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Monetary policy and indeterminacy after the 2001 slump☆

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ABSTRACT

This paper estimates a simple New Keynesian model of the U.S. economy, allowing for indeterminacy, over the period following the 2001 slump, an episode for which the adequacy of monetary policy is intensely debated. We find that only when measuring inflation with core PCE does monetary policy appear to have been sufficiently active to rule out indeterminacy. We then relax the assumption that inflation in the model is measured by a single indicator and re-formulate the artificial economy as a factor model where the theory's concept of inflation is the common factor to the empirical inflation series. CPI and PCE provide better indicators of the latent concept while core PCE is less informative. Finally, we estimate an extended economy that distinguishes between core and headline inflation rates. This model comfortably rules out indeterminacy and confirms the view that the Federal Reserve put more weight on core PCE inflation when setting the policy rate during this period.

1. Introduction

It has become prevalent to think of monetary policy in terms of nominal interest rate feedback rules. In certain situations, for example, loose monetary policy, these rules may introduce indeterminacy and sunspot equilibria into otherwise stable economic environments. Lubik and Schorfheide (2004) and many others suggest that, empirically, such sunspots-based instability was confined to the seventies and that the post-Volcker years can ostensibly be characterized by determinacy. The current paper extends this analysis to more recent data leading up to the Great Recession.

The issue of loose monetary policy during the 2000s is closely related to Taylor (2007, 2012), who asserts that the Federal Reserve kept the policy rate too low for too long following the recession of 2001. While Taylor does not touch the issue of indeterminacy, he nevertheless argues that this loose policy created an environment that ultimately brought the economy close to the brink. To bolster his thesis of an extra easy monetary policy, Taylor constructs an artificial path for the Federal Funds rate that follows his proposed rule. He characterizes this counterfactual rate's loose fitting to the actual rate as

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> "[...] the biggest deviation, comparable to the turbulent 1970s." Taylor (2007, 2)

His view is disputed by many. Amongst them, Bernanke (2010) argues that Taylor's use of the headline consumer price index (CPI) to measure inflation in the Federal Reserve's reaction function is misleading. In fact, the Federal Reserve switched the inflation measures that inform its monetary policy deliberations several times over the last two decades. In particular, it moved away from the CPI to the personal consumption expenditure deflator (PCE) in early 2000. In turn, PCE was abandoned midway through 2004 in favor of the core PCE deflator (which excludes food and energy prices).[1] Bernanke (2015) revisits Taylor's exercise and constructs his own counterfactual Federal Funds rate using core PCE. Bernanke's verdict of the Federal Reserve's policy during the 2000s is inimical to Taylor's and he says that

> "[...] the predictions of my updated Taylor rule and actual Fed policy are generally quite close over the past two decades. In particular, it is no longer the case that the actual funds rate falls below the predictions of the rule in 2003–2005." Bernanke (2015)

Our paper sheds further light on this debate. It takes as a point of departure Taylor's claim of an analogy between the 1970s and the 2000s as well as one of the key recommendations for monetary policy that has emanated from New Keynesian modeling: interest rates should react strongly to inflation movements to not destabilize the economy. Phrased alternatively, if the central bank's response to inflation is tuned too passively in a Taylor rule sense, multiplicity and endogenous instability may arise. In fact, the U.S. economy of the 1970s can be well represented by an indeterminate version of the New Keynesian model as was shown by Lubik and Schorfheide (2004). Along these lines, the current paper turns Taylor's *too low for too long* story into questioning whether the Federal Reserve operated on the indeterminacy side of the rule after the 2001 slump. Knowledge about the economy's regime is important for policymakers because indeterminacy introduces sunspots and alters the propagation of fundamental shocks. Thus, for central banks to use models for policy analysis, a good understanding about the presence of (in-)determinacy is vital.

The empirical plausibility of a link between monetary policy and macroeconomic instability was first established by Clarida et al. (2000). They estimate variants of the Taylor rule and their research suggests that the Federal Reserve's policy may have steered the economy into an indeterminate equilibrium during the 1970s. Yet, they also find that the changes to policy which have taken place after 1980 – essentially a more aggressive response to inflation – brought about a stable and determinate environment. Lubik and Schorfheide (2004) reinforce this point but they refrain from using a single equation approach. They recognize that indeterminacy is a property of a rational expectations system and apply Bayesian estimation techniques to a general equilibrium model. Their results parallel the earlier findings that the U.S. economy veered from indeterminacy to determinacy around 1980 – largely as the result of a more aggressive response of monetary policy towards inflation.

Moreover, this monetary policy change had perhaps an even greater influence on the economy: the transformation from the Great Inflation of the 1970s to the Great Moderation is often conjoined to the conduct of monetary policy.[2] Yet, the Great Moderation came to an end sometime during the 2000s, and it was followed by enormous economic volatility. Our aim is to examine the possible connection between this transformation and an alteration in the Federal Reserve's monetary policy. In particular, we concentrate on the effects of a possibly too easy monetary policy after the 2001 slump. We frame our analysis from the perspective of (in-)determinacy and conduct it under the umbrella of the Bernanke versus Taylor dispute by considering the measures of inflation that repeatedly occur in the discussion: CPI, PCE and core PCE.

Accordingly, we estimate a small-scale New Keynesian model allowing for indeterminacy over the period between the 2001 slump and the onset of the Great Recession, thus, the NBER-dated 2002:I–2007:III window to be precise. To test for indeterminacy, we employ the method of Lubik and Schorfheide (2004) to compute the posterior probabilities of determinacy and indeterminacy. We take as starting point the same basic New Keynesian model, priors and observables as Lubik and Schorfheide (2004). This strategy allows us to create a continuity between their and our results, which is important given the shortness of our period of interest.

We establish a number of new insights regarding recent U.S. monetary policy. For example, we can indeed expose a violation of the Taylor principle for most of the 2000s when using CPI to measure inflation. This finding supports the visual inspection checks based on single equations in Taylor (2012) who coined the phrase *Great Deviation* to refer to this period. Hence, the 2002:I to 2007:III period would appear to be best described by an indeterminate version of the New Keynesian model. Our upshot is different when basing the analysis on PCE data: we can neither rule in nor rule out indeterminacy. Finally, the evidence in favor of indeterminacy altogether vanishes when we use core PCE. Monetary policy then appears to have been quite appropriate. This conclusion parallels the insight from Bernanke's (2015) counterfactual Federal Funds rate. We thus establish that tests for indeterminacy are susceptible to the data used in the estimation.

We next consider whether our results are an artifact of the six year sample of data. To address this issue, we re-estimate the model on rolling windows of fixed length (23 quarters to match the length of the 2002:I–2007:III period) starting in the mid-1960s and focusing on the same inflation measure as Lubik and Schorfheide (2004) namely CPI inflation. The outcomes of the indeterminacy test performed on rolling windows are highly plausible. In particular, we identify only two broad periods (i.e. several consecutive windows) in which a passive policy has likely led to indeterminacy: the 1970s and the

[1] See Mehra and Sawhney (2010).

[2] See, for example, Benati and Surico (2009), Bernanke (2012), Coibion and Gorodnichenko (2011), Arias et al. (2014) and Hirose et al. (2015).