{1}_{t\geq t^*}$		0.321**
		(0.138)
Constant	0.252	4.057***
	(0.183)	(1.198)
Observations	111	111
R-squared	0.877	0.903

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.934***	0.654***
	(0.0627)	(0.126)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.135***
		(1.181)
Lag$*\mathbb{1}_{t\geq t^*}$		0.373***
		(0.132)
Constant	0.252	4.015***
	(0.183)	(1.189)
Observations	111	111
R-squared	0.877	0.903

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.8: Finland

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.886***	0.289***
	(0.0470)	(0.0927)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.532***
		(0.303)
Lag$*\mathbb{1}_{t\geq t^*}$		0.740***
		(0.0842)
Constant	0.147*	1.488***
	(0.0779)	(0.312)
Observations	114	114
R-squared	0.810	0.940

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.886***	0.0174
	(0.0470)	(0.0142)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.977***
		(0.0866)
Lag$*\mathbb{1}_{t\geq t^*}$		0.984***
		(0.0128)
Constant	0.147*	2.974***
	(0.0779)	(0.0853)
Observations	114	114
R-squared	0.810	0.997

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.9: Germany

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.895***	0.815***
	(0.0577)	(0.0759)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.550***
		(0.181)
Lag$*\mathbb{1}_{t\geq t^*}$		0.322***
		(0.0779)
Constant	0.161*	0.367**
	(0.0919)	(0.179)
Observations	114	114
R-squared	0.842	0.862

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.895***	0.758***
	(0.0577)	(0.0822)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.804***
		(0.203)
Lag$*\mathbb{1}_{t\geq t^*}$		0.381***
		(0.0776)
Constant	0.161*	0.613***
	(0.0919)	(0.211)
Observations	114	114
R-squared	0.842	0.871

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.10: Hungary

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.947***	0.882***
	(0.0243)	(0.0421)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.869***
		(0.708)
Lag$*\mathbb{1}_{t\geq t^*}$		0.169***
		(0.0570)
Constant	0.190	1.589**
	(0.163)	(0.697)
Observations	114	114
R-squared	0.969	0.971

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.947***	0.871***
	(0.0243)	(0.0418)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.086***
		(0.713)
Lag$*\mathbb{1}_{t\geq t^*}$		0.160***
		(0.0587)
Constant	0.190	1.862***
	(0.163)	(0.700)
Observations	114	114
R-squared	0.969	0.971

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.11: India

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.845***	0.821***
	(0.0741)	(0.0791)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.286***
		(0.766)
Lag$*\mathbb{1}_{t\geq t^*}$		0.398***
		(0.133)
Constant	1.067**	1.280**
	(0.488)	(0.546)
Observations	114	114
R-squared	0.742	0.751

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.845***	0.815***
	(0.0741)	(0.0791)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.543***
		(0.761)
Lag$*\mathbb{1}_{t\geq t^*}$		0.415***
		(0.129)
Constant	1.067**	1.355**
	(0.488)	(0.553)
Observations	114	114
R-squared	0.742	0.754

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.12: Ireland

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.930***	0.152***
	(0.0510)	(0.0571)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.857***
		(0.147)
Lag$*\mathbb{1}_{t\geq t^*}$		0.857***
		(0.0556)
Constant	0.114	1.838***
	(0.142)	(0.144)
Observations	114	114
R-squared	0.868	0.976

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.930***	0.130**
	(0.0510)	(0.0519)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.971***
		(0.162)
Lag$*\mathbb{1}_{t\geq t^*}$		0.879***
		(0.0502)
Constant	0.114	1.954***
	(0.142)	(0.160)
Observations	114	114
R-squared	0.868	0.980

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.13: Israel

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.514***	0.0125
	(0.110)	(0.0344)
Cons $*\mathbb{1}_{t\geq t^*}$		-2.550***
		(0.196)
Lag $*\mathbb{1}_{t\geq t^*}$		0.997***
		(0.00748)
Constant	0.392***	2.546***
	(0.115)	(0.198)
Observations	111	111
R-squared	0.268	0.909

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.514***	-0.00492
	(0.110)	(0.0140)
Cons $*\mathbb{1}_{t\geq t^*}$		-2.790***
		(0.303)
Lag $*\mathbb{1}_{t\geq t^*}$		1.002***
		(0.00621)
Constant	0.392***	2.792***
	(0.115)	(0.303)
Observations	111	111
R-squared	0.268	0.959

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.14: Italy

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.944***	0.806***
	(0.0235)	(0.0544)
Cons $*\mathbb{1}_{t\geq t^*}$		-0.743***
		(0.238)
Lag $*\mathbb{1}_{t\geq t^*}$		0.261***
		(0.0541)
Constant	0.0771	0.618**
	(0.0639)	(0.241)
Observations	114	114
R-squared	0.934	0.946

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.944***	0.730***
	(0.0235)	(0.0755)
Cons $*\mathbb{1}_{t\geq t^*}$		-1.130***
		(0.357)
Lag $*\mathbb{1}_{t\geq t^*}$		0.332***
		(0.0708)
Constant	0.0771	1.011***
	(0.0639)	(0.368)
Observations	114	114
R-squared	0.934	0.950

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.15: Japan

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.816***	0.713***
	(0.0523)	(0.0614)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.0961
		(0.122)
Lag$*\mathbb{1}_{t\geq t^*}$		0.428***
		(0.148)
Constant	0.0376	0.00499
	(0.0499)	(0.0566)
Observations	114	114
R-squared	0.710	0.754

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.816***	0.709***
	(0.0523)	(0.0613)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.119
		(0.101)
Lag$*\mathbb{1}_{t\geq t^*}$		0.438***
		(0.133)
Constant	0.0376	0.0184
	(0.0499)	(0.0588)
Observations	114	114
R-squared	0.710	0.757

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.16: Korea

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.866***	0.476***
	(0.0457)	(0.102)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.862***
		(0.577)
Lag$*\mathbb{1}_{t\geq t^*}$		0.576***
		(0.0941)
Constant	0.365***	2.744***
	(0.114)	(0.597)
Observations	114	114
R-squared	0.807	0.860

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.866***	0.365***
	(0.0457)	(0.121)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.641***
		(0.690)
Lag$*\mathbb{1}_{t\geq t^*}$		0.665***
		(0.126)
Constant	0.365***	3.538***
	(0.114)	(0.676)
Observations	114	114
R-squared	0.807	0.905

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.17: Mexico

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.949***	0.913***
	(0.0647)	(0.102)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.750
		(1.673)
Lag$*\mathbb{1}_{t\geq t^*}$		0.193*
		(0.108)
Constant	0.305	1.250
	(0.437)	(1.705)
Observations	114	114
R-squared	0.912	0.913

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.949***	0.888***
	(0.0647)	(0.107)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.114
		(2.102)
Lag$*\mathbb{1}_{t\geq t^*}$		0.0977
		(0.114)
Constant	0.305	2.071
	(0.437)	(2.100)
Observations	114	114
R-squared	0.912	0.914

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.18: Netherlands

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.881***	0.338***
	(0.0435)	(0.0838)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.645***
		(0.178)
Lag$*\mathbb{1}_{t\geq t^*}$		0.701***
		(0.0781)
Constant	0.225**	1.570***
	(0.0959)	(0.186)
Observations	114	114
R-squared	0.793	0.923

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.881***	0.315***
	(0.0435)	(0.0823)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.738***
		(0.186)
Lag$*\mathbb{1}_{t\geq t^*}$		0.722***
		(0.0763)
Constant	0.225**	1.667***
	(0.0959)	(0.195)
Observations	114	114
R-squared	0.793	0.928

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.19: Norway

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.662***	0.160***
	(0.0804)	(0.0531)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.018***
		(0.137)
Lag$*\mathbb{1}_{t\geq t^*}$		0.895***
		(0.0379)
Constant	0.696***	1.903***
	(0.188)	(0.164)
Observations	114	114
R-squared	0.443	0.873

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.662***	0.102**
	(0.0804)	(0.0392)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.965***
		(0.128)
Lag$*\mathbb{1}_{t\geq t^*}$		0.932***
		(0.0276)
Constant	0.696***	1.892***
	(0.188)	(0.149)
Observations	114	114
R-squared	0.443	0.917

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.20: Paraguay

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.895***	0.825***
	(0.0609)	(0.0751)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.127***
		(0.720)
Lag$*\mathbb{1}_{t\geq t^*}$		0.273*
		(0.138)
Constant	0.680*	1.592**
	(0.379)	(0.649)
Observations	97	97
R-squared	0.790	0.800

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.895***	0.715***
	(0.0609)	(0.0900)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.735***
		(0.955)
Lag$*\mathbb{1}_{t\geq t^*}$		0.423***
		(0.0936)
Constant	0.680*	3.006***
	(0.379)	(0.974)
Observations	97	97
R-squared	0.790	0.824

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.21: Peru

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.851***	0.345**
	(0.0644)	(0.156)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.504*
		(0.773)
Lag$*\mathbb{1}_{t\geq t^*}$		0.692***
		(0.141)
Constant	0.382**	1.418*
	(0.192)	(0.804)
Observations	81	81
R-squared	0.726	0.873

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.851***	1.50e-08
	(0.0644)	(9.43e-09)
Cons$*\mathbb{1}_{t\geq t^*}$ = o,		-
Lag$*\mathbb{1}_{t\geq t^*}$		1.000***
		(1.18e-08)
Constant	0.382**	-4.97e-09
	(0.192)	(1.63e-08)
Observations	81	81
R-squared	0.726	1.000

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.22: Philippines

(A) Implementation

VARIABLES	1	2
Lag Inflation	0.802***	0.583***
	(0.0534)	(0.0728)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.023***
		(0.544)
Lag$*\mathbb{1}_{t\geq t^*}$		0.492***
		(0.0780)
Constant	0.864***	2.738***
	(0.244)	(0.550)
Observations	114	114
R-squared	0.817	0.878

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Inflation	0.802***	0.568***
	(0.0534)	(0.0743)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.201***
		(0.551)
Lag$*\mathbb{1}_{t\geq t^*}$		0.507***
		(0.0783)
Constant	0.864***	2.909***
	(0.244)	(0.561)
Observations	114	114
R-squared	0.817	0.883

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.23: Poland

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.907***	0.871***
	(0.0296)	(0.0561)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.781
		(1.368)
Lag$*\mathbb{1}_{t\geq t^*}$		0.168***
		(0.0640)
Constant	0.325*	1.659
	(0.191)	(1.373)
Observations	114	114
R-squared	0.985	0.986

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.907***	0.836***
	(0.0296)	(0.0605)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.135*
		(1.644)
Lag$*\mathbb{1}_{t\geq t^*}$		0.144**
		(0.0700)
Constant	0.325*	3.110*
	(0.191)	(1.643)
Observations	114	114
R-squared	0.985	0.987

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.24: Russia

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.889***	0.889***
	(0.0958)	(0.0976)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.050
		(3.036)
Lag$*\mathbb{1}_{t\geq t^*}$		0.222
		(0.143)
Constant	0.264	0.153
	(2.411)	(3.063)
Observations	107	107
R-squared	0.924	0.924

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.889***	0.889***
	(0.0958)	(0.0977)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.016
		(3.112)
Lag$*\mathbb{1}_{t\geq t^*}$		0.222
		(0.143)
Constant	0.264	0.136
	(2.411)	(3.137)
Observations	107	107
R-squared	0.924	0.924

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.25: South Africa

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.886***	0.658***
	(0.0366)	(0.0937)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.117***
		(0.921)
Lag$*\mathbb{1}_{t\geq t^*}$		0.416***
		(0.103)
Constant	0.633***	2.738***
	(0.239)	(0.879)
Observations	114	114
R-squared	0.838	0.881

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.886***	0.540***
	(0.0366)	(0.103)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.508***
		(0.919)
Lag$*\mathbb{1}_{t\geq t^*}$		0.527***
		(0.103)
Constant	0.633***	4.136***
	(0.239)	(0.919)
Observations	114	114
R-squared	0.838	0.905

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.26: Spain

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.918***	0.264***
	(0.0349)	(0.0878)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.441***
		(0.436)
Lag$*\mathbb{1}_{t\geq t^*}$		0.767***
		(0.0787)
Constant	0.168	3.372***
	(0.112)	(0.455)
Observations	114	114
R-squared	0.861	0.955

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.918***	0.0964**
	(0.0349)	(0.0413)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.632***
		(0.208)
Lag$*\mathbb{1}_{t\geq t^*}$		0.913***
		(0.0377)
Constant	0.168	4.608***
	(0.112)	(0.214)
Observations	114	114
R-squared	0.861	0.982

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.27: Switzerland

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.882***	0.773***
	(0.0269)	(0.0487)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.357***
		(0.112)
Lag$*\mathbb{1}_{t\geq t^*}$		0.336***
		(0.0592)
Constant	0.0539	0.289***
	(0.0460)	(0.103)
Observations	114	114
R-squared	0.889	0.915

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.882***	0.777***
	(0.0269)	(0.0492)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.328***
		(0.116)
Lag$*\mathbb{1}_{t\geq t^*}$		0.338***
		(0.0588)
Constant	0.0539	0.263**
	(0.0460)	(0.107)
Observations	114	114
R-squared	0.889	0.916

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.28: Thailand

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.879***	0.606***
	(0.0618)	(0.109)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.953***
		(0.534)
Lag$*\mathbb{1}_{t\geq t^*}$		0.503***
		(0.0979)
Constant	0.294*	1.723***
	(0.177)	(0.550)
Observations	114	114
R-squared	0.779	0.849

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.879***	0.595***
	(0.0618)	(0.115)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.011***
		(0.578)
Lag$*\mathbb{1}_{t\geq t^*}$		0.511***
		(0.102)
Constant	0.294*	1.793***
	(0.177)	(0.596)
Observations	114	114
R-squared	0.779	0.849

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.29: Turkey

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.975***	0.794***
	(0.0318)	(0.127)
Cons$*\mathbb{1}_{t\geq t^*}$		-13.35
		(9.489)
Lag$*\mathbb{1}_{t\geq t^*}$		-0.0445
		(0.186)
Constant	0.385	15.55*
	(0.692)	(9.139)
Observations	114	114
R-squared	0.955	0.963

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.975***	0.774***
	(0.0318)	(0.130)
Cons$*\mathbb{1}_{t\geq t^*}$		-17.17*
		(9.538)
Lag$*\mathbb{1}_{t\geq t^*}$		0.214
		(0.140)
Constant	0.385	16.91*
	(0.692)	(9.628)
Observations	114	114
R-squared	0.955	0.960

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.30: Ukraine

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.893***	0.885***
	(0.0816)	(0.0814)
Cons$*\mathbb{1}_{t\geq t^*}$		-8.383**
		(3.906)
Lag$*\mathbb{1}_{t\geq t^*}$		0.613**
		(0.273)
Constant	1.187*	1.703**
	(0.707)	(0.810)
Observations	81	81
R-squared	0.793	0.805

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.893***	0.930***
	(0.0816)	(0.102)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.705
		(2.833)
Lag$*\mathbb{1}_{t\geq t^*}$		-0.103
		(0.182)
Constant	1.187*	1.395
	(0.707)	(0.980)
Observations	81	81
R-squared	0.793	0.806

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.31: United States

(a) Implementation

VARIABLES	1	2
Lag Inflation	0.784***	0.690***
	(0.115)	(0.146)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.988**
		(0.397)
Lag$*\mathbb{1}_{t\geq t^*}$		0.429***
		(0.159)
Constant	0.482*	0.783**
	(0.271)	(0.391)
Observations	114	114
R-squared	0.626	0.656

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.784***	0.432***
	(0.115)	(0.136)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.708***
		(0.299)
Lag$*\mathbb{1}_{t\geq t^*}$		0.676***
		(0.108)
Constant	0.482*	1.541***
	(0.271)	(0.356)
Observations	114	114
R-squared	0.626	0.764

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.32: Uruguay

(a) Implementation

VARIABLES	(1)	(2)
Lag Inflation	0.773***	0.746***
	(0.155)	(0.162)
Cons$*\mathbb{1}_{t\geq t^*}$		-14.32***
		(3.685)
Lag$*\mathbb{1}_{t\geq t^*}$		0.611***
		(0.122)
Constant	4.127	3.995
	(2.591)	(2.447)
Observations	115	115
R-squared	0.659	0.679

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Inflation	0.909***	0.906***
	(0.0172)	(0.0213)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.147**
		(0.909)
Lag$*\mathbb{1}_{t\geq t^*}$		0.256***
		(0.0767)
Constant	0.762***	0.916
	(0.284)	(0.702)
Observations	113	113
R-squared	0.985	0.985

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

0.0.2 Inflation Expectations

Table H.33: Argentina

(A) Implementation

VARIABLES	(1)	(2)
Lag Expectations	0.773***	0.746***
	(0.155)	(0.162)
$Cons*\mathbb{1}_{t\geq t^*}$		-14.32***
		(3.685)
$Lag*\mathbb{1}_{t\geq t^*}$		0.611***
		(0.122)
Constant	4.127	3.995
	(2.591)	(2.447)
Observations	115	115
R-squared	0.659	0.679

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	(1)	(2)
Lag Expectations	0.773***	0.743***
	(0.155)	(0.163)
$Cons*\mathbb{1}_{t\geq t^*}$		-14.01***
		(3.366)
$Lag*\mathbb{1}_{t\geq t^*}$		0.611***
		(0.119)
Constant	4.127	3.909
	(2.591)	(2.406)
Observations	115	115
R-squared	0.659	0.681

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.34: Austria

(A) Implementation

VARIABLES	(1)	(2)
Lag Expectations	0.907***	0.738***
	(0.0440)	(0.0944)
$Cons*\mathbb{1}_{t\geq t^*}$		-0.918***
		(0.270)
interactPi_e		0.401***
		(0.0879)
Constant	0.180**	0.663**
	(0.0890)	(0.275)
Observations	115	115
R-squared	0.850	0.888

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.907***	0.666***
	(0.0440)	(0.108)
$Cons*\mathbb{1}_{t\geq t^*}$		-1.148***
		(0.315)
$Lag*\mathbb{1}_{t\geq t^*}$		0.461***
		(0.0951)
Constant	0.180**	0.914***
	(0.0890)	(0.332)
Observations	115	115
R-squared	0.850	0.898

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.35: Belgium

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.816***	0.403***
	(0.105)	(0.132)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.574***
		(0.309)
Lag$*\mathbb{1}_{t\geq t^*}$		0.686***
		(0.115)
Constant	0.357*	1.407***
	(0.194)	(0.330)
Observations	115	115
R-squared	0.704	0.883

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.816***	0.192*
	(0.105)	(0.102)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.315***
		(0.281)
Lag$*\mathbb{1}_{t\geq t^*}$		0.850***
		(0.0837)
Constant	0.357*	2.234***
	(0.194)	(0.311)
Observations	115	115
R-squared	0.704	0.939

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.36: Brazil

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.934***	0.913***
	(0.105)	(0.114)
Cons$*\mathbb{1}_{t\geq t^*}$		-36.87
		(35.47)
Lag$*\mathbb{1}_{t\geq t^*}$		0.269*
		(0.157)
Constant	7.300	35.74
	(7.147)	(35.53)
Observations	115	115
R-squared	0.872	0.873

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.934***	0.857***
	(0.105)	(0.141)
Cons$*\mathbb{1}_{t\geq t^*}$		-114.9
		(106.7)
Lag$*\mathbb{1}_{t\geq t^*}$		0.0335
		(0.172)
Constant	7.300	115.4
	(7.147)	(106.6)
Observations	115	115
R-squared	0.872	0.875

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.37: Chile

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.893***	0.814***
	(0.0499)	(0.0764)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.993***
		(0.559)
Lag$*\mathbb{1}_{t\geq t^*}$		0.367***
		(0.0833)
Constant	0.410*	1.349**
	(0.212)	(0.610)
Observations	115	115
R-squared	0.933	0.942

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.893***	1.70e-08
	(0.0499)	(1.12e-08)
Cons$*\mathbb{1}_{t\geq t^*}$		-
Lag$*\mathbb{1}_{t\geq t^*}$		1.000***
		(1.19e-08)
Constant	0.410*	-1.43e-08
	(0.212)	(1.32e-08)
Observations	115	115
R-squared	0.933	1.000

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.38: Colombia

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.977***	0.759***
	(0.0119)	(0.0751)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.884***
		(1.650)
Lag$*\mathbb{1}_{t\geq t^*}$		0.180**
		(0.0865)
Constant	0.0332	5.093***
	(0.0898)	(1.630)
Observations	115	115
R-squared	0.987	0.990

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.977***	0.0359*
	(0.0119)	(0.0196)
Cons$*\mathbb{1}_{t\geq t^*}$		-25.53***
		(0.602)
Lag$*\mathbb{1}_{t\geq t^*}$		0.964***
		(0.0200)
Constant	0.0332	25.53***
	(0.0898)	(0.602)
Observations	115	115
R-squared	0.987	0.999

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.39: Czech Republic

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.910***	0.446***
	(0.0534)	(0.151)
Cons$*\mathbb{1}_{t\geq t^*}$		-5.769***
		(1.455)
Lag$*\mathbb{1}_{t\geq t^*}$		0.556***
		(0.151)
Constant	0.299	5.725***
	(0.184)	(1.467)
Observations	111	111
R-squared	0.909	0.944

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.910***	0.445***
	(0.0534)	(0.151)
Cons$*\mathbb{1}_{t\geq t^*}$		-5.803***
		(1.455)
Lag$*\mathbb{1}_{t\geq t^*}$		0.557***
		(0.151)
Constant	0.299	5.762***
	(0.184)	(1.466)
Observations	111	111
R-squared	0.909	0.944

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.40: Finland

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.853***	0.309***
	(0.0500)	(0.111)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.265***
		(0.439)
Lag$*\mathbb{1}_{t\geq t^*}$		0.740***
		(0.0956)
Constant	0.253***	2.179***
	(0.0889)	(0.465)
Observations	115	115
R-squared	0.791	0.919

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.853***	0.0523
	(0.0500)	(0.0491)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.576***
		(0.293)
Lag$*\mathbb{1}_{t\geq t^*}$		0.954***
		(0.0436)
Constant	0.253***	3.564***
	(0.0889)	(0.301)
Observations	115	115
R-squared	0.791	0.976

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.41: Germany

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.929***	0.795***
	(0.0342)	(0.0780)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.717***
		(0.238)
Lag$*\mathbb{1}_{t\geq t^*}$		0.333***
		(0.0842)
Constant	0.122*	0.510**
	(0.0675)	(0.224)
Observations	115	115
R-squared	0.886	0.908

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.929***	0.736***
	(0.0342)	(0.0822)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.941***
		(0.256)
Lag$*\mathbb{1}_{t\geq t^*}$		0.387***
		(0.0848)
Constant	0.122*	0.734***
	(0.0675)	(0.248)
Observations	115	115
R-squared	0.886	0.916

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.42: Hungary

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.941***	0.890***
	(0.0222)	(0.0356)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.609**
		(0.637)
Lag$*\mathbb{1}_{t\geq t^*}$		0.136***
		(0.0503)
Constant	0.266*	1.431**
	(0.146)	(0.625)
Observations	115	115
R-squared	0.975	0.976

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.941***	0.887***
	(0.0222)	(0.0366)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.679**
		(0.673)
Lag$*\mathbb{1}_{t\geq t^*}$		0.134***
		(0.0493)
Constant	0.266*	1.517**
	(0.146)	(0.662)
Observations	115	115
R-squared	0.975	0.976

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.43: India

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.878***	0.862***
	(0.0672)	(0.0718)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.662***
		(0.755)
Lag$*\mathbb{1}_{t\geq t^*}$		0.476***
		(0.140)
Constant	0.780*	0.930*
	(0.422)	(0.471)
Observations	115	115
R-squared	0.801	0.804

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.878***	0.855***
	(0.0672)	(0.0725)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.062**
		(0.841)
Lag$*\mathbb{1}_{t\geq t^*}$		0.330**
		(0.161)
Constant	0.780*	1.004**
	(0.422)	(0.482)
Observations	115	115
R-squared	0.801	0.805

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.44: Ireland

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.921***	0.111***
	(0.0528)	(0.0414)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.388***
		(0.129)
Lag$*\mathbb{1}_{t\geq t^*}$		0.898***
		(0.0400)
Constant	0.170	2.366***
	(0.130)	(0.129)
Observations	115	115
R-squared	0.844	0.978

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.921***	0.0694**
	(0.0528)	(0.0293)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.556***
		(0.109)
Lag$*\mathbb{1}_{t\geq t^*}$		0.936***
		(0.0279)
Constant	0.170	2.543***
	(0.130)	(0.110)
Observations	115	115
R-squared	0.844	0.986

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.45: Israel

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.736***	0.156
	(0.137)	(0.203)
Cons$*\mathbb{1}_{t\geq t^*}$		-8.273***
		(2.575)
Lag$*\mathbb{1}_{t\geq t^*}$		0.852***
		(0.194)
Constant	1.112*	8.241***
	(0.664)	(2.616)
Observations	115	115
R-squared	0.539	0.716

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.736***	0.122
	(0.137)	(0.177)
Cons$*\mathbb{1}_{t\geq t^*}$		-8.220***
		(2.852)
Lag$*\mathbb{1}_{t\geq t^*}$		0.888***
		(0.164)
Constant	1.112*	8.180***
	(0.664)	(2.905)
Observations	115	115
R-squared	0.539	0.747

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.46: Italy

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.951***	0.882***
	(0.0223)	(0.0453)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.551**
		(0.226)
Lag$*\mathbb{1}_{t\geq t^*}$		0.201***
		(0.0528)
Constant	0.0775	0.385*
	(0.0550)	(0.215)
Observations	115	115
R-squared	0.950	0.955

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.951***	0.839***
	(0.0223)	(0.0764)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.784*
		(0.402)
Lag$*\mathbb{1}_{t\geq t^*}$		0.241***
		(0.0755)
Constant	0.0775	0.624
	(0.0550)	(0.406)
Observations	115	115
R-squared	0.950	0.956

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.47: Japan

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.885***	0.853***
	(0.0531)	(0.0578)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.159**
		(0.0683)
Lag$*\mathbb{1}_{t\geq t^*}$		0.308***
		(0.0851)
Constant	0.0502*	0.0438
	(0.0281)	(0.0323)
Observations	115	115
R-squared	0.826	0.837

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.885***	0.852***
	(0.0531)	(0.0579)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.122**
		(0.0572)
Lag$*\mathbb{1}_{t\geq t^*}$		0.279***
		(0.0816)
Constant	0.0502*	0.0446
	(0.0281)	(0.0342)
Observations	115	115
R-squared	0.826	0.836

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.48: Korea

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.906***	0.582***
	(0.0409)	(0.0893)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.957***
		(0.638)
Lag$*\mathbb{1}_{t\geq t^*}$		0.441***
		(0.0923)
Constant	0.305**	2.839***
	(0.143)	(0.658)
Observations	115	115
R-squared	0.886	0.918

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.906***	0.527***
	(0.0409)	(0.0955)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.210***
		(0.668)
Lag$*\mathbb{1}_{t\geq t^*}$		0.474***
		(0.101)
Constant	0.305**	3.159***
	(0.143)	(0.672)
Observations	115	115
R-squared	0.886	0.925

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.49: Mexico

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.929***	0.868***
	(0.0848)	(0.123)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.996
		(1.975)
Lag$*\mathbb{1}_{t\geq t^*}$		0.0850
		(0.154)
Constant	0.529	2.145
	(0.587)	(1.920)
Observations	115	115
R-squared	0.868	0.871

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.929***	0.850***
	(0.0848)	(0.124)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.829
		(2.209)
Lag$*\mathbb{1}_{t\geq t^*}$		0.109
		(0.135)
Constant	0.529	2.934
	(0.587)	(2.190)
Observations	115	115
R-squared	0.868	0.873

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.50: Netherlands

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.899***	0.385***
	(0.0738)	(0.121)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.702***
		(0.266)
Lag$*\mathbb{1}_{t\geq t^*}$		0.660***
		(0.102)
Constant	0.213	1.613***
	(0.142)	(0.298)
Observations	115	115
R-squared	0.811	0.918

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.899***	0.371***
	(0.0738)	(0.118)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.765***
		(0.267)
Lag$*\mathbb{1}_{t\geq t^*}$		0.672***
		(0.100)
Constant	0.213	1.679***
	(0.142)	(0.298)
Observations	115	115
R-squared	0.811	0.920

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.51: Norway

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.717***	0.445***
	(0.0657)	(0.103)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.675***
		(0.205)
Lag$*\mathbb{1}_{t\geq t^*}$		0.694***
		(0.0808)
Constant	0.621***	1.376***
	(0.156)	(0.254)
Observations	115	115
R-squared	0.577	0.770

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.717***	0.442***
	(0.0657)	(0.102)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.693***
		(0.202)
Lag$*\mathbb{1}_{t\geq t^*}$		0.705***
		(0.0779)
Constant	0.621***	1.376***
	(0.156)	(0.255)
Observations	115	115
R-squared	0.577	0.786

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.52: Paraguay

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.796***	0.669***
	(0.107)	(0.132)
Cons$*\mathbb{1}_{t\geq t^*}$		-4.248***
		(1.296)
Lag$*\mathbb{1}_{t\geq t^*}$		0.449***
		(0.161)
Constant	1.793**	3.625***
	(0.823)	(1.301)
Observations	115	115
R-squared	0.642	0.669

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.796***	0.442***
	(0.107)	(0.139)
Cons$*\mathbb{1}_{t\geq t^*}$		-7.679***
		(1.543)
Lag$*\mathbb{1}_{t\geq t^*}$		0.619***
		(0.125)
Constant	1.793**	7.274***
	(0.823)	(1.651)
Observations	115	115
R-squared	0.642	0.721

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.53: Peru

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.123***	0.118***
	(0.0102)	(0.00878)
Cons$*\mathbb{1}_{t\geq t^*}$		-47.70***
		(11.81)
Lag$*\mathbb{1}_{t\geq t^*}$		0.913***
		(0.0152)
Constant	18.91***	47.61***
	(4.625)	(11.81)
Observations	115	115
R-squared	0.766	0.804

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.123***	0.0989***
	(0.0102)	(0.00425)
Cons$*\mathbb{1}_{t\geq t^*}$		-172.0***
		(29.04)
Lag$*\mathbb{1}_{t\geq t^*}$		0.870***
		(0.00718)
Constant	18.91***	172.1***
	(4.625)	(29.04)
Observations	115	115
R-squared	0.766	0.938

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.54: Philippines

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.881***	0.688***
	(0.0435)	(0.0918)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.014***
		(0.731)
Lag$*\mathbb{1}_{t\geq t^*}$		0.411***
		(0.0955)
Constant	0.613***	2.541***
	(0.233)	(0.764)
Observations	115	115
R-squared	0.857	0.886

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.881***	0.685***
	(0.0435)	(0.0931)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.050***
		(0.747)
Lag$*\mathbb{1}_{t\geq t^*}$		0.413***
		(0.0955)
Constant	0.613***	2.583***
	(0.233)	(0.781)
Observations	115	115
R-squared	0.857	0.886

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.55: Poland

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.780***	0.604***
	(0.0902)	(0.149)
Cons$*\mathbb{1}_{t\geq t^*}$		-9.322**
		(4.098)
Lag$*\mathbb{1}_{t\geq t^*}$		0.381**
		(0.155)
Constant	1.500**	9.308**
	(0.661)	(4.101)
Observations	115	115
R-squared	0.845	0.874

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.780***	0.560***
	(0.0902)	(0.166)
Cons$*\mathbb{1}_{t\geq t^*}$		-11.54**
		(5.086)
Lag$*\mathbb{1}_{t\geq t^*}$		0.408**
		(0.177)
Constant	1.500**	11.58**
	(0.661)	(5.076)
Observations	115	115
R-squared	0.845	0.881

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE H.56: Russia

(A) Implementation

VARIABLES	1	2
Lag Expectations	0.876***	0.876***
	(0.110)	(0.111)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.981
		(4.624)
Lag$*\mathbb{1}_{t\geq t^*}$		0.218
		(0.147)
Constant	1.099	1.172
	(3.599)	(4.643)
Observations	107	107
R-squared	0.890	0.890

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(B) Announcement

VARIABLES	1	2
Lag Expectations	0.876***	0.876***
	(0.110)	(0.112)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.983
		(4.741)
Lag$*\mathbb{1}_{t\geq t^*}$		0.218
		(0.148)
Constant	1.099	1.179
	(3.599)	(4.759)
Observations	107	107
R-squared	0.890	0.890

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.57: South Africa

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.926***	0.801***
	(0.0388)	(0.0796)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.567***
		(0.705)
Lag$*\mathbb{1}_{t\geq t^*}$		0.329***
		(0.0795)
Constant	0.463*	1.761**
	(0.248)	(0.769)
Observations	115	115
R-squared	0.897	0.914

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.926***	0.761***
	(0.0388)	(0.0831)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.016***
		(0.746)
Lag$*\mathbb{1}_{t\geq t^*}$		0.358***
		(0.0809)
Constant	0.463*	2.255***
	(0.248)	(0.818)
Observations	115	115
R-squared	0.897	0.918

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.58: Spain

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.915***	0.454***
	(0.0625)	(0.104)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.801***
		(0.467)
Lag$*\mathbb{1}_{t\geq t^*}$		0.592***
		(0.0963)
Constant	0.199	2.685***
	(0.158)	(0.484)
Observations	115	115
R-squared	0.866	0.919

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.915***	0.286***
	(0.0625)	(0.0880)
Cons$*\mathbb{1}_{t\geq t^*}$		-3.980***
		(0.586)
Lag$*\mathbb{1}_{t\geq t^*}$		0.735***
		(0.0828)
Constant	0.199	3.919***
	(0.158)	(0.599)
Observations	115	115
R-squared	0.866	0.936

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.59: Switzerland

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.936***	0.886***
	(0.0303)	(0.0449)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.217**
		(0.101)
Lag$*\mathbb{1}_{t\geq t^*}$		0.206***
		(0.0637)
Constant	0.0423	0.144
	(0.0387)	(0.0915)
Observations	115	115
R-squared	0.932	0.939

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.936***	0.884***
	(0.0303)	(0.0463)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.227**
		(0.108)
Lag$*\mathbb{1}_{t\geq t^*}$		0.209***
		(0.0641)
Constant	0.0423	0.154
	(0.0387)	(0.0993)
Observations	115	115
R-squared	0.932	0.939

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.60: Thailand

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.907***	0.646***
	(0.0502)	(0.131)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.349***
		(0.777)
Lag$*\mathbb{1}_{t\geq t^*}$		0.489***
		(0.133)
Constant	0.286*	1.988**
	(0.159)	(0.781)
Observations	115	115
R-squared	0.840	0.882

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.907***	0.597***
	(0.0502)	(0.138)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.678***
		(0.809)
iLag$*\mathbb{1}_{t\geq t^*}$		0.528***
		(0.134)
Constant	0.286*	2.344***
	(0.159)	(0.826)
Observations	115	115
R-squared	0.840	0.888

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.61: Turkey

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.964***	0.715***
	(0.0323)	(0.116)
Cons $*\mathbb{1}_{t\geq t^*}$		-19.37**
		(8.739)
Lag $*\mathbb{1}_{t\geq t^*}$		0.147
		(0.148)
Constant	0.879	20.49**
	(0.696)	(8.547)
Observations	115	115
R-squared	0.929	0.941

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.964***	0.714***
	(0.0323)	(0.119)
Cons $*\mathbb{1}_{t\geq t^*}$		-20.82**
		(8.938)
Lag $*\mathbb{1}_{t\geq t^*}$		0.324**
		(0.146)
Constant	0.879	20.13**
	(0.696)	(8.883)
Observations	115	115
R-squared	0.929	0.939

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.62: Ukraine

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.798***	0.796***
	(0.165)	(0.166)
Cons $*\mathbb{1}_{t\geq t^*}$		43.52
		(32.55)
Lag $*\mathbb{1}_{t\geq t^*}$		-0.570
		(1.014)
Constant	-30.52	-36.28
	(25.32)	(30.00)
Observations	108	108
R-squared	0.638	0.639

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.798***	0.796***
	(0.165)	(0.165)
Cons $*\mathbb{1}_{t\geq t^*}$		33.66
		(30.15)
Lag $*\mathbb{1}_{t\geq t^*}$		0.426**
		(0.185)
Constant	-30.52	-37.46
	(25.32)	(30.63)
Observations	108	108
R-squared	0.638	0.639

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.63: United States

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.831***	0.767***
	(0.0642)	(0.0746)
Cons$*\mathbb{1}_{t\geq t^*}$		-0.950***
		(0.251)
Lag$*\mathbb{1}_{t\geq t^*}$		0.389***
		(0.114)
Constant	0.409***	0.616***
	(0.151)	(0.189)
Observations	115	115
R-squared	0.755	0.771

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.831***	0.641***
	(0.0642)	(0.112)
Cons$*\mathbb{1}_{t\geq t^*}$		-1.457***
		(0.475)
Lag$*\mathbb{1}_{t\geq t^*}$		0.563***
		(0.180)
Constant	0.409***	1.017***
	(0.151)	(0.321)
Observations	115	115
R-squared	0.755	0.828

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table H.64: Uruguay

(a) Implementation

VARIABLES	1	2
Lag Expectations	0.925***	0.924***
	(0.0250)	(0.0277)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.816**
		(1.154)
Lag$*\mathbb{1}_{t\geq t^*}$		0.353***
		(0.124)
Constant	0.627*	0.652
	(0.345)	(0.629)
Observations	114	114
R-squared	0.974	0.974

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

(b) Announcement

VARIABLES	1	2
Lag Expectations	0.925***	0.921***
	(0.0250)	(0.0300)
Cons$*\mathbb{1}_{t\geq t^*}$		-2.549**
		(1.022)
Lag$*\mathbb{1}_{t\geq t^*}$		0.297***
		(0.0825)
Constant	0.627*	0.842
	(0.345)	(0.838)
Observations	114	114
R-squared	0.974	0.974

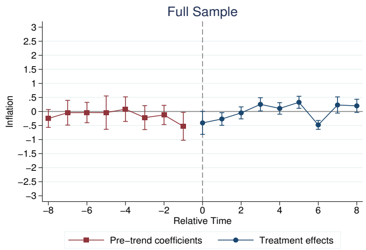
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix I

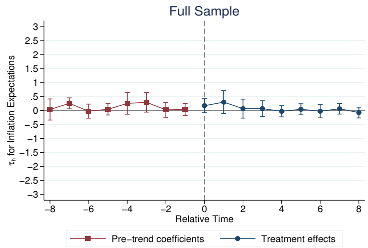
Characteristics based Sub-Samples

FIGURE I.1: Treatment Effects Around Implementation: Full Sample

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

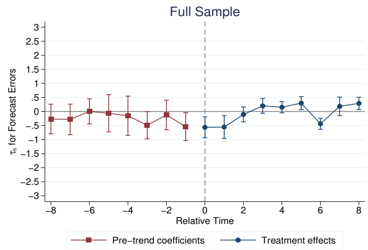
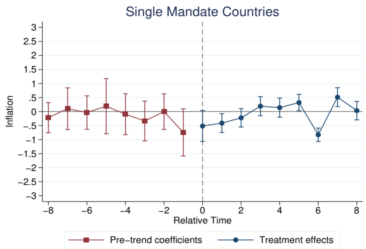
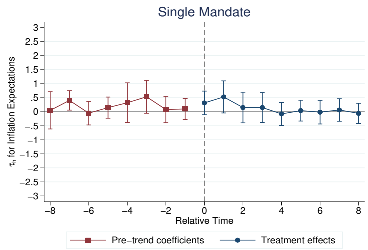


FIGURE I.2: Treatment Effects Around Implementation: Single Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

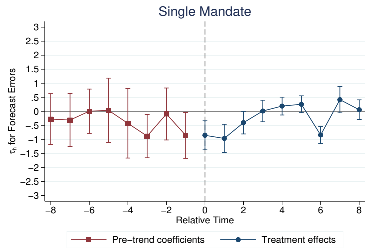
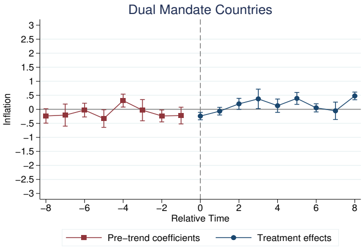
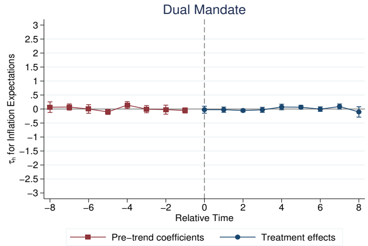


Figure I.3: Treatment Effects Around Implementation: Dual Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

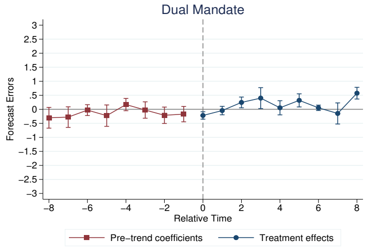
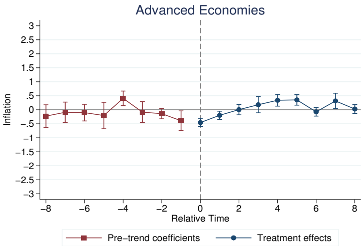
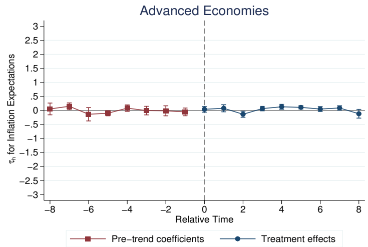


Figure I.4: Treatment Effects Around Implementation: Advanced Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

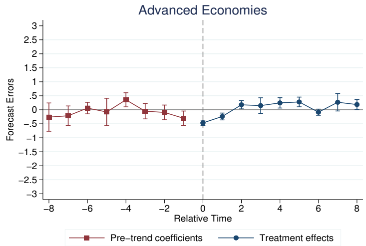
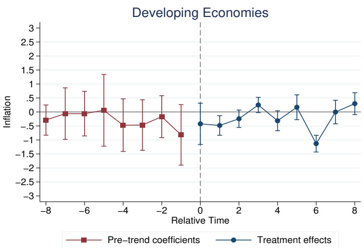
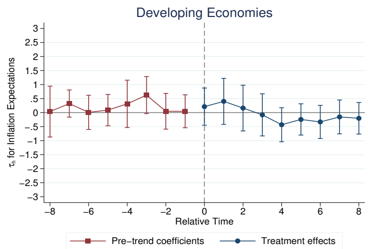


Figure I.5: Treatment Effects Around Implementation: Developing Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

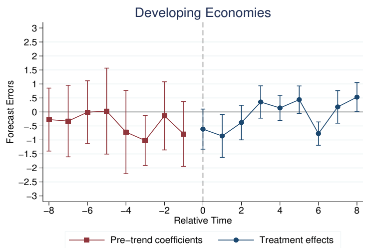
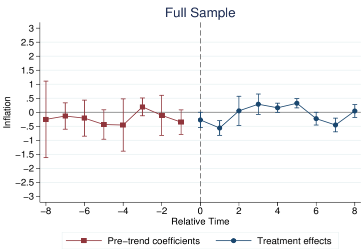
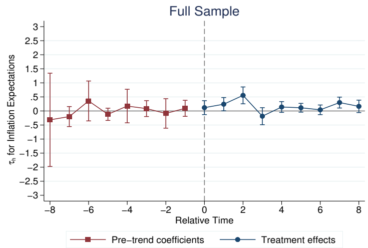


Figure I.6: Treatment Effects Around Announcement: Full Sample

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

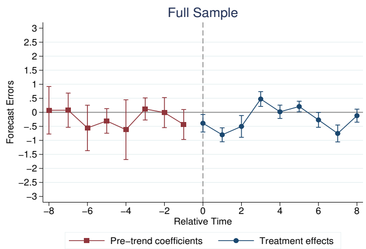
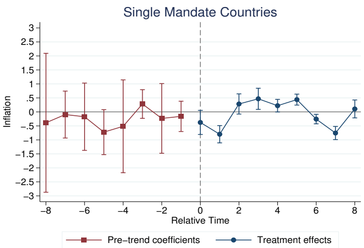
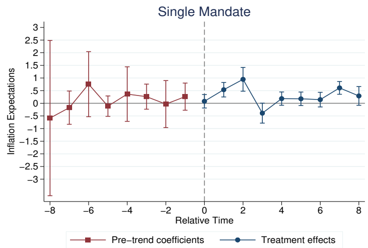


Figure I.7: Treatment Effects Around Announcement: Single Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

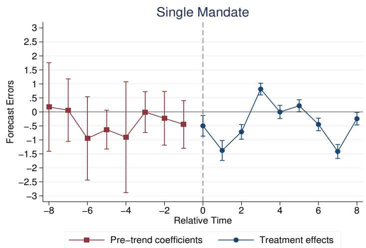
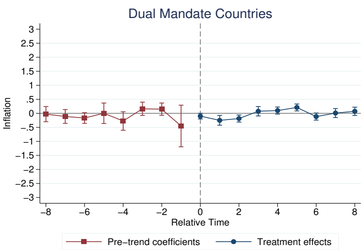
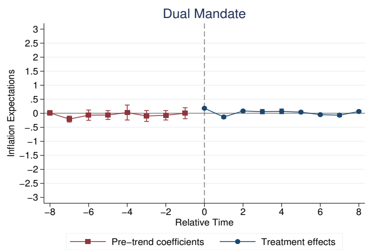


Figure I.8: Treatment Effects Around Announcement: Dual Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

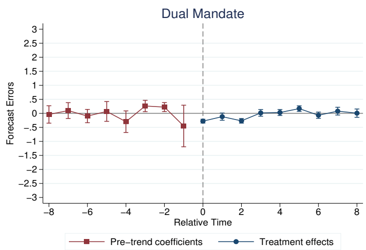
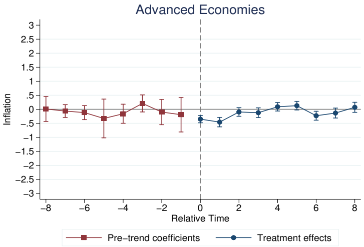
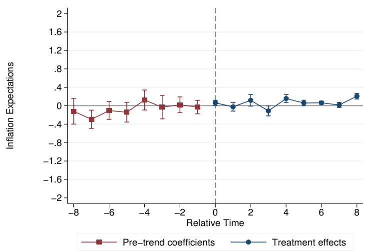


Figure I.9: Treatment Effects Around Announcement: Advanced Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

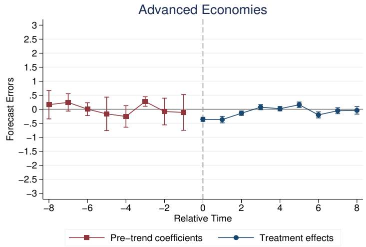
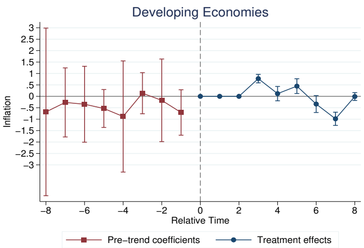
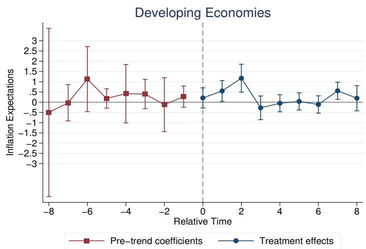


Figure I.10: Treatment Effects Around Announcement: Developing Economies

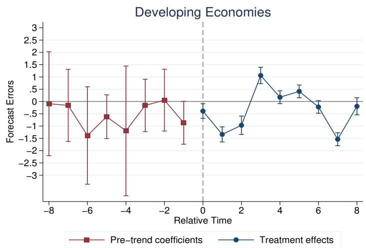
(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

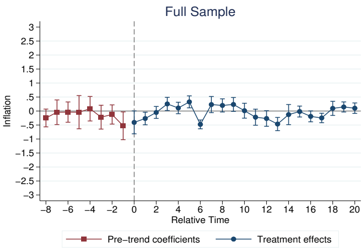


Appendix J

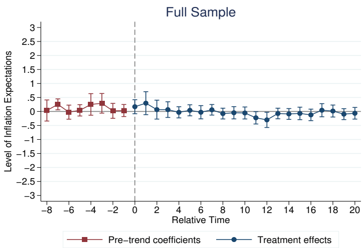
Treatment Effect After 5 Years

FIGURE J.1: Treatment Effects Around Implementation: Full Sample

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

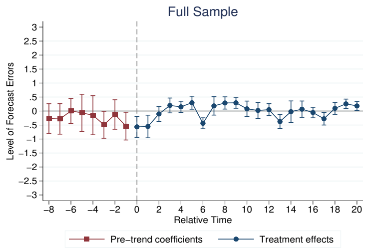
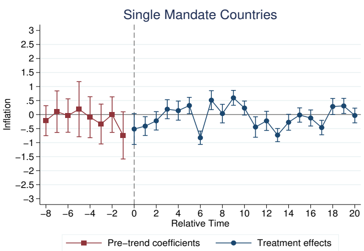
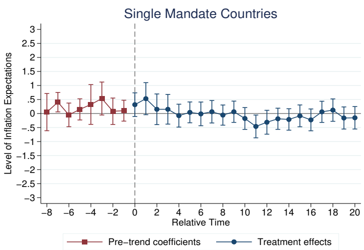


FIGURE J.2: Treatment Effects Around Implementation: Single Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

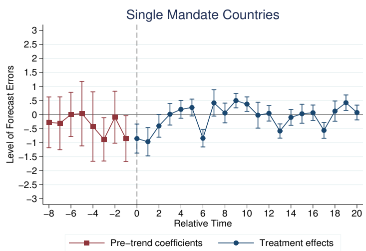
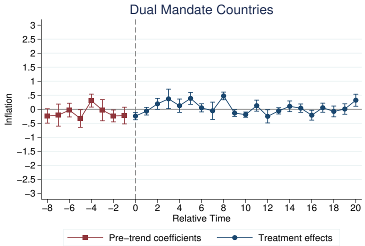
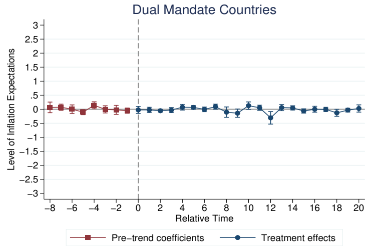


FIGURE J.3: Treatment Effects Around Implementation: Dual Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

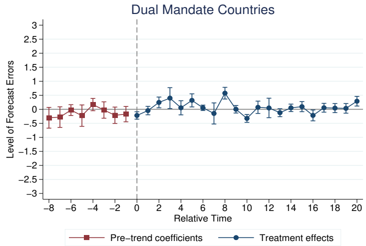
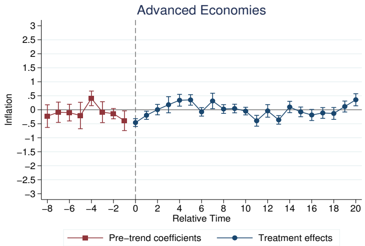
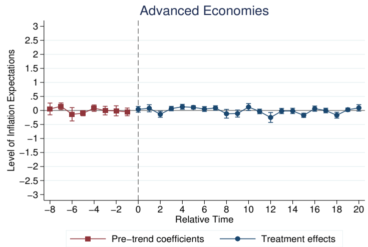


FIGURE J.4: Treatment Effects Around Implementation: Advanced Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

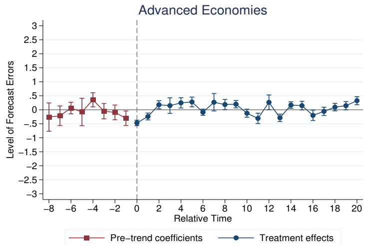
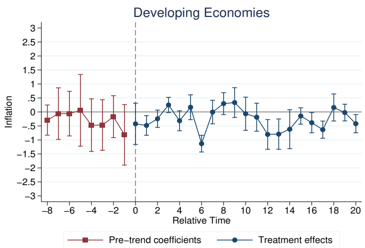
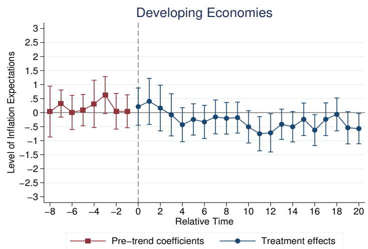


FIGURE J.5: Treatment Effects Around Implementation: Developing Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

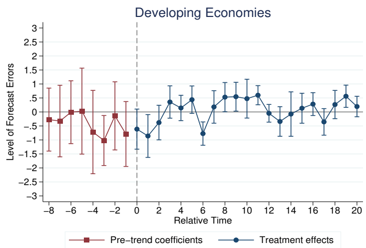
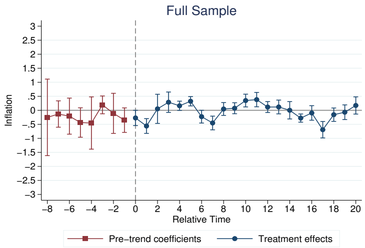
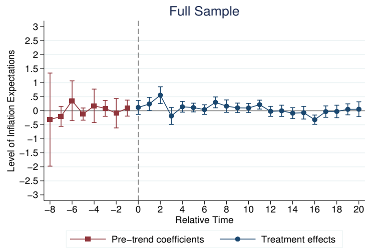


FIGURE J.6: Treatment Effects Around Announcement: Full Sample

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

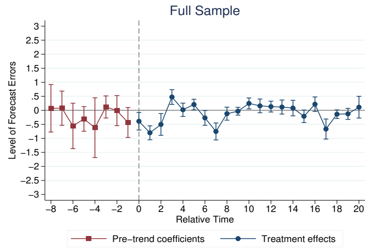
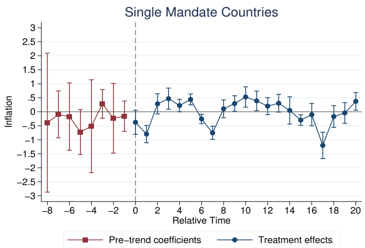
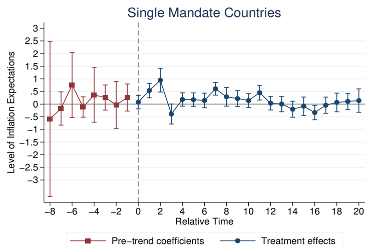


FIGURE J.7: Treatment Effects Around Announcement: Single Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

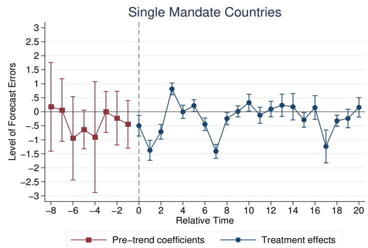
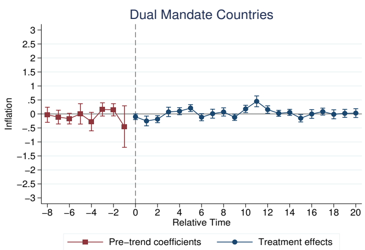
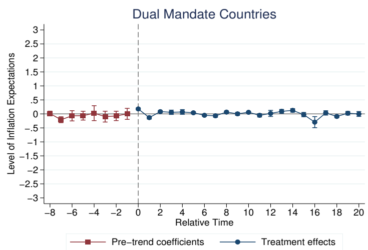


FIGURE J.8: Treatment Effects Around Announcement: Dual Mandate Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

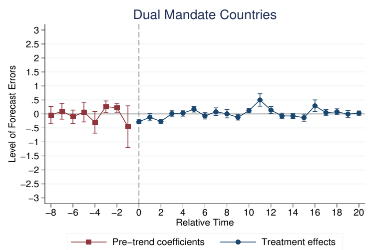
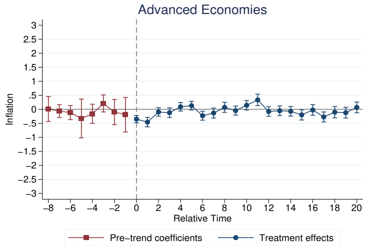
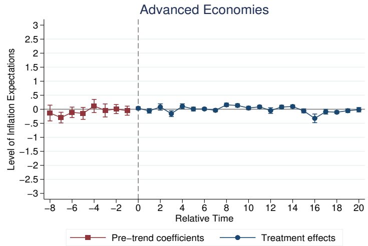


FIGURE J.9: Treatment Effects Around Announcement: Advanced Economies

(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors

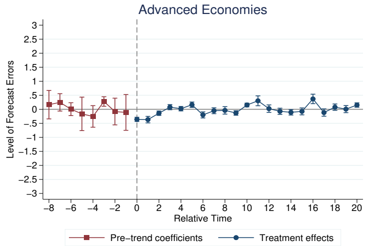
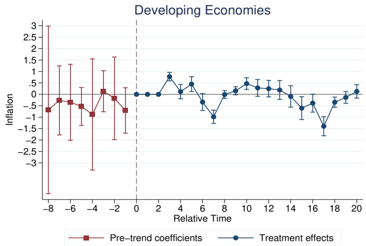
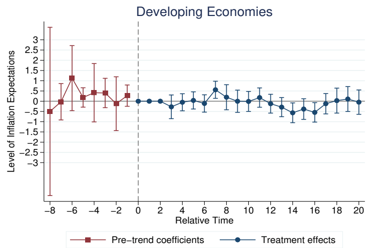


FIGURE J.10: Treatment Effects Around Announcement: Developing Economies

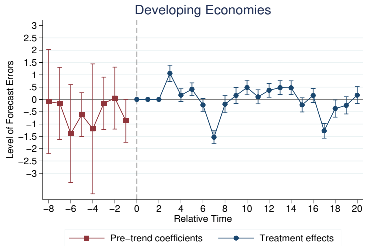
(A) Inflation



(B) Inflation Expectations



(C) Forecast Errors



Appendix K

Dynamic Panel Data

One of the assumptions this paper makes to be able to undertake the analysis in the previous section is to assume, $\alpha_i = \bar{\alpha}$, which is the unobserved heterogeneity for each country. The previous assumption was important because it dealt with the inconsistency of the estimator under the setting of a dynamic panel. Without the previous assumption, equation 1.8 would need to be estimated using panel data models such as those by Anderson and Hsiao (1981) and Arellano and Bond (1991). The paper now makes the assumption flexible in order to allow for unobserved heterogeneity. Therefore, the estimation now takes the following form in addition to equation (1.8),

$$\beta_{it} = \delta_i + \beta_{it-1} + \gamma_1 t + \kappa(\pi_{it} - \beta_{it-1}) + \gamma_2 \bar{\pi}_t + \epsilon_{it} \tag{K.1}$$

The instruments will be for the forecast error since the forecast errors and lagged inflation expectations. The paper uses $(y_{t-1} - \beta_{t-2})$, β_{t-2}, $(\Delta y_{t-1} - \Delta\beta_{t-2})$, $\Delta\beta_{t-2}$ as the instruments for the forecast errors and lagged expectations. The table below presents the results from the Arellano-Bond estimator. Notice, this estimation is not an exact replication of the previous estimation. This is because (K.1) produces the estimate of a version of the gain parameter. Whereas under Borusyak et al. (2021) the estimate is the treatment effect, τ_t. Moreover, the paper follows the strategy of Borusyak et al. (2021) and performs the estimation in two stages. First, on only pre-IT observations (periods) and then on post-IT observations (periods).

The interpretation of regression (K.1) is as follows. The left hand side (LHS) of the equation measures the revision of the agents' forecasts. Thus, if the forecast revision responds significantly to the forecast errors, it implies agents are responding to inflation surprises. If this coefficient increases after the introduction of IT, it would suggest low credibility of the central bank. Since, agents should stop responding to significant forecasts errors if the central bank is able to keep inflation close to the target.

Table K.1 presents the results from the Arellano-Bond estimation. The table is divided into four columns. Column (1) presents the findings based on the regression for the pre-IT observations. The results suggest that there is a positive correlation between inflation expectations and the forecast errors. Moreover, it is a measure of the gain parameter which is roughly 0.40 and significant at the 5% level. Columns (2) - (4) present the findings for the post IT period after 1 year, 2 years, and for the full sample, respectively. There are two things worth noticing in the post IT results. First, there is a marginal decline in the gain parameter from 0.40 to 0.31. This decline is surprising because if the policy is credible, the agents should immediately adjust their forecasts to reflect new information which should lead to an increase in the gain.

Table K.1: Arellano-Bond Estimation results for equation (1.8)

VARIABLES	Pre-IT	Post-IT		
	(1)	(2)	(3)	(4)
	π_t^e	π_t^e (1 year)	π_t^e (2 years)	π_t^e (Full Sample)
$\pi_{t-1}^e(\rho)$	0.903***	0.954***	0.996***	0.935***
	(0.0616)	(0.198)	(0.097)	(0.045)
$\pi_{t,fe}(\kappa)$	0.402**	0.156	0.226	0.316***
	(0.160)	(0.210)	(0.079)	(0.044)
Constant	0.491	0.152	0.079	0.221
	(0.496)	(0.155)	(0.227)	(0.129)
Observations	947	115	207	1,683
Number of countries	23	23	23	23

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Second, the decline in the gain is not statistically significant for the first 2 years while the full sample has a marginal and statistically significant decline. Therefore, this result supports the result from section 4.3, of no significant change in expectations following an introduction of IT. To change the implementation dates for the announcement dates does not change the result. There is no statistical change in expectations even with an announcement. Results for this regression are provided in Appendix K. One difference between the announcement dates and the implementation dates is the estimated value of the gain for the full sample under the Post-IT regime is significant at the 10% level. However, contrary to what one would expect, the gain falls from 0.473 to 0.305 after the announcement of the policy. Thus, indicative of a lack of credibility of the announcement by the central bank.

Finally, while the estimated value of the gain might seem high relative to what is found in the asset pricing literature (for example, Adam et al. (2016)). The value of the gain is comparable to those found by Gáti (2022).

Appendix L

Moment Selection and Computation

1 Introduction

In this appendix, I present the analytical computation of the derivative matrix for the simulate method of moments, following the notation and definitions from Adam et al. (2016) online appendix.

2 Definitions

Let μ_π represent the mean of inflation expectations, σ_π represent the standard deviation of inflation expectations, μ_ϵ represent the mean of forecast errors, σ_ϵ represent the standard deviation of forecast errors.

2.1 The Statistic and Moment Functions

Le $(S(\dot{}))$represent the vector of statistics (statistic function), and $\partial\mathcal{S}(\dot{})$ represent the derivative matrix.

The underlying sample moments needed to construct the statistics are given by,

$$\widehat{M_N} \equiv \frac{1}{N}\sum_{t=1}^{N} h(\boldsymbol{y}_t)$$

Where, $h(.)$ and $\boldsymbol{y_t}$ are defined as,

$$h((y)_t) = \begin{bmatrix} \pi_t^e \\ (\pi_t^e)^2 \\ \pi_t^e \pi_{t-1}^e \\ \pi_t - \pi_t^e \\ (\pi_t - \pi_t^e)^2 \\ (\pi_t - \pi_t^e)(\pi_{t-1} - \pi_{t-1}^e) \end{bmatrix}$$

Therefore, $\mathcal{S}(\mathcal{M})$ is expressed as

$$\mathcal{S}(\mathcal{M}) = \begin{bmatrix} E(\pi_t^e) \\ E(\pi_t - \pi_t^e) \\ \sigma_\pi \\ \sigma_\epsilon \\ \rho_\pi \\ \rho_\epsilon \end{bmatrix}$$

3 Derivative Matrix Computation

Based on the moment statistic function, the folloiwing is the derivative of the moment matrix, $\frac{\partial(S(M))}{\partial M}$, computed as follows:

$$\frac{\partial(S(M))}{\partial M} = \begin{bmatrix} 1 & -\frac{\mu_\pi}{\sigma_\pi} & \frac{2\mu_\pi(\sigma_\epsilon^2 - \sigma_\pi^2)}{\sigma_\pi^4} & 0 & 0 & 0 \\ 0 & 1 & \frac{\sigma_\epsilon^2 - \mu_\pi^2}{\sigma_\pi^4} & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & -\frac{\mu_\epsilon}{\sigma_\epsilon} & \frac{2\mu_\epsilon(\sigma_\epsilon^2 - \sigma_\pi^2)}{\sigma_\epsilon^4} \\ 0 & 0 & 0 & 0 & 1 & \frac{\sigma_\epsilon^2 - \mu_\epsilon^2}{\sigma_\epsilon^4} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

Here, μ_π, σ_π, μ_ϵ, and σ_ϵ are the moments of inflation expectations and forecast errors computed analytically based on the provided code.

Appendix M

Proof of Proposition 3.1

Now that we have the first order conditions and a perceived law of motion (PLM) about how agents believe expectations evolve. We proceed with computing an Actual Law of Motion (ALM) for our model. The ALM will give us the mapping between the true stochastic process of inflation and how agents perceive inflation will evolve. Before proceeding, we must iterate the fact that some of the procedures of the proof have been computed numerically and we restrict the solution to the baseline parameters and some sensitivity analysis.

Using equations 2.21 - 2.25, we know the following,

1. $\lambda_{1t} = 0$
2. $2\alpha x_t + \lambda_{1t} - \kappa\lambda_{2t} - \gamma_{t+1}\lambda_{4t} = 0$
3. $2(\pi_t - \pi^T) + \lambda_{2t} - \gamma_{t+1}\lambda_{3t} = 0$
4. $\mathbb{E}_t^{\mathcal{P}}\Big\{\frac{\beta}{\sigma}\lambda_{1t+1} + \beta^2\lambda_{2t+1} + \beta(1-\nu)(1-\gamma_{t+2}\lambda_{3t+1})\Big\} = \lambda_{3t}$
5. $\lambda_{4t} = 0$
6. $\lambda_{2t} = \frac{2\alpha x_t}{\kappa}$
7. $\lambda_{3t} = \Big[2\pi^t - 2\pi^T + \frac{2\alpha x_t}{\kappa}\Big]$

Substitute 1, 6, and 7 in 4 to get the following,

$$\frac{\kappa}{\alpha}\pi_t - \frac{\kappa}{\alpha}\pi_T + x_t = \beta E_t\Big[\beta(1-\nu)\gamma x_{t+1} + (1-\nu)(1-\gamma)(\frac{\kappa}{\alpha}\pi_{t+1} - \frac{\kappa}{\alpha}\pi_T + x_{t+1})\Big] \quad \text{(M.1)}$$

Using the NKPC (2.13) and the learning rule for inflation (2.16), we can substitute $\mathbb{E}_t x_t$ in M.1. From the NKPC we know that,

$$x_t = \frac{1}{\kappa}\Big[\pi_t - \beta\mathbb{E}_t^{\mathcal{P}}\pi_{t+1} - u_t\Big] \tag{M.2}$$

$$\Rightarrow x_{t+1} = \frac{1}{\kappa}\Big[\pi_{t+1} - \beta\mathbb{E}_t^{\mathcal{P}}\pi_{t+2} - u_{t+1}\Big]$$

$$\Rightarrow x_{t+1} = \frac{1}{\kappa}\Big[\pi_{t+1} - \beta\mathbb{E}_t^{\mathcal{P}}\Big((1-\nu)(a_t+\gamma(\pi_t-a_t))+\nu\pi^T\Big) - u_{t+1}\Big]$$

$$\Rightarrow \mathbb{E}_t^{\mathcal{P}} x_{t+1} = \frac{1}{\kappa}\Big[\mathbb{E}_t^{\mathcal{P}}\pi_{t+1} - \beta\mathbb{E}_t^{\mathcal{P}}\Big((1-\nu)(a_t+\gamma(\pi_t-a_t))+\nu\pi^T\Big)\Big] \tag{M.3}$$

Replace equations (M.2) and (M.3) in (M.1) to get the following,

$$E_t\pi_{t+1} = A_{11}\pi_t + A_{12}a_t + P_1u_t + P_2\pi^T \tag{M.4}$$

$$A_{11} = \frac{\kappa^2+\alpha+\alpha\beta^2(1-\nu)^2(1-\gamma(1-\beta))\gamma}{\alpha\beta(1-\nu)(1-\gamma(1-\beta))+\kappa^2\beta(1-\nu)(1-\gamma)} \tag{M.5}$$

$$A_{12} = -\frac{\alpha\beta(1-\beta(1-\nu)^2(1-\gamma)(1-\gamma(1-\beta)))}{\alpha\beta(1-\nu)(1-\gamma(1-\beta))+\kappa^2\beta(1-\nu)(1-\gamma)} \tag{M.6}$$

$$P_1 = -\frac{\alpha}{\alpha\beta(1-\nu)(1-\gamma(1-\beta))+\kappa^2\beta(1-\nu)(1-\gamma)} \tag{M.7}$$

$$P_2 = -\frac{\alpha\beta(1-\nu)(1-\gamma(1-\beta))(\beta\nu+\kappa(1-\beta\nu))-\kappa^2(1-\beta(1-\nu)(1-\gamma))}{\alpha\beta(1-\nu)(1-\gamma(1-\beta))+\kappa^2\beta(1-\nu)(1-\gamma)} \tag{M.8}$$

Using the above, we can write a system of equations which have the following form,

$$E_t y_{t+1} = Ay_t + Pu_t + K\pi^T \tag{M.9}$$

$$\begin{bmatrix} E_t\pi_{t+1} \\ E_t a_{t+1} \\ E_t b_{t+1}\end{bmatrix} = \underbrace{\begin{bmatrix} A_{11} & A_{12} & 0 \\ (1-\nu)\gamma & (1-\nu)(1-\gamma) & 0 \\ \frac{\gamma}{\kappa} & \frac{-\beta\gamma}{\kappa} & (1-\gamma)\end{bmatrix}}_{A}\begin{bmatrix}\pi_t \\ a_t \\ b_t\end{bmatrix} + \begin{bmatrix} P_1 \\ 0 \\ \frac{-\gamma}{\kappa}\end{bmatrix} u_t + \begin{bmatrix} P_2 \\ \nu a_t \\ 0\end{bmatrix}$$

This system is subject to the boundary conditions given by a_0, b_0 and $\lim_{s\to\infty} |E_t \pi_{t+s}| < \infty$.[1] These conditions must be satisfied for a minimum to exist and for us to solve this problem of the central bank.

Since A is block triangular, its eigenvalues are given by $(1-\gamma)$ and

$$A_1 = \begin{pmatrix} A_{11} & A_{12} \\ (1-\nu)\gamma & (1-\nu)(1-\gamma) \end{pmatrix}$$

We just need to prove now that the eigenvalues for A_1 are one inside the unit circle and one outside the unit circle. For this, we need to show that,

$$\lambda_1 \lambda_2 > 1 + \lambda_1 \lambda_2 \tag{M.10}$$

Where, λ_1 and λ_2 are the eigenvalues of A_1. We employ the property that the trace is equal to the sum of the eigenvalues and that the deteminant is equal to the product of the eigenvalues. We solve for this numerically and find that for our set of parameters, this holds true.

Now, we can invoke Proposition 1 of Blanchard and Kahn (1980) to conclude that inflation can follow the process described in the proposition. As well as the fact that the system in 33, only has one unique solution.

Following this, we can compute the coefficients for the law of motion, to do so we use the method of undetermined coefficients. The results for which have been presented in the proposition.

[1] For the baseline parameters and the Monte Carlo simulation of legnth 10,000 this condition is satisfied.

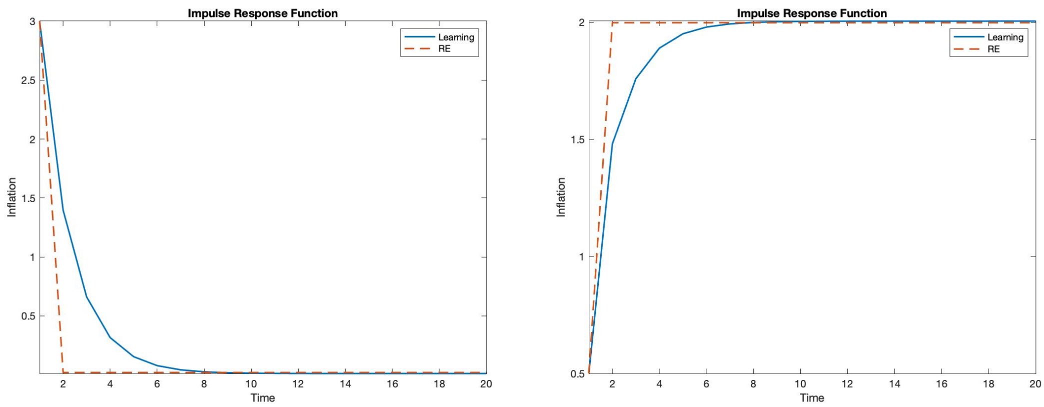
Appendix N

Persistence in Inflation Response to Cost-Push shocks

0.1 Persistence in inflation

The figure below plots the reaction of inflation to a cost-push shock under learning and rational expectations. We use initial conditions where expectations are below and above target.

FIGURE N.1: Impulse Response Function to a cost-push shock, u=1



(A) Initial Conditions above target, $a_0 = 3$

(B) Initial Conditions Below Target, $a_0 = 0$

As can be seen in figure N.1, under learning with *iid* shocks, we find that the central bank reacts slowly to initial inflation and only in subsequent periods does inflation revert to the steady state. Erceg and Levin (2003) show that disinflations are costly precicelsy because expectations adjust slowly. This persistence is also supported by Milani (2006) and Milani et al. (2005). This indicates that not only the process for perceived inflation matters. But the initial conditions matter as well.

Appendix O

Welfare Loss: Independent Central Bank

To mitigate the welfare loss from excess inflation in the long run, as seen in practice, we now introduce an independent institution whose objective is to control inflation and prevent the deviation of inflation from the optimal level. That is, we now introduce an independent central bank. Thus, the loss function of the Central Bank is given by the following,

$$L^{CB} = \pi_t^2 \tag{O.1}$$

The rational expectation model implies that $\pi_t = \pi_t^e$. Therefore, the loss from the output gap is zero. Therefore, actual inflation is the only variable that impacts the welfare of the economy.

However, this institutional environment is new for the agents, who are forming expectations about inflation. Therefore, they perceive that the central bank follows a loss function similar to the one of the government. Thus, the agents' Perceived Loss Function is given by,

$$L^A = \pi_t^2 - \tilde{a}\tilde{y} \tag{O.2}$$

Agents therefore now have to learn about $\tilde{a}$ which is the weight that the central bank attaches to the output gap (zero, in this case). While knowing the government's loss function is an extreme assumption, we use the fact that the agents have been in the regime that produces an inflation bias for a long time such that they have learned the government's objective.

Let the prior be given by $a \sim \mathcal{N}(\tilde{a}_0, \tilde{\sigma}_0^2)$. We can now write the state space for the agents in the following way,

$$\pi_t = \frac{ac}{2} + \epsilon_t \tag{O.3}$$

$$a_t = a_{t-1} + \eta_t \tag{O.4}$$

Where $\epsilon \sim ii\mathcal{N}(0, \tilde{\sigma}_\epsilon^2)$ and $\eta \sim ii\mathcal{N}(0, \tilde{\sigma}_\eta^2)$.

With the updating equations given by,

$$\tilde{a}_t = \tilde{a}_{t-1} + K_t\Big(\pi_t - \frac{\tilde{a}_{t-1}c}{2}\Big) \tag{O.5}$$

$$\tilde{\sigma}_t^2 = \tilde{\sigma}_{t-1}^2 - K_t\Big(\frac{c}{2}\Big)\tilde{\sigma}_{t-1}^2 + \tilde{\sigma}_\eta^2 \tag{O.6}$$

The Kalman Gain is therefore given by the following,

$$K_t = \Big(\frac{\tilde{\sigma}_{t-1}^2(\frac{c}{2})}{(\frac{c}{2})^2\tilde{\sigma}_{t-1}^2 + \tilde{\sigma}_\epsilon^2}\Big) \tag{O.7}$$

Based on the above information, we have that inflation expectations are given by,

$$\pi_{t+1|t}^e = \pi_{t|t-1}^e + \left(\frac{\tilde{\sigma}_{t-1}^2\,(c/2)^2}{\left((c/2)^2\,\tilde{\sigma}_{t-1}^2 + \tilde{\sigma}_\epsilon^2\right)}\right)\left(\bar{\pi}_t - \pi_{t|t-1}^e + \epsilon_t\right) \tag{O.8}$$

Therefore, the sequence of expected inflation is dependent on the sequence of $\bar{\pi}_t$ and the exogenous variation in inflation and the variance of the prior $\tilde{\sigma}_0^2$, which can be seen in equation O.9.

0.1 Welfare Loss

Since there is now an independent central bank with $a = 0$, and optimal inflation $\bar{\pi}_t = 0$, inflation is given by $\pi_t = \epsilon_t$ and therefore the sequence of inflation expectations are given by,

$$E_0\left\{\pi^e_{t|t-1}\right\} = \left(\frac{\tilde{\sigma}^2_\epsilon}{\left((c/2)^2\,\tilde{\sigma}^2_{t-1} + \tilde{\sigma}^2_\epsilon\right)}\right) E_0\left\{\left(\pi^e_{t-1|t-2}\right)\right\} \tag{O.9}$$

To simplify the expectations, let us define the following,

$$\kappa_{t-1} = \frac{\tilde{\sigma}^2_\epsilon}{\left((c/2)^2\,\tilde{\sigma}^2_{t-1} + \tilde{\sigma}^2_\epsilon\right)} \tag{O.10}$$

The above expression allows us to re-write expectations as,

$$E_0\left\{\pi^e_{t|t-1}\right\} = \kappa_{t-1} E_0\left\{\left(\pi^e_{t-1|t-2}\right)\right\} \tag{O.11}$$

Iterating backwards and writing expectations today as a function of the prior π^e_0 we have,

$$E_0\left\{\pi^e_{t|t-1}\right\} = \left(\prod_{j=1}^{t} \kappa_{t-j}\right)\left(\frac{\tilde{a}_0 c}{2}\right) \tag{O.12}$$

With $\pi^e_0 = \frac{ac}{2}$.

Define $\kappa_t \in (0,1)$[1] as the persistence in inflation expectations.

Now that we have the building blocks of our model (equations O.9 to O.12), we can define the expected welfare loss in period $t = 0$.

$$E\{\mathcal{L}_0\} = E\left\{\sum_{t=0}^{\infty} \beta^t \left((\pi_t)^2 - \tilde{a}\tilde{y}_t\right)\right\}$$
$$E\{\mathcal{L}_0\} = E\left\{\sum_{t=0}^{\infty} \beta^t \left((\epsilon_t)^2 - \tilde{a}\tilde{y}_t\right)\right\}$$
$$= E\left\{\sum_{t=0}^{\infty} \beta^t \tilde{a}\tilde{y}_t\right\} + \frac{\tilde{\sigma}^2_\epsilon}{1-\beta} \tag{O.13}$$

[1] Notice, $\kappa_t = 1 - K_t$ (Kalman Gain)

Substituting for $\tilde{\tilde{y}}_t = c(\epsilon_t - \pi^e_{t|t-1})$ and $E_0\left\{\pi^e_{t|t-1}\right\} = \left(\prod_{j=1}^t \kappa_{t-j}\right)\left(\frac{\tilde{a}_0 c}{2}\right)$ we have that,

$$E\{L_0^{G,CB}\} = \frac{ac^2}{2}\sum_{t=0}^{\infty}\beta^t \tilde{a}_0\left(\prod_{j=1}^{t}\kappa_{t-j}\right) + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{O.14}$$

The present value of the welfare loss given that agents learn $\tilde{a}$ over time, is given in equation O.14.

Let us compute the present value of the welfare loss in the event there is no new institution and the government maintains an inflation bias. With no new institution (central bank) we will have that optimal inflation is given by, $\bar{\pi}_t = \frac{ac}{2}$ and agents don't learn a. Therefore,

$$E\left\{L_0^G\right\} = \left(\frac{ac}{2}\right)^2 \sum_{t=0}^{\infty}\beta^t + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{O.15}$$

Appendix P

Optimal Introduction of the Central Bank

To further understand whether the introduction of a central bank is beneficial for the economy we define a parameter ϑ_t. In order to do so, we re-write κ_t as,

$$\kappa_t = \frac{1}{\left((c/2)^2 \frac{\tilde{\sigma}^2_{t-1}}{\tilde{\sigma}^2_\epsilon} + 1\right)} \tag{P.1}$$

Therefore, now we can define,

$$\frac{\tilde{\sigma}^2_t}{\tilde{\sigma}^2_\epsilon} = \left(\frac{1}{(c/2)^2 + \frac{\tilde{\sigma}^2_\epsilon}{\tilde{\sigma}^2_{t-1}}}\right) + \frac{\tilde{\sigma}^2_\eta}{\tilde{\sigma}^2_\epsilon} \tag{P.2}$$

We now define ϑ_t as the following,

$$\vartheta_t = \frac{\tilde{\sigma}^2_t}{\tilde{\sigma}^2_\epsilon} = \left(\frac{1}{(c/2)^2 + \frac{\tilde{\sigma}^2_\epsilon}{\tilde{\sigma}^2_{t-1}}}\right) + \frac{\tilde{\sigma}^2_\eta}{\tilde{\sigma}^2_\epsilon} \tag{P.3}$$

$$= \left(\frac{1}{(c/2)^2 + \frac{1}{\vartheta_{t-1}}}\right) + \frac{\tilde{\sigma}^2_\eta}{\tilde{\sigma}^2_\epsilon} \tag{P.4}$$

Now, the sequence of $\{\vartheta_t\}_{t=0}^\infty$ is determined by the initial value ϑ_0 which is given by $\vartheta_0 = \frac{\tilde{\sigma}^2_0}{\tilde{\sigma}^2_\epsilon}$.

$$\vartheta_t = \left(\frac{1}{(c/2)^2 \vartheta_{t-1} + 1}\right) \vartheta_{t-1} + \frac{\tilde{\sigma}^2_\eta}{\tilde{\sigma}^2_\epsilon} \tag{P.5}$$

ϑ_t can be interpreted as a persistence parameter which relies on the variation of the prior $\tilde{\sigma}^2_0$ (or how $\tilde{a}$ is centred around a) and the exogenous variation in inflation, $\tilde{\sigma}^2_\epsilon$. Therefore, the tighter the prior (small $\tilde{\sigma}^2_0$), the higher is the persistence in inflation expectations and the longer it will take the agents to learn about the objective of the central bank. Consequently, the welfare loss from having a central bank will be higher.

On the other hand, higher exogenous variation to inflation implies a lower ϑ_t and therefore higher persistence in inflation expectations. Which would also then lead to a higher welfare loss from the introduction of a central bank.

There are several things to note here. First, if two economies have the same ϑ_0, they will have the same welfare loss from changing the policy. Therefore, it is not only the variation of inflation that is important but also the prior that agents in the economy hold. Ideally, we would like that the agents have a lightly held prior ($\tilde{a}$ is far from a), that is they believe that the central bank is independent of the government and will commit and achieve the target that has been set.

Thus far, it seems that introducing a central bank if there is a tight prior implies a higher welfare cost for the economy. This leads to the natural question of whether there is a level of patience which would incline the government to introduce a central bank for each possible ϑ_0. That is, is it possible to find that a change in policy is optimal for a government irrespective of the persistence in expectations?

To answer this question we limit ourselves to the very simple case where $\vartheta_0 = 0$. This outcome is possible if $\tilde{a}_0 = a$ or if $\epsilon \to \infty$. That is, either the agents don't believe the new institution at all or external shocks to inflation are high. With $\vartheta_0 = 0$, the whole sequence $\{\vartheta_t\}_{t=0}^{\infty}$ will be zero (see equation P.5). This implies $\kappa_t = 0$ (refer to equation P.1). This implies that the welfare loss with the central bank is now,

$$E\left\{\mathcal{L}_0^{G,CB}\right\} = \frac{a\tilde{a}_0 c^2}{2}\sum_{t=0}^{\infty}\beta^t + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} = \frac{a\tilde{a}_0 c^2}{2}\frac{1}{1-\beta} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{P.6}$$

Now, the change in policy is optimal if the following is true,

$$
\begin{aligned}
\frac{a\tilde{a}_0c^2}{2}\frac{1}{1-\beta}+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta} &\leq \left(\frac{ac}{2}\right)^2\frac{1}{1-\beta}+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \\
\tilde{a}_0 &\leq \frac{a}{2}
\end{aligned} \tag{P.7}
$$

Therefore, even in the case where the agents do not learn about the introduction of a new institution and its objective, it is optimal to introduce a central bank as long as the prior after the change is low enough. Specifically, half the prior based on the government's objective.

Let us now assume that $\vartheta_0 = e$ where $e \to 0$. That is, agents hold a loose prior compared to the case where $\vartheta_0 = 0$. Let us now compute the welfare loss in this case. If this were the case, we know that the maximum value of $\prod_{j=1}^{t}\kappa_{t-j} \in [0,1]$. Therefore, the upper bound on the product is one. Therefore,

$$
E\{\mathcal{L}_0^{G,CB}\} = \frac{a\tilde{a}_0c^2}{2}\sum_{t=0}^{\infty}\beta^t\left(\prod_{j=1}^{t}\kappa_{t-j}\right)+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta} < \frac{a\tilde{a}_0c^2}{2}\left(1+\sum_{t=1}^{\infty}\beta^t\kappa_0\right)+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{P.8}
$$

$$
\implies E\{\mathcal{L}_0^{C,GB}\} < \frac{a\tilde{a}_0c^2}{2}\left(\frac{1}{1-\beta}-\beta\frac{1-\kappa_0}{1-\beta}\right)+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{P.9}
$$

For the policy to be optimal, a sufficient condition would be, given $\tilde{a} = a$ we will have,

$$
\begin{aligned}
&\Rightarrow \frac{a\tilde{a}_0c^2}{2}\left(\frac{1}{1-\beta}-\beta\frac{1-\kappa_0}{1-\beta}\right)+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \\
&< \left(\frac{ac}{2}\right)^2\frac{1}{1-\beta}+\frac{\tilde{\sigma}_\epsilon^2}{1-\beta}\frac{a\tilde{a}_0c^2}{2}\left(\frac{1}{1-\beta}-\beta\frac{1-\kappa_0}{1-\beta}\right) \\
&< \left(\frac{ac}{2}\right)^2\frac{1}{1-\beta}
\end{aligned}
$$

This implies that,

$$
\frac{1}{2}\frac{\left((c/2)^2\,\tilde{\sigma}_0^2+\tilde{\sigma}_\epsilon^2\right)}{(c/2)^2\,\tilde{\sigma}_0^2} < \beta \tag{P.10}
$$

This generalises the result that $\beta > \frac{1}{2}$ when $\tilde{\sigma}_\epsilon^2 = 0$. Therefore, when there is a tight prior $\tilde{a} \approx a$ and volatile inflation $\tilde{\sigma}_\epsilon^2$, the larger the patience of a planner to implement a new institution and a policy change. It is also important to note here, the larger the prior, the higher the welfare cost of introducing a central bank. Moreover, we do not have any cost of output volatility in this model. This is because a loose prior will imply larger volatility to output since expectations react more to new information. However, for the purposes of this paper, we shut down this channel.

The above discussion raises an important conclusion. Given the presence of a central bank, if agents notice high inflation in the previous period, they may be unable to discern if the higher inflation is a result of high exogenous variation to inflation or the central bank facing the same trade-off between inflation and output as the government. Thus, in order to aid the agents' expectation formation process, the central bank might want to use intermediate announcements as a way to gain credibility. We build on this idea in the following section where we introduce the idea of intermediate inflation targets which were used by the Latin American economies in order to bring inflation under control.

Appendix Q

Welfare Loss: Without Announcements

We begin with intermediate targets which are not announced. As before, the independent central bank does not face a trade-off between inflation and output therefore $a = 0$ in the central bank loss function. Furthermore, it sets the sequence of inflation targets as $\bar{\pi}_t = 0$ for all t.

The loss function of the central bank is now given by,

$$\mathcal{L}^{CB} = (\pi_t - \pi_t^o)^2 \tag{Q.1}$$

The perceived loss function by the agents is now given by,

$$\mathcal{L}^{A} = \gamma_t (\pi_t)^2 + (1 - \gamma_t)\left((\pi_t)^2 - a\tilde{y}_t\right) \tag{Q.2}$$

If expectations are formed in accordance with equation Q.2, then optimal inflation by the central bank should be,

$$\bar{\pi}_t = \frac{ac}{2} - \gamma_t \frac{ac}{2} \tag{Q.3}$$

Therefore, agents now must learn γ using the following state space,

$$\pi_t = \frac{ac}{2} + \gamma_t \frac{-ac}{2} + \epsilon_t \tag{Q.4}$$

$$\gamma_t = \gamma_{t-1} + \eta_t \tag{Q.5}$$

With the updating equations given by,

$$\tilde{\gamma}_t = \tilde{\gamma}_{t-1} + K_t\left(\pi_t - \frac{ac}{2} + \tilde{\gamma}_{t-1}\left(\frac{(ac)}{2}\right)\right) \tag{Q.6}$$

$$K_t = \frac{\left(\tilde{\sigma}_{t-1|t-1}\right)\frac{(-ac)}{2}}{\left(\left(\frac{(-ac)}{2}\right)^2\left(\tilde{\sigma}_{t-1|t-1}\right) + \tilde{\sigma}^2_{\epsilon}\right)} \tag{Q.7}$$

$$\tilde{\sigma}_{t|t} = \left(1 + \frac{1}{\left(1 + \frac{\tilde{\sigma}^2_{\epsilon}}{\left(\tilde{\sigma}_{t-1|t-1}\right)\left(\frac{(ac)}{2}\right)^2}\right)}\right)\tilde{\sigma}_{t-1|t-1} + \tilde{\sigma}^2_{\eta} \tag{Q.8}$$

Replace the fact that $\pi_t = \pi^o_t + \epsilon_t$ we get,

$$\tilde{\gamma}_t = \tilde{\gamma}_{t-1} + K_t\left(\pi^o_t - \frac{ac}{2} + \gamma_{t-1}\left(\frac{ac}{2}\right) + \epsilon_t\right) \tag{Q.9}$$

Subsequently, inflation expectation are given by,

$$\pi^e_{t+1|t} = \pi^e_{t|t-1} - K_t\left(\frac{ac}{2}\right)\left(\pi^o_t + \epsilon_t - \pi^e_{t|t-1}\right) \tag{Q.10}$$

Based on the equations above, we can now compute the welfare loss in an economy where there are inflation targets which are not announced,

$$\max_{\{\bar{\pi}_t\}^{\infty}_{t=0}} E\Big\{\sum_{t=0}^{\infty}\beta^t\left(a\tilde{y}_t + (\pi_t)^2\right)\Big\} \tag{Q.11}$$

$$\text{s.t.} \qquad \pi^e_{t+1|t} = \pi^e_{t|t-1} - \left(\frac{\left(\tilde{\sigma}^2_{t-1}\right)(ac/2)^2}{\left((ac/2)^2\,\tilde{\sigma}^2_{t-1}\right) + \tilde{\sigma}^2_{\epsilon}}\right)\left(\pi^o_t - \pi^e_{t|t-1} + \epsilon_t\right) \tag{Q.12}$$

Therefore, having inflation targets but not announcements of those targets implies that inflation expectations will follow the same path as if there were no intermediate inflation targets. This implies that for the agents, their information set is no different between having an independent central bank and an independent central bank who has targets but are those which are not public information.

We can now write the loss function in the following way,

$$E\{\mathcal{L}^G_0\} = E\left\{\sum_{t=0}^{\infty}\beta^t\left((\pi_t)^2 - \tilde{a}y_t\right)\right\} \tag{Q.13}$$

Every period $\pi_t = \pi_t^o + \epsilon_t$ and $\pi_t^o = \rho^t\left(\frac{ac}{2}\right)$ consequently the expected loss we have is,

$$E\{\mathcal{L}_0\} = E\left\{\sum_{t=0}^{\infty}\beta^t\left(a\tilde{y}_t\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.14}$$

Where output is given by $\tilde{y}_t = c(\pi_t - \pi^e_{t|t-1}) = c\left(\rho^t\left(\frac{-ac}{2}\right) + \epsilon_t - \pi^e_{t|t-1}\right)$ and the expected value at $t = 0$ is

$$E_0\left(\tilde{y}_t\right) = c\left(\rho^t\left(\frac{ac}{2}\right) - E_0\left\{\pi^e_{t|t-1}\right\}\right) \tag{Q.15}$$

We know the following,

$$\pi^e_{t+1|t} = \gamma_t\frac{ac}{2} - \frac{ac}{2} \tag{Q.16}$$

Plug in the value of γ_t from the updating equations,

$$\pi^e_{t+1|t} = \underbrace{\left(\gamma_{t-1} + \frac{\left(\tilde{\sigma}_{t-1|t-1}\right)\frac{(ac)}{2}}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-1|t-1}\right) + \tilde{\sigma}_\epsilon^2\right)}\left(\pi_t + \frac{ac}{2} - \gamma_{t-1}\left(\frac{(ac)}{2}\right)\right)\right)}_{A}\frac{ac}{2} - \frac{ac}{2} \tag{Q.17}$$

To compute the expected sequence of inflation expectations, we need to compute $E_0\gamma_{t-1}$ (given by A).

$$E_0\gamma_{t-1} = E_0\Bigg(\gamma_{t-2} + \frac{\left(\tilde{\sigma}_{t-2|t-2}\right)\frac{(ac)}{2}}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-2|t-2}\right) + \tilde{\sigma}_\epsilon^2\right)}\left(\pi_{t-1} + \frac{ac}{2} - \gamma_{t-2}\left(\frac{(ac)}{2}\right)\right)\Bigg) \tag{Q.18}$$

Which can be re-written the following way,

$$E_0\gamma_{t-1} = E_0\Bigg(\frac{\tilde{\sigma}_\epsilon^2}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-2|t-2}\right) + \tilde{\sigma}_\epsilon^2\right)}\gamma_{t-2} + \frac{\left(\tilde{\sigma}_{t-2|t-2}\right)\frac{(ac)}{2}}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-2|t-2}\right) + \tilde{\sigma}_\epsilon^2\right)}\left(\pi_{t-1} + \frac{ac}{2}\right)\Bigg) \tag{Q.19}$$

Since, $\pi_{t-1} = \pi^o_{t-1} + \epsilon_{t-1}$, $\pi^o_{t-1} = \rho^{t-1}\left(\frac{ac}{2}\right)$ and $E_0\epsilon_{t-1} = 0$ we have the following,

$$E_0\gamma_{t-1} = E_0\Bigg(\frac{\tilde{\sigma}^2_\epsilon}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-2|t-2}\right)+\tilde{\sigma}^2_\epsilon\right)}\gamma_{t-2}+\frac{\left(\tilde{\sigma}_{t-2|t-2}\right)\frac{(ac)}{2}}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-2|t-2}\right)+\tilde{\sigma}^2_\epsilon\right)}\left(\rho^{t-1}\frac{ac}{2}+\frac{ac}{2}\right)\Bigg) \tag{Q.20}$$

Let $\kappa_{t-1} = \frac{\tilde{\sigma}^2_\epsilon}{\left(\left(\frac{(ac)}{2}\right)^2\left(\tilde{\sigma}_{t-2|t-2}\right)+\tilde{\sigma}^2_\epsilon\right)}$. Therefore, re-writing the previous equation, we have the following,

$$E_0\gamma_{t-1} = E_0\Big(\kappa_{t-1}\gamma_{t-2} + (1-\kappa_{t-1})(1+\rho^{t-1})\Big) \tag{Q.21}$$

Let's expand the previous equation in the following way,

$$\Rightarrow \kappa_{t-1}\kappa_{t-2}\kappa_{t-3}E_0\gamma_{t-4} + \kappa_{t-1}\kappa_{t-2}(1-\kappa_{t-3})(1+\rho^{t-3}) + \kappa_{t-1}(1-\kappa_{t-2})(1+\rho^{t-2}) + (1-\kappa_{t-1})(1+\rho \tag{Q.22}$$

$$\Rightarrow \kappa_{t-1}\kappa_{t-2}\kappa_{t-3}E_0\gamma_{t-4} + \kappa_{t-1}\kappa_{t-2}(1-\kappa_{t-3}) + \kappa_{t-1}(1-\kappa_{t-2}) + (1-\kappa_{t-1})$$
$$+ \kappa_{t-1}\kappa_{t-2}(1-\kappa_{t-3})\rho^{t-3} + \kappa_{t-1}(1-\kappa_{t-2})\rho^{t-2} + (1-\kappa_{t-1})\rho^{t-1} \tag{Q.23}$$
$$\Rightarrow \kappa_{t-1}\kappa_{t-2}\kappa_{t-3}E_0\gamma_{t-4} + \kappa_{t-1}\kappa_{t-2}\kappa_{t-3} + \kappa_{t-1}\kappa_{t-2}(1-\kappa_{t-3})\rho^{t-3} + \kappa_{t-1}(1-\kappa_{t-2})\rho^{t-2} + (1-\kappa_{t-1})\rho^{t-} \tag{Q.24}$$

We can now iterate on equation Q.25 to get the following,

$$E_0\pi^e_{t|t-1} = \prod_{s=1}^{t}\kappa_{t-s}\frac{-ac}{2} + (1-\kappa_{t-1})\rho^{t-1}\left(\frac{-ac}{2}\right) \tag{Q.25}$$

Now the loss is given by,

$$E\{\mathcal{L}_0\} = E\left\{\sum_{t=0}^{\infty}\beta^t\left(a\tilde{y}_t\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}^2_\epsilon}{1-\beta} \tag{Q.26}$$

$$E\{\mathcal{L}_0\} = \left\{\sum_{t=0}^{\infty}\beta^t\left(ac\left(\rho^t\left(\frac{ac}{2}\right) - E_0\left\{\pi^e_{t|t-1}\right\}\right)\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}^2_\epsilon}{1-\beta} \tag{Q.27}$$

$$E\{\mathcal{L}_0\} = \left\{\sum_{t=0}^{\infty} \beta^t \left(ac\left(\rho^t\left(\frac{ac}{2}\right) - \prod_{s=1}^{t}\kappa_{t-s}\frac{-ac}{2} - (1-\kappa_{t-1})\rho^{t-1}\Big(\frac{-ac}{2}\Big)\right)\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.28}$$

$$E\{\mathcal{L}_0\} = \frac{(ac)^2}{2}\left\{\sum_{t=0}^{\infty} \beta^t \left(\left(\rho^t + \prod_{s=1}^{t}\kappa_{t-s} + (1-\kappa_{t-1})\rho^{t-1}\right)\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.29}$$

$$E\{\mathcal{L}_0\} = \frac{(ac)^2}{2}\left\{\sum_{t=0}^{\infty} \beta^t \left(\left(\rho^t + \rho^{t-1} + \prod_{s=1}^{t}\kappa_{t-s} - \kappa_{t-1}\rho^{t-1}\right)\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.30}$$

$$E\{\mathcal{L}_0\} = \frac{(ac)^2}{2}\left\{\sum_{t=0}^{\infty} \beta^t \left(\left(\rho^t + \rho^{t-1} + \prod_{s=1}^{t}\kappa_{t-s} - \prod_{s=1}^{t}\kappa_{t-s}\rho^0\right)\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.31}$$

$$E\{\mathcal{L}_0\} = \frac{(ac)^2}{2}\left\{\sum_{t=0}^{\infty} \beta^t(\rho^{t-1}(\rho+1)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.32}$$

$$E\{\mathcal{L}_0\} = \frac{(ac)^2}{2}\left(\frac{1-\rho}{\rho(\beta\rho-1)}\right) + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{Q.33}$$

Appendix R

Welfare Loss: With Announcements

We now introduce an alternative policy environment where there is an announcement of a sequence of inflation targets given by $\{\pi_t^o\}_{t=0}^{\infty}$. In order to make the model simple and comparable to the previous model we assume that the inflation targets are given by $\pi_t^o = \rho^t \left(\frac{ac}{2}\right)$ with $\rho \in (0, 1)$. This is turn implies that, $\pi_t^o = \rho \pi_{t-1}^o$. That is, every subsequent period the target is a ratio ρ of the inflation target in the previous period. Under the presence of a central bank, the optimal inflation is still zero. However, the cost of zero inflation is very high for the government as it leads to a high loss in output. Therefore, the government decides to introduce intermediate targets which allow for a gradual decline in inflation.

We make another assumption about who sets the inflation targets. In this model, the government does not delegate the decision of the targets to the central bank. The central bank is only responsible for the implementation of the inflation targets. This assumption is not unusual since most monetary policy committees have a few members who are from the government including the Finance Minister.

Given the addition of the new policy, the welfare loss function of the independent central bank is given by the deviation from these announced inflation targets,

$$\mathcal{L}^{CB} = (\pi_t - \pi_t^o)^2 \tag{R.1}$$

The perceived loss function by the agents is now given by,

$$\mathcal{L}^{A} = \gamma_t (\pi_t - \pi_t^o)^2 + (1 - \gamma_t) \left((\pi_t)^2 - a\tilde{y}_t\right) \tag{R.2}$$

Thus, the agents think that the loss function is a weighted combination of the central bank loss function and the government's loss function. The loss function for the government and then process for actual inflation remain the same as in the previous model. Notice, agents now learn about γ instead of learning about a. Where γ measures the likelihood individuals think the central bank is only committed to the target.

This is so that we are able to compute optimal inflation when agents do not know if the central bank is following the implemented policy or face the same trade-off as the government.

The optimal inflation level for a given γ is given by

$$\implies \bar{\pi}_t = \gamma_t(\pi_t^o + \frac{ac}{2}) - \frac{ac}{2} \tag{R.3}$$

Learning about γ
As before, we have the agents learning about γ which is based on the observed level of inflation in the economy. As before, the agents are Bayesian and therefore the state space is given by,

$$\bar{\pi}_t = \gamma_t(\pi_t^o + \frac{ac}{2}) - \frac{ac}{2} + \epsilon_t \tag{R.4}$$

$$\gamma_t = \gamma_{t-1} + \eta_t \tag{R.5}$$

The agents observe the current level of inflation to make an inference about the policy being followed by the central bank. Therefore, the agents are learning about the fact that $\gamma = 0$ such that the only thing that matters for the central bank policy is for inflation to be at target.

The updating equations with respect to the Kalman Filter are given by,

$$\gamma_t = \gamma_{t-1} + K_t \left(\pi_t + \frac{ac}{2} - \gamma_{t-1} \left(\pi_t^o + \frac{(ac)}{2} \right) \right) \tag{R.6}$$

$$K_t = \frac{\left(\tilde{\sigma}_{t-1}^2\right)\left(\pi_t^o + \frac{(ac)}{2}\right)}{\left(\pi_t^o + \frac{(ac)}{2}\right)^2 \left(\tilde{\sigma}_{t-1}^2\right) + \tilde{\sigma}_\epsilon^2} \tag{R.7}$$

$$\tilde{\sigma}_{t|t} = \left(1 - \frac{1}{\left(1 + \frac{\tilde{\sigma}_\epsilon^2}{\left(\tilde{\sigma}_{t-1|t-1}\right)\left(\pi_t^o + \frac{(ac)}{2}\right)^2} \right)} \right) \tilde{\sigma}_{t-1|t-1} + \tilde{\sigma}_\eta^2 \tag{R.8}$$

Using the updating equations, we can re-write the updating equations as below,

Replacing the equation for inflation ($\pi_t = \pi_t^o + \epsilon_t$) we have,

$$\tilde{\gamma}_t = \tilde{\gamma}_{t-1} + \frac{\left(\tilde{\sigma}_{t-1}^2\right)\left(\pi_t^o + \frac{(ac)}{2}\right)}{\left(\pi_t^o + \frac{(ac)}{2}\right)^2 \left(\tilde{\sigma}_{t-1}^2\right) + \tilde{\sigma}_\epsilon^2} \left(\pi_t^o - \pi_{t|t-1}^e + \epsilon_t \right) \tag{R.9}$$

Replace the updating equation for γ_t in the previous equation to get the following,

$$\pi_{t+1|t}^e = \left(\tilde{\gamma}_{t-1} + \left(\frac{\left(\tilde{\sigma}_{t-1}^2\right)\left(\frac{(ac)}{2} + \pi_t^o\right)}{\left(\frac{(ac)}{2} + \pi_t^o\right)^2 \left(\tilde{\sigma}_{t-1}^2\right) + \tilde{\sigma}_\epsilon^2} \right) \left(\pi_t + \frac{ac}{2} - \gamma_{t-1} \left(\pi_t^o + \frac{ac}{2} \right) \right) \right) \left(\frac{(ac)}{2} + \pi_{t+1}^o \right) - \frac{ac}{2}$$

$$\pi_{t+1|t}^e = \left(\frac{(ac)}{2} + \pi_{t+1}^o \right) \tilde{\gamma}_{t-1} + K_t \left(\pi_t + \frac{ac}{2} - \gamma_{t-1} \left(\pi_t^o + \frac{ac}{2} \right) \right) \left(\frac{(ac)}{2} + \pi_{t+1}^o \right) - \frac{ac}{2}$$

We can now add and subtract $\gamma_{t-1}\pi_t^o$ to write the following,

$$\pi_{t+1|t}^e = \pi_{t|t-1}^e + \gamma_{t-1}(\pi_{t+1}^o - \pi_t^o) + \left(\left(\frac{\left(\tilde{\sigma}_{t-1}^2\right)\left(\frac{(ac)}{2} + \pi_t^o\right)\left(\frac{(ac)}{2} + \pi_{t+1}^o\right)}{\left(\frac{(ac)}{2} + \pi_t^o\right)^2 \left(\tilde{\sigma}_{t-1}^2\right) + \tilde{\sigma}_\epsilon^2} \right) \left(\pi_t - \pi_{t|t-1}^e \right) \right)$$

Unlike the previous model, where the only driving force of expectations was the prior of the agents and the exogenous volatility in inflation. Inflation expectations are now influenced by the change in the inflation target in the current and previous period, adjusted by the weight that agents attached to the loss function of the central bank in the previous period. The greater the value of γ, the tighter the prior or the lower the belief on the deviation of policy from the government's loss function.

The expected sequence of inflation expectations is given by

$$E_0\left\{\pi^e_{t+1|t}\right\} = \left(\frac{\tilde{\sigma}^2_\epsilon}{\left(\frac{(ac)}{2}+\pi^o_t\right)^2\tilde{\sigma}^2_{t-1}+\tilde{\sigma}^2_\epsilon}\right)E_0\left\{\pi^e_{t|t-1}\right\} + \left(\frac{ac}{2}\rho^t\right)\left(\left(\frac{\tilde{\sigma}^2_{t-1}\left(\frac{(ac)}{2}+\pi^o_t\right)^2}{\left(\frac{(ac)}{2}+\pi^o_t\right)^2\tilde{\sigma}^2_{t-1}+\tilde{\sigma}^2_\epsilon}\right) - E_0\left\{\tilde{\gamma}_{t-1}\right\}(1-\rho)\right) \quad \text{(R.10)}$$

As before, inflation expectations depend on the variation of the prior and the variation in exogenous inflation. However, now the inflation targets set by the government is relevant for the expectations. In addition, ρ which is the speed at which the government resets the inflation target also defines expectations. γ which is the credibility parameter is also a determinant factor for inflation expectations.

As in section 2.1, let us define $\kappa_t = \frac{\tilde{\sigma}^2_\epsilon}{\left(\frac{(ac)}{2}+\pi^o_t\right)^2\tilde{\sigma}^2_{t-1}+\tilde{\sigma}^2_\epsilon}$ which allows us to re-formulate inflation expectations in the following way,

$$E_0\left\{\pi^e_{t+1|t}\right\} = \kappa_t E_0\left\{\pi^e_{t|t-1}\right\} + (1-\kappa_t)\left(\frac{ac}{2}\rho^t\right) - E_0\left\{\tilde{\gamma}_{t-1}\right\}\left(\frac{ac}{2}\rho^t\right)(1-\rho) \quad \text{(R.11)}$$

Thus, inflation expectations for tomorrow $(t+1)$ are expected to evolve as an average between expectations for t, the target at t with an adjustment on the change of the target $\left(\frac{ac}{2}\rho^t\right)(1-\rho)$ weighted by the expected credibility of the central bank $E_0\left\{\tilde{\gamma}_{t-1}\right\}$.

With a central bank that only cares about hitting the announced inflation target we have, $\gamma = 1 \rightarrow \bar{\pi}_t = \pi^o_t$. If $\bar{\pi}_t = \pi^o_t$ then there is exogenous variation in inflation still driving actual inflation. This would imply that the agent never believes the central bank? Unless, the agent is aware that the process of inflation is some mean inflation with shocks. Notice, agents are not learning about inflation they are learning about the objective of the central bank.

Loss from announcing targets

With this stochastic process for the dynamics of inflation, and inflation expectations we can now compute the present value of the policy change that is, the introduction of the intermediate central banks. The loss function is given by,

$$E\{\mathcal{L}_0^G\} = E\left\{\sum_{t=0}^{\infty} \beta^t \left(a\tilde{y}_t + (\pi_t)^2\right)\right\} \tag{R.12}$$

Every period $\pi_t = \pi_t^o + \epsilon_t$ and $\pi_t^o = \rho^t\left(\frac{ac}{2}\right)$ consequently the expected loss we have is,

$$E\{\mathcal{L}_0\} = E\left\{\sum_{t=0}^{\infty} \beta^t \left(a\tilde{y}_t\right)\right\} + \frac{\left(\frac{ac}{2}\right)^2}{1-\beta\rho^2} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \tag{R.13}$$

Where output is given by $\tilde{y}_t = c(\pi_t - \pi_{t|t-1}^e) = c\left(\rho^t\left(\frac{ac}{2}\right) + \epsilon_t - \pi_{t|t-1}^e\right)$ and the expected value at $t = 0$ is

$$E_0\left(\tilde{y}_t\right) = c\left(\rho^t\left(\frac{ac}{2}\right) - E_0\left\{\pi_{t|t-1}^e\right\}\right) \textit{ and} \tag{R.14}$$

We can now use the updating equation for γ_t to compute the expected sequence of inflation expectations,

$$E_0\pi_{t+1|t}^e = E_0\left(\tilde{\gamma}_t\left(\frac{(ac)}{2} + \pi_{t+1}^o\right) - \frac{ac}{2}\right)$$

We can now compute the expected credibility of the central bank based on equation R.9 and iterating backwards.

$$E_0\left\{\tilde{\gamma}_{t-1}\right\} = E_0\left\{\tilde{\gamma}_{t-2} + \left(\frac{(\tilde{\sigma}^2_{t-2})\left(\frac{(ac)}{2}+\pi^o_{t-1}\right)}{\left(\frac{(ac)}{2}+\pi^o_{t-1}\right)^2(\tilde{\sigma}^2_{t-2})+\tilde{\sigma}^2_\epsilon}\right)\left(\pi^o_{t-1}+\frac{ac}{2}-\tilde{\gamma}_{t-2}\left(\frac{(ac)}{2}+\pi^o_{t-1}\right)+\epsilon_{t-1}\right)\right\} \tag{R.15}$$

$$= E_0\left\{\left(\frac{\tilde{\sigma}^2_\epsilon}{\left(\frac{(ac)}{2}+\pi^o_{t-1}\right)^2\tilde{\sigma}^2_{t-2}+\tilde{\sigma}^2_\epsilon}\right)\tilde{\gamma}_{t-2} + \left(\frac{\tilde{\sigma}^2_{t-2}\left(\frac{(ac)}{2}+\pi^o_{t-1}\right)^2}{\left(\frac{(ac)}{2}+\pi^o_{t-1}\right)^2\tilde{\sigma}^2_{t-2}+\tilde{\sigma}^2_\epsilon}\right)\right\} \tag{R.16}$$

$$\tag{R.17}$$

Iterating backwards we can write the following,

$$\begin{aligned}
&\kappa_{t-1}E_0\left\{\tilde{\gamma}_{t-2}\right\}+(1-\kappa_{t-1})\\
&=\kappa_{t-1}\kappa_{t-2}\kappa_{t-3}E_0\left\{\tilde{\gamma}_{t-4}\right\}+\kappa_{t-1}\kappa_{t-2}(1-\kappa_{t-3})+\kappa_{t-1}(1-\kappa_{t-2})+(1-\kappa_{t-1})\\
&=\left(\prod_{s=1}^{t-1}\kappa_{t-s}\right)(\tilde{\gamma}_0-1)+1
\end{aligned} \tag{R.18}$$

We now define a parameter as $\alpha = 1-\gamma$ to allow for comparability across the two models. Then, we can re-write equation R.18 in the following way,

$$E_0\left\{\tilde{\alpha}_{t-1}\right\} = \left(\prod_{s=1}^{t-1}\kappa_{t-s}\right)\tilde{\alpha}_0 \tag{R.19}$$

Recall that we are able to compute the inflation expectations for the next period in the following way,

$$\begin{aligned}
\pi^e_{t+1|t} &= \tilde{\gamma}_t\left(\frac{(ac)}{2}+\pi^o_{t+1}\right)-\frac{(ac)}{2}\\
&=\pi^o_{t+1}-\tilde{\alpha}_t\left(\frac{(ac)}{2}+\pi^o_{t+1}\right)
\end{aligned} \tag{R.20}$$

Taking expectations and using R.18 we get,

$$E_0\left\{\pi^e_{t+1|t}\right\} = \pi^o_{t+1}-\left(\prod_{s=1}^{t}\kappa_{t+1-s}\right)\tilde{\alpha}_0\left(\frac{(ac)}{2}+\pi^o_{t+1}\right) \qquad \text{for } t\geq 0 \tag{R.21}$$

With, $E_0\left\{\pi^e_{0|-1}\right\} = \pi^o_0 = \frac{ac}{2}$ as the initial expectations (Rational Expectations before the reform). Replacing this in the loss function we have,

$$E_0\{\mathcal{L}_0^{G,CB,O}\} = \frac{(ac)^2}{2}\tilde{\alpha}_0 \sum_{t=1}^{\infty} \beta^t \left(\prod_{s=1}^{t-1} \kappa_{t-s}\right) \left(1-\rho^t\right) + \frac{\left(\frac{ac}{2}\right)^2}{1-\rho^2\beta} + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta} \quad \text{(R.22)}$$

We now have the welfare loss function that depends on the prior of the agents, exogenous variation in inflation, the inflation targets set by the government and the speed at which the targets are reset.

Recall the welfare loss from only introducing the central bank is given by,

$$E\{L_0^{G,CB}\} = \frac{ac^2}{2} \sum_{t=0}^{\infty} \beta^t \tilde{a}_0 \left(\prod_{j=1}^{t} \kappa_{t-j}\right) + \frac{\tilde{\sigma}_\epsilon^2}{1-\beta}$$

Thus, the terms marked in blue in equation R.22 denote the differences in welfare loss when introducing a central bank and when introducing a central bank and intermediate targets. Therefore introducing inflation targets has two opposing forces on the welfare loss, a higher ρ implies a costly temporary inflation bias term $\frac{\left(\frac{ac}{2}\right)^2}{1-\rho^2\beta}$ but also a smaller output loss (term $(1-\rho^t)$) and faster learning (because of smaller κ_t values). We now turn to simulating the model which will allow us to see the effect of introducing the targets and compute the welfare loss.

Appendix S

Calibration Welfare Loss

Table S.1: Parameter Values for both models

Parameter	Definition	Independent Central Bank	Intermediate Targets
β	Discount Factor	0.99	0.99
a	Weight on output gap	100	100
c	Weight on output and inflation	0.35	0.35

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