The Optimal Inflation Target and the
Natural Rate of Interest: Comment[*]

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In this paper, Andrade, Galí, LeBihan & Matheron (2019b) study how the inflation rate targeted by the monetary authority should vary with changes in the natural rate of interest. The authors characterize the (r^*, π^*) relationship in the textbook medium-scale New Keynesian (NK) model, augmented with a zero (or effective) lower bound on nominal interest rates. They quantify the following tradeoff: a higher inflation target reduces the costs associated with the zero lower bound (ZLB) constraint, but it also entails larger welfare losses from allowing higher permanent inflation. When disciplined by the properties of the modern U.S. economy, the model generates a "hockey stick" relationship between the inflation target and the natural rate, with the slope near -1 for r^* less than 5%, when ZLB concerns dominate the welfare analysis, and near 0 for r^* larger than 6% (roughly), when the probability of hitting the ZLB is effectively 0. In terms of levels, when the natural rate falls below 1%, the optimal inflation target exceeds 3.5%. The authors conclude by calling for a reassessment of the Federal Reserve's inflation target in light of the recent decline of the real rate.[1]

There is little to quibble with inside the framework set up by the authors: the paper offers an incredibly transparent and comprehensive analysis, with extensive robustness checks. It provides a wide range of valuable results that all future work will be benchmarked against.

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[1]For example, in their model of the U.S. economy, Christiano, Eichenbaum & Evans (2005) target a steady state real rate of 3%, whereas in its 2017 projections, the Federal Reserve's estimate was 1%. See Holston, Laubach & Williams (2017) for a detailed analysis of the recent decline in real rates.

My discussion approaches the paper's results from the practical question of what the Federal Reserve should do with respect to its inflation target in the current environment. I will push outside the authors' framework to highlight the large uncertainties regarding some key components of the net welfare gains that the model associates with a higher inflation target. In turn, these uncertainties imply a large degree of uncertainty regarding the model's policy prescription. While future research may reduce some of these uncertainties, it may be more prudent for now to embrace policies that are specific to ZLB episodes, such as "make-up" policies in the aftermath of ZLB realizations (Yellen, 2016; Bernanke, 2017). This is especially the case since many of the uncertainties and credibility concerns that critics raise for these alternative policies likely apply to the same extent—if not even more—to the transition to a higher inflation target.

The severity of ZLB episodes: Theory and practice The welfare gains of a higher inflation target depend critically on the average severity of ZLB episodes. Given the scarcity of historical ZLB episodes, estimates of the associated output loss are entirely model-based. The standard NK model generates very strong incentives to avoid the ZLB because of large output losses and the risk of deflationary spirals, as the economy's self-correcting mechanism breaks down: when nominal rates reach zero, if prices continue to fall, real rates rise, demand contracts, prices fall more, and so on. Key to this spiral is the formation of expectations by private agents.

What is the empirical relevance of such deflationary spirals? And what are the mechanisms that generate or help avoid such spirals?[2] In practice, such a spiral has not been observed since the Great Depression, and did not occur even during the Great Recession. The severity of the Great Recession had more to do with the nature and size of the shocks that hit the economy than with reaching the ZLB *per se*. By the time the ZLB was reached in December 2008, almost all of the output decline and half of the unemployment increase had already occurred.[3] Sustained deflation was avoided despite the large drop in output and the liquidity trap. A number of explanations have been proposed, bearing mixed news

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[2]Of note, the likelihood of converging to the deflationary equilibrium, once the ZLB has been reached, is *independent* of the inflation target prior to the shock (Aruoba & Schorfheide, 2015).

[3]For example, by December 2008 real GDP per capita had already declined by 4.9%, out of a total decline of 5.2%.

for inflation dynamics in future ZLB episodes. Coibion & Gorodnichenko (2015) argue that inflation was stable because the increase in oil prices between 2009 and 2011 kept consumer inflation expectations high. This does not bode well for the future: if expectations respond to oil price changes, then they are not well anchored, and hence may spiral next time, if an inflationary shock does not happen to coincide with the ZLB entry. Countering this concern at least somewhat, Baqaee (2019) documents that household inflation expectations are in fact rigid downwards, and he rationalizes this asymmetry with a model of household ambiguity aversion. Wiederholt (2015) points to survey evidence of dispersed and sluggish household inflation expectations and shows that deflationary spirals become less severe in an NK model with imperfect, dispersed information among consumers. Stevens (2019) focuses on price setters and argues that the high uncertainty that characterized the Great Recession gave information-constrained firms the incentive to keep prices relatively high, to protect themselves against losses in a volatile environment. These mechanisms all work to limit deflationary spirals when decision-makers are very uncertain about the future. Lastly, controlled laboratory experiments also provide some potentially relevant news: asset market experiments reliably produce overvaluation relative to the rational expectations response in markets with decreasing fundamental values (Smith, Suchanek & Williams, 1988; Stöckl, Huber & Kirchler, 2015).

These theoretical, survey-based, and experimental findings suggest that deviations from the benchmark model—particularly in terms of how expectations are formed and updated—need to be studied much more closely in the context of liquidity traps, to better understand the emergence of deflationary spirals. For now, it is not clear that we can draw strong conclusions about the costs we are willing to bear to avoid such spirals, if we are not sure how and under what conditions they occur.

The probability of ZLB episodes versus that of inflationary pressures The model estimates a probability of at least 10% of reaching the ZLB going forward, if the inflation target is kept around 2%. One distinguishing feature of the results (for example, versus the ZLB paper of Coibion, Gorodnichenko & Wieland, 2012) is that they are based on a model that is estimated using pre-Great Recession data. This is a sensible approach, but it is

subject to the same challenges as any attempt to estimate rare events, and comes with large error bands. Moreover, the ZLB probabilities reflect the structure of the model used by the authors. A useful extension would be the introduction of capital, inventories, or housing, which significantly affect the likelihood of reaching the lower bound.

Whatever its value, this probability should be weighed against the probability of inflationary shocks we face today. The paper presents the trade-offs of higher inflation given historical shocks. However, not just the size of shocks (which the authors experiment with), but also the nature of the shocks may change in the future. First, relative to the Great Moderation period, increased policy uncertainty regarding fiscal, trade, and monetary policies may be inflationary. There is precedent for such policy uncertainty to lead to an increase in long-run inflation expectations. Second, increased risk-taking in a low interest rate environment may increase the likelihood and magnitude of financial shocks in the future. In a controlled lab experiment, Lian, Ma & Wang (2018) find that "all else equal, individuals demonstrate a stronger preference for risky assets when the risk-free rate is low." In turn, more risk taking may fuel more financial cycles and inflation variability: depending on the mechanism that is active, financial shocks may either raise or lower inflation. But on net, Abbate, Eickmeier & Prieto (2016) find that in the modern U.S. economy, financial shocks have moved output and inflation in opposite directions.

Inflationary shocks may make it more challenging for the Federal Reserve to control inflation, especially since these challenges rise convexly as inflation rises above 5% or so. At the same time, they may limit deflationary spirals that make ZLB episodes so costly, tipping the scales towards a lower inflation target. Overall, an analysis of the desirability of changing the monetary policy regime and increasing inflation expectations should take into account the possibility of such risks going forward.

The nature and severity of the pricing frictions   The cost of having a higher inflation target depends on the severity of inefficient nominal price dispersion and its sensitivity to inflation. The model considered by Andrade et al. (2019b) generates price dispersion by incorporating nominal price and wage rigidities a la Calvo (1983), augmented with exogenous indexation. The authors estimate the parameters of price and wage rigidities to match time

series data on inflation, GDP, wages and real rates. The estimated values imply low price rigidity. This makes having higher inflation not so costly in normal times, and it also makes deflationary spirals more severe in ZLB times. Both of these effects favor higher inflation targets for a given real rate. An alternative would be to estimate the severity of pricing frictions so as to match the degree of monetary non-neutrality implied by the U.S. economy in normal times (e.g., Christiano et al., 2005).

Moreover, the results may be sensitive to nature of pricing frictions. Calvo frictions do not generate a good approximation of the welfare costs of nominal price rigidities (Sheremirov, 2019). They under-estimate the level of inefficient price dispersion versus the data, and they also generate a sensitivity of inefficient price dispersion to inflation that is at odds with the data. Conversely, a model of myopic, information-constrained pricing (Morales-Jimenez & Stevens, 2019) yields higher price rigidity for a given degree of price dispersion, and larger inefficient price dispersion for a given level of inflation. Both of these forces would push towards a lower inflation target.

A volatile and uncertain policy? The results imply considerable variation in the optimal inflation target. Optimality would require increasingly frequent increases in the inflation target in the United States: 1.2% circa 1990, 2.2% circa 2005, 3.5% circa 2015, 4.2% circa 2020.[4] Another challenge, as illustrated by much of the literature trying to estimate r^*, is that these estimates are very imprecise, dependent on the estimation method, and subject to considerable revisions as we accumulate more data (e.g., Del Negro, Giannone, Giannoni & Tambalotti, 2019). This means that not only is there a risk that what is perceived as a permanent decline in r^* turns out to be transitory, but there is also the practical difficulty of knowing what the rate currently is so as to know what the current inflation target should be. Since the model predicts that the inflation target is very sensitive to changes in the real rate for rates below 5%, it seems it would be a unstable inflation target. We may prefer instead to solve for a robust policy in the face of natural rate uncertainty (Orphanides & Williams, 2002).

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[4]I use the figures for the real rate of Laubach & Williams (2003) for historical estimates, and simple extrapolations for the future.

Interpretation, credibility, and expectations How should we expect private agents to interpret and respond to such a path of the inflation target? First, private agents could differ in how they update their beliefs — e.g. immediately, or in a gradual, adaptive way, resulting in very different welfare implications. Experiments on the formation of expectations find significant support for gradual adjustment rather than sharp updating in response to regime changes (Khaw, Stevens & Woodford, 2019). Second, private agents could have one or more interpretations of a given policy action: they may correctly understand and respond to the change (either on impact or gradually), they may think that the inflation target has been abandoned, or conversely, they may not believe the commitment to a higher target long term at all. In any case, it is quite likely that any announcement of a potential change in policy regime would result in increased dispersion in expectations and would increase the probability of unanchoring long term expectations. Falck, Hoffmann & Huertgen (2019) show that disagreement about inflation expectations can result in contractionary monetary policy being inflationary, as agents update beliefs about the state of the economy. In a similar vein, Andrade, Gaballo, Mengus & Mojon (2019a) show a decrease in the effectiveness of forward guidance when private agents have heterogeneous beliefs. More pointedly, Branch & Evans (2017) show how when agents have adaptive expectations, increasing the inflation target can lead to overshooting and instability in the inflation rate. In light of this work, the present analysis of the net benefits of a higher inflation target should be extended in the future to include deviations from fully informed rational private agents, allowing for dispersed and sluggish updating of beliefs regarding the state of the economy and the policy regime expected to prevail.

Conclusion This paper by Andrade et al. (2019b) presents a strong conclusion. It pushes us further from Friedman's (1968) optimal disinflation rule, from the complete price stability prescribed by the textbook NK model (Woodford, 2003), and from the 2% level that is the current inflation target of the Federal Reserve, and the standard among inflation targeting economies. It does so in the context of a well-understood and widely used model of the aggregate economy, and hence it serves as both benchmark and launching pad for future work.

More generally, the analysis also makes the point that the target of an inflation-targeting monetary authority is not an invariant constant; rather, it can vary with the economic environment and perhaps other policies. This raises the question of how other structural changes in the economy may affect the optimality of different monetary policy regimes.

In practice, there remain big uncertainties surrounding how deflationary spirals arise, persist, and end. We furthermore face great uncertainties regarding inflationary pressures going forward, the prevailing rate of natural interest and its stability, and the costs in such an environment of targeting higher average inflation. Last but not least, the literature offers virtually no encouraging guidance in terms of how agents' expectations would respond to such a policy change. Along all of these dimensions, departures from the benchmark of fully informed, rational agents consistently push against the results based on full information. To what degree remains an open question, but it seems urgent to incorporate such departures more consistently in basic analyses of monetary policy.

In the meantime, for the purposes of practical policy recommendations, it may be more prudent to focus on ZLB-specific policies such as pursuing a "lower-for-longer" policy for the nominal rate upon exiting the ZLB (Reifschneider & Williams, 2000; Woodford, 2012; Yellen, 2016; or Bernanke, 2017), rather than attempting to implement a higher inflation target uniformly, thus increasing distortions all the time to help deal with infrequent episodes of unknown frequency and severity. While such ZLB-specific policies may have credibility issues of their own, they at least do not come with the added cost of additional distortions outside the ZLB. The paper is encouraging on this front. One meaningful deviation to the baseline results is that smaller changes in the inflation target are optimal when the monetary authority implements policies that have this flavor, since these alternatives substantially reduce the costs of the ZLB constraint. I found this deviation encouraging and worthy of future exploration.

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