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Globalization Institute Working Paper 417

July 2022

Research Department

<https://doi.org/10.24149/gwp417>

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Flexible Average Inflation Targeting: How Much Is U.S. Monetary Policy Changing?*

Jarod Coulter[†], Roberto Duncan[‡] and Enrique Martínez-García[§]

July 7, 2022

Abstract

One major outcome of the Federal Reserve's 2019 – 20 framework review was the adoption of a Flexible Average Inflation Targeting (FAIT) strategy in August 2020. Using synthetic control methods, we document that U.S. inflation rose post-FAIT considerably more than predicted had the strategy not changed (an average of 1.18 percentage points during 2020:M8-2022:M2). To explore the extent to which targeting average inflation delayed the Fed's response and contributed to post-FAIT inflation, we adopt a version of the open-economy New Keynesian model in [Martínez-García \(2021\)](#) and document the economic consequences of adopting alternative measures of average inflation as policy objectives. We document three additional major findings using this general equilibrium setup: First, depending on how far back and how much weight is assigned to past inflation misses, the policy outcomes under FAIT are similar to those under the pre-FAIT regime. Secondly, we find that the implementation of FAIT can have large effects over short periods of time as it tends to delay action. However, over longer periods of time—such as the 1984:Q1-2019:Q4 pre-FAIT period—its effects wash out and appear negligible. Finally, we find that different average inflation measures explain an average of 0.5 percentage points per quarter of the post-FAIT inflation surge, indicating that targeting average inflation by itself can only explain part of the inflation spike since August 2020.

JEL Classification: F41, F42, F47, E52, E58, E65.

Keywords: Open-Economy New Keynesian Model, Monetary Policy, Flexible Average Inflation Targeting, Flexible Inflation Targeting, Survey Expectations.

* This document has greatly benefited from valuable feedback provided by Michael B. Devereux, Charles Engel, Marc P. Giannoni, Valerie Grossman, John Keating, Christoffer Koch, Carlos Rondon-Moreno, Efthymios Pavlidis, Lorenza Rossi, Eric Sims, Joseph S. Tracy, Víctor Valcárcel, Christian Velazquez, Mark A. Wynne, and Fabrizio Zampolli. We also acknowledge the excellent research assistance provided by James Sanford and the feedback we received presenting this paper at the 2022 Computing in Economics and Finance conference in Dallas (TX). The dataset and codes for the paper are publicly available and can be found here: <https://bit.ly/3Pfs5B3>. All remaining errors are ours alone. The views expressed here do not necessarily reflect those of the Federal Reserve Bank of Dallas or the Federal Reserve System.

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1 Introduction

On August 27, 2020, Federal Reserve Chairman Jerome Powell announced that the Federal Reserve was adopting a new strategy for its monetary policy framework—a strategy known as flexible average inflation targeting (FAIT). Much discussion has ensued this shift in the Federal Reserve’s strategy as it has coincided with the beginning of an inflation hike unlike anything the U.S. has experienced since the 1970s and early 1980s. Some scholars and observers have even argued whether FAIT itself may not have been one of the causes of the rising inflation, as noted by [Waller \(2022\)](#).

In this paper, we investigate empirically how the U.S. economy’s performance has been affected by the implementation of this new FAIT strategy. Using the synthetic control method (SCM) to evaluate the likely impact of FAIT on monthly U.S. headline CPI inflation, we find that the inflation rate increased excessively compared with our estimated counterfactual during the post-FAIT period (an average of 1.18 percentage points during 2020:M8-2022:M2).

Then, to quantitatively assess the cyclical implications of FAIT, we adopt a more structural approach based on a variant of the workhorse two-country New Keynesian dynamic stochastic general equilibrium model of [Martínez-García and Wynne \(2010\)](#) and [Martínez-García \(2019\)](#). This workhorse model describes the U.S. economy and its interdependence with the rest of the world. We capture monetary policy prior to the adoption of FAIT with a [Taylor \(1993\)](#) rule as in [Martínez-García \(2021\)](#), augmented with monetary policy news shocks as in [Del Negro et al. \(2012\)](#).

Following in the footsteps of [Martínez-García \(2021\)](#), we discipline the estimation of the workhorse model by including survey data to constrain the path of future interest rates. We estimate this structural model with Bayesian techniques. With the estimated model at hand, we investigate the performance of the U.S. economy under a [Taylor \(1993\)](#) rule targeting different average inflation measures in order to reflect alternative ways of responding to past inflation misses under the new FAIT monetary policy framework. In particular, we assume that the Federal Reserve could choose to react to current as well as past inflation over one-year, two-year or five-year windows using either a simple moving average or an exponentially-weighted moving average.¹

¹Simple and exponentially weighted moving averages are symmetric measures. However, the Statement on Longer-Run Goals and Monetary Policy Strategy amended on August 27, 2020 to introduce the new FAIT strategy emphasized the case of moderately overshooting inflation after a prolonged period of persistently below-target inflation ([Board of Governors \(2020\)](#)). Hence, by considering only symmetric forms of implementing FAIT in our analysis, we have taken a stand on the meaning of the FOMC’s language. We interpret

We perform a series of counterfactual exercises based on the estimated workhorse model under alternative average inflation measures and conclude that:

First, each moving average measure differs on the weight it puts on past inflation misses and the length of the period that it covers. However, in practice, the differences between most of the alternative moving average measures under consideration are fairly small over the full (quarterly) sample period from 1984:Q1 until 2021:Q4. We find that a range of moving average measures would give an inflation signal very close to that of the year-over-year inflation rate (or four quarter inflation rate change) when inflation fluctuations in deviations from the long-run expected inflation rate are not too large. The differences become larger the longer the window into the past that policymakers select—5 years or more—or the larger inflation fluctuations are. This suggests that the horizon over which past misses are considered and the magnitude of inflation deviations from their long-run expectations are not trivial.

Second, we estimate the workhorse model over the pre-FAIT subsample excluding the 2020 quarters impacted by the COVID pandemic (that is, over the 1984:Q1–2019:Q4 period) and set its parameter values at their posterior point estimates. Under the assumption that any form of the FAIT strategy followed by the Federal Reserve would not have materially altered the observed long-run expectations, we can generate a counterfactual path for U.S. inflation and other macro variables over the same subsample using the realized shocks recovered from the estimated model and feeding them through the estimated model under alternative inflation objectives implied by each moving average of inflation under the [Taylor \(1993\)](#) rule. In this counterfactual exercise, we conclude that most moving average specifications that can be used for FAIT, if announced and viewed as credible by private agents, would only have limited effects over long periods of time.

Similar to [Nessen and Vestin \(2005\)](#), average inflation targeting can have sizeable effects over short periods of time by delaying the response to inflation fluctuations and, in doing so, may preclude the central bank from overreacting to transitory shocks. In general, however,

the amended Statement as directly tied to the recent U.S. experience mainly for motivation purposes, but not as an explicit requirement that the new strategy be applied asymmetrically. On the one hand, if anything, we know this interpretation to be consistent with how the Federal Reserve in the past has tended to emphasize symmetric responses. On the other hand, even though in its wording the FOMC indeed chose to illustrate the need for make-up policies, we argue that it did so judging that inflation shortfalls—particularly at the zero lower bound (ZLB)—posed the bigger threat to de-anchoring inflation expectations and, for that reason, provided a strong justification for the Fed’s change of strategy. In other words, we argue that the reference to inflation shortfalls is meant to make the stronger case possible for explicitly allowing for the possibility of make-up inflation policies. From this point of view, it was not meant as a constraint leading to asymmetric responses to inflation as that asymmetry is neither stated as the FOMC’s preferred practice nor explained anywhere in the Statement.

the symmetry of the responses implies that those macro effects tend to wash out over longer periods so the performance of the U.S. economy would not have been significantly different over the 1984:Q1–2019:Q4 period under FAIT. We also emphasize that long-term inflation expectations must be properly managed for any short-term benefits that can accrue from FAIT to actually materialize, and that any FAIT strategy may be difficult to manage in practice if long-run inflation expectations become de-anchored.²

Third, we explore the consequences of the adoption of FAIT in August 2020 by considering what would have been expected to occur had the Federal Reserve retained its pre-FAIT strategy rather than undertake the switch to FAIT right after the COVID pandemic hit the U.S. and global economies. We keep the model at its pre-FAIT estimated parameter values and recover the shocks under all possible implementations of FAIT—all possible moving average measures—under consideration over the subsample 2020:Q4–2021:Q4. From the counterfactual analysis of what would have happened had those shocks recovered hit the economy under the pre-FAIT regime, we conclude that different average inflation measures may have contributed an average of 0.5 percentage points per quarter to the post-FAIT inflation surge. This indicates that the shift to targeting average inflation by itself can only explain part of the inflation spike that followed the adoption of FAIT.

Our findings also suggest that forward guidance played a major role in keeping policy rates low for too long since the COVID pandemic. In that sense, our findings generally support [Waller \(2022\)](#)’s assessment that—rather than the new FAIT strategy—the Fed’s guidance on monetary policy normalization given in September and December 2020 was the primary cause of the Fed’s slow response to the rising tide of inflation in the later part of 2020 and during 2021.

The remainder of the paper proceeds as follows: [Section 2](#) explores the background and context that lead to the adoption of FAIT by the Federal Reserve. It also uses the SCM to provide evidence about the likely impact that FAIT has had on U.S. inflation. [Section 3](#) describes the workhorse open-economy New Keynesian model and the different forms of implementing FAIT that we consider in this paper. [Section 4](#) discusses our methodology and reviews the estimation results based on the pre-FAIT period from 1984:Q1 until 2019:Q4. [Section 5](#) reports our main findings regarding the effects of adopting different variants of FAIT on the U.S. economy based on a series of counterfactual exercises where we explore:

²De-anchoring long-term expectations can result from the private agents’ misperceptions about the aggressiveness with which the central bank is going to respond to its preferred inflation moving average under the new FAIT strategy leading to an erosion of central bank credibility. Or due to uncertainty about how current and past inflation feature in the policymakers decision process having a similar negative impact on the credibility of the new FAIT strategy.

(a) what U.S. inflation and other macro variables could have been under different moving average inflation objectives during the pre-FAIT period; and (b) what the U.S. economy’s performance could have been had the pre-FAIT strategy been maintained in the post-FAIT period. [Section 6](#) concludes arguing that average inflation targeting represents an evolution of the U.S. monetary policy framework whose impact on U.S. inflation has not been trivial, but is likely relatively modest in magnitude.

2 Monetary Policy Framework: The Road to FAIT

2.1 Background Details

U.S. monetary policy has come a long way since the 1970s when inflation averaged 7.1%, topping 10% first in 1974 and then again when Chairman Paul Volcker took the helm of the Federal Reserve in 1979. Although inflation would stay above 10% until 1981, Chairman Volcker managed to gradually bring inflation down by sticking with a monetary policy strategy that kept interest rates high in spite of the ensuing recession. The lasting consequence of the tough actions taken during the 1980s to curb inflation was that businesses and households internalized the Federal Reserve’s low inflation objective in their own decision-making processes over the past 40 years.

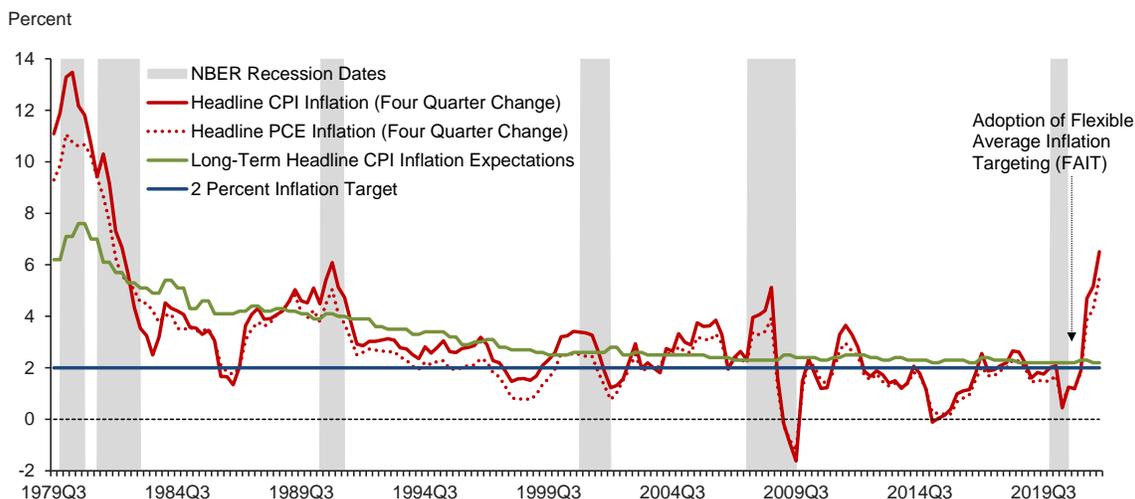
Having earned its credibility beating back inflation, U.S. policymakers gained significant policy leeway to respond to the short-term trade-offs arising from the Federal Reserve’s dual mandate of price stability and full employment. Already under Chairman Volcker, the Federal Reserve embraced the federal funds rate as its primary instrument to conduct monetary policy. U.S. monetary policy became more predictable and systematic (or rules-based) also, closely aligning with the prescriptions of a [Taylor \(1993\)](#)-type reaction function.

The Federal Reserve’s monetary policy framework evolved since the 1980s under the overarching goals of strengthening the Fed’s inflation credibility to anchor long-run expectations and retaining its short-term policy leeway for macroeconomic stabilization. As can be seen in [Figure 1](#), long-term CPI inflation expectations became progressively anchored at a low level, above but increasingly closer to 2% during the 1980s and 1990s. This translated into more stable prices, with observed inflation averaging about 3% during Chairman Alan Greenspan’s long tenure.³

³Federal Reserve Chairman Alan Greenspan’s tenure from 1987 till 2006 coincides almost exactly with the period of the Great Moderation in the U.S. which is conventionally dated from 1984 until the 2007–09 global financial crisis. This period is characterized by low business cycle volatility as documented by [Martínez-García \(2018\)](#). The Great Moderation is thought to be partly caused by institutional changes, in particular

The Federal Reserve kept long-term expected CPI inflation solidly anchored close to 2% even after the federal funds rate hit the zero lower bound (ZLB henceforth) for an extended period of time starting in the midst of the 2007 – 09 global financial crisis. In spite of the resilience shown by the long-term inflation expectations, CPI inflation averaged a persistently low 1.6% during the decade from 2009:Q1 until 2019:Q4, prior to the pandemic, seemingly defying the Federal Reserve’s many efforts to prop up inflation (Caldara et al. (2021)).⁴

Figure 1. U.S. Headline Inflation and Long-Term Inflation Expectations
(Relative to 2 Percent Inflation Target)



Note: Shaded bars indicate NBER recessions. Long-term inflation expectations correspond to the five-year average of the annual U.S. inflation rate, five years forward as reported in Blue Chip Economic Indicators by Aspen Publishers (2022).

Sources: Aspen Publishers (2022); CBO (2022); NBER; and authors’ calculations.

In the aftermath of the 2007 – 09 global financial crisis, the Federal Reserve expanded its active toolkit with balance sheet policies and forward guidance becoming more prominent by better central bank policies (including inflation targeting), and also by the tailwinds of structural change, notably globalization (Martínez-García (2019)).

⁴As discussed in Board of Governors (2000), the FOMC prioritized CPI inflation prior to 2000 but, after an extensive evaluation process, switched its emphasis to PCE inflation for several reasons: (1) expenditure weights in the PCE deflator change as people substitute away from some goods and services toward others, (2) the PCE deflator includes more comprehensive coverage of goods and services, and (3) the PCE deflator gets revised for more than seasonal factors, incorporating new information as it becomes available. In practice, however, the headline CPI inflation plotted in Figure 1 has been only 0.3 percentage points higher than the corresponding headline PCE inflation over the period from 2000:Q1 until 2021:Q4 and 0.2 percentage points higher over the period from 2009:Q1 until 2019:Q4.

instruments, albeit as imperfect substitutes for the federal funds rate, with which to provide monetary accommodation. The Fed also adapted its communication strategy to enhance the reach of its forward guidance with the introduction of the summary of economic projections (SEP) as its cornerstone in 2008.

In 2012, renewed concerns—which had arisen before in the early 2000s—about deflationary risks and de-anchoring of long-run inflation expectations led the Federal Reserve to adjust its strategy again by releasing its first-ever Statement on Longer-Run Goals and Monetary Policy Strategy and by adopting an explicit numerical 2% inflation target. In doing so, policymakers made *de iure* what *de facto* had been understood as the Fed’s inflation target for quite some time—as can be gauged from the behavior of long-term inflation expectations in [Figure 1](#). This shift sought to increase accountability and, in that way, further strengthen the credibility of the Federal Reserve’s inflation expectations anchor.⁵

At the 2020 economic symposium at Jackson Hole, Federal Reserve Chairman Jerome Powell presented the main takeaways of the Fed’s first-ever public review of its monetary policy framework (strategy, tools, and communication practices) conducted during 2019–20.⁶ One of the key lessons that policymakers took to heart after this review is that below-target inflation misses at the ZLB, like those experienced during the prior decade, pose a risk of eroding the Fed’s 2% long-term inflation anchor if they persist and become entrenched as a ceiling in the expectations of households and businesses.⁷ To dispel that risk, Chairman Powell announced on behalf of the Federal Open Market Committee (FOMC) a new shift in

⁵The 2012 changes to the Fed’s monetary policy strategy aligned it closer to that of an inflation targeting central bank. Inflation targeting became quite popular around the world as a monetary policy strategy aimed to stabilize inflation and inflation expectations since first introduced in New Zealand in 1989 and became widespread from then on, especially in the 1990s ([Bernanke and Mishkin \(1997\)](#)). In the U.S., it was not until the Chairmanship of Ben Bernanke (2006 – 14) that the Federal Reserve started adopting many of the features often associated with an inflation targeter. Then Vice Chair Janet Yellen facilitated the efforts that would codify the FOMC’s own approach to inflation targeting in the Fed’s 2012 Statement on Longer-Run Goals and Monetary Policy Strategy by finally making explicit and verifiable its inflation commitment.

⁶The interested reader can explore the Fed’s 2019 – 20 Monetary Policy Framework Review and the resulting changes to the Fed’s Statement on Longer-Run Goals and Monetary Policy Strategy (adopted effective January 24, 2012; amended effective January 29, 2019) announced on August 27, 2020 here: [Board of Governors \(2020\)](#).

⁷The decline of the long-run U.S. real and natural rates documented by [Caldara et al. \(2021\)](#) and [Martínez-García \(2021\)](#) since the 2007 – 09 global financial crisis (or even before) underlies another one of the key concerns raised during the Fed’s 2019 – 20 Monetary Policy Framework Review—that a sustained period of low interest rates increases the likelihood of monetary policy hitting the ZLB even after only modest economic downturns ([Caldara et al. \(2021\)](#)). This was an important motivation for the FOMC’s subsequent update of the Longer-Run Statement announced by Chairman Powell at the 2020 Jackson Hole Symposium. After all, a low interest rate environment makes it more likely that the Fed will find itself again having to deal with inflation shortfalls while at the ZLB, putting at risk the Fed’s anchoring of inflation expectations (as explained in greater detail by [Powell \(2020\)](#) and [Clarida \(2020\)](#)).

the Federal Reserve's strategy, formalized in a revised Statement on Longer-Run Goals and Monetary Policy Strategy.

The fundamental change under the Federal Reserve's new strategy, often referred as flexible average inflation targeting (FAIT), is to recognize explicitly the possibility of temporary inflation overshooting to make-up for prolonged periods of below-target inflation. This committed U.S. policymakers to preempt a downward drift of the long-term inflation expectations even when that meant realized inflation may have to rise above target for a while. In the FOMC's own words:

"The Committee judges that longer-term inflation expectations that are well anchored at 2 percent foster price stability and moderate long-term interest rates and enhance the Committee's ability to promote maximum employment in the face of significant economic disturbances. In order to anchor longer-term inflation expectations at this level, the Committee seeks to achieve inflation that averages 2 percent over time, and therefore judges that, following periods when inflation has been running persistently below 2 percent, appropriate monetary policy will likely aim to achieve inflation moderately above 2 percent for some time." Federal Reserve's Statement on Longer-Run Goals and Monetary Policy Strategy amended effective August 27, 2020 ([Board of Governors \(2020\)](#)).

Alluding to the need for making-up inflation after prolonged periods of below-target inflation misses seeks to prevent the erosion of the reputational capital earned by Chairman Paul Volcker and to keep long-term inflation expectations solidly anchored around 2%.⁸ In other words, the Fed wanted to steer the U.S. away from a fate like that of Japan characterized since the 1990s by decades of persistently low inflation and interest rates.

In practice, FAIT represents more of an evolution than a break with respect to the prior monetary policy framework and strategy in the U.S.:

First, the word flexible in FAIT recognizes that monetary policy does not have price stability as its sole goal as it would be expected under a purest form of an inflation targeting regime. In turn, the Federal Reserve is statutorily required to balance price stability with full employment under its dual mandate. This did not fundamentally change with the adoption of FAIT as it was already a long-standing feature of U.S. monetary policy. The new strategy did, however, add some language allowing for a more granular understanding of what achieving full employment means.

⁸While the Federal Reserve has not provided an explicit window for which it would target average inflation to be 2%, a range of between 1 and 2 years is thought to set a reasonable timeframe for episodes of inflation shortfall that can be sustained over the medium-term. Although the FOMC's emphasis put on the language is on inflation shortfalls, we interpret the Fed's approach to FAIT as symmetric in regards to prolonged deviations above and below the 2% target.

Second, an inflation targeting framework in its purest form is characterized by more than an explicit numerical inflation target and accountability mechanism, and it rests on the policy principle of "letting bygones be bygones" when it comes to past inflation data. By contrast, the word average in FAIT indicates that the Federal Reserve may take into account past inflation in conducting monetary policy. However, the FOMC reaffirmed that "inflation at the rate of 2%, as measured by the annual change in the price index for personal consumption expenditures, is most consistent over the longer run with the Federal Reserve's statutory mandate" in the 2020 amended Statement on Longer-Run Goals and Monetary Policy Strategy ([Board of Governors \(2020\)](#)). In fact, the Federal Reserve has emphasized the annual rate of change of its preferred price index even before that measure was introduced in the 2012 Statement on Longer-Run Goals and Monetary Policy Strategy. In practice this meant that past inflation misses up to a year were already having an influence on U.S. monetary policy before FAIT. Therefore, the adoption of the new FAIT strategy in August 2020, simply put, was aimed to signaling that monetary policy can make-up for inflation shortfalls over periods longer than a year too for the purpose of strengthening the long-term inflation expectations anchor.⁹

2.2 The new FAIT Strategy: Economic Consequences

We can evaluate empirically the null hypothesis that the adoption of FAIT in August 2020 did not cause more inflation in the U.S. economy. In order to do that, we employ the SCM and construct a donor pool that can be used to estimate a plausible counterfactual of the inflation rate in the U.S. had FAIT not been adopted. The SCM was originally proposed by [Abadie and Gardeazabal \(2003\)](#), [Abadie et al. \(2010\)](#), and [Abadie et al. \(2015\)](#). Given that this method is well known, we provide here only a brief discussion of its implementation for our application.

The outcome variable is the monthly headline inflation rate measured as the approximate year-over-year percent change in the seasonally-adjusted CPI: $\pi_{it} \equiv 100 [\ln(CPI_{it}) - \ln(CPI_{it-12})]$, for any given country indexed $i = 1, \dots, J + 1$. Even though not every inflation-targeting central bank uses the CPI to measure the inflation rate, this is a common measure of price stability for most of the central banks in the world. The data source is the Federal Reserve

⁹[Martínez-García et al. \(2021\)](#) provides further details and a succinct discussion of how the main purpose of the new FAIT framework is to explicitly recognize the role of make-up strategies. In doing so, the Federal Reserve sought to better anchor long-term inflation expectations by dissuading private agents from embracing the belief that the 2% inflation target had become a ceiling for the Fed after a period of persistent below-target inflation readings.

Bank of Dallas’ Database of Global Economic Indicators or DGEI ([Grossman et al. \(2014\)](#)).

We define the dynamic treatment effect (DTE), τ_t , occurring at any given time since the intervention period (T_0) on the intervened unit ($i = 1$) which in our case is the U.S. as

$$\tau_t = \pi_{1t} - \pi_{1t}^N = Y_{1t} - \sum_{i=2}^{J+1} w_i Y_{it}, \text{ for all } t \geq T_0, \quad (1)$$

where π_{1t}^N is the inflation rate that would be observed in the intervened unit at time t in the absence of the intervention. The period of analysis starts in January 2012 as it is then when the Federal Reserve made explicit its numerical 2% inflation target and introduced its Statement on Longer-Run Goals and Monetary Policy Strategy to articulate key features of the U.S. monetary policy framework. The last period corresponds to February 2022 before the oil price shock associated with the 2022 Russian invasion of Ukraine. The post-intervention period starts in August 2020 (T_0 in our notation above) which is when the announcement of FAIT was made.

The first equality in (1) defines the DTE. The SCM estimates this counterfactual by finding a weighted average of the J control units: $\sum_{i=2}^{J+1} w_i \pi_{it}$, for $t \geq T_0$, where $0 \leq w_i \leq 1$ is the synthetic weight associated with the control unit i for $i = 2, \dots, J + 1$. Such a weighted average of inflation rates among the control units is the synthetic control. The second equality in (1) defines an estimate of the DTE by replacing the unobserved counterfactual π_{1t}^N with the synthetic control. The weights are estimated by matching the intervened unit’s outcome variable with the synthetic control over the pre-intervention period.¹⁰

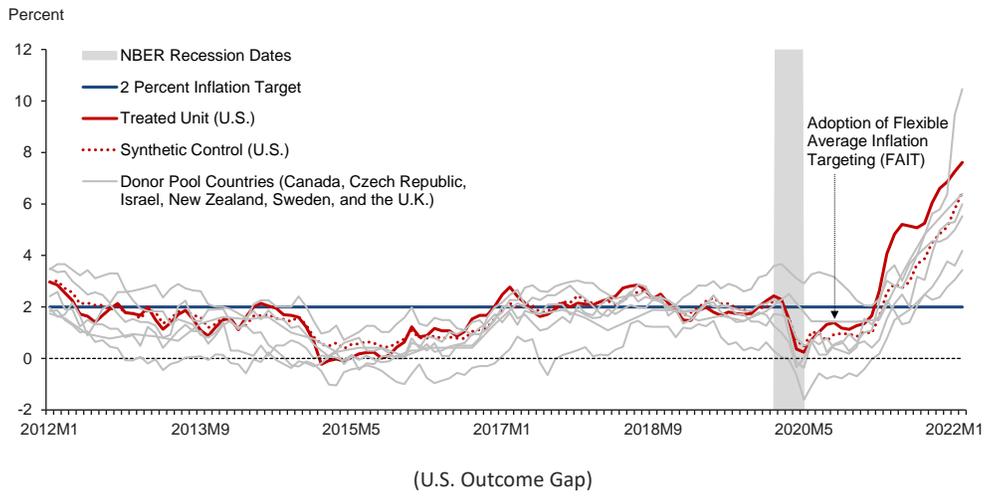
The donor pool for the U.S. is composed of six economies ($J = 6$): Canada, Czech Republic, New Zealand, Sweden, and the United Kingdom. All of these economies share with the U.S. similar macroeconomic policies—all are OECD countries, have a similar (flexible) inflation targeting regime in place, and the same target (either point inflation target or midpoint of an inflation target band) of 2%. Put differently, we discard any economy that does not belong to the OECD group, has not adopted a form of flexible inflation targeting, or has not targeted 2% inflation over the period of analysis in spite of being an inflation targeter. We also remove any inflation targeter that modified its target during the pre- or post-intervention periods (e.g., Japan in 2013). We obtain inflation targets and adoption periods from central banks’ documentation. The top panel of [Figure 2](#) shows the U.S. and the control units’ inflation rates.¹¹

¹⁰Under certain conditions, if the number of pre-treatment periods is large relative to the scale of the transitory shocks, [Abadie et al. \(2010\)](#) show that the SCM estimator is asymptotically unbiased.

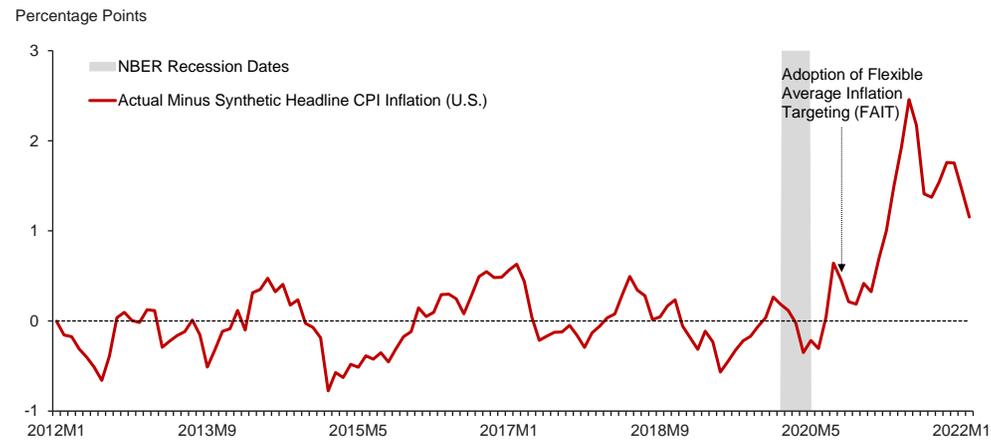
¹¹The figure also marks with a dashed vertical arrow the beginning of the treatment period which corresponds to the Federal Reserve’s announcement of FAIT from August 2020.

Figure 2. U.S. Headline Inflation and Counterfactual Using Synthetic Control Methods (SCM)

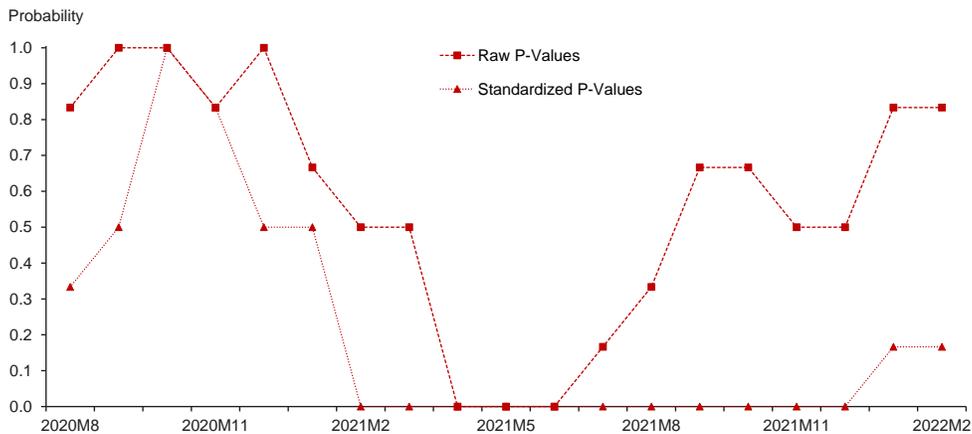
(U.S. Actual and Synthetic Headline CPI Inflation Rate)



(U.S. Outcome Gap)



(Probability that U.S. Post-Treatment Effects Would Happen by Chance)



Note: All data reported is expressed at monthly frequency. Inflation rates refer to the headline CPI of the U.S. and the donor pool (Canada, Czech Republic, Israel, New Zealand, Sweden, and the U.K.) measured as a 12 month change.

Sources: [Grossman et al. \(2014\)](#); NBER; and authors' calculations.

As [Abadie et al. \(2010\)](#) suggest, the risk of interpolation biases can be reduced if one restricts the donor pool to units that are similar to the intervened unit in terms of the values of the predictors or covariates. The top panel of [Figure 2](#) illustrates the similar dynamics observed in the inflation rates of both the treated unit which is the U.S. (red line) and its donor pool (gray lines), especially during the pre-FAIT periods from 2012:M1 until 2020:M7. For that reason, we opt to use pre-intervention values of the outcome variable as the main predictor. In particular, we use 50% of the pre-treatment outcome values as covariates in the SCM estimation.

The top panel of [Figure 2](#) also compares the actual and synthetic inflation rates for the U.S. Regarding the degree of pre-treatment fit, we can observe that the synthetic inflation closely matches its actual counterpart over the 2012:M1-2020:M7 period. This is confirmed by looking at the value of the root mean squared prediction error ($RMSPE$) which is 0.2893. If the pre-treatment fit is very weak, [Abadie \(2021\)](#) recommends not using the SCM approach but that is clearly not the case here. [Adhikari et al. \(2018\)](#) recommend keeping (discarding) SCM estimates if the MSPE-to-standard-deviation ratio is lower (higher) than one. In our case, such a ratio satisfies that criterion ($\frac{MSPE}{SD} = \frac{0.0837}{0.7589} = 0.1103 < 1$).

Overall, we observe a reasonable level of sparsity for the weights obtained in the SCM estimation. The most important weights are those of Canada (46.8%), the U.K. (39.5%), Sweden (6.9%), and the Czech Republic (6.7%). The other control units, Israel and New Zealand, did not contribute anything to the synthetic inflation rate. That is, about 86.3% of the synthetic inflation rate for the U.S. is constructed based on the inflation rates from countries in the core Anglosphere (that is, with Canada and U.K. inflation rates).

Our main result is shown in the middle panel of [Figure 2](#). We find that the FAIT announcement was followed by a rise in the U.S. inflation rate. The final effect is expressed in the form of an outcome gap, the difference between the actual inflation and its estimated counterfactual for the U.S. The DTE (τ_t) is the gap during the post-intervention period. As we can see, the DTE fluctuates above the zero line over the entire post-treatment period reaching a peak of 2.46 percentage points in June 2021. The average of the DTE (average treatment effect) on the treated unit (the U.S.) is 1.18 percentage points.

We address the significance of the treatment effects over time using exact inference via a placebo study ([Abadie \(2021\)](#)). The bottom panel of [Figure 2](#) helps us examine whether the DTE is statistically significant or not. Following [Cavallo et al. \(2013\)](#) and [Galiani and Quistorff \(2017\)](#), we report the raw p-values for the null hypothesis of no effect for each

post-intervention period jointly with the standardized p-values. The reason is that looking at the raw p-values alone can give us an inaccurate picture as those raw p-values can be too conservative when the control units used in the placebo simulation are not matched properly during the pre-intervention period. The standardized (studentized) p-values deal with this issue by rescaling the effects by the pre-treatment RMSPE that measures the quality of the balance prior to the application of the policy.

Thus, the bottom panel of [Figure 2](#) shows standardized p-values equal to zero in several post-treatment months (to be precise, from 2021:M2 until 2021:M12). This indicates that we find statistically significant positive effects on the U.S. inflation rate. We conclude that the empirical evidence reported in this section suggests that the implementation of the FAIT could have caused a rise in the U.S. headline inflation rate with respect to its estimated counterfactual. We recognize also that by the end of our sample—February 2022—inflation well above target had become a feature of U.S. inflation judging by the above-target level reached by our synthetic estimate (as can be seen in the top panel of [Figure 2](#)).¹² In the remainder of the paper, we are going to use a structural approach to refine the question on how FAIT affected U.S. inflation further and investigate to what extent did the implementation of alternative measures of average inflation targeting contributed to the Federal Reserve’s getting late to respond to increasing inflation in 2021 contributing by omission to the surge.

3 The Workhorse Open-Economy Model

The new FAIT framework keeps in place the toolkit and communication practices that the Federal Reserve had already been using, but seeks to give policymakers more space to maneuver by clarifying that make-up strategies previously understood to be out of bounds are, in fact, permissible. But, adopting FAIT did not commit policymakers to a particular time window or approach to weighting past inflation misses, introducing a degree of discretion that—some fear—may result in less policy predictability and the losses associated from "more discretion."¹³ We recognize that this lack of definition on how to mesh current and

¹²The estimated synthetic inflation was 47% lower than actual U.S. inflation in June 2021 and has been on average 30% lower than actual inflation during the post-treatment period (2020:M8-2022:M2). Our estimate of synthetic inflation reached 2.7% in June 2021 which is not too far above the 2% objective set by the Federal Reserve precisely at the point in time where the outcome gap peaked. Since then, our estimate of U.S. synthetic inflation has continued to increase reaching a high point of 6.5% by 2022:M2 which is well above the 2% objective set by the Federal Reserve.

¹³[Kydland and Prescott \(1977\)](#) noted that central banks with discretionary power have an incentive to renege on commitments to price stability (the so-called "time inconsistency" problem). A binding rule which is known and verifiable, [Kydland and Prescott \(1977\)](#) argued, can lead to better outcomes by making the

past inflation misses can become a vulnerability that erodes the central bank’s credibility. It can also be a challenge to the Fed’s ability to put a lid on inflation to stem the risk of de-anchoring long-term inflation expectations.

While those concerns should be taken seriously, in this paper we focus on the implications of FAIT for U.S. inflation as well as for other macro variables taking as given that the new framework intends to strengthen the anchoring of long-run inflation expectations. While we analyze the causal effect of total inflation using SCM in the previous section, here our structural model more narrowly explores the cyclical implications of adopting FAIT as this is something that—in our view—has not received much attention in the literature so far.

3.1 Equilibrium Conditions

We adopt the workhorse two-country New Keynesian model which incorporates nominal rigidities à la [Calvo \(1983\)](#) and explicit trade linkages with the rest of the world following in the footsteps of [Martínez-García and Wynne \(2010\)](#), [Martínez-García \(2019\)](#), and [Martínez-García \(2021\)](#). We use this model to investigate the role that the Fed’s monetary policy strategy has played on the cyclical dynamics of the U.S. economy.

The key equilibrium conditions of the model are log-linearized around a deterministic, zero-inflation steady state. We denote $\widehat{g}_t \equiv \ln\left(\frac{G_t}{\bar{G}}\right)$ the deviation of a given variable in logs from its steady-state and, similarly, we refer to $\widehat{\bar{g}}_t \equiv \ln\left(\frac{\bar{G}_t}{\bar{G}}\right)$ as the deviation of a variable in logs from its steady-state in the counterfactual scenario where all nominal rigidities are removed. We use the superscript $*$ to distinguish the rest of the world from the home country (that is, from the U.S.).

The U.S. and the rest of the world are described with an open-economy Phillips curve and an open-economy dynamic Investment-Saving (IS) equation each—all the relevant equilibrium conditions of the model are succinctly summarized in [Table 1](#).¹⁴ We refer to $\mathbb{E}_t(\cdot)$ as the expectations operator conditional on information up to time t , $\widehat{\pi}_t \equiv \widehat{p}_t - \widehat{p}_{t-1}$ and $\widehat{\pi}_t^* \equiv \widehat{p}_t^* - \widehat{p}_{t-1}^*$ denote home and foreign inflation (quarter-over-quarter changes in the price index), \widehat{p}_t and \widehat{p}_t^* correspond to the domestic and foreign price indexes, and $\widehat{x}_t \equiv \left(\widehat{y}_t - \widehat{\bar{y}}_t\right)$ and $\widehat{x}_t^* \equiv \left(\widehat{y}_t^* - \widehat{\bar{y}}_t^*\right)$ stand for the home and foreign output gaps expressed as the difference

central bank’s commitment to price stability credible.

¹⁴This model abstracts from capital accumulation considering only linear-in-labor technologies. Moreover, firms supply the home and foreign markets and set prices under local currency pricing. Deviations from purchasing power parity (PPP) still arise in the aggregate if households put a higher weight on domestic than imported varieties in their consumption basket (i.e., $0 < \xi < \frac{1}{2}$).

between their respective output and output potential.¹⁵

The natural rate of interest and the output potential for each country correspond to the real rate and output of the frictionless equilibrium absent all nominal rigidities. The home and foreign output are \widehat{y}_t and \widehat{y}_t^* , so \widehat{y}_t and \widehat{y}_t^* refer to the frictionless home and foreign output potential. The real rates in the home and foreign country, \widehat{r}_t and \widehat{r}_t^* respectively, are defined by Fisher's equation as:

$$\widehat{i}_t \approx \widehat{r}_t + \mathbb{E}_t(\widehat{\pi}_{t+1}), \quad (2)$$

$$\widehat{i}_t^* \approx \widehat{r}_t^* + \mathbb{E}_t(\widehat{\pi}_{t+1}^*), \quad (3)$$

with \widehat{i}_t and \widehat{i}_t^* being the home and foreign one-period nominal interest rates. We then denote the home and foreign natural rates of interest (the frictionless real rates) as \widehat{r}_t and \widehat{r}_t^* respectively.

A key takeaway from the frictionless allocation is that the natural rates respond to expected changes in both home and foreign output potential growth. The output potential equations show that potential growth itself is a convex combination of the growth of home and foreign productivity. Hence, neither the monetary policy framework nor any shock other than the productivity shocks (which excludes the monetary policy shocks too) ought to have any effect over the frictionless allocation.¹⁶

We also introduce a pair of auxiliary equations—derived by arbitrage—which relate yields at different maturities to the policy path for the short-term interest rate (e.g., [Campbell and Shiller \(1987\)](#), [Campbell and Shiller \(1991\)](#), [Hall et al. \(1992\)](#), and [Campbell \(1995\)](#)) and are commonly referred as the expectations hypothesis of the term structure of interest rates:

$$\widehat{i}_{n,t} \equiv \frac{1}{n} \sum_{j=1}^n \mathbb{E}_t(\widehat{i}_{t+j-1}), \quad (4)$$

$$\widehat{i}_{n,t}^* \equiv \frac{1}{n} \sum_{j=1}^n \mathbb{E}_t(\widehat{i}_{t+j-1}^*), \quad (5)$$

where $\widehat{i}_{n,t}$ and $\widehat{i}_{n,t}^*$ are the nominal yield of an n -quarter pure discount bond issued in the

¹⁵We should point out that the model makes no distinction between the consumption price index, CPI, or the personal consumption expenditures, PCE, deflator. Therefore, we can interpret the price indexes \widehat{p}_t and \widehat{p}_t^* as either CPI or PCE indexes.

¹⁶The New Keynesian natural rate concept traces its origins back to the work of [Wicksell \(1898\)](#) if not to earlier contributions (see, e.g., [Niehans \(1987\)](#)).

home and foreign country respectively that are bought at time t and mature after n -quarters.

Table 1 - Log-Linearized Equilibrium Conditions of the Workhorse Model	
<i>Home Country</i>	
Phillips Curve	$\widehat{\pi}_t \approx \beta \mathbb{E}_t (\widehat{\pi}_{t+1}) + \left(\frac{(1-\alpha)(1-\beta\alpha)(\varphi+\gamma)}{\alpha} \right) [\kappa \widehat{x}_t + (1-\kappa) \widehat{x}_t^* + (1-\xi) \widehat{u}_t + \xi \widehat{u}_t^*],$ $\kappa \equiv (1-\xi) \left[1 - (\sigma\gamma - 1) \left(\frac{\gamma}{\varphi+\gamma} \right) \left(\frac{(2\xi)(1-2\xi)}{1+(\sigma\gamma-1)(2\xi)(2(1-\xi))} \right) \right] > 0,$
IS Equation	$\widehat{x}_t \approx \mathbb{E}_t [\widehat{x}_{t+1}] + \gamma^{-1} \left[\Omega (\widehat{r}_t - \widehat{r}_t) + (1-\Omega) (\widehat{r}_t^* - \widehat{r}_t^*) \right],$ $\Omega \equiv (1-\xi) \left(\frac{1-2\xi(1-\sigma\gamma)}{1-2\xi} \right) > 0,$
Real Rate	$\widehat{r}_t \approx \widehat{i}_t - \mathbb{E}_t [\widehat{\pi}_{t+1}],$
Output	$\widehat{y}_t \equiv \widehat{y}_t + \widehat{x}_t,$
Natural Rate	$\widehat{r}_t \approx \gamma \left[\Theta \left(\mathbb{E}_t [\widehat{y}_{t+1}] - \widehat{y}_t \right) + (1-\Theta) \left(\mathbb{E}_t [\widehat{y}_{t+1}^*] - \widehat{y}_t^* \right) \right],$ $\Theta \equiv (1-\xi) \left(\frac{1+(\sigma\gamma-1)(2\xi)}{1+(\sigma\gamma-1)(2\xi)(2(1-\xi))} \right) > 0,$
Potential Output	$\widehat{y}_t \approx \left(\frac{1+\varphi}{\gamma+\varphi} \right) [\Lambda \widehat{a}_t + (1-\Lambda) \widehat{a}_t^*],$ $\Lambda \equiv 1 + \frac{1}{2} \left(\frac{\left(\frac{\gamma}{\varphi+\gamma} \right) (\sigma\gamma-1)(2\xi)(2(1-\xi))}{1+\left(1-\frac{\gamma}{\varphi+\gamma}\right) (\sigma\gamma-1)(2\xi)(2(1-\xi))} \right) > 0.$
<i>Rest of the World</i>	
Phillips Curve	$\widehat{\pi}_t^* \approx \beta \mathbb{E}_t (\widehat{\pi}_{t+1}^*) + \left(\frac{(1-\alpha)(1-\beta\alpha)(\varphi+\gamma)}{\alpha} \right) [(1-\kappa) \widehat{x}_t + \kappa \widehat{x}_t^* + \xi \widehat{u}_t + (1-\xi) \widehat{u}_t^*],$ $\kappa \equiv (1-\xi) \left[1 - (\sigma\gamma - 1) \left(\frac{\gamma}{\varphi+\gamma} \right) \left(\frac{(2\xi)(1-2\xi)}{1+(\sigma\gamma-1)(2\xi)(2(1-\xi))} \right) \right] > 0,$
IS Equation	$\widehat{x}_t^* \approx \mathbb{E}_t [\widehat{x}_{t+1}^*] + \gamma^{-1} \left[(1-\Omega) (\widehat{r}_t - \widehat{r}_t) + \Omega (\widehat{r}_t^* - \widehat{r}_t^*) \right],$ $\Omega \equiv (1-\xi) \left(\frac{1-2\xi(1-\sigma\gamma)}{1-2\xi} \right) > 0,$
Real Rate	$\widehat{r}_t^* \approx \widehat{i}_t^* - \mathbb{E}_t [\widehat{\pi}_{t+1}^*],$
Output	$\widehat{y}_t^* \equiv \widehat{y}_t^* + \widehat{x}_t^*,$
Natural Rate	$\widehat{r}_t^* \approx \gamma \left[(1-\Theta) \left(\mathbb{E}_t [\widehat{y}_{t+1}] - \widehat{y}_t \right) + \Theta \left(\mathbb{E}_t [\widehat{y}_{t+1}^*] - \widehat{y}_t^* \right) \right],$ $\Theta \equiv (1-\xi) \left(\frac{1+(\sigma\gamma-1)(2\xi)}{1+(\sigma\gamma-1)(2\xi)(2(1-\xi))} \right) > 0,$
Potential Output	$\widehat{y}_t^* \approx \left(\frac{1+\varphi}{\gamma+\varphi} \right) [(1-\Lambda) \widehat{a}_t + \Lambda \widehat{a}_t^*],$ $\Lambda \equiv 1 + \frac{1}{2} \left(\frac{\left(\frac{\gamma}{\varphi+\gamma} \right) (\sigma\gamma-1)(2\xi)(2(1-\xi))}{1+\left(1-\frac{\gamma}{\varphi+\gamma}\right) (\sigma\gamma-1)(2\xi)(2(1-\xi))} \right) > 0.$

Table 2 - Exogenous (Non-Monetary) Shock Processes

Productivity	$\begin{pmatrix} \hat{a}_t \\ \hat{a}_t^* \end{pmatrix}$	\approx	$\begin{pmatrix} \delta_a & \delta_{a,a^*} \\ \delta_{a,a^*} & \delta_a \end{pmatrix}$	$\begin{pmatrix} \hat{a}_{t-1} \\ \hat{a}_{t-1}^* \end{pmatrix}$	$+$	$\begin{pmatrix} \hat{\varepsilon}_t^a \\ \hat{\varepsilon}_t^{a^*} \end{pmatrix}$		
	$\begin{pmatrix} \hat{\varepsilon}_t^a \\ \hat{\varepsilon}_t^{a^*} \end{pmatrix}$	$\sim N$	$\begin{pmatrix} 0 \\ 0 \end{pmatrix}$	$\begin{pmatrix} \sigma_a^2 & \rho_{a,a^*}\sigma_a\sigma_{a^*} \\ \rho_{a,a^*}\sigma_a\sigma_{a^*} & \sigma_{a^*}^2 \end{pmatrix}$				
Cost-Push	$\begin{pmatrix} \hat{u}_t \\ \hat{u}_t^* \end{pmatrix}$	\approx	$\begin{pmatrix} \delta_u & 0 \\ 0 & \delta_u \end{pmatrix}$	$\begin{pmatrix} \hat{u}_{t-1} \\ \hat{u}_{t-1}^* \end{pmatrix}$	$+$	$\begin{pmatrix} \hat{\varepsilon}_t^u \\ \hat{\varepsilon}_t^{u^*} \end{pmatrix}$		
	$\begin{pmatrix} \hat{\varepsilon}_t^u \\ \hat{\varepsilon}_t^{u^*} \end{pmatrix}$	$\sim N$	$\begin{pmatrix} 0 \\ 0 \end{pmatrix}$	$\begin{pmatrix} \sigma_u^2 & \rho_{u,u^*}\sigma_u\sigma_{u^*} \\ \rho_{u,u^*}\sigma_u\sigma_{u^*} & \sigma_{u^*}^2 \end{pmatrix}$				

Naturally, it also follows that:

$$\hat{r}_{n,t} \equiv \hat{i}_{n,t} - \frac{1}{n} \sum_{j=1}^n \mathbb{E}_t(\hat{\pi}_{t+j}) \approx \frac{1}{n} \sum_{j=1}^n \mathbb{E}_t(\hat{r}_{t+j-1}), \quad (6)$$

$$\hat{r}_{n,t}^* \equiv \hat{i}_{n,t}^* - \frac{1}{n} \sum_{j=1}^n \mathbb{E}_t(\hat{\pi}_{t+j}^*) \approx \frac{1}{n} \sum_{j=1}^n \mathbb{E}_t(\hat{r}_{t+j-1}^*), \quad (7)$$

where $\hat{r}_{n,t}$ and $\hat{r}_{n,t}^*$ are the n -quarter home and foreign real yields, respectively. The auxiliary equations (4) – (7) permit us to link the short-end of the yield curve where monetary policy operates to the long-end of the yield curve affecting the economy.

We summarize the structural (non-monetary policy) shocks in Table 2. Home and foreign exogenous cost-push shocks, \hat{u}_t and \hat{u}_t^* , follow a bivariate VAR(1) process where $0 < \delta_u < 1$ is the persistence parameter, $\sigma_u, \sigma_{u^*} > 0$ are the home and foreign volatility parameters, and $0 < \rho_{u,u^*} < 1$ determines the correlation of the cost-push shock innovations across countries. These cost-push shocks can be motivated as exogenous price markups, as argued by Martínez-García (2020b).

Similarly, the home and foreign productivity shocks, \hat{a}_t and \hat{a}_t^* , also follow a bivariate VAR(1) process where $0 < \delta_a < 1$ is the persistence parameter, $\sigma_a, \sigma_{a^*} > 0$ are the home and foreign volatility parameters, and $0 < \rho_{a,a^*} < 1$ introduces a positive correlation of the productivity shock innovations across countries. This specification also permits cross-country spillovers in the stochastic process through the parameter $0 < \delta_{a,a^*} < 1$. We interpret δ_{a,a^*} as an exogenous form of cross-country technological diffusion.

The deep structural parameters of the workhorse model include the inverse of the intertemporal elasticity of substitution $\gamma > 0$, the inverse of the Frisch elasticity of labor

supply $\varphi > 0$, the intertemporal discount factor $0 < \beta < 1$, and the Calvo (1983) price stickiness parameter $0 < \alpha < 1$. As shown by Martínez-García (2019), the endogenous international propagation of this class of open-economy models depends critically on two additional structural parameters: the steady state import share parameter $0 < \xi < 1$ which measures the degree of trade openness and the elasticity of intratemporal substitution between home and foreign goods $\sigma > 0$ that underpins the trade elasticity.

3.2 Pre-FAIT Monetary Policy Framework

To complete the open-economy model, we need to add a home and a foreign Taylor (1993)-type interest rate feedback rule to the expectations difference system of equations which describes the home and foreign economies in Table 1 and Table 2 as follows:

$$\hat{r}_t \approx \widehat{\bar{r}}_t + \psi_\pi \widehat{\pi}_t^4 + \psi_x \widehat{x}_t + \widehat{m}_t + \sum_{l=1}^L \widehat{\varepsilon}_{l,t-l}^{FG}, \quad (8)$$

$$\hat{r}_t^* \approx \widehat{\bar{r}}_t^* + \psi_\pi \widehat{\pi}_t^{4,*} + \psi_x \widehat{x}_t^* + \widehat{m}_t^*. \quad (9)$$

The policy rules in (8) and (9) are expressed in log-deviations from steady state, based on the simple rule advocated by Taylor (1993) in his seminal work on the practice of U.S. monetary policy during the early days of Chairman Alan Greenspan’s tenure at the helm of the Federal Reserve (1987 – 1992). The Taylor (1993) rule—or some version of it—has been in effect the cornerstone of the strategy pursued by the Federal Reserve and by the central banks across many other countries around the world since the 1980s, aimed at securing price stability.¹⁷

With the policy rules in (8) and (9), the dual mandate goals for the home country and the rest of the world are pursued through one intermediate target in each country—the short-term home and foreign real interest rates \hat{r}_t and \hat{r}_t^* , respectively.¹⁸ The nominal policy rate is but one of a variety of instruments the central bank can use to influence the real interest

¹⁷Taylor (1993) focuses in his study on the 1987 – 1992 period. However, we argue that the beginning of Greenspan’s Chairmanship in August 1987 did not constitute a major policy break on its own. In fact, the policy rule of Taylor (1993) also appears to describe well the policy strategy during the latter part of Volcker’s Chairmanship. This is because the groundwork for the rule described by Taylor (1993) was laid out already when the Fed’s “monetarist experiment” championed by Volcker ended in October 1982. Since then, the FOMC largely abandoned the targeting of monetary aggregates and quickly adopted what is commonly known as a borrowed reserves operating procedure together with a federal funds rate targeting strategy (Thornton (2006)).

¹⁸We should note that this is in keeping with the rule envisioned by Taylor (1993) itself. A closer counterpart of Taylor (1993)’s policy rule would be:

$$\begin{aligned} \hat{i}_t &\approx \widehat{\bar{r}}_t + \widehat{\pi}_t^4 + \psi_\pi \widehat{\pi}_t^4 + \psi_x \widehat{x}_t + \widehat{m}_t, \\ \hat{i}_t^* &\approx \widehat{\bar{r}}_t^* + \widehat{\pi}_t^{4,*} + \psi_\pi \widehat{\pi}_t^{4,*} + \psi_x \widehat{x}_t^* + \widehat{m}_t^*, \end{aligned}$$

rate in order to achieve macroeconomic stability by tracking the frictionless allocation (that is, seeking stable prices and output at potential). As noted by [Martínez-García \(2021\)](#), describing policy rules in terms of the real rate (intermediate target) helps bypass many of the complications that arise from the nonlinearity of the ZLB constraint on the nominal policy rate instrument.¹⁹

The parameters $\psi_\pi > 0$ and $\psi_x \geq 0$ determine the strength of each central bank's response to its (*de iure* or *de facto*) dual mandate on local inflation fluctuations and the local output gap, respectively. This specification captures a flexible implementation of an inflation targeting strategy whenever $\psi_x > 0$ because that implies policymakers are not solely focused on price stability, but must balance price stability and real economic activity considerations over the short-run. In [Taylor \(1993\)](#), these parameters are set to be $\psi_\pi = 0.5$ and $\psi_x = 0.5$ implying a flexible strategy implementation that puts equal weight on both dual mandate objectives.

The [Taylor \(1993\)](#) rules in (8) and (9) also imply that monetary policy responds to local economic conditions alone. Hence, monetary policy reacts to developments abroad only to the extent that those shocks impact local conditions. As in [Taylor \(1993\)](#), fluctuations in the cyclical inflation rate are measured with the year-over-year growth rate of the price index for consumption goods (or, in Fed's parlour, the annual change in the price index). That is, the home policy rule reacts to $\hat{\pi}_t^4 \equiv \frac{1}{4} \sum_{j=0}^3 4\hat{\pi}_{t-j} = \hat{p}_t - \hat{p}_{t-4}$ where $4\hat{\pi}_{t-j}$ is the annualized home quarter-over-quarter inflation rate for $j = 0, \dots, 3$, while the foreign policy rule responds to $\hat{\pi}_t^{4,*} \equiv \frac{1}{4} \sum_{j=0}^3 4\hat{\pi}_{t-j}^* = \hat{p}_t^* - \hat{p}_{t-4}^*$ where $4\hat{\pi}_{t-j}^*$ is the annualized foreign quarter-over-quarter inflation rate for $j = 0, \dots, 3$. In turn, output deviations from target are identified with an output gap measure—that is, with \hat{x}_t in the home country and \hat{x}_t^* in the foreign country—whereby the central bank's output target is equated to the local economy's output potential—that is, the output achievable absent all nominal rigidities—rather than its trend level as in the original [Taylor \(1993\)](#) rule.

A neutral monetary policy stance requires cyclical inflation to be at zero on average over the past four quarters and output to equate its potential. While [Taylor \(1993\)](#) envisioned the

where \hat{i}_t and \hat{i}_t^* are the home and foreign short-term nominal interest rates. In describing this type of policy rule, [Taylor \(1993\)](#) writes in page 202: "Using the inflation rate over the previous four quarters on the right-hand side (...) indicates that the interest-rate policy rule is written in 'real' terms with the lagged inflation rate serving as a proxy for the expected inflation [that is, $\mathbb{E}_t(\hat{\pi}_{t+1})$ and $\mathbb{E}_t(\hat{\pi}_{t+1}^*)$, respectively]." If we replace the inflation rate on the right-hand side of each of the policy rules above with the inflation expectations it is intended to proxy for, the resulting interest rate feedback rules can be expressed as in (8) and (9).

¹⁹More so because the mix of policy instruments can vary over time and whenever the ZLB constraint is itself binding or non-binding.

real rate settling at its steady state when achieving a neutral stance, the monetary policy specification in (8) and (9) tracks instead the local short-term natural rate—that is, the local short-term real rate achievable absent all nominal rigidities. This is more consistent conceptually with the dual mandate objectives of both central banks each of which aims to support the frictionless allocation in its respective country. In other words, we adopt the view that short-term real rates must align with their short-term natural rates whenever the home and foreign central banks aim to bring their local output closer to their potential while keeping local prices stable.²⁰

The monetary policy rules in (8) and (9) also include home and foreign unanticipated (surprise) monetary policy shocks, \widehat{m}_t and \widehat{m}_t^* , under the following bivariate VAR(1) stochastic process:

$$\begin{pmatrix} \widehat{m}_t \\ \widehat{m}_t^* \\ \widehat{\varepsilon}_t^m \\ \widehat{\varepsilon}_t^{m*} \end{pmatrix} \approx \begin{pmatrix} \delta_m & 0 \\ 0 & \delta_m \end{pmatrix} \begin{pmatrix} \widehat{m}_{t-1} \\ \widehat{m}_{t-1}^* \end{pmatrix} + \begin{pmatrix} \widehat{\varepsilon}_t^m \\ \widehat{\varepsilon}_t^{m*} \end{pmatrix}, \quad (10)$$

$$\begin{pmatrix} \widehat{\varepsilon}_t^m \\ \widehat{\varepsilon}_t^{m*} \end{pmatrix} \sim N \left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_m^2 & \rho_{m,m^*} \sigma_m \sigma_{m^*} \\ \rho_{m,m^*} \sigma_m \sigma_{m^*} & \sigma_{m^*}^2 \end{pmatrix} \right),$$

which introduces exogenous persistence through the parameter $0 < \delta_m < 1$, volatility through the home and foreign parameters $\sigma_m, \sigma_{m^*} > 0$, and correlation of the shock innovations through the parameter $0 < \rho_{m,m^*} < 1$. Hence, here we introduce persistence through the unanticipated monetary policy shocks themselves—a form of exogenous inertia in the policy rule consistent with the yield-curve evidence documented in [Rudebusch \(2006\)](#).

Following [Laséen and Svensson \(2011\)](#) and [Del Negro et al. \(2012\)](#), we incorporate forward guidance (news) shocks, $\widehat{\varepsilon}_{l,t-l}^{FG}$ for all $l = 1, \dots, L$, in the monetary policy rule (8) of the home country in order to better capture the role that the Fed's communication strategy plays in shaping the future path of its intermediate policy target (the U.S. real rate).²¹ Home

²⁰Our specification of the policy rule can be interpreted as a short-run version of [Taylor \(1993\)](#)'s seminal rule. After all, over the long-run the natural rate in this model must converge to the steady state real rate and output potential—detrended to stationarize the series—must also be equal to its steady state. Hence, [Taylor \(1993\)](#)'s rule simply defines a neutral monetary policy stance over the long-run as consistent with cyclical inflation averaging zero over the past four quarters and output growing at its long-run trend. Notice that since all prices can be adjusted over long periods of time, monetary policy is neutral over the long-run and, therefore, the output long-run trend and potential long-run trend ought to be the same in the setup of our model.

²¹We model forward guidance shocks in the spirit of the "news" or anticipated shocks of [Schmitt-Grohé and Uribe \(2012\)](#).

forward guidance shocks are assumed to be purely uncorrelated and transitory or *i.i.d.*, i.e.,

$$\widehat{\varepsilon}_{l,t-l}^{FG} \stackrel{iid}{\sim} N\left(0, \sigma_l^{2,FG}\right), \quad \forall l = 1, \dots, L. \quad (11)$$

Each $\widehat{\varepsilon}_{l,t-l}^{FG}$ represents anticipated shocks about the home real rate that private agents receive in period $t - l$ but do not materialize until l periods later at time t . The maximum length of the forward guidance horizon is defined by $1 \leq L < +\infty$ implying that there is a finite number of L forward guidance shocks in the summation term in equation (8) which, in practice, we constraint to be 12 quarters. The volatility of the anticipated forward guidance shocks is given by $\sigma_l^{2,FG} > 0$ for all $l = 1, \dots, L$, respectively. The innovations of anticipated forward guidance and unanticipated monetary policy shocks are uncorrelated with each other and with all other shocks and at all leads and lags.

The following recursive representation describes the home forward guidance (news) shocks on the home policy rule:

$$\widehat{v}_{1,t} = \widehat{v}_{2,t-1} + \widehat{\varepsilon}_{1,t}^{FG}, \quad (12)$$

$$\widehat{v}_{2,t} = \widehat{v}_{3,t-1} + \widehat{\varepsilon}_{2,t}^{FG}, \quad (13)$$

\vdots

$$\widehat{v}_{L,t} = \widehat{\varepsilon}_{L,t}^{FG}. \quad (14)$$

Each component of the vector $\widehat{v}_t = [\widehat{v}_{1,t}, \widehat{v}_{2,t}, \dots, \widehat{v}_{L,t}]^T$ represents all past and present central bank announcements shifting the real interest rate path 1, 2, \dots , L periods later which private agents receive at time t . In addition, we define $\widehat{\varepsilon}_t^{FG} = [\widehat{\varepsilon}_{1,t}^{FG}, \widehat{\varepsilon}_{2,t}^{FG}, \dots, \widehat{\varepsilon}_{L,t}^{FG}]^T$ as the vector containing all current-period forward guidance shock innovations known today which will affect the monetary policy rule 1, 2, \dots , L periods later. Equations (12) – (14) permit us to re-write (8) more compactly as:

$$\widehat{r}_t \approx \widehat{r}_t + \psi_\pi \widehat{\pi}_t^A + \psi_x \widehat{x}_t + \widehat{m}_t + \widehat{v}_{1,t-1}, \quad (15)$$

as $\widehat{v}_{1,t-1}$ is equal to the summation of all anticipated monetary policy shocks realized at time t , that is $\widehat{v}_{1,t-1} = \sum_{l=1}^L \widehat{\varepsilon}_{l,t-l}^{FG}$.

Forward guidance shocks of this sort can be interpreted as the reduced-form means by which the home central bank communicates (announces) the time-contingent path of future policy rates.²² We assume that rest of the world monetary policy shocks are purely unan-

²²Monetary policy in the home country (which we identify with the U.S. in our empirical analysis) has

anticipated for private agents as the practice of forward guidance has been more localized and occasional outside the U.S.

3.3 Alternative Monetary Policy Strategies

To explore the cyclical implications that adopting FAIT could have for the U.S. economy, we estimate the model under the benchmark home and foreign policy rules given by (15) and (9), respectively. Then we conduct a series of counterfactual exercises where we replace (15) with an alternative representation of the home policy rule more in line with the features of the new FAIT strategy while keeping the foreign rule in (9) and the expectations difference system of equations which describes the home and foreign economies (Table 1 and Table 2) otherwise unchanged.

For our counterfactual analysis, we consider two basic alternatives that merely replace the year-over-year inflation rate, $\hat{\pi}_t^4$, in the home policy rule (15) with either a simple moving average (henceforth, SMA) or an exponentially weighted moving average (henceforth, EWMA) over different time lengths. This is the smallest departure possible consistent with the qualitative features of the FAIT strategy announced by Fed Chairman Powell in August 2020. This is because we retain a flexible strategy with the policy weights on the dual mandate goals unchanged and we retain the inherent symmetry of the home Taylor (1993)-type rule that described policy pre-FAIT. In other words, the only break from the pre-FAIT policy rule (15) is that we re-define its price stability objective. Under our alternative specifications based on FAIT, policy is allowed to respond to past inflation misses over a longer time window and also put different weights on past misses over time.

Although the Federal Reserve did not adopt a formal average inflation measure to target, in all our counterfactuals we simply assume that private agents either "discover" or "receive" enough additional communication to infer the average inflation measure favored by the policymakers. We abstract here from the learning mechanisms that would have led them to that conclusion. We also abstract from the possibility that this lack of a formal average measure could introduce uncertainty; or, worse, that this could lead private agents to believe that

used balance sheet policies as well as forward guidance. We have explicitly modeled forward guidance in (15), but implicitly we assume that these news shocks also capture the effects of balance sheet actions. This is because balance sheet policies are thought to be effective primarily through a signaling mechanism—that is, the effect of balance sheet actions comes from the support these policies provide to the expected policy path announced by the central bank by either complementing the forward guidance announcements or tying the hands of policymakers to follow a certain future path. Other channels through which balance sheet policies can have an impact like, for example, by lowering the risk premium on long-term yields can be implicitly integrated in our model as well by employing long yields among the observables, using the auxiliary equations (4) – (7).

there was no strong commitment to a particular average measure and that the introduction of "average inflation" language was instead meant to open up more room for discretionary policy.

We refer to the first average inflation specification we propose here as a simple moving average FAIT (or SMA-FAIT) which can be described as follows:

$$\text{SMA-FAIT} : \widehat{r}_t \approx \widehat{r}_t + \psi_\pi \widehat{\pi}_t^k + \psi_x \widehat{x}_t + \widehat{m}_t + \widehat{v}_{1,t-1}, \quad (16)$$

where:

$$\widehat{\pi}_t^k \equiv \frac{1}{k} \sum_{j=0}^{k-1} 4\widehat{\pi}_{t-j} = \widehat{\pi}_{t-1}^k + \frac{1}{k} (4\widehat{\pi}_t - 4\widehat{\pi}_{t-k}). \quad (17)$$

Here, $\widehat{\pi}_t^k$ refers to the annualized quarter-over-quarter inflation whenever $k = 1$, the past year average of the annualized quarter-over-quarter inflation rates whenever $k = 4$ and, analogously, the past two-year and five-year averages of the annualized quarter-over-quarter inflation rates whenever $k = 8$ and $k = 20$, respectively.

We note from equations (16) and (17) that imposing SMA-FAIT with $k = 4$ corresponds exactly to the pre-FAIT policy rule in (15), so we can argue that the Fed's policy rule was already pursuing a form of FAIT even before August 2020. We argue also that the pre-FAIT policy rule was not a form of flexible inflation targeting (henceforth, FIT) as that strategy implies that a central bank seeking price stability ought to respond only to current cyclical inflation deviations letting bygones be bygones rather than taking into consideration any past inflation misses. That was not the case pre-FAIT as the Federal Reserve had traditionally preferred to gauge inflation through the year-over-year inflation rate (which is approximated here by SMA-FAIT with $k = 4$). The closest a Taylor (1993)-type rule comes to implement a pure form of FIT is when SMA-FAIT assumes $k = 1$ as then monetary policy responds solely to current cyclical inflation fluctuations without any regard for past inflation realizations.

The second inflation average specification is referred to as an exponentially weighted moving average FAIT (or EWMA-FAIT) and can be described as follows:

$$\text{EWMA-FAIT} : \widehat{r}_t \approx \widehat{r}_t + \psi_\pi \widehat{\pi}_t^{\theta_k} + \psi_x \widehat{x}_t + \widehat{m}_t + \widehat{v}_{1,t-1}, \quad (18)$$

where:

$$\widehat{\pi}_t^{\theta_k} \equiv (1 - \theta_k) 4\widehat{\pi}_t + \theta_k \widehat{\pi}_{t-1}^{\theta_k}, \quad (19)$$

for some period of reference k and a consistent weighting parameter $\theta_k \equiv 1 - \frac{2}{k+1} = \frac{k-1}{k+1}$ which

satisfies that $0 \leq \theta_k \leq 1$.²³ Whenever $\theta_k = 0$ as $k = 1$, the formula implies that monetary policy reduces to targeting deviations on the annualized quarter-over-quarter inflation rate $4\hat{\pi}_t$. This is also the case under SMA-FAIT if $k = 1$, so EWMA-FAIT with $k = 1$ also corresponds to the purest form of a FIT rule. Whenever $0 < \theta_k \leq 1$, the exponentially weighted moving average given by (19) puts more weight on recent cyclical inflation deviations and less on past misses.

For consistency with the SMA-FAIT variants we consider, we explore EWMA-FAIT under $k = 4$ where most of the weight is assigned to the first four quarters (1 year) and in that way comes closest to the benchmark inflation measure in (15), under $k = 8$ as it puts most of the weight over the first eight quarters (2 years), and under $k = 20$ where most of the weight is assigned to the first twenty quarters (5 years).

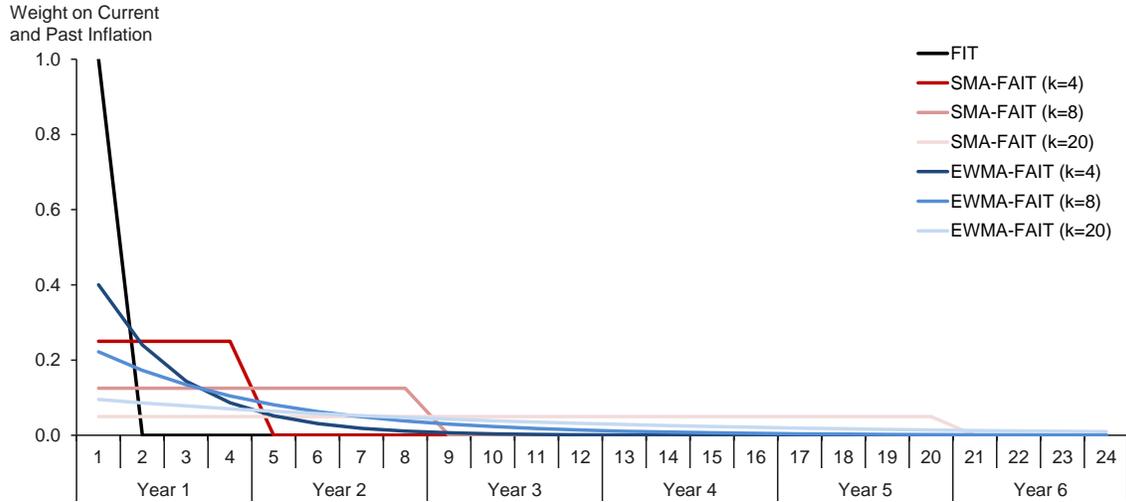
We should highlight that monetary policy under SMA-FAIT and EWMA-FAIT puts different emphasis on past deviations depending on how far they have occurred in the past and how those past misses are weighted. The top panel of Figure 3 illustrates how all possible implementations of SMA-FAIT, EWMA-FAIT, and even FIT weight past inflation misses. As can be inferred from the illustration, EWMA-FAIT has a longer memory but the significance of past policy mistakes declines more quickly than under the corresponding SMA-FAIT specification. So, even for the periods for which the EWMA-FAIT implementation most overlaps with the SMA-FAIT implementation, EWMA-FAIT assigns higher values to the more recent inflation misses and lower values to the older inflation deviations than SMA-FAIT does.

All the average inflation measures for monetary policy are plotted in the bottom panel in Figure 3. Each moving average inflation measure under SMA-FAIT or EWMA-FAIT is reported at quarterly frequency, expressed in percentage terms, and annualized. In practice, the differences between the alternative moving average measures over the full sample period from 1984:Q1 until 2021:Q4 are often fairly small. Significant differences arise by expanding the window over which the Federal Reserve puts some significant weight on past inflation misses beyond two years, but also from shortening the window to the FIT case (that is, the FAIT-SMA ($k = 1$) case or equivalently the FAIT-EWMA ($k = 1$) case).

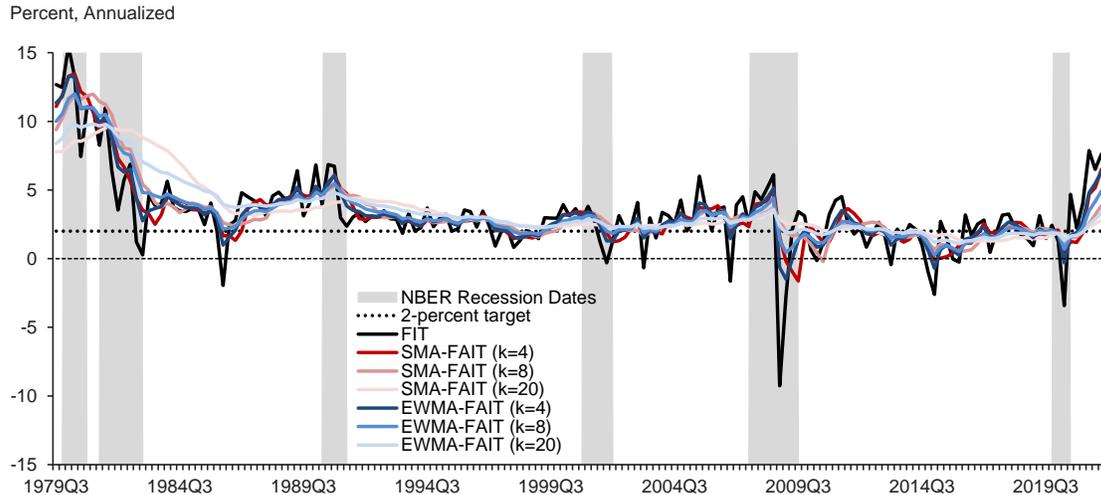
²³The formula in (19) can also be expressed showing how $\hat{\pi}_t$ adjusts according to the last data point, but only by a proportion of the difference each period such that:

$$\hat{\pi}_t^{\theta_k} - \hat{\pi}_{t-1}^{\theta_k} = (1 - \theta_k) \left(4\hat{\pi}_t - \hat{\pi}_{t-1}^{\theta_k} \right). \quad (20)$$

Figure 3. U.S. Inflation Under Alternative FAIT Strategies
(Alternative Weighting Schemes)



(Alternative Average Inflation Measures)



Note: FIT refers to the inflation measure favored under flexible inflation targeting while FAIT refers to the corresponding inflation measure under flexible average inflation targeting. SMA indicates that the inflation measure is constructed with a simple moving average of either 4, 8, or 20 quarters while EWMA indicates an exponentially weighted moving average that puts most of its weight on either the first 4, 8, or 20 quarters. For practical purposes, we truncate the weights for the EWMA-based inflation measures after 122 quarters (or 30.5 years) in the calculations shown in the bottom panel. All inflation measures are calculated using the headline CPI. Cyclical inflation refers to the difference between the corresponding CPI inflation indicator and the U.S. long-term CPI inflation expectations from [Aspen Publishers \(2022\)](#).

Sources: [Aspen Publishers \(2022\)](#); [CBO \(2022\)](#); NBER; and authors' calculations.

We find that average inflation measures that are close to SMA-FAIT ($k = 4$) give an inflation signal quite close to that of the pre-FAIT preferred year-over-year inflation rate so long as inflation fluctuations themselves are not too large. The differences across average inflation measures can be sizeable when considering only inflation misses one or two years back if those periods happen to correspond with times where inflation deviations from their long-run have been quite large—for example, during the high inflation of the 1970s and early 1980s or, more recently, during the inflation burst after the COVID pandemic. This suggests that the horizon over which past misses are taken under consideration and the magnitude of inflation fluctuations are important to determine how much of an impact the break from the pre-FAIT regime could have on the dynamics of the U.S. economy.

This, in fact, already foreshadows our main insight on this paper. It stands to reason that if implementing FAIT leads the Federal Reserve to focus on inflation misses over longer periods but those alternative average measures turn out to be very close to the Fed’s pre-FAIT inflation measure, then the resulting monetary policy actions and outcomes would likely be similar under both the pre-FAIT and the new FAIT regimes. Hence, arguably, we should not expect this change to result in very large macro differences in observed inflation and economic activity levels.

The adoption of FAIT and its success will hinge primarily on whether it successfully sustains the anchor of inflation expectations around the Federal Reserve’s desired 2% target. The cyclical costs of this are likely limited, unless the new FAIT regime introduces other major changes such as a different weighting of the dual mandate objectives (presumably putting higher emphasis on economic activity at the expense of inflation), greater reliance on discretionary policy actions weakening the perceived systematic part of the rule, or perhaps even a shift towards a more passive monetary policy and greater fiscal dominance. In the remainder of the paper, we set those issues aside to explore only the cyclical impact of FAIT through the lens of the open-economy workhorse model presented earlier in this section.

4 Methodological Approach

We adopt the log-linear equilibrium conditions in [Table 1](#) and all the auxiliary equations of the workhorse open-economy New Keynesian model described in [Section 3](#). The forcing processes are the cost-push shocks and the productivity shocks in [Table 2](#) together with the unanticipated monetary policy shock process in [\(10\)](#). We also introduce home forward guidance shocks recursively as in equations [\(12\) – \(14\)](#). We then replace the definitions of

the natural rates of interest (\widehat{r}_t and \widehat{r}_t^*) and potential output (\widehat{y}_t and \widehat{y}_t^*) of both countries into the equilibrium relationships in [Table 1](#) in order to re-express them in terms of the home and foreign productivity shocks (\widehat{a}_t and \widehat{a}_t^*). The resulting system of equations characterizes the dynamics of quarter-over-quarter inflation in both countries, $\widehat{\pi}_t$ and $\widehat{\pi}_t^*$, as well as the home and foreign growth rates given by $\Delta\widehat{y}_t \equiv \widehat{y}_t - \widehat{y}_{t-1}$ and $\Delta\widehat{y}_t^* \equiv \widehat{y}_t^* - \widehat{y}_{t-1}^*$, respectively.

We use the foreign Fisher equation relationship in [\(3\)](#) to replace \widehat{r}_t^* with $\widehat{i}_t^* - \mathbb{E}_t(\widehat{\pi}_{t+1}^*)$. We do this because, while the endogenous real short-term interest rate can be easily mapped to observable survey-based measures of the U.S. real 3-month interest rate, there is no readily available measure of the rest-of-the-world real rate that can be observed and used in our estimation. In turn, the short-term nominal policy rate for the rest of the world is observable and well above zero within our sample period. Given that, we argue that estimating the model using the observed path of this foreign policy instrument—the nominal policy rate \widehat{i}_t^* —is without great loss of generality and suffices to describe the tone of monetary policy in the rest of the world.²⁴

To estimate the richer monetary policy specification of the home country, we look not just at survey-based measures of the home real interest rate, \widehat{r}_t , but also at the realized short-term nominal rate, \widehat{i}_t , using the home Fisher equation relationship in [\(2\)](#). Furthermore, we also use survey-based measures of the expected path up to four quarters into the future for the home short-term nominal rate, $\left\{ \mathbb{E}_t(\widehat{i}_{t+j}) \right\}_{j=1}^4$, and for the home real interest rate, $\left\{ \mathbb{E}_t(\widehat{r}_{t+j}) \right\}_{j=1}^4$. Additionally, we also include data on the 10-year nominal and real yields for the home country, $\widehat{i}_{n,t}$ and $\widehat{r}_{n,t}$ for $n = 40$ quarters, in order to pin down the long-end of the policy path in the home country (the U.S.). The policy path over a long period of 10 years is tied to those long-term yields with the expectations hypothesis equations in [\(4\)](#) and [\(6\)](#).

Using survey-based expectations as observables follows in the footsteps of [Martínez-García et al. \(2021\)](#) which requires the model predictions to be consistent with the private agents’ understanding of the expected policy path. We additionally require—albeit implicitly—that the model must also be consistent with the private agents’ future inflation expectations since we require not just expected real rates but also expected nominal rates to align with the survey-based projections. Furthermore, as noted earlier, the empirical strategy that we follow here also exploits the information content that the long-end of the yield

²⁴We abstract from the ZLB constraint for the rest-of-the-world policy instrument as not only the constraint is non-binding at all times, but also the foreign policy path is so far away from the ZLB during our sample period that the odds of the rest-of-the-world policy instrument getting stuck at zero at any point in time were likely negligible. Therefore, the ZLB constraint is in practice of second-order importance for the aggregate rest-of-the-world block in our model, even though for some of the countries bundled together within this aggregate, policy rates indeed fell to zero.

curve contains about the policy path over long horizons.

We summarize the vector of 17 endogenous variables that will be matched to observables as $\widehat{Z}_t = \left(\widehat{\pi}_t, \widehat{\pi}_t^*, \Delta \widehat{y}_t, \Delta \widehat{y}_t^*, \widehat{i}_t, \widehat{i}_t^*, \left\{ \mathbb{E}_t \left(\widehat{i}_{t+j} \right) \right\}_{j=1}^4, \widehat{r}_t, \left\{ \mathbb{E}_t \left(\widehat{r}_{t+j} \right) \right\}_{j=1}^4, \widehat{i}_{40,t}, \widehat{r}_{40,t} \right)^T$. The vector of 18 structural shock innovations $\widehat{\varepsilon}_t$ includes $\widehat{\varepsilon}_t = \left(\widehat{\varepsilon}_t^u, \widehat{\varepsilon}_t^{u*}, \widehat{\varepsilon}_t^a, \widehat{\varepsilon}_t^{a*}, \widehat{\varepsilon}_t^m, \widehat{\varepsilon}_t^{m*}, \left\{ \widehat{\varepsilon}_{t-l}^{FG} \right\}_{l=1}^{12} \right)^T$. Given the recursive nature of the forward guidance shocks given by (12) – (14), at any given point in time there is just one related state variable that captures the role played by news shocks (lagged one quarter), $\widehat{v}_{1,t-1}$. Hence, although there are 12 forward guidance shock innovations hitting the economy today, they will not influence monetary policy actions until next quarter or later. In order to recover the vector of structural shock innovations $\widehat{\varepsilon}_t$ from the vector of observable endogenous variables in \widehat{Z}_t , we then must augment the contemporaneous shocks.

We do so by introducing measurement error on the survey-based observable variables $\left(\left\{ \mathbb{E}_t \left(\widehat{i}_{t+j} \right) \right\}_{j=1}^4, \widehat{r}_t, \left\{ \mathbb{E}_t \left(\widehat{r}_{t+j} \right) \right\}_{j=1}^4 \right)^T$ and a mixture of exogenous risk-premium and measurement error on the long-term yield variables $\left(\widehat{i}_{40,t}, \widehat{r}_{40,t} \right)^T$. For that, we posit the following 11 auxiliary equations to be added to the estimated version of the workhorse open-economy model:

$$\widehat{r}_t \approx \widehat{i}_t - \mathbb{E}_t^{survey} \left(\widehat{\pi}_{t+1} \right) + \widehat{o}_t^0, \quad (21)$$

$$\mathbb{E}_t \left(\widehat{r}_{t+h} \right) \approx \mathbb{E}_t^{survey} \left(\widehat{i}_{t+h} \right) - \mathbb{E}_t^{survey} \left(\widehat{\pi}_{t+h+1} \right) + \widehat{o}_t^h, \quad \forall h = 1, \dots, 4, \quad (22)$$

$$\widehat{i}_{40,t} \approx \widehat{i}_{40,t}^{obs} + \widehat{o}_t^5, \quad (23)$$

$$\mathbb{E}_t \left(\widehat{i}_{t+h} \right) \approx \mathbb{E}_t^{survey} \left(\widehat{i}_{t+h} \right) + \widehat{o}_t^{5+h}, \quad \forall h = 1, \dots, 4, \quad (24)$$

$$\widehat{r}_{40,t} \approx \widehat{i}_{40,t}^{obs} - \frac{1}{40} \sum_{j=1}^{40} \mathbb{E}_t^{survey} \left(\widehat{\pi}_{t+j} \right) + \widehat{o}_t^{10}, \quad (25)$$

where the superscript *survey* indicates that the variables or forecasts on the right-hand side are derived from survey-based data and, therefore, subject to measurement error. Similarly, the superscript *obs* means the variable is observed but in this case may contain a risk premium that we need to isolate as it is not explicitly accounted for in the model. The added shock innovations here \widehat{o}_t^h for $h = 0, \dots, 10$ are modeled as *i.i.d.*, uncorrelated Gaussian white noise, i.e.,

$$\widehat{o}_t^h \sim N \left(0, \sigma_h^2 \right), \quad \forall h = 0, \dots, 10. \quad (26)$$

The vector that collects all the measurement and risk premium shocks is denoted $\widehat{o}_t =$

$[\hat{\sigma}_t^0, \hat{\sigma}_t^1, \hat{\sigma}_t^2, \hat{\sigma}_t^3, \hat{\sigma}_t^4, \hat{\sigma}_t^5, \hat{\sigma}_t^6, \hat{\sigma}_t^7, \hat{\sigma}_t^8, \hat{\sigma}_t^9, \hat{\sigma}_t^{10}]$.

4.1 Data

All data is collected from the Congressional Budget Office ([CBO \(2022\)](#)), the Federal Reserve Bank of Dallas’ Database of Global Economic Indicators ([Grossman et al. \(2014\)](#)), and from the Blue Chip Economic Indicators survey dataset ([Aspen Publishers \(2022\)](#)) at quarterly frequency. Our dataset includes time series for the U.S. and an aggregate of its 33 major trading partners.²⁵ The rest of the world aggregate is trade-weighted as explained in [Grossman et al. \(2014\)](#).

The data goes back to the onset of the Great Moderation period in 1984:Q1 (as dated by [McConnell and Pérez-Quirós \(2000\)](#)) and ends in 2021:Q4, before the start of Russia’s invasion of Ukraine. For estimation purposes, we use the data up to 2019:Q4 excluding the COVID-19 pandemic and also the subsequent announcement by Federal Reserve Chairman Jerome Powell of a new FAIT strategy. The sample period used for our estimation, therefore, covers the entire Great Moderation period as well as the 2007 – 09 global financial crisis and its aftermath. We use the data between 2020:Q1 and 2021:Q4 for our counterfactual policy analysis as it allows us to investigate what would have happened with the inflation spike actually observed had monetary policy not adopted a new inflation average measure as its price stability target.

The U.S. macro data include:

(1) the quarter-over-quarter annualized inflation rate of the Consumer Price Index For All Urban Consumers (CPI-U): All Items (SA, 1982 – 84 = 1) ($\Delta \ln CPI_t^{U.S.}$) from the Congressional Budget Office ([CBO \(2022\)](#));

(2) the quarter-over-quarter annualized growth rate of Real Gross Domestic Product (SAAR, Mil.Chn.2012.\$) ($\Delta \ln RGDP_t^{U.S.}$) from the Congressional Budget Office ([CBO \(2022\)](#));

(3) the nominal 3–Month Treasury Bill Yield (% , per annum) ($i_t^{U.S.}$) from the Congressional Budget Office ([CBO \(2022\)](#)) and the quarterly averages of the monthly reports of the 3–Month Treasury Bill Yield Consensus Forecasts one- to four-quarters ahead (% , per annum) ($\mathbb{E}_t^{survey}(i_{t+1}^{U.S.}), \dots, \mathbb{E}_t^{survey}(i_{t+4}^{U.S.})$) from Blue Chip Economic Indicators ([Aspen Publishers \(2022\)](#));

²⁵Apart from the U.S., the other countries included in our sample are: Australia, Austria, Belgium, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Czech Republic, France, Germany, Greece, Hungary, India, Indonesia, Italy, Japan, Malaysia, Netherlands, Nigeria, Philippines, Poland, Portugal, Russia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Thailand, and the U.K.

(4) the quarterly averages of the monthly reports of the Consumer Price Index Consensus Forecasts one- to five-quarters ahead in quarter-over-quarter (annualized) percent rates ($\mathbb{E}_t^{survey} (\Delta \ln CPI_{t+1}^{U.S.}), \dots, \mathbb{E}_t^{survey} (\Delta \ln CPI_{t+5}^{U.S.})$) from Blue Chip Economic Indicators ([Aspen Publishers \(2022\)](#));

(5) the nominal 10-Year Treasury Bond Yield at constant maturity (% , per annum) ($i_{40,t}^{U.S.}$) from the Congressional Budget Office ([CBO \(2022\)](#)) together with the average expected annual inflation rate of the Consumer Price Index Consensus Forecast over 10 years ($\frac{1}{2} (\mathbb{E}_t^{survey} (\Delta^{ann} \ln CPI_{y \rightsquigarrow y+5}^{U.S.}) + \mathbb{E}_t^{survey} (\Delta^{ann} \ln CPI_{y+5 \rightsquigarrow y+10}^{U.S.}))$), where the subscript y refers to the current year and the superscript *ann* denotes annual rate, from Blue Chip Economic Indicators ([Aspen Publishers \(2022\)](#));

and (6) the 5-year expected average, 5-year forward of the annual CPI inflation rate ($\mathbb{E}_t^{survey} (\Delta^{ann} \ln CPI_{y+5 \rightsquigarrow y+10}^{U.S.})$), the 5-year expected average, 5-year forward of the annual Real GDP growth rate ($\mathbb{E}_t^{survey} (\Delta^{ann} \ln RGDP_{y+5 \rightsquigarrow y+10}^{U.S.})$), the 5-year expected average, 5-year forward of the annual 3-Month Treasury Bill Yield ($\mathbb{E}_t^{survey} (i_{y+5 \rightsquigarrow y+10}^{ann,U.S.})$), and the 5-year expected average, 5-year forward of the annual 10-Year Treasury Bond Yield ($\mathbb{E}_t^{survey} (i_{40,y+5 \rightsquigarrow y+10}^{ann,U.S.})$), where the subscript y refers to the current year and the superscript *ann* denotes annual rate, from Blue Chip Economic Indicators ([Aspen Publishers \(2022\)](#)).²⁶

The data we collect for the 33 largest trading partners of the U.S. includes:

(7) the quarter-over-quarter annualized inflation rate on headline CPI ($\Delta \ln CPI_t^{RoW}$) from the Database of Global Economic Indicators ([Grossman et al. \(2014\)](#));

(8) the quarter-over-quarter annualized growth rate of Real Gross Domestic Product ($\Delta \ln RGDP_t^{RoW}$) from the Database of Global Economic Indicators ([Grossman et al. \(2014\)](#));

and (9) the short-term nominal interest rate (% , per annum) (i_t^{RoW}) from the Database of Global Economic Indicators ([Grossman et al. \(2014\)](#)).

Mapping the endogenous variables of the workhorse open-economy New Keynesian model to the observed data requires filtering out the trend since the model describes only the cyclical behavior of the macro aggregates. Here, we proceed as in [Martínez-García \(2021\)](#) and exploit the long-range survey-based forecasts available ($\mathbb{E}_t^{survey} (\Delta^{ann} \ln CPI_{y+5 \rightsquigarrow y+10}^{U.S.})$, $\mathbb{E}_t^{survey} (\Delta^{ann} \ln RGDP_{y+5 \rightsquigarrow y+10}^{U.S.})$, $\mathbb{E}_t^{survey} (i_{y+5 \rightsquigarrow y+10}^{ann,U.S.})$, $\mathbb{E}_t^{survey} (i_{40,y+5 \rightsquigarrow y+10}^{ann,U.S.})$)^T as a proxy for the trends on inflation, real GDP growth, and the short- and long-term interest rate data.

²⁶We match the long-range forecasts from the March report with quarters Q1 and Q2 of the given year and, similarly, those of the October report with quarters Q3 and Q4.

Hence, we postulate the following set of observation equations for the U.S.:

$$\Delta \ln CPI_t^{U.S.} = \bar{\pi}_t^{\text{long-run}} + 4\hat{\pi}_t, \quad (27)$$

$$\Delta \ln RGDP_t^{U.S.} = \bar{g}_t^{\text{long-run}} + 4\Delta\hat{y}_t, \quad (28)$$

$$i_t^{U.S.} = \bar{i}_t^{\text{long-run}} + 4\hat{i}_t, \quad (29)$$

$$\mathbb{E}_t^{\text{survey}} (i_{t+h}^{U.S.}) = \bar{i}_t^{\text{long-run}} + \mathbb{E}_t (4\hat{i}_{t+h}), \quad \forall h = 1, \dots, 4, \quad (30)$$

$$i_{40,t}^{U.S.} = \bar{i}_{40,t}^{\text{long-run}} + 4\hat{i}_{40,t}, \quad (31)$$

$$i_t^{U.S.} - \mathbb{E}_t^{\text{survey}} (\Delta \ln CPI_{t+1}^{U.S.}) = r_t^{U.S.} = \bar{i}_t^{\text{long-run}} - \bar{\pi}_t^{\text{long-run}} + 4\hat{r}_t, \quad (32)$$

$$\begin{aligned} \mathbb{E}_t^{\text{survey}} (i_{t+h}^{U.S.}) - \mathbb{E}_t^{\text{survey}} (\Delta \ln CPI_{t+h+1}^{U.S.}) &= \mathbb{E}_t^{\text{survey}} (r_{t+h}^{U.S.}) \\ &= \bar{i}_t^{\text{long-run}} - \bar{\pi}_t^{\text{long-run}} + \mathbb{E}_t (4\hat{r}_{t+h}), \quad \forall h = 1, \dots, 4, \end{aligned} \quad (33)$$

$$\begin{aligned} i_{40,t}^{U.S.} - \frac{1}{2} (\mathbb{E}_t^{\text{survey}} (\Delta^{\text{ann}} \ln CPI_{y \rightsquigarrow y+5}^{U.S.}) + \mathbb{E}_t^{\text{survey}} (\Delta^{\text{ann}} \ln CPI_{y+5 \rightsquigarrow y+10}^{U.S.})) &= r_{40,t}^{U.S.} \\ &= \bar{i}_{40,t}^{\text{long-run}} - \bar{\pi}_t^{\text{long-run}} + 4\hat{r}_{40,t}, \end{aligned} \quad (34)$$

and, similarly, the following set of observation equations for the rest of the world aggregate:

$$\Delta \ln CPI_t^{\text{RoW}} = \bar{\pi}_t^{\text{long-run}^*} + 4\hat{\pi}_t^*, \quad (35)$$

$$\Delta \ln RGDP_t^{\text{RoW}} = \bar{g}_t^{\text{long-run}^*} + 4\Delta\hat{y}_t^*, \quad (36)$$

$$i_t^{\text{RoW}} = \bar{i}_t^{\text{long-run}^*} + 4\hat{i}_t^*. \quad (37)$$

The equations in (27) – (37) map the observable series to the endogenous variables characterized by the workhorse model.

Here, the trend components for expected U.S. inflation, expected U.S. real GDP growth, and expected U.S. short- and long-term interest rates are taken to be their corresponding observable survey-based long-range forecasts, i.e.,

$$\mathbb{E}_t^{\text{survey}} (\Delta \ln CPI_{y+5 \rightsquigarrow y+10}^{U.S.}) \approx \bar{\pi}_t^{\text{long-run}} \approx \bar{\pi}_t^{\text{long-run}^*}, \quad (38)$$

$$\mathbb{E}_t^{\text{survey}} (\Delta \ln RGDP_{y+5 \rightsquigarrow y+10}^{U.S.}) \approx \bar{g}_t^{\text{long-run}} \approx \bar{g}_t^{\text{long-run}^*}, \quad (39)$$

$$\mathbb{E}_t^{\text{survey}} (i_{y+5 \rightsquigarrow y+10}^{\text{ann},U.S.}) \approx \bar{i}_t^{\text{long-run}} \approx \bar{i}_t^{\text{long-run}^*}. \quad (40)$$

$$\mathbb{E}_t^{\text{survey}} (i_{40,y+5 \rightsquigarrow y+10}^{\text{ann},U.S.}) \approx \bar{i}_{40,t}^{\text{long-run}}. \quad (41)$$

Equations (38) – (41) also implicitly assume that the long-term trends are approximately equal between the home and foreign countries. This is consistent with the notion that the U.S. and the trade-weighted aggregate for the rest of the world are growing along a common

balanced growth path. Moreover, this has also the practical advantage of allowing us to proxy the unobserved foreign long-term inflation, real GDP growth and short-term nominal interest rate trends with the observed survey-based long-term forecasts of U.S. inflation, U.S. real GDP growth, and the U.S. nominal short-term interest rate.

4.2 Prior Selection

We summarize the 44 structural plus measurement and risk parameters of the model with $\lambda = \left(\beta, \gamma, \varphi, \sigma, \xi, \alpha, \psi_\pi, \psi_x; \delta_a, \delta_{a,a^*}, \sigma_a, \sigma_{a^*}, \rho_{a,a^*}, \delta_u, \sigma_u, \sigma_{u^*}, \rho_{u,u^*}, \delta_m, \sigma_m, \sigma_{m^*}, \rho_{m,m^*}, \left\{ \sigma_l^{2,FG} \right\}_{l=1}^{12} \right)^T$ and $\sigma^2 = \left(\{\sigma_h^2\}_{h=0}^{10} \right)^T$. [Table 3](#) lists the 8 structural parameters that characterize the model solution. [Table 4](#) collects the 10 parameters that describe the exogenous productivity, cost-push, and unanticipated monetary shock processes. Furthermore, [Table 4](#) also includes 12 other parameters that describe the volatility of the forward guidance (news) shocks.²⁷ Finally, [Table 5](#) contains the remaining 11 volatility parameters that describe the measurement error on the survey-based forecast data and the risk premium on the long-term yields.

Of all the model parameters, we parameterize the 8 structural parameters in [Table 3](#). The intertemporal discount factor β is set at 0.995012479 in order to attain an annualized real interest rate of about $-400 \ln(\beta) = 2$ percent in steady state. We calibrate the policy parameters ψ_π and ψ_x to be 0.5 as under the seminal policy rule proposed by [Taylor \(1993\)](#). The frequency of price adjustments is tied to the [Calvo \(1983\)](#) parameter α and for this we adopt a value of 0.75 which implies an average of one price change per year.

In regards to the structural parameters that affect the endogenous international transmission of shocks through trade: the parameter for the import share ξ is set to 0.18 to match the U.S. experience during our sample period as reported by [Martínez-García \(2018\)](#), while the trade elasticity σ takes a conventional value of 1.5 based on [Backus et al. \(1994\)](#).

Finally, we choose the intertemporal elasticity of substitution γ to equate the inverse of the Frisch elasticity of labor supply φ at 5 consistent with the estimates reported by [Martínez-García \(2021\)](#) and the prevailing calibration in the related open-economy literature (see, e.g., [Chari et al. \(2002\)](#), [Martínez-García et al. \(2012\)](#), [Martínez-García and Søndergaard \(2013\)](#), and [Martínez-García and Wynne \(2014\)](#), among others). This ensures consistency of the solution with the idea of a common balanced growth path.

²⁷Notice that not all parameters in [Table 3](#) and [Table 4](#) affect the dynamics of the frictionless allocation. Only the 5 parameters that describe the exogenous productivity shock VAR(1) process and 4 of the preference parameters (the trade elasticity σ , the import share ξ , the intertemporal elasticity of substitution γ , and the inverse of the Frisch elasticity of labor supply φ) affect the frictionless allocation.

Shock processes plus measurement error and risk parameters. All the remaining 36 parameters which describe the different shock processes that play a part in our estimated model need to be disciplined with the observed time series data—in other words, they all need to be estimated. This aims to ensure that our subsequent counterfactual and policy analysis aligns well with the observed macro data during the period from 1984:Q1 until 2019:Q4. Given that we estimate the model with Bayesian techniques, we summarize all our knowledge about the parameters to be estimated through their priors and report them in [Table 4](#) and [Table 5](#).

We set the prior means of the productivity shock parameters to align with the estimates in [Heathcote and Perri \(2002\)](#) and [Martínez-García \(2021\)](#). For that purpose, we choose a tight Beta distribution and set the prior mean of δ_a (the persistence parameter) to 0.87, the prior mean of δ_{a,a^*} (the cross-country spillover parameter) to -0.008 , and the prior mean of ρ_{a,a^*} (the correlation between domestic and foreign innovations) to 0.15. The volatility of home and foreign productivity shocks, σ_a and σ_{a^*} , are set with a tight Inverse Gamma distribution with both their prior means at 0.79. The prior standard deviation in all cases is a narrow 0.001 except for ρ_{a,a^*} for which we adopt a slightly less tight prior standard deviation of 0.01.

We choose a Beta distribution for the first-order autocorrelation of the monetary shock, δ_m , as well as for the persistence of the cost-push shock, δ_u . The priors are centered around 0.90 and 0.50, respectively, with a fairly tight prior standard deviation equal to 0.01. The prior volatilities of the unanticipated monetary policy shocks, σ_m and σ_{m^*} , are centered at 0.50, and the prior volatilities of the cost-push shocks, σ_u and σ_{u^*} , at 0.10, respectively. We select an Inverse Gamma distribution to represent the prior of each of these volatility parameters, with a standard deviation of 0.01 for all. We choose Beta priors for the cross-country correlation of the monetary policy shock innovations and the cost-push shock innovations, ρ_{m,m^*} and ρ_{u,u^*} . We center both at 0 with a standard deviation of 0.01.

Finally, we adopt an Inverse Gamma prior distribution for the forward guidance (news) shock volatilities, $\left\{ \sigma_l^{2,FG} \right\}_{l=1}^{12}$, all of which are centered at 0.30 with a fairly uninformative prior standard deviation of 2. In doing so, we provide more room for the observed data to help us identify these forward guidance shocks. Analogously, we select an Inverse Gamma prior distribution for the measurement error and risk premium volatilities, $\left\{ \sigma_h^2 \right\}_{h=0}^{10}$, all of which are centered at 0.15 with a tight standard deviation of 0.005.

Table 3 - Parameterization of the Structural Parameters

Structural Parameters		Domain	Value	Density
<i>Non-policy parameters</i>				
Intertemporal discount factor	β	$(0, 1)$	0.995	Target 2% annualized real rate (steady state)
Inv. Intert. elasticity of substitution	γ	\mathbb{R}^+	5	Chari et al. (2002)
Inv. Frisch elasticity of labor supply	φ	\mathbb{R}^+	5	Chari et al. (2002)
Elast. of subst. Home & Foreign	σ	\mathbb{R}^+	1.5	Martínez-García (2018)
Cons. share of foreign goods	ξ	$(0, 1)$	0.18	Backus et al. (1994)
Calvo (1983) price stickiness	α	$(0, 1)$	0.75	Target a price change every four quarters (a year) on average
<i>Policy parameters</i>				
Response to inflation	ψ_π	\mathbb{R}^+	0.5	Taylor (1993)
Response to output gap	ψ_x	\mathbb{R}^+	0.5	Taylor (1993)

Note: The parameterization reported in this table falls within the determinacy region ensuring that a solution exists and is unique for the open-economy workhorse New Keynesian model.

Table 4 - Shock Parameters: Prior Distributions & Posterior Estimates

Shock Parameters	Prior Distributions			Posterior Estimates		
	Domain	Density	Mean	Std. Dev.	Mean	95%-CI
Productivity shock persistence	$(-1, 1)$	Beta	0.87	0.001	0.917	0.917 0.918
Productivity shock spillover	$(-1, 1)$	Beta	-0.008	0.001	0.056	0.056 0.057
Home Productivity shock volatility	\mathbb{R}^+	InvGamma	0.79	0.001	0.787	0.786 0.787
Foreign Productivity shock volatility	\mathbb{R}^+	InvGamma	0.79	0.001	0.792	0.792 0.793
Productivity shock corr. innovations	$(-1, 1)$	Beta	0.15	0.01	0.121	0.115 0.127
Cost-push shock persistence	$(-1, 1)$	Beta	0.50	0.01	0.621	0.615 0.627
Home Cost-push shock volatility	\mathbb{R}^+	InvGamma	0.10	0.01	0.444	0.433 0.457
Foreign Cost-push shock volatility	\mathbb{R}^+	InvGamma	0.10	0.01	0.470	0.461 0.478
Cost-push shock corr. innovations	$(-1, 1)$	Beta	0.00	0.01	-0.076	-0.083 -0.067
Unanticipated Monetary shock persistence	$(-1, 1)$	Beta	0.90	0.01	0.916	0.914 0.919
Home Unanticipated Monetary shock volatility	\mathbb{R}^+	InvGamma	0.50	0.01	0.549	0.543 0.560
Foreign Unanticipated Monetary shock volatility	\mathbb{R}^+	InvGamma	0.50	0.01	0.587	0.580 0.595
Unanticipated Monetary shock corr. innovations	$(-1, 1)$	Beta	0.00	0.01	-0.026	-0.031 -0.020
<i>Home Forward Guidance</i>						
Monetary news (one-quarter-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.092	0.080 0.104
Monetary news (two-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.152	0.135 0.170
Monetary news (three-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.181	0.161 0.200
Monetary news (four-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	4.022	3.687 4.363
Monetary news (five-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.408	0.073 0.847
Monetary news (six-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	9.044	8.402 9.671
Monetary news (seven-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.182	0.077 0.286
Monetary news (eight-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.187	0.071 0.302
Monetary news (nine-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	28.712	26.646 30.228
Monetary news (ten-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	0.198	0.073 0.328
Monetary news (eleven-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	3.754	2.258 5.008
Monetary news (twelve-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.30	2	22.430	21.106 24.144

Note: The priors reported in this table generally fall within the determinacy region ensuring that a solution exists and is unique for the open-economy workhorse New Keynesian model most of the time. We use Matlab 9.11.0.1809720 (R2021b) and Dynare v4.6.3 for the stochastic simulation and estimation.

Note: v and s are the pair of parameters that characterize each prior distribution. For the Normal distribution, the mean is $\mu=v$ and the variance is $\sigma^2=s^2$. For the Beta distribution, the mean is $\mu=v/(v+s)$ and the variance is $\sigma^2=vs/((v+s)^2(v+s+1))$. For the Gamma distribution, the mean is $\mu=vs$ and the variance is $\sigma^2=vs^2$. For the Uniform distribution, the upper and lower bound of the support are v and s respectively, while the mean is $\mu=(v+s)/2$ and the variance is $\sigma^2=(v-s)^2/12$. For the Inverse Gamma distribution, the mean is $\mu=s/(v-1)$ and the variance is $\sigma^2=s^2/((v-1)^2(v-2))$.

Table 5 - Measurement Error Parameters: Prior Distributions & Posterior Estimates

Measurement Error Parameters	Domain	Prior Distributions			Posterior Estimates		
		Density	Mean	Std. Dev.	Mean	Std. Dev.	95%-CI
Home real rate volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.244	0.237	0.250
Home real rate (one-quarter-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.135	0.133	0.139
Home real rate (two-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.148	0.146	0.150
Home real rate (three-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.174	0.172	0.177
Home real rate (four-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.180	0.177	0.183
Home nominal rate (one-quarter-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.161	0.157	0.164
Home nominal rate (two-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.167	0.163	0.170
Home nominal rate (three-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.155	0.150	0.158
Home nominal rate (four-quarters-ahead) volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.154	0.152	0.156
<i>Risk Premium</i>							
Home 10-year real yield volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.420	0.416	0.425
Home 10-year nominal yield volatility	\mathbb{R}^+	InvGamma	0.15	0.005	0.172	0.166	0.177

Note: The priors reported in this table generally fall within the determinacy region ensuring that a solution exists and is unique for the open-economy workhorse New Keynesian model most of the time. We use Matlab 9.11.0.1809720 (R2021b) and Dynare v4.6.3 for the stochastic simulation and estimation.

Note: v and s are the pair of parameters that characterize each prior distribution. For the Normal distribution, the mean is $\mu=v$ and the variance is $\sigma^2=s^2$. For the Beta distribution, the mean is $\mu=v/(v+s)$ and the variance is $\sigma^2=vs/((v+s)^2(v+s+1))$. For the Gamma distribution, the mean is $\mu=vs$ and the variance is $\sigma^2=vs^2$. For the Uniform distribution, the upper and lower bound of the support are v and s respectively, while the mean is $\mu=(v+s)/2$ and the variance is $\sigma^2=(v-s)^2/12$. For the Inverse Gamma distribution, the mean is $\mu=s/(v-1)$ and the variance is $\sigma^2=s^2/((v-1)^2(v-2))$.

The parameterization and estimates of the parameters in [Table 3](#), [Table 4](#), and [Table 5](#) not only guarantees that a solution exists and is unique most of the time, but it also ensures that a realization of the shock innovations $\widehat{\varepsilon}_t$ can be recovered from the observed data vector \widehat{Z}_t when such a unique solution exists.²⁸

4.3 Posterior Estimates

We take as given the vector of observable endogenous variables given by $\widehat{Z}_t = \left(\widehat{\pi}_t, \widehat{\pi}_t^*, \Delta \widehat{y}_t, \Delta \widehat{y}_t^*, \widehat{i}_t, \widehat{i}_t^*, \left\{ \mathbb{E}_t(\widehat{i}_{t+j}) \right\}_{j=1}^4, \widehat{r}_t, \left\{ \mathbb{E}_t(\widehat{r}_{t+j}) \right\}_{j=1}^4, \widehat{i}_{40,t}, \widehat{r}_{40,t} \right)^T$. The selection of this vector of observables avoids the well-known stochastic singularity problem in the estimation of the workhorse model with structural plus measurement error and risk shock innovations. Our choice of observables is conditioned partly by data availability, but it is also based on data known to be informative about current policy, the policy path, and the trade-offs between nominal and real variables as this would help us identify the parameters that underpin the workhorse open-economy New Keynesian model laid out in [Section 3](#).

We estimate the equilibrium conditions and auxiliary measurement equations of the workhorse model with the Bayesian techniques surveyed by [Martínez-García et al. \(2012\)](#) and [Martínez-García and Wynne \(2014\)](#), among others. Not all parameters are estimated, though. We take the approach of parameterizing the 8 structural parameters of the workhorse model that do not describe any of the shock processes—that is $\lambda^{structural} = (\beta, \gamma, \varphi, \sigma, \xi, \alpha, \psi_\pi, \psi_x)$ —as given by [Table 3](#). The rest of the parameters to be estimated are then summarized in the vector of 25 structural parameters that characterize the structural shock processes $\lambda^{shocks} = \left(\delta_a, \delta_{a,a^*}, \sigma_a, \sigma_{a^*}, \rho_{a,a^*}, \delta_u, \sigma_u, \sigma_{u^*}, \rho_{u,u^*}, \delta_m, \sigma_m, \sigma_{m^*}, \rho_{m,m^*}, \left\{ \sigma_l^{2,FG} \right\}_{l=1}^{12} \right)^T$ together with the auxiliary vector $\sigma^2 = \left(\left\{ \sigma_h^2 \right\}_{h=0}^{10} \right)^T$ which includes the remaining 11 measurement error and risk parameters. In other words, our approach is to use the data to identify the parameters for all shock processes in $(\lambda^{shocks}, \sigma^2)$ conditional on a calibration of $\lambda^{structural}$ that is consistent with the literature or with steady state values that capture key long-run patterns of the data during the 1984:Q1-2019:Q4 period.

With the software package Dynare (see, e.g., [Villemot \(2011\)](#)), the Bayesian estimation proceeds as follows: for a given draw of $(\lambda^{shocks}, \sigma^2)$, the model is solved to obtain its state-space representation. If a unique stable solution exists, then the Kalman fil-

²⁸[Hansen and Sargent \(1980\)](#) and [Martínez-García \(2020a\)](#) show the conditions under which, if a solution exists and is unique, we can recover the realization of the shock innovations in $\widehat{\varepsilon}_t$ from the vector of observable endogenous variables \widehat{Z}_t for given initial conditions.

ter evaluates the likelihood function $\mathcal{L}(\lambda^{shocks}, \sigma^2 | \widehat{Z}_t)$ in order to infer the posterior as $p(\lambda^{shocks}, \sigma^2 | \widehat{Z}_t) \propto \mathcal{L}(\lambda^{shocks}, \sigma^2 | \widehat{Z}_t) p(\lambda^{shocks}, \sigma^2)$ where $p(\lambda^{shocks}, \sigma^2)$ is the prior density. Otherwise, $\mathcal{L}(\lambda^{shocks}, \sigma^2 | \widehat{Z}_t) p(\lambda^{shocks}, \sigma^2)$ is set to zero. The Monte Carlo-based Metropolis-Hastings (MH) algorithm generates two Markov chains with a stationary distribution on the basis of 250,000 draws per chain. That approximates the posterior distribution of the vector $(\lambda^{shocks}, \sigma^2)$ which, under general regularity conditions, is asymptotically normal around the mode. The algorithm implemented then goes on to maximize the posterior density kernel with a Newton-type optimization routine.

[Table 4](#) and [Table 5](#) summarize the results of the estimation of the vector of parameters $(\lambda^{shocks}, \sigma^2)$ over the period pre-FAIT, pre-COVID pandemic from 1984:Q1 until 2019:Q4.²⁹ We find that in most cases the posterior estimates are largely in line with our priors. We are more agnostic in our choice of priors about the parameters that describe the volatility of the forward guidance (news) shocks and those end up recording more sizeable and heterogenous differences between our priors and the estimated posteriors. The evidence suggests that the size of forward guidance shocks tends to vary significantly depending on the horizon and, most importantly, it shows that forward guidance shocks can indeed have significant macro effects.

5 Counterfactual Analysis

With our model estimates at hand, we now proceed to evaluate quantitatively the impact of the different average inflation measures that could be used as targets by the home central bank (the Federal Reserve) on the performance of the U.S. economy. We do this through the lens of the workhorse open-economy New Keynesian model in [Section 3](#) setting its parameters at their posterior values estimated over the pre-FAIT, pre-COVID pandemic period from 1984:Q1 until 2019:Q4 (estimates which we briefly analyzed in [Subsection 4.3](#)). We then assess the significance of adopting FAIT by means of a couple of counterfactual policy exercises. First, we explore how the pre-FAIT, pre-COVID pandemic period would have evolved under FAIT. Second, we investigate what contribution the new FAIT strategy may have had on the inflation surge that followed Chairman Powell’s announcement of its adoption on August 2020.

²⁹The reason for not extending our estimation sample to the announcement of the Fed’s new framework in 2020:Q3 is due to potential contamination from the effects of the pandemic that started in 2020:Q1. However, we extend our counterfactual analysis into 2021:Q4 in the next section.

We explore in our counterfactual exercises the effect of FAIT on the cyclical fluctuations of the home and foreign economies in the case where the only thing that varies is how past inflation misses are incorporated into the U.S. policymakers reaction function. In other words, we focus narrowly only on the cyclical effects of FAIT while implicitly assuming that long-term expectations would be unaffected by this new policy strategy. We also consider a variety of inflation average measures in our counterfactual analysis to account for the uncertainty that the Federal Reserve may have introduced with its implementation of a FAIT strategy without explicitly adopting a formula for how averaging should be done. In so doing, we hope to capture the range of outcomes possible (and most plausible) under different interpretations of what "average" inflation could mean for U.S. policymakers.

5.1 Effects of Inflation Averaging (1984:Q1-2019:Q4)

We use the workhorse model described earlier setting its parameters at their posterior values estimated over 1984:Q1 until 2019:Q4. We use this parameterized model and the observable data to recover the realization of the structural shocks for both the home and foreign economies. Here the U.S. is the home country and the aggregate of U.S. trading partners outlined in [Subsection 4.1](#) is the foreign economy. Whenever the parameterized model follows the baseline specification of the monetary policy rule pre-FAIT for the home country (the U.S.) given by (15), we denote the recovered realization of the vector of structural shock innovations as $\hat{\varepsilon}_t^{baseline}$ and the associated recovered realization of the vector of measurement error and risk premium innovations as $\hat{o}_t^{baseline}$. If we feed those innovations $\hat{\varepsilon}_t^{baseline}$ and $\hat{o}_t^{baseline}$ through the reduced-form solution of the estimated workhorse model under the baseline monetary policy rule (15), then we generate the same vector of observables \hat{Z}_t we started with and, more generally, a vector of endogenous variables \hat{Y}_t that itself contains \hat{Z}_t .

We also feed that same realization of shock innovations $\hat{\varepsilon}_t^{baseline}$ and $\hat{o}_t^{baseline}$ through the reduced-form solution of the workhorse model under any of our alternative inflation averaging measures for the home monetary policy rule. Accordingly, we can derive the counterfactual vector of endogenous variables \hat{Y}_t^m (including the counterfactual observable endogenous variables \hat{Z}_t^m) under different inflation average targets indexed with the superscript m . In doing this, we are assuming that the shock innovations recovered—including the sequence of U.S. unanticipated monetary policy shock innovations and forward guidance shock innovations—would have been the same ones that the U.S. and rest-of-the-world economies would have faced had the Federal Reserve utilized any of the different average inflation measures as policy targets.

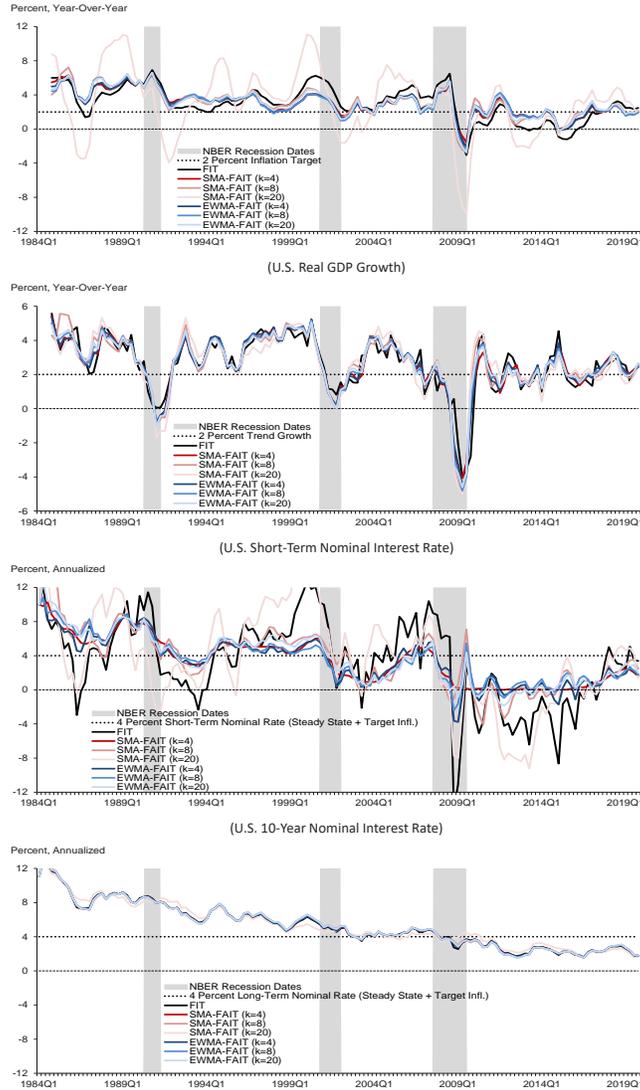
We use this counterfactual approach comparing the implied endogenous variables \widehat{Y}_t^m against \widehat{Y}_t to help us assess the economic consequences of FAIT over long periods of time—in this case, over the period from 1984:Q1 until 2019:Q4. The strongest assumptions here are that long-term inflation expectations would have remained unchanged during this long historical episode irrespective of the average inflation measure targeted, and that under any form of FAIT the Federal Reserve would have chosen the same sequence of unanticipated monetary policy and forward guidance shocks that characterized the current and expected policy path under the baseline rule.

The differences in the performance of the U.S. economy between the baseline rule which corresponds to the SMA-FAIT ($k = 4$) case and all our counterfactuals are summarized in [Table 6](#) and [Figure 4](#) which show the implied effects on headline CPI inflation (year-over-year), real GDP output growth (year-over-year), the short-term nominal interest rate and the 10-year nominal interest rates (all of which are observable). [Figure 5](#) plots additional information about the impact of FAIT on the estimate of the U.S. output gap, the rest-of-the-world output gap, the short-term real interest rate relative to the short-term natural rate, and the 10-year real interest rate relative to the 10-year natural interest rate. These additional variables give us information about the buildup of inflationary pressures associated with slack and the stance of monetary policy.

[Table 6](#) reports a series of statistics for the difference between the counterfactual and the observed data (SMA-FAIT, $k = 4$) on inflation, growth, short-term interest rates, and long-term interest rates. Our first observation is that the choice of inflation measurement has little to no effect on the average (and median) response of the variables. Most notably, average U.S. inflation is at most 0.1 percent higher or lower across all the counterfactuals, and growth on average remains unchanged over the 1984:Q1-2019:Q4 period. The average short-term nominal interest rate differences range from -0.2 to 0.3 percentage points, but the average differences for the 10-year nominal interest rate are almost negligible.

The different counterfactuals can, however, produce drastically different responses over short periods of time, with very large differences between counterfactual and realized outcomes particularly apparent for the two most polar cases under consideration—the FIT case which bluntly ignores all past inflation misses and the SMA-FAIT ($k = 20$) scenario that puts as much weight to inflation misses today as to inflation misses 20 quarters (5 years) ago. [Figure 4](#) illustrates the differences that emerge across all counterfactuals more neatly. The red line is the actual data and stems from the baseline case, that is from SMA-FAIT ($k = 4$). Apart from the black (FIT) and pink (SMA-FAIT, $k = 20$) lines, most other specifications are fairly tight around the baseline except perhaps for the short-term nominal interest rate.

Figure 4. Counterfactual Macro Performance During 1984:Q1-2019:Q4
under Alternative FAIT Strategies
(U.S. Inflation)



Note: The data plotted here includes the U.S. headline CPI inflation, the U.S. real GDP growth, the U.S. short-term (3-month) nominal interest rate, and the U.S. 10-year nominal interest rate. FIT refers to the inflation measure favored under flexible inflation targeting while FAIT refers to the corresponding series under flexible average inflation targeting. SMA indicates that the inflation measure is constructed with a simple moving average of either 4, 8, or 20 quarters while EWMA indicates an exponentially weighted moving average that puts most of its weight on either the first 4, 8, or 20 quarters. The baseline that describes the pre-FAIT strategy is the SMA-FAIT ($k = 4$) which corresponds to the red line. The results plotted describe how would the different series have behaved in the pre-FAIT period if the economy had been described with the same set of estimated parameters and hit with the same sequence of shocks recovered from the estimation (including the same monetary policy shocks) but the measure of inflation targeted by the Federal Reserve had been different than the baseline one. We use Matlab 9.11.0.1809720 (R2021b) and Dynare v4.6.3 for the stochastic simulation and estimation.

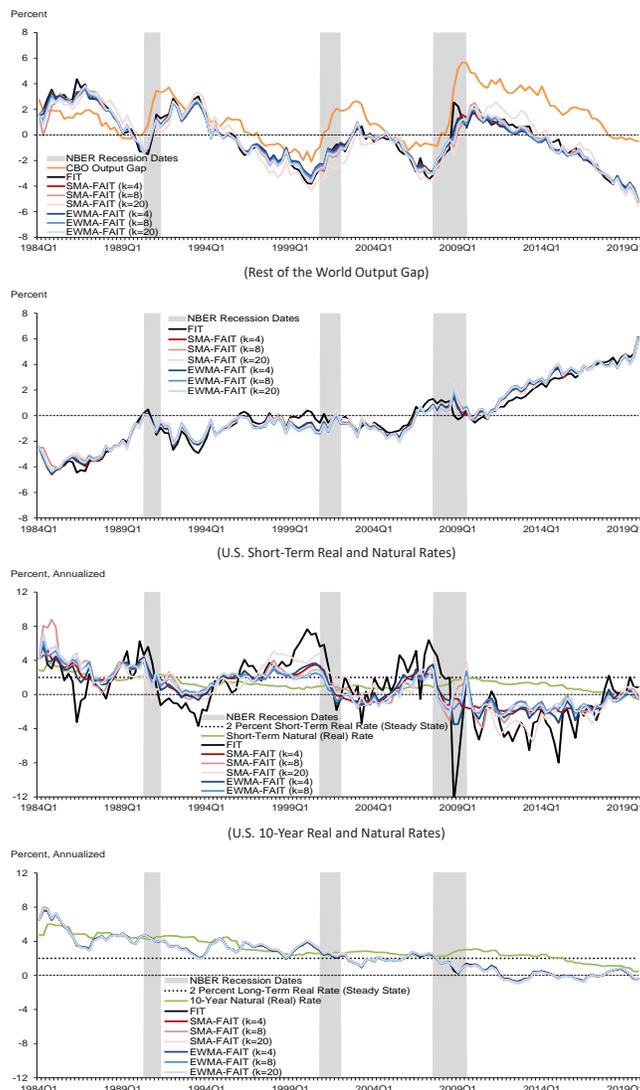
Sources: [Aspen Publishers \(2022\)](#); [CBO \(2022\)](#); [Grossman et al. \(2014\)](#); NBER; and authors' calculations.

Table 6 - U.S. Cyclical Differences under Alternative FAIT Regimes: 1984:Q1-2019:Q4

Variable	Regime	Mean	Median	Min.	Max.	IQR
U.S. Inflation (Year-Over-Year)	FIT	-0.1	0.0	-2.3	2.2	1.6
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	0.0	0.0	-1.6	1.3	0.5
	SMA ($k = 20$)	0.1	0.6	-8.4	7.1	3.6
	EWMA ($k = 4$)	0.0	0.0	-0.6	0.3	0.2
	EWMA ($k = 8$)	0.0	0.0	-1.2	0.8	0.4
	EWMA ($k = 20$)	0.0	0.1	-1.3	0.7	0.4
U.S. GDP Growth (Year-Over-Year)	FIT	0.0	0.0	-2.9	3.1	0.6
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	0.0	-0.1	-1.1	1.9	0.4
	SMA ($k = 20$)	0.0	-0.1	-1.4	2.2	0.9
	EWMA ($k = 4$)	0.0	0.0	-0.7	0.6	0.2
	EWMA ($k = 8$)	0.0	0.0	-0.8	0.7	0.2
	EWMA ($k = 20$)	0.0	0.0	-0.7	1.0	0.3
U.S. Short-Term Nom. Interest Rate	FIT	-0.2	0.0	-14.3	7.2	4.4
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	0.3	0.1	-4.3	6.9	1.8
	SMA ($k = 20$)	0.3	0.2	-9.3	11.3	5.2
	EWMA ($k = 4$)	0.0	0.0	-4.0	4.3	0.7
	EWMA ($k = 8$)	0.1	0.1	-2.7	5.3	1.0
	EWMA ($k = 20$)	0.2	0.1	-1.9	4.2	0.9
U.S. 10-Year Nom. Interest Rate	FIT	0.0	0.0	-0.5	0.2	0.1
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	0.0	0.0	-0.2	0.3	0.1
	SMA ($k = 20$)	0.0	-0.1	-1.0	1.1	0.8
	EWMA ($k = 4$)	0.0	0.0	-0.1	0.1	0.0
	EWMA ($k = 8$)	0.0	0.0	-0.1	0.1	0.1
	EWMA ($k = 20$)	0.0	0.0	-0.2	0.2	0.1

IQR stands for interquartile range. Otherwise, same note and sources as for [Figure 4](#).

Figure 5. Counterfactual Macro Performance During 1984:Q1-2019:Q4 under Alternative FAIT Strategies (U.S. Output Gap)



Note: The data plotted here includes the U.S. output gap, the rest of the world output gap, the U.S. short-term real and natural interest rate, and the U.S. 10-year real and natural interest rate. FIT refers to the inflation measure favored under flexible inflation targeting while FAIT refers to the corresponding series under flexible average inflation targeting. SMA indicates that the inflation measure is constructed with a simple moving average of either 4, 8, or 20 quarters while EWMA indicates an exponentially weighted moving average that puts most of its weight on either the first 4, 8, or 20 quarters. The baseline that describes the pre-FAIT strategy is the SMA-FAIT ($k = 4$) which corresponds to the red line. The results plotted describe how would the different series have behaved in the pre-FAIT period if the economy had been described with the same set of estimated parameters and hit with the same sequence of shocks recovered from the estimation (including the same monetary policy shocks) but the measure of inflation targeted by the Federal Reserve had been different than the baseline one. We use Matlab 9.11.0.1809720 (R2021b) and Dynare v4.6.3 for the stochastic simulation and estimation.

Sources: Aspen Publishers (2022); CBO (2022); Grossman et al. (2014); NBER; and authors' calculations.

The key message is that small departures from the baseline (namely the SMA-FAIT, $k = 4$ case) may have limited effects over short periods of time as well as over longer periods. However, if the Federal Reserve had departed significantly from the baseline by adopting a longer time window into the past and putting significant weight on past inflation misses beyond 1 or 2 years, the short-term consequences could easily become large as the new policy would tend to delay the policy response to a given shock. Adopting a policy like FIT would also represent a significant departure from the baseline and have large effects but for the opposite reason—because it would tend to favor overreacting to transitory shocks. In any event, the symmetry of the model and the shocks embedded in our model specification has the consequence that differences between the counterfactual and the baseline wash out over long periods of time explaining why even in the most extreme counterfactuals under consideration we find that the average differences over the 1984:Q1-2019:Q4 period are small.

Our second observation is that the evolution of interest rates under the counterfactuals are plausible for most specifications. In all cases, the natural rate of interest plotted in [Figure 5](#) is unchanged. This is by definition, as neither monetary policy nor any form of monetary policy shocks have any real effects absent all nominal rigidities as is the case for the frictionless allocation. Moreover, the long-run nominal and real interest rates shown in [Figure 4](#) and [Figure 5](#) respectively are hardly changed under even the most extreme counterfactuals. Most of the "action" comes in the short-term nominal and real rates plotted also in [Figure 4](#) and [Figure 5](#).

The short-term nominal rates that make the Fisher equations given by (2) and (3) hold should be interpreted as the path of that policy instrument necessary to sustain the prescriptions of the monetary policy rules for any given sequence of realized shock innovations. The sequence of shocks that we obtain from the parameterized model is consistent with the ZLB by construction whenever the home policy rule corresponds to the baseline given by (15). However, the same sequence of shock innovations may violate the ZLB in our counterfactual exercises as there is nothing that would enforce the ZLB constraint in those counterfactuals. Hence, we should interpret the deviations of the counterfactual and baseline policy path as a signal that the policy stance prescribed would have had to be more or less restrictive/expansive than it actually was.

In our counterfactual exercises, when the nominal short-term interest rate falls into negative territory we should interpret that as an indication that either the Federal Reserve would have had to abandon its commitment to keep rates in non-negative territory or, most likely, would have deemed the sequence of monetary policy and forward guidance shocks that led

them there impractical and, therefore, not to be followed.³⁰ Interestingly, during the period at the ZLB, few of the counterfactuals call for nominal short-term interest rates significantly lower than the SMA-FAIT ($k = 4$) baseline, suggesting that the issue of the ZLB would not necessarily require the Federal Reserve to adjust its forward guidance to preclude negative policy rates. That is not the case, however, for the two most different counterfactuals (FIT and SMA-FAIT, $k = 20$)—both of which would have required significantly negative policy rates relative to the baseline during the ZLB episode. In other words, the farther away we move from the baseline policy, the more likely it becomes that policymakers would have had to adjust more than their measure of price stability in the policy rule—adjusting their guidance (the sequence of forward guidance shocks) would have likely been necessary.

Finally, [Figure 5](#) also plots the relevant measures of home and foreign slack that arise from the open-economy Phillips curve. We add the [CBO \(2022\)](#) implied measure of slack (calculated as the percent log-difference between the actual and potential U.S. output) to the subplot on home slack to provide a point of reference. In all counterfactuals, we find that the differences that emerge on the output gap are not large but are not trivial in some cases either. The main observation we want to highlight here is that adopting FAIT in the U.S. alone—which is what we are assuming here—has some effect not just on U.S. slack but also on rest-of-the-world slack.

A related point that is worth making is that the measures of domestic slack implied by our model and those produced by the [CBO \(2022\)](#) with a different methodology are highly correlated. Our measure of rest-of-the-world slack has been increasing significantly since the 2007 – 09 global financial crisis implying that rest-of-the-world output continues to outpace its potential. This has happened at a time when the gap between our estimate of U.S. slack and the [CBO \(2022\)](#) slack has widened with our measure suggesting that the U.S. potential output has strengthened more than the [CBO \(2022\)](#) would imply. The result is that the U.S. economy has continued to underperform its potential even more so than under the [CBO \(2022\)](#) measure.

5.2 The Inflation Surge (2020:Q4-2021:Q4)

A timely and pertinent question that we should ask is whether our counterfactual analysis through the lens of the workhorse open-economy New Keynesian model can help us understand the effect that the adoption of FAIT may have had on the performance of the U.S.

³⁰While the ZLB has been the effective constraint for the Federal Reserve, other central banks around the world have experimented setting their nominal policy rates somewhat below zero.

economy—particularly in light of the inflation surge that followed FAIT and the evidence of non-trivial effects that we have uncovered using the SMC method earlier in [Subsection 2.2](#). To that end, we continue to exploit the workhorse open-economy model fixing its parameters at their calibrated values in [Table 3](#) and estimated values in [Table 4](#) and [Table 5](#).

All of the parameter values of the model are based on data pre-FAIT, pre-COVID pandemic from 1984:Q1 until 2019:Q4. This implies that *a priori* we rule out any structural break in the parameters of the model—in particular, we rule out that the possibility that the policy parameters ψ_π and ψ_x in the [Taylor \(1993\)](#) rules (15) and (9) may have shifted or that the processes for unanticipated monetary policy and forward guidance shocks may have changed since the adoption of FAIT. In other words, here U.S. monetary policy is expected to behave consistently with the pre-FAIT historical experience except for the fact that the price stability objective is now defined in terms of an inflation average. This is not to say that structural breaks or even breaks in how policy operates beyond that resulting from targeting an inflation average have not occurred, though. We do this for the purpose of isolating how this newly re-defined goal of targeting average inflation can explain the U.S. performance post-FAIT.

As noted earlier already, the Federal Reserve may have introduced a degree of uncertainty with its implementation of a FAIT strategy by not explicitly adopting a formula for how averaging inflation should be done. We therefore consider a variety of plausible average inflation measures in our counterfactual analysis to account, at least to some extent, for that uncertainty of possible outcomes. Like in the previous subsection, we will explore the special case of FIT too but focus our attention particularly on different implementations of either simple moving averages (SMA) and exponentially-weighted moving averages (EWMA) extending over one, two, and five years of past inflation misses. We then recover the shock innovations from the observed data during the post-FAIT period prior to Russia’s invasion of Ukraine (2020:Q4-2021:Q4) under each one of the inflation average measures under consideration. We refer to the recovered vectors of shock innovations as $\widehat{\varepsilon}_t^m$ and $\widehat{\delta}_t^m$ where the superscript m indexes the different average inflation scenarios.

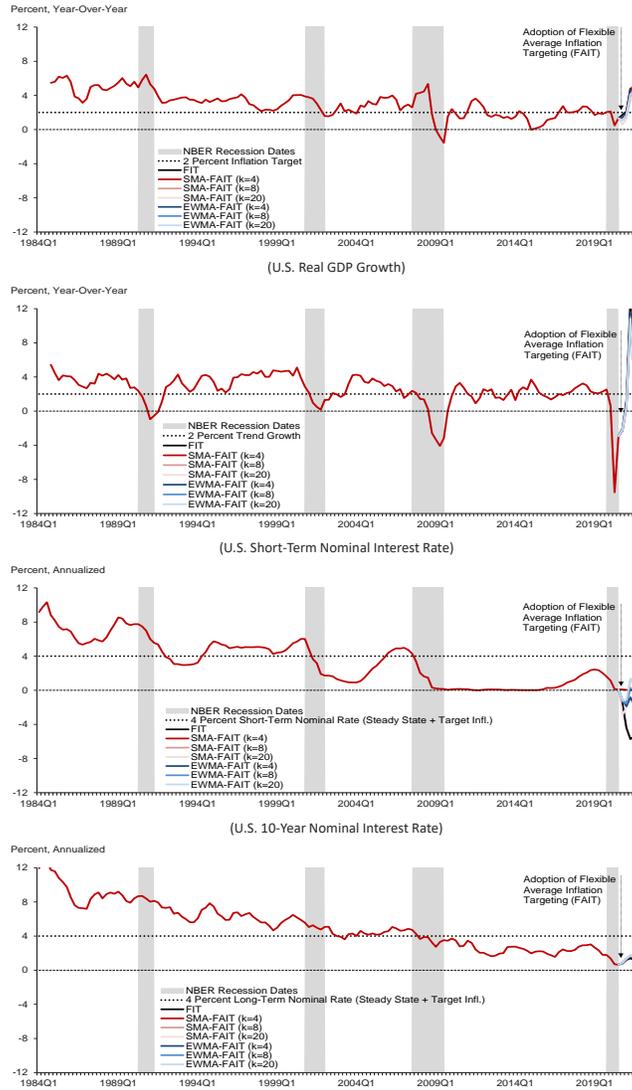
Finally, the next step in our counterfactual analysis is to determine what would have happened in each scenario m if the Federal Reserve had chosen to maintain their pre-FAIT baseline policy rule in (15) instead. We do this by feeding the recovered shock innovations $\widehat{\varepsilon}_t^m$ and $\widehat{\delta}_t^m$ through the reduced-form solution of the baseline model which corresponds to the reduced-form solution of the SMA-FAIT ($k = 4$). In that way, we obtain the vector of endogenous variables $\widehat{Y}_t^{m,baseline}$ for our counterfactual where the same shocks recovered from scenario m hit the economy but the inflation measure targeted by policymakers is the same

one used prior to FAIT. We plot in [Figure 6](#) the realized path of the observable inflation, growth, nominal short-term interest rate and nominal 10-year interest rate, all in red. We then illustrate how the paths of this counterfactual branch from there starting after the adoption of FAIT in 2020:Q4. Summary statistics of the differences between the realized variables and these counterfactual paths are reported in [Table 7](#).

The period we are considering is fairly short (including only 5 quarters), and the effects on the endogenous variables are sizeable in most cases. One way to attempt to incorporate the uncertainty about the average inflation measure favored by policymakers would be to look at an average effect across all the scenarios we report (excluding FIT). If we do that on the effects recorded in [Table 7](#), we find that on average inflation would have been 0.5 percentage points lower per quarter during 2020:Q4-2021:Q4 if the Federal Reserve had retained its pre-FAIT measure of inflation. In the most extreme case under SMA-FAIT ($k = 20$), keeping the pre-FAIT inflation measure could have lowered inflation by as much as 1.2 percentage points per quarter. Similarly, we observe that keeping the pre-FAIT inflation measure would have resulted on average in a decline of 0.2 percentage points of growth per quarter, 0.3 percentage points lower short-term nominal interest rates, and 0.1 percentage points higher 10-year nominal interest rates. In other words, the pre-FAIT monetary policy would have softened growth a bit but exercised some more substantive restraint on inflation—lower interest rates today could have cushioned the impact on economic activity while forward guidance would steepen the policy path and increase modestly the long-term nominal rates to put a check on inflation.

The first panel of [Figure 6](#) highlights that under all specifications, the expected inflation should have been lower than what was realized had the Federal Reserve retained its pre-FAIT inflation measure. Similarly, we observe that the impact on lower growth and higher 10-year nominal interest rates would have been fairly modest in general. Apart from the FIT and EWMA-FAIT ($k = 4$) cases which put large weights on current inflation, the rest of measures imply a policy rate liftoff between 2021:Q2 and 2021:Q4 had they not been adopted. That is, our counterfactuals suggest that under most measures of average inflation policy would have reacted with a lag to the inflation spike post-FAIT and, therefore, contributed to it by delaying liftoff by several quarters. The caveat here is that monetary policy and forward guidance shocks would have been inconsistent early on with the ZLB constraint and should have been adjusted—possibly by keeping the current short-term nominal rate close to zero early on and compensating that with a downward shift of the expected policy path, that is, by staying low (near the ZLB) for a bit longer closer to what actually happened.

Figure 6. Counterfactual Macro Performance During 2020:Q4-2021:Q4 under Alternative FAIT Strategies (U.S. Inflation)



Note: The data plotted here includes the U.S. headline CPI inflation, the U.S. real GDP growth, the U.S. short-term (3-month) nominal interest rate, and the U.S. 10-year nominal interest rate. FIT refers to the inflation measure favored under flexible inflation targeting while FAIT refers to the corresponding series under flexible average inflation targeting. SMA indicates that the inflation measure is constructed with a simple moving average of either 4, 8, or 20 quarters while EWMA indicates an exponentially weighted moving average that puts most of its weight on either the first 4, 8, or 20 quarters. The baseline that describes the pre-FAIT strategy is the SMA-FAIT ($k = 4$) which corresponds to the red line. The results plotted describe how would the different series have behaved in the post-FAIT period if the economy had been described with the same set of pre-FAIT estimated parameters but hit with the same sequence of shocks since 2020:Q3 recovered from a given specification of FAIT (including the same monetary policy shocks associated with that form of implementing FAIT) but the measure of inflation targeted by the Federal Reserve had been the same one used for the pre-FAIT baseline. We use Matlab 9.11.0.1809720 (R2021b) and Dynare v4.6.3 for the stochastic simulation and estimation.

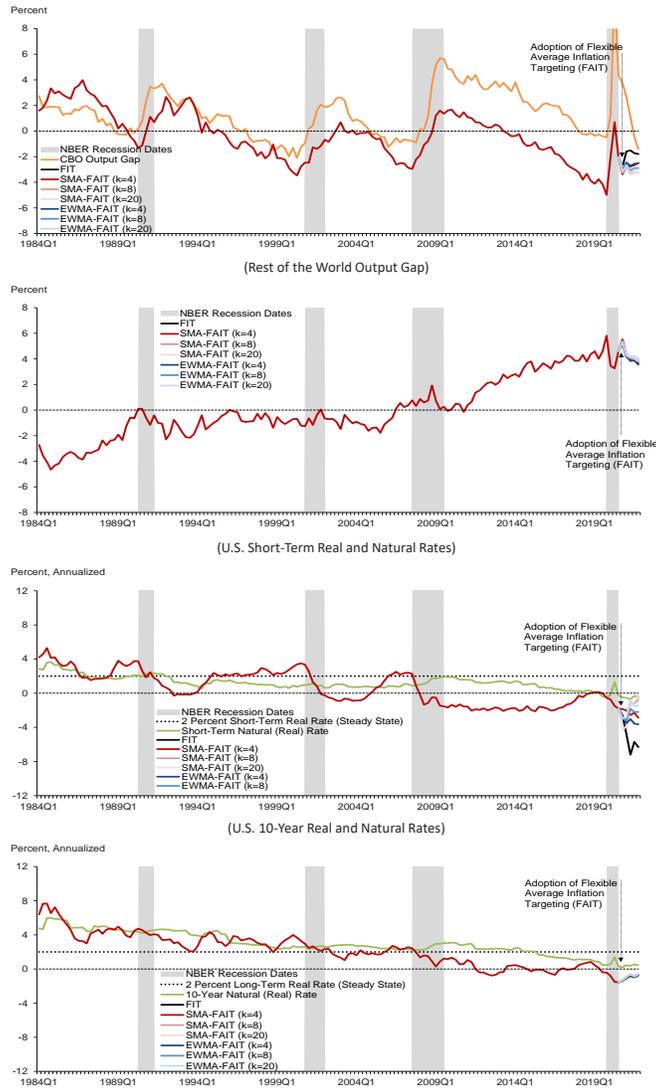
Sources: [Aspen Publishers \(2022\)](#); [CBO \(2022\)](#); [Grossman et al. \(2014\)](#); NBER; and authors' calculations.

Table 7 - U.S. Cyclical Differences under Alternative FAIT Regimes: 2020:Q4-2021:Q4

Variable	Regime	Mean	Median	Min.	Max.	IQR
U.S. Inflation (Year-Over-Year)	FIT	-0.1	0.1	-0.7	0.4	0.8
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	-0.6	-0.7	-0.9	-0.2	0.5
	SMA ($k = 20$)	-1.2	-1.4	-1.8	-0.7	0.8
	EWMA ($k = 4$)	-0.2	-0.1	-0.4	0.1	0.3
	EWMA ($k = 8$)	-0.5	-0.5	-0.8	-0.1	0.4
	EWMA ($k = 20$)	-0.5	-0.6	-0.8	-0.2	0.4
U.S. GDP Growth (Year-Over-Year)	FIT	0.3	0.2	-0.8	1.5	0.7
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	-0.4	-0.6	-0.8	0.1	0.7
	SMA ($k = 20$)	-0.4	-0.5	-0.9	0.2	0.7
	EWMA ($k = 4$)	0.0	0.1	-0.3	0.2	0.4
	EWMA ($k = 8$)	-0.2	-0.4	-0.5	0.2	0.5
	EWMA ($k = 20$)	-0.3	-0.2	-0.7	0.1	0.5
U.S. Short-Term Nom. Interest Rate	FIT	-4.4	-4.6	-5.8	-1.7	1.0
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	0.5	1.2	-1.5	2.8	2.6
	SMA ($k = 20$)	-0.8	-0.1	-3.0	1.1	2.2
	EWMA ($k = 4$)	-1.4	-1.3	-1.9	-0.9	0.6
	EWMA ($k = 8$)	-0.5	-0.3	-1.6	0.5	1.7
	EWMA ($k = 20$)	0.2	0.5	-1.3	1.4	2.5
U.S. 10-Year Nom. Interest Rate	FIT	-0.1	-0.1	-0.2	-0.1	0.0
	SMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	SMA ($k = 8$)	0.1	0.2	0.0	0.3	0.2
	SMA ($k = 20$)	0.2	0.2	-0.1	0.4	0.2
	EWMA ($k = 4$)	0.0	0.0	0.0	0.0	0.0
	EWMA ($k = 8$)	0.1	0.1	0.0	0.2	0.1
	EWMA ($k = 20$)	0.1	0.1	0.0	0.2	0.1

IQR stands for interquartile range. Otherwise, same note and sources as for [Figure 6](#).

Figure 7. Counterfactual Macro Performance During 2020:Q4-2021:Q4 under Alternative FAIT Strategies (U.S. Output Gap)



Note: The data plotted here includes the U.S. output gap, the rest of the world output gap, the U.S. short-term real and natural interest rate, and the U.S. 10-year real and natural interest rate. FIT refers to the inflation measure favored under flexible inflation targeting while FAIT refers to the corresponding series under flexible average inflation targeting. SMA indicates that the inflation measure is constructed with a simple moving average of either 4, 8, or 20 quarters while EWMA indicates an exponentially weighted moving average that puts most of its weight on either the first 4, 8, or 20 quarters. The baseline that describes the pre-FAIT strategy is the SMA-FAIT ($k = 4$) which corresponds to the red line. The results plotted describe how would the different series have behaved in the post-FAIT period if the economy had been described with the same set of pre-FAIT estimated parameters but hit with the same sequence of shocks since 2020:Q3 recovered from a given specification of FAIT (including the same monetary policy shocks associated with that form of implementing FAIT) but the measure of inflation targeted by the Federal Reserve had been the same one used for the pre-FAIT baseline. We use Matlab 9.11.0.1809720 (R2021b) and Dynare v4.6.3 for the stochastic simulation and estimation.

Sources: Aspen Publishers (2022); CBO (2022); Grossman et al. (2014); NBER; and authors' calculations.

Figure 7 plots the path of the U.S. output gap, the rest-of-the-world output gap, the short-term real interest rate and the 10-year real interest rates, illustrating how the counterfactual paths branch out since the adoption of FAIT. The effect on rest-of-the-world slack and the 10-year real interest rate is not large, but is non-trivial. This shows that the impact of a shift in U.S. monetary policy such as targeting average inflation can be felt around the world. The evidence also shows that there is a bit of a bounce back on the 10-year real interest rate and a modest narrowing of the rest-of-the-world output gap since the COVID pandemic. The differences across our counterfactuals are more substantive when we look at the U.S. output gap which, in any event, appears to have narrowed in closer to its potential output relative to the gap that was present before the COVID pandemic. The results even suggest that the distance between our measure of U.S. slack and the one implied by the CBO (2022) is closing. However, the most significant differences appear on the short-term real interest rate. Each of the FAIT scenarios calls for more negative interest rates early on, but would have closed the gap with the short-term natural rate much earlier too (except, once again, under FIT and EWMA-FAIT, $k = 4$).³¹ Thus, the path of monetary policy and forward guidance shocks would necessarily have had to be different than what we have recovered for these counterfactuals.

The bottom line of our results is this: differences in the way that the Fed weights past cyclical inflation misses, we estimate, may have contributed partly to the increase in inflation since the adoption of FAIT. This would result from delaying the response to the rising inflation tide. However, unless average inflation involves a major departure from the pre-FAIT inflation measure, the direct effect of changing the weighting scheme by itself would only generate a modest impact under the implied sequence of monetary policy and forward guidance shocks. Having retained the pre-FAIT inflation measure would surely have required a different policy path and, in particular, a somewhat different approach to forward guidance. This is precisely how Federal Reserve Governor Christopher J. Waller put it:

"There are some other lessons (...) from the experience of tightening monetary policy, a process which was put in motion by the [forward] guidance that the FOMC issued in 2020 about how long it would keep the federal funds rate at the effective lower bound and continue asset purchases. In September and December of 2020, the FOMC provided criteria or conditions in the meeting statement that would need to be met before the FOMC would consider raising interest rates and begin to reduce asset purchases, respectively. These conditions were, in effect, the FOMC's plan for starting the process of tightening policy. This [forward]

³¹It is worth noticing that the short-term natural rate of interest estimated by the model has stabilized since the COVID-related recession but remains in negative territory.

guidance was short term, specific to the task of when to tighten policy in this current cycle [and begin liftoff], and focused on specific tools.

(...) A bit earlier, in August 2020, the Committee completed a multi-year review of our overall strategy for achieving and sustaining our economic goals. The strategy statement is very different than the tightening [forward] guidance—it is about longer-run goals, not specific actions related to the current circumstances. The goals in the strategy statement apply in all economic circumstances and don't include any details on the settings of policy tools. I mention this distinction because some have argued that the FOMC's new strategy was a factor that led the Committee to wait too long to begin tightening monetary policy.

(...) Based on our positive experience with unwinding after the Global Financial Crisis (GFC), we thought it would be appropriate to use the same sequence of steps: taper asset purchases until they ceased, then lift rates off the effective lower bound, then gradually and passively reduce our balance sheet by redeeming maturing securities. Most importantly, through various communications, we made it clear that tapering of asset purchases would have to be completed before rate liftoff to avoid the conflict that would occur by easing via continuing asset purchases versus tightening through rate hikes.

(...) Implementing this approach required two pieces of guidance: first, criteria for beginning the tapering process, and, second, criteria to begin raising the policy rate from the effective lower bound. Through explicit language in FOMC statements, we told the public the necessary conditions that needed to be met before we would adjust these two policies.

For asset purchases, the Committee declared that tapering would wait "until substantial further progress has been made toward the Committee's maximum employment and price stability goals." Meanwhile, the FOMC said that it would keep rates near zero until our employment goal had been reached and until inflation had reached 2 percent and was "on track to moderately exceed 2 percent for some time."

(...) Unlike the normalization timeline after the financial crisis, we did not have flexibility to raise the target range sooner. However, if we had less restrictive tapering criteria and had started tapering sooner, the Committee could have had more flexibility on when to begin raising rates. So, by requiring substantial further progress toward maximum employment to even begin the process of tightening policy, one might argue that it locked the Committee into holding the policy rate at the zero lower bound longer than was optimal.

(...) [The liftoff criteria] was also quite restrictive." Excerpts from *Lessons Learned on Normalizing Monetary Policy*, speech by Governor Christopher J. Waller, at the Dallas Fed's sponsored policy panel on *Monetary Policy at a Crossroads*, June 18, 2022 ([Waller \(2022\)](#)).

In summary, [Waller \(2022\)](#)'s own assessment suggests that the key policy mistake may have occurred because the forward guidance that the Federal Reserve provided was based on the experience with the process of monetary policy normalization after the ZLB episode during the 2007 – 09 global financial crisis and its aftermath. In hindsight, the forward guidance strategy turned out to be too restrictive for the very different circumstances that followed from the COVID-related recession in early 2020 contributing to keep the policy rate at the ZLB longer than was optimal. This forward guidance was introduced immediately after the adoption of FAIT in August 2020 so its impact can be easily confounded with that which could be attributed directly to the Federal Reserve's strategy change. [Waller \(2022\)](#) argues here that the adjustment in the long-run goals that resulted from the adoption of the new FAIT strategy is likely not the culprit that we are looking for. Our counterfactual analysis lends some support for that view—modest changes to the inflation measure targeted by the Federal Reserve can have an impact, but likely a relatively modest one. Furthermore, our evidence also is consistent with the notion that forward guidance—as reflected in our forward guidance shocks—is crucial to explain the slow policy response and the rising inflation during 2020:Q4-2021:Q4.

6 Concluding Remarks

One result of the 2019 – 20 Fed framework review was the adoption of a Flexible Average Inflation Targeting (FAIT) strategy. In this paper, we document using synthetic control methods that U.S. inflation rose considerably more post-FAIT than one would predict had the monetary policy strategy not changed. We also utilize estimates from the workhorse open-economy New Keynesian model of [Martínez-García \(2021\)](#) augmented with monetary policy rule specifications under alternative average inflation measures to elicit counterfactuals that help us assess the performance of the U.S. economy at business cycle frequencies. For that, we consider a number of variants of the [Taylor \(1993\)](#) rule that place different weights on past inflation misses. Using our structural model, we document three significant findings:

First, though much of the conversation about the Federal Reserve's framework review has centered around the differences between Flexible Inflation Targeting (FIT) and FAIT in response to past inflation misses, in practice the FAIT approach can be more similar to the *de facto* rule that it replaced than is often thought. Moreover, depending on how FAIT is implemented, it can produce results closer to those that could be expected under the pre-FAIT rule. FAIT is, in practice, much more an incremental change to policy than a

revolutionary one.

Secondly, we find that under the strong assumption that inflation expectations in the U.S. would have remained the same under FAIT than under the Federal Reserve's previous rule, the gains in terms of inflation and growth would have been quite marginal, and the optimal policy path would have remained relatively unchanged under any form of average inflation targeting over the 1984:Q1-2019:Q4 period.

Finally, we observe that FAIT on average could have added as much as 0.5 percentage points to inflation per quarter over the post-FAIT period between 2020:Q4 and 2021:Q4 by delaying the policy response to rising inflation. Our findings also suggest that forward guidance played a major role in keeping policy rates low for too long during this time—an idea that has been echoed recently by, among others, [Waller \(2022\)](#). In other words, through the lens of the workhorse open-economy New Keynesian model, a policy mistake through forward guidance is a more plausible explanation for the large inflation spike that the U.S. has experienced than a modest strategy adjustment to targeting average inflation.

Thus it seems that the ongoing rise in inflation and inflation expectations is more likely due to the execution of monetary policy being confounded with the adoption of a new monetary policy framework under FAIT. Economic conditions have worsened even further in 2022 with the oil and commodities shock caused by Russia's invasion of Ukraine ([Coulter and Martínez-García \(2022\)](#)), complicating further the policy reaction for the Federal Reserve. Given the historically high inflation recorded so far, we also caution that the new FAIT strategy could become destabilizing if private agents' credibility on the Fed's anchoring of long-term inflation expectations starts to slip away. Preventing the current high inflation from becoming entrenched into expectations and into rising wages is neither going to be easy nor painless, and surely will put to the test the limits of the new FAIT strategy.

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