The Forward Guidance Puzzle is Not a Puzzle: Evidence from the Great Depression*

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Abstract

In standard New Keynesian models, future interest rate cuts have larger effects than current cuts—a phenomenon known as the forward guidance puzzle. We argue that this puzzle arises from a radical policy-regime change assumption: between announcement and implementation, the central bank commits never to respond to inflation and output. Once standard policy responses are restored, the puzzle disappears. We test whether genuine regime changes at the zero lower bound generate the model's predicted effects by examining four Depression-era episodes which are empirically comparable: Roosevelt's 1933 gold exit and reflation pledge, Eccles's 1934 appointment, the "Mistake of 1937" and the 1938 reversal. Calibrating a minimalistic New Keynesian model to term-structure movements, we find predicted output swings of 10-25% match the data within percentage points. The forward guidance puzzle is thus a feature, not a bug—one that helps explain dramatic historical episodes when monetary regimes credibly shifted.

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1 Introduction

Identifying scientific puzzles—observations that flout prevailing paradigms—has long propelled progress: Mercury's anomalous orbit led from Newtonian mechanics to Einstein's theory of relativity, and the photoelectric effect opened the door to quantum mechanics. Macroeconomics recently met its own enigma: the *forward-guidance puzzle*. In standard New Keynesian models, promising to lower interest rates eight quarters ahead boosts output and inflation far more than cutting rates today.

Like many puzzles in the history of science, this striking prediction emerged from practical application. In 2010 a team of researchers at the Federal Reserve Bank of New York used the FRBNY-DSGE model to assess policy options at the zero lower bound (ZLB). Pledging to keep the policy rate at zero for five additional quarters—only at maximum *15 bp* deviation from the prior forecast—pushed modelled output growth from 2% to 9% on impact. They coined this startling result the forward guidance puzzle (FGP) (Del Negro et al., 2012, 2023).

The discovery struck at the heart of modern macroeconomics, questioning how central banks' primary tool affects the economy, and spawned an enormously productive literature. Several prominent scholars in the profession proposed solutions that have appeared in leading journals over the past decade. These resolutions span incomplete markets and borrowing constraints (McKay et al. (2016)), overlapping generations (Del Negro et al. (2023)), behavioral departures or rational inattention (Woodford (2019); Gabaix (2020)), limited commitment (Bernanke (2020)), and equilibrium-selection (Cochrane (2017)).[1] These papers advanced monetary theory significantly, but a unifying resolution remains elusive.

This paper reframes the debate by proposing a solution requiring no new frictions.

What we do. We revisit the canonical experiment and show that the puzzle arises only under a *radical regime change*: the central bank pegs the rate for a fixed horizon and promises not to respond to overshoots in inflation or output. With the "firefighters" sworn to inaction, a small spark becomes a conflagration; restore any rule or optimal-policy regime that re-engages when targets are breached and the anomaly evaporates—responses decay with horizon rather than explode.

[1]For additional work, for incomplete markets see Werning (2015); Bilbiie (2017, 2020, 2024); Caballero and Farhi (2018); Kaplan et al. (2018); Hagedorn et al. (2019);Acharya and Dogra (2020), overlapping generations Eggertsson et al. (2019a), deviation from full information Angeletos and Lian (2018), and incomplete credibility Bodenstein et al. (2012); Haberis et al. (2014); Andrade et al. (2019); Campbell et al. (2019); de Groot and Mazelis (2020); Lunsford (2020).

We then show that the FGP is the positive-sign mirror image of the deflationary spiral first derived at the ZLB in Eggertsson and Woodford (2003). Flip the sign of the interest-rate gap and the contractionary spiral turns expansionary, each intensifying with expected duration. Yet, this makes clear the sharp difference: FGP expansionary spiral can always be stopped by central bank sticking to a normal policy regime and raising rates, deflationary spiral cannot be as easily stopped due to ZLB—a major policy regime change would be required to curb it. Thus the extreeme effect of FGP relies on a central bank deviating from standard policy regime perscription, while a deflationary spiral at the ZLB does not.

The empirical test. Can we find real-world episodes that enact the radical policy regime proposed by the FGP experiment? If so, is the model outcome consistent with the data?

Post-2008 forward guidance was explicitly state-contingent and had moderate effects (Bundick and Smith, 2020), consistent with an active regime.

We therefore turn to the one period that featured a strict peg—a fundamental regime shift—at the ZLB: the U.S. Great Depression. Four policy turns fit the FGP template: Roosevelt's 1933 exit from the gold standard and pledge to inflate prices to 1926 levels; the 1934 appointment of Eccles as Fed chairman to reaffirm the credibility of the reflation policy regime; the "Mistake of 1937" when the new policy regime was temporarily abandoned; and the 1938 reversal recommitting to the reflation policy regime. Using Treasury term-structure shifts to infer ZLB-duration expectations, a stripped-down NK model predicts real-GDP swings of 10–25%, matching the data within a few percentage points.

Contribution. Theory: we unify the contractionary spiral of Eggertsson and Woodford (2003) with the forward-guidance puzzle, showing their mathematical equivalence but with opposite signs; demonstrate that any responsive policy regime neutralizes the explosion; and establish that while Maliar and Taylor (2024) and Ahn and Holm (2025) independently analyze the FGP's explosive dynamics, the equivalence to the deflationary spiral reveals why the FGP never arises absent a radical regime change. Evidence: Depression-era regime shifts provide the first historical evidence that the FGP captures real phenomena when policy credibly abandons stabilization, clarifying why routine forward guidance yields moderate effects while genuine regime changes unleash dramatic outcomes.

The remainder of the paper proceeds as follows. Section 2 formalizes the FGP and its resolution in a three-equation New Keynesian model. Section 3 calibrates the model to the four Great-Depression episodes and presents quantitative results. Section 4 concludes.

2 The Forward-Guidance Puzzle: Definition

We define the forward-guidance puzzle (FGP) with two ingredients:

1. In the canonical New-Keynesian model, changing the policy rate at date $t+k$ has a *larger* impact on current output and inflation than an identical change at date t.
2. This result obtains under the assumption that the nominal rate is *pegged* at a constant level for every period between t and $t+k$.

Many papers emphasize point (1) while *implicitly assuming* point (2) or treating it as a technical detail. Taken in *partial equilibrium*, point (1) is indeed counter-intuitive: under typical financial conditions facing households, a distant reduction in interest rates should matter less for current spending than an immediate one.[2] This partial-equilibrium logic explains why much of the literature tries to 'solve' the FGP by introducing stronger effective discounting—through incomplete markets, overlapping generations, inattention, and related mechanisms.

We do not dispute the value of such extensions; richer forms of discounting illuminate various phenomena, such as permanently negative natural rates (e.g. Eggertsson et al., 2019b). Our claim is narrower: *none of these frictions is required to resolve the FGP itself*. Once the interim peg in point (2) is relaxed—once the firefighters are allowed to act—the puzzle disappears in general equilibrium. This observation links the FGP directly to the earlier literature on deflationary spirals.

Even the seminal study by Del Negro et al. (2023) notes this peg-dependence:

> "If monetary policy instead responds aggressively enough to deviations of inflation from its target between periods t and $t+k$ so that it satisfies the Taylor principle ($\omega_p > 1$), the eigenvalues lie inside the unit circle and the responses of inflation and consumption are bounded."[3]

[2] Formally, intuition assumes the interest rate facing households, i_t^b, exceeds the rate implied by their subjective discount factor, β, so that $1/(1+i_t^b) < \beta$. In the representative-agent, complete-markets New Keynesian model the real rate adjusts endogenously to equate intertemporal marginal utilities, offsetting this inequality; hence the apparent paradox arises only once general-equilibrium effects are considered.

[3] Journal version, pp. 54–55.

Despite that caveat they retain the peg assumption and instead solve the FGP proposing an overlapping-generations solution. **Yet this technical observation about eigenvalues encodes the economic heart of the matter: forward guidance only generates puzzling effects when the central bank abandons its fundamental stabilizing role.** Much subsequent work followed suit. The mathematics were recognised; the economics hid in plain sight.

In what follows we show that when the peg assumption is dropped—or, equivalently, when policy re-engages with inflation and output—the forward-guidance "paradox" dissolves without additional frictions. Conversely, in historical episodes that truly match the FGP's radical regime-change assumption, the model's dramatic predictions align reasonably well with the data.

2.1 The Model

We use the textbook three-equation, log-linear New-Keynesian model (Woodford, 2003; Galí, 2015):

$$y_t = \mathbb{E}_t y_{t+1} - \sigma(i_t - \mathbb{E}_t \pi_{t+1} - r_t^n), \tag{1}$$

$$\pi_t = \kappa y_t + \beta \mathbb{E}_t \pi_{t+1}, \tag{2}$$

$$i_t = \max\{0,\ \phi_\pi \pi_t + \phi_y y_t + r_t^n + \varepsilon_t\}. \tag{3}$$

Here y_t is the output gap, $\pi_t = \log(P_t/P_{t-1})$ inflation, and ε_t a monetary-policy shock. Following Eggertsson and Woodford (2003), the nominal rate is written $i_t = \log R_t$ and r_t^n denotes the natural real rate. The zero lower bound (ZLB) is imposed by the $\max\{\cdot, 0\}$ operator.

Because the IS and Phillips curves are forward-looking, the entire path of expected real rates drives current demand, making forward guidance potentially powerful.

When the policy rate is strictly positive, the model has a unique bounded solution when

$$\phi_\pi + \frac{1-\beta}{\kappa}\phi_y > 1, \tag{4}$$

(Woodford, 2003, Prop. 4.3). This "active policy" condition ensures the real rate rises after an inflationary shock; a violation corresponds to passive policy, with the special case $\phi_\pi = \phi_y = 0$ representing an interest-rate peg.

2.2 The Deflationary Spiral

We begin with the deflationary spiral in Eggertsson and Woodford (2003) and then show that the forward-guidance puzzle is simply its mirror image. The difference is that, during the spiral, the policy rule (3) is *suspended*: the central bank cannot cut rates below zero but can always raise them.

For closed-form intuition we temporarily set $\beta = 0$; numerical simulations later use conventional $\beta < 1$. Suppose the natural rate falls to $r_S^n < 0$ for τ periods, after which it reverts to r_L^n and policy returns to an active Taylor rule. The nominal rate path is

$$i_t = \begin{cases} 0, & 0 < t \leq \tau, \\ \phi_\pi \pi_t + \phi_y y_t + r_L^n, & t > \tau. \end{cases}$$

With the ZLB binding for $t \leq \tau$, the IS curve collapses to a single forward-looking equation,

$$y_t = (1 + \kappa\sigma)\, E_t y_{t+1} + \sigma r_S^n, \tag{5}$$

and inflation is simply $\pi_t = \kappa y_t$. Imposing $y_t = \pi_t = 0$ for all $t \geq \tau$, backward induction yields

$$y_t = \sum_{j=0}^{\tau-t} (1 + \kappa\sigma)^j \sigma r_S^n = \frac{(1 + \kappa\sigma)^{\tau-t} - 1}{\kappa}\, r_S^n, \qquad \pi_t = \kappa y_t. \tag{6}$$

Because $(1 + \kappa\sigma) > 1$ and $r_S^n < 0$, the output gap collapses without bound as the duration τ lengthens: falling inflation raises the real rate, which further depresses demand—a self-reinforcing spiral.

Reversing the sign of r_S^n under the same passive peg flips every inequality and produces the explosive *forward-guidance amplification* analyzed in the next subsection.

2.3 The Forward-Guidance Puzzle Thought Experiment

The forward-guidance experiment is the mirror image of the deflationary spiral. With the policy rate *pegged*, an anticipated rate cut triggers an inflation–output feedback loop that grows the farther the cut is pushed into the future. The mechanism is identical—only the sign differs. Whereas the ZLB prevents cuts in a downturn, the FGP assumes the central bank will *not* raise rates when inflation overshoots, effectively suspending the policy rule (3) and marking a major regime change.

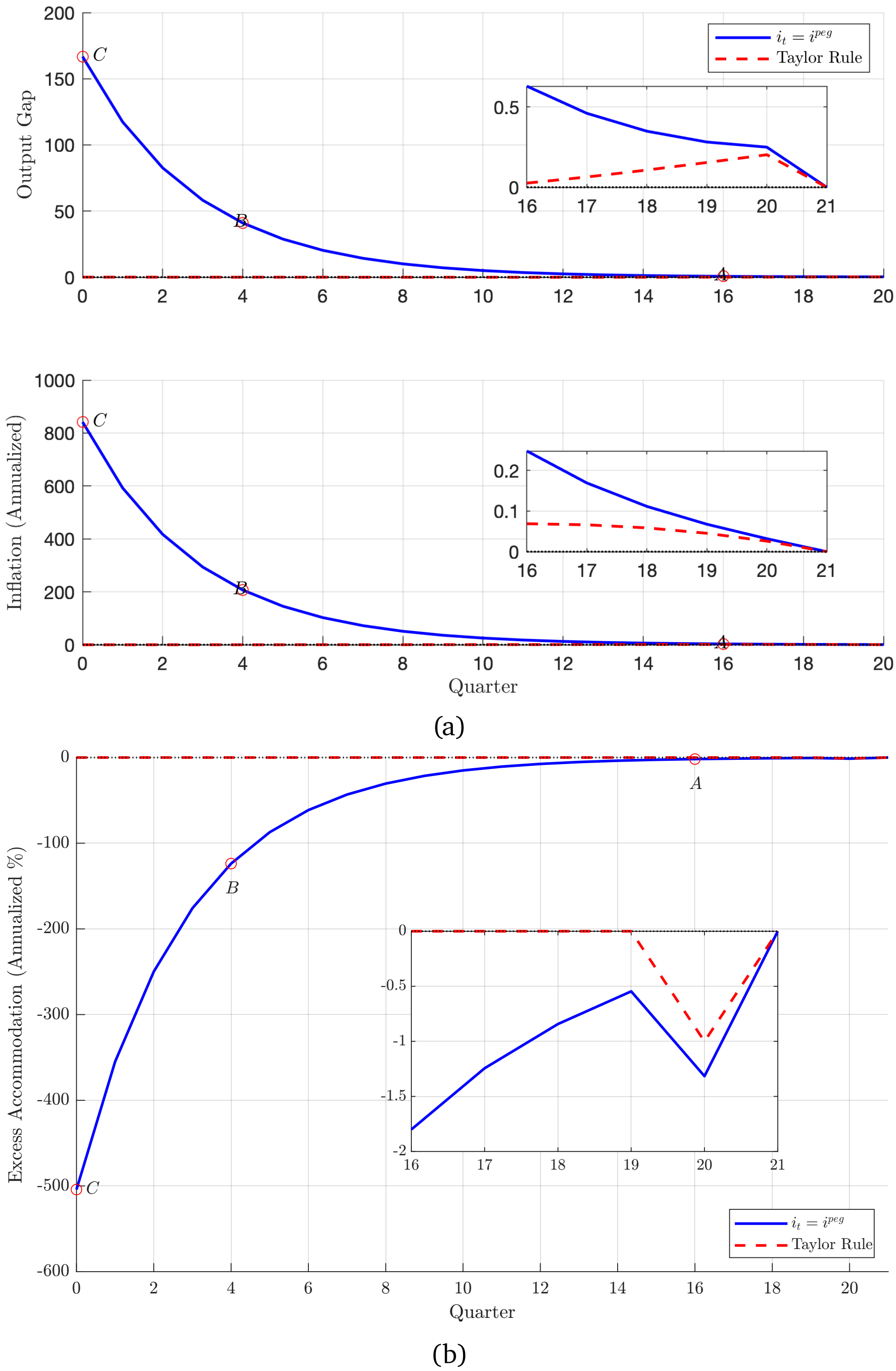


Figure 1: Top: Time path of output and inflation after a 1% rate cut in 20 quarters. Bottom: The solid line shows excess accommodation from holding rates constant relative to a Taylor rule after a 1% shock in 20 quarters. The dashed line indicates zero excess accommodation under a Taylor rule (except in the period when the shock actually hits). Y-axis is in percentage points. The insets highlight quarters 16 to 20.

At time 0 the central bank announces a cut of size Δ to occur in T quarters ($E_0\varepsilon_T = -\Delta$) and keeps the rate pegged in the interim:

$$i_t = \begin{cases} i^{\text{peg}}, & 0 < t < T, \\ i^{\text{peg}} - \Delta, & t = T, \\ \phi_\pi \pi_t + \phi_y y_t + r_t^n, & t > T. \end{cases} \tag{7}$$

For symmetry we set $\Delta = -r_L^n$ and $i^{\text{peg}} = 0$, so the peg extends the ZLB into a period when the natural rate is positive. With $\beta = 0$ for closed-form intuition, the IS curve for $t \leq T$ reduces to

$$y_t = (1 + \kappa\sigma) E_t y_{t+1} + \sigma r_L^n, \tag{8}$$

implying

$$y_t = \frac{(1+\kappa\sigma)^{T-t} - 1}{\kappa} r_L^n, \qquad \pi_t = \kappa y_t. \tag{9}$$

This is the same expression as in the deflationary case, except r_L^n now has the opposite sign. Because $(1 + \kappa\sigma) > 1$ and $r_L^n > 0$, output and inflation grow explosively with the peg horizon T.

Figure 1a shows the dynamics using textbook parameters with $\beta = 0.99$.[4] Points A, B, C correspond to cuts 4, 16, 20 quarters ahead; pushing the cut outward magnifies the impact exponentially.

The explosion arises only because the central bank abandon its policy rule between announcement and implementation. If the reaction function in (3) remains in force, the peg would be lifted in response to output growth and inflation. The puzzle disappears. Hence the large effect of forward-guidance requires a deliberate regime change; absent that commitment, the standard New Keynesian model predicts moderate effects, as we discuss next.

[4]Built on Galí (2015), $\sigma = 1$, $\kappa = 0.1275$, $\Delta = 1$ pp, $i^{\text{peg}} = r_t^n$. Results are robust to alternative calibrations.

2.4 There is No Forward-Guidance Puzzle without a Regime Change

To show the FGP disappears in the absence of a regime change, we replace the interim peg with the policy rule (3) and assume it satisfies condition (4). There are variety of other ways of characterizing policy in the interim, such as optimal policy, leading to the same basic conclusion. Returning to the $\beta = 0$ case for a closed-form solution, suppose the central bank still announces a cut of size Δ at T, but follows the policy rule from $t = 0$ up to and including $t = T$:

$$i_t = \begin{cases} r_t^n + \phi_\pi \pi_t + \phi_y y_t - \Delta, & t = T, \\ r_t^n + \phi_\pi \pi_t + \phi_y y_t, & t \neq T. \end{cases} \tag{10}$$

With this rule, the model collapses to

$$y_t = \frac{1 + \kappa\sigma}{1 + \sigma(\phi_\pi \kappa + \phi_y)} E_t y_{t+1}, \tag{11}$$

and because $\phi_\pi \kappa + \phi_y > \kappa$, the coefficient is strictly less than one. Imposing terminal conditions $y_t = \pi_t = 0$ for $t > T$ gives

$$y_T = \frac{\sigma\Delta}{1 + \sigma(\phi_\pi \kappa + \phi_y)}, \tag{12}$$

$$y_t = \left(\frac{1 + \kappa\sigma}{1 + \sigma(\phi_\pi \kappa + \phi_y)} \right)^{T-t} \frac{\sigma\Delta}{1 + \sigma(\phi_\pi \kappa + \phi_y)}, \qquad t < T. \tag{13}$$

Since the multiplier in parentheses is below one, the impact of a future shock now *diminishes* the farther into the future it occurs. The single eigenvalue lies inside the unit circle, so the system is no longer backwards explosive.

This illustrates an underappreciated point: it is *not* inherent to the New Keynesian model that a shock at $t + 2$ has a larger effect than one at $t + 1$. Following the policy rule, the opposite is true. What *is* inherent is that a two-period regime change moves the economy more than a one-period regime change, as intuition suggests.

Figure 1a confirms the result under conventional parameters ($\beta = 0.99$): the red dashed lines show that a shock five years ahead has virtually no effect today.[5] Thus the explosive FGP arises only under a deliberate regime change that suspends the normal reaction to inflation and output.

[5] $\kappa = 0.1275$, $\sigma = 1$, $\Delta = 1$ pp. Results are robust to alternative calibrations.

2.5 Forward Guidance at the ZLB

So far we have shown that forward guidance is innocuous when policy remains active. What changes if the policy rate is already at the ZLB? Since Eggertsson and Woodford (2003) it has been understood that, in such circumstances, keeping the rate at zero until a future date *may even be optimal*.[6]

This scenario is what sparked the FGP literature. Figure 1 of Del Negro et al. (2023) shows their model predicts output growth jumping from 2% to nearly 9% on the mere announcement of a two-year peg (2012Q3–2015Q2), even though the implied deviation from baseline is only 15bp at the end of 2014.

We replicate that exercise in a stripped-down model to demonstrate that the *entire peg*—not the 15bp tweak—drives the boom. Start with the $\beta = 0$ economy. Let the natural rate fall to $r_S^n < 0$ at $t = 0$, returning to its steady-state value r_L^n at $t = \tau + 1$. Without forward guidance, output at impact is

$$y_t = \frac{(1+\kappa\sigma)^{\tau-t} - 1}{\kappa} r_S^n,$$

a deflationary spiral that deepens with τ.

Now suppose the central bank commits to keep $i_t = 0$ for an additional T quarters, i.e. through $\tau + T$, before reverting to its active rule. Combining the inflationary and deflationary expressions yields

$$y_t = \begin{cases} \dfrac{(1+\kappa\sigma)^{\tau+T-t} - 1}{\kappa} r_L^n, & \tau < t \leq \tau + T, \\ (1+\kappa\sigma)^{\tau-t+1} \dfrac{(1+\kappa\sigma)^{T-1} - 1}{\kappa} r_L^n + \dfrac{(1+\kappa\sigma)^{\tau-t} - 1}{\kappa} r_S^n, & 0 < t \leq \tau. \end{cases} \tag{14}$$

The first term is the inflationary spiral that drives the boom; the second is the lingering deflationary drag. Crucially, the multiplier $(1+\kappa\sigma)^{\tau-t+1}$ shows how passivity *perpetuates* the boom backward to time 0. Thus the FGP at the ZLB is still a regime change: the central bank promises not to react even if inflation and output soar.

[6] Eggertsson and Woodford (2003) formulate the commitment in terms of state-contingent triggers—raising the rate once inflation or the output gap hit thresholds—rather than a fixed calendar path. A predetermined nominal path is generally compatible with multiple equilibria. In practice the ZLB duration can shorten endogenously if inflation accelerates.

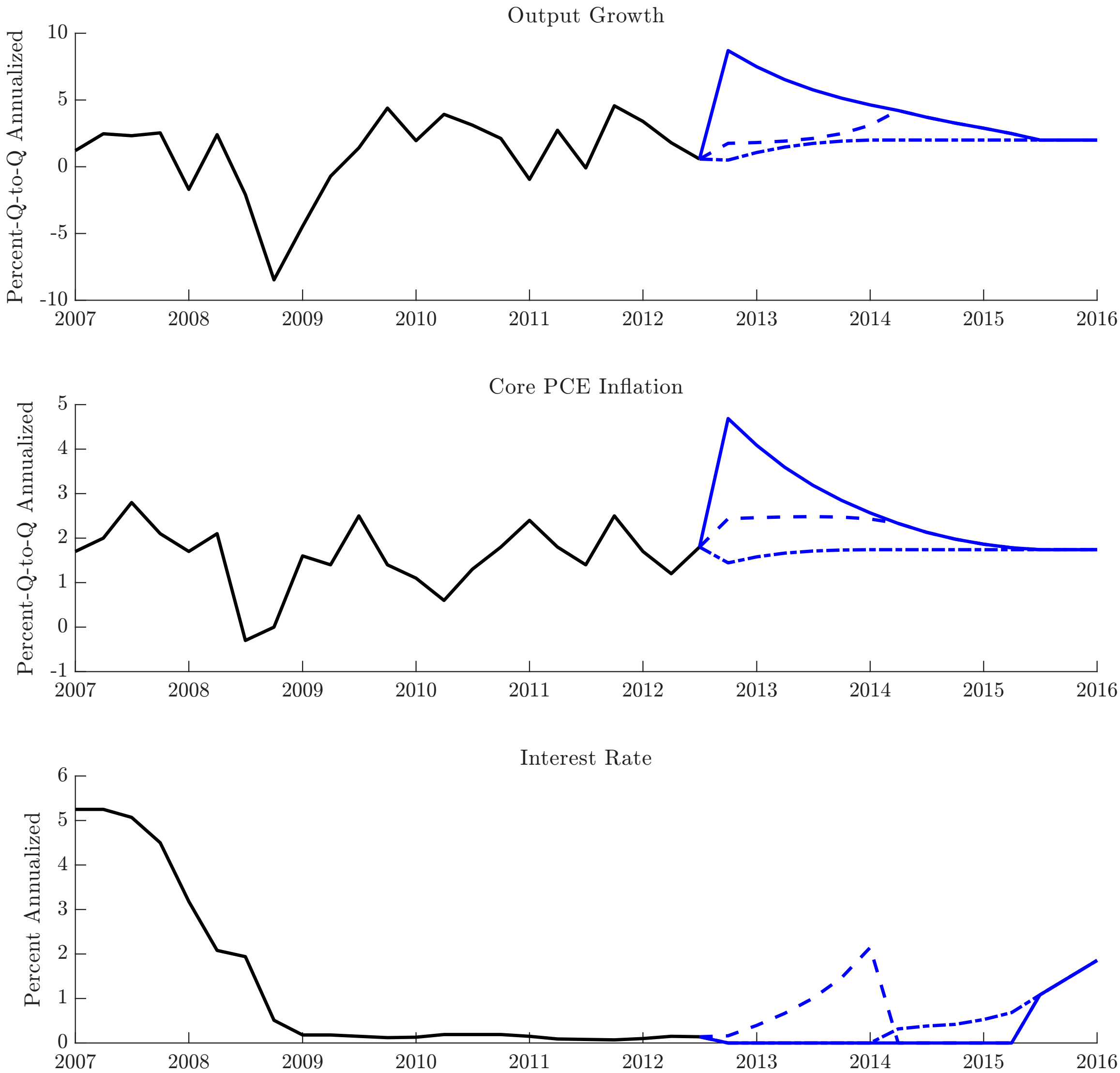


Figure 2: A replication of Del Negro et al. (2023) Figure 1. The solid blue line is our calibration, designed to roughly replicate the paths of output growth, inflation, and the federal funds rate in the original figure when the central bank commits to keep the interest rate pegged at 25 basis points until 2015Q2. The dash dotted blue line shows what our model predicts would have happened to output and inflation without forward guidance. And the dashed blue line shows what would have happened with the commitment to keep the interest rate at zero from mid-2014 to 2015Q2, but with active monetary policy in all other periods.

We confirm this in a calibrated version with $\beta = 0.99$ and a gradual natural-rate path that matches Figure 1 of Del Negro et al. (2023).[7] Figure 2 reproduces their output and inflation boom (solid blue) and the no-guidance baseline (dash-dotted). The dashed blue line overlays the path when the peg is kept but the Taylor rule remains active in all other periods; the boom all but disappears, and by 2014 Q1 the ZLB is no longer binding—policy would raise the rate by about 2 percentage points.[8]

Hence, even at the ZLB, explosive forward-guidance effects hinge on a radical suspension of the usual reaction function. During the Great Recession no central bank embraced such a commitment; forward-guidance statements were explicitly state-contingent. To find policy regimes that truly mimicked an unconditional peg we must look back to the Great Depression, to which we now turn.

3 Evidence from the Great Depression

In this section, we examine four events during the Great Depression which we view as major regime changes. Evidence from these four regime changes leads us to conclude that the effects of forward guidance in the New Keynesian model are consistent with the data, at least in broad terms. The model successfully reproduces the data for forward guidance durations that align with shifts in the anticipated ZLB duration, which we infer from changes in the 3-year yield using the expectations hypothesis of the term structure, our reading of the historical narrative, and evaluation of inflation expectations in the prior literature.

The four pivotal events we study are:

1. Franklin D. Roosevelt's inauguration as President in March 1933, which ushered in the New Deal era, the elimination of the gold standard, and, crucially, a commitment to reflate prices to their 1926 level.

2. Marriner S. Eccles' accession to the Chair of the Federal Reserve Board in November 1934, which brought the Federal Reserve on board with the inflation objective and the ambitious New Deal program, helping to break a crisis of confidence in the original price-level pledge.

[7] Parameters: $\kappa = 0.0899$, $\sigma = 0.7089$, $r^n_S = -2.38\%$, $r^n_L = 11.6$ bp, $\overline{\pi} = 1.7\%$. See Appendix B for details.

[8] The same occurs in the original New-York-Fed model: their rule (a moving-average variant) also calls for tightening once inflation accelerates.

3. The administration's premature retreat from Roosevelt's commitment to reflate prices in the mistake of 1937. This shocked markets and led to the sharpest recession in U.S. economic history.

4. The subsequent policy reversal in March 1938, when policymakers recognized and corrected their 1937 misstep and once again re-committed to reflation.

These episodes share two key features that are central to our approach.

First, they focus on expectations about future economic policy. Specifically, when the Roosevelt administration assumed power in April 1933, it committed to inflating prices back to their 1926 levels within 3–4 years. This commitment implied approximately 10 percent annual inflation if achieved. Eggertsson (2008) discusses this policy in detail. The subsequent three regime breaks either strengthened or weakened the perceived commitment to reflate the price-level. Eggertsson and Pugsley (2006), for instance, shows that a drop in the credibility of the inflation commitment in 1937 can explain the Recession of 1937. We identify these policies as clear examples of forward guidance: Economic policymakers communicated specific objectives for future inflation, which implied a reduction in real interest rates due to an increase in expected inflation and, with short-term interest rates already stuck at zero, an increase in expected future monetary accommodation as measured by expected duration of short-term interest rate at the ZLB. The historical data suggest they succeeded.

Second, the four episodes occurred when the short-run interest rate—the 3-month yield, shown in blue in Figure 3c—remained stuck near zero. As a result, we can treat the Great Depression as a ZLB episode. We assume a negative shock to the natural interest rate caused the Great Depression and that this shock was large enough to keep the lower bound binding throughout. Through the lens of the expectations hypothesis of the term structure, this allows us to interpret changes in long-run yields as changes in expectations about the duration of the ZLB—in other words, expectations of an extended duration at the ZLB as in the FGP experiment. As we will show, long-run yields moved substantially around each of our four episodes, suggesting that the regime shifts were interpreted as commitments to maintain the interest rate at zero even after the natural rate reverted to normal.

We adhere to the textbook New Keynesian model throughout—not because we believe it provides the best possible description of the Great Depression but because it offers a benchmark for evaluating the central core of the New Keynesian model's predictions about forward guidance. The textbook model features no discounting in the IS equation, no deviations from rational expectations, and no mechanism generating inertia in the variables. Output and inflation therefore respond especially strongly and quickly to announcements about future policy. In this sense, our results are conservative as the model likely exaggerates the response of output to forward guidance.

Episode	**△ 3-Year Yield**	**Months of FG**		**Δ Output (Y)**		
		Estim. from Yield Curve	Chosen to Match ΔY	Estim. from Yield Curve	Chosen to match ΔY	Obs. Data
	$(\Delta\%)$	(months)	(months)	$(\Delta\%)$	$(\Delta\%)$	$(\Delta\%)$
FDR Takes Office	-0.88	11	14	6.58	8.81	8.65
Eccles Nominated	-1.18	35	35	26.72	24.49	24.23
Mistake of 1937	0.85	15	20	-23.69	-19.27	-18.46
Reversal of 1938	-0.67	27	29	12.11	10.27	9.81

Table 1: Preview of Results. Second column is changes in 3-year yields over period of gray shaded areas in figure 3 in percentage points. Next two columns are durations of forward guidance in months. The first column labeled Estim. from Yield Curve is changes in duration at the ZLB implied by the yield curve, the next column labeled Chosen to Match ΔY are changes in duration needed for model to match the data. The next three columns are changes in output following each regime change in response to the forward guidance in columns 3 and 4. The last column contains observed changes in output in the data.

Yet we show that even in this simple model, where forward guidance has the most extreme effect, is not unrealistically powerful. As the preview our results in Table 1 demonstrates, the New Keynesian model predicts that regime changes have large effects on output and inflation, and the data confirm that this is indeed the case, even if the response is more gradual as predicted by more empirically grounded versions of the New Keynesian models.

As we stress in the introduction, our central contention is not that the most basic version of the New Keynesian model provides the best fit to the data. Instead, it is that the strong reaction to forward guidance should not be considered puzzling in light of the data from the Great Depression which best corresponds to the FGP thought experiments in this literature.

We show in the appendix that these results remain valid in a model with habit formation—better matching the more gradual changes in output observed in the data—and when we account for parameter uncertainty using Bayesian methods.

We begin this section by describing our model, calibration procedure, and empirical exercise in Section 3.1. We then discuss our findings alongside the historical narrative in Section 3.2. Section 3.3 presents external evidence to validate our conclusions.

3.1 Model and Calibration

This section describes the model and calibration we use to capture the Great Depression. Our strategy is to keep the model as simple as possible, adhering to the textbook New Keynesian model with a two-state Markov process for the natural rate of interest. We calibrate this model to match the decline in output and inflation from 1929 to 1933. We then solve for the duration of forward guidance needed to match the subsequent recovery (or further contraction) following each of the regime changes. Finally, we show that these durations of forward guidance match up well with evidence on expectations for short-term rates from the yield curve.

3.1.1 Model

Our strategy is to write the simplest possible model capable of generating the drop in output from 1929 to 1933 and the subsequent recovery. We use the textbook New Keynesian model as our starting point to highlight that even at its core, the New Keynesian model is not out of line with the data.

To generate the large drop in output from 1929 to 1933, we assume that the Great Depression resulted from a negative shock to the natural rate of interest of unknown duration. The shock follows a two-state Markov process. The natural rate drops to $r_S^n < 0$ in 1929, where S stands for short-run. Every month, there is a probability α that the natural rate reverts to $r_L^n = -\log\beta$, its long-run steady state value, and a probability $1-\alpha$ that it stays at r_S^n. Once the natural rate reverts to r_L^n, it stays there forever.

In this setup, absent any forward guidance, output and inflation are the same in every period while $r_t^n = r_S^n$ and jump to the steady state as soon as $r_t^n = r_L^n$. Adding forward guidance—a commitment to keep the nominal interest rate at zero for T months after r_t^n reverts to r_L^n—changes expected future output and inflation. Because of the forward-looking nature of the model, expected future output and inflation effect output and inflation while the natural rate is in the low state. If τ is the stochastic period when the natural rate reverts to r^n_L, then output and inflation in the low state are

$$y_t = \sigma\delta_y r^n_S + \alpha\delta_y \mathbb{E}_t y_\tau + \frac{\sigma\alpha}{1-\beta(1-\alpha)}\delta_y \mathbb{E}_t \pi_\tau, \tag{15}$$

$$\pi_t = \sigma\delta_\pi r^n_S + \alpha\delta_\pi \mathbb{E}_t y_\tau + \frac{\alpha\sigma\delta_\pi + \beta\alpha}{1-\beta(1-\alpha)}\mathbb{E}_t \pi_\tau, \tag{16}$$

where $\delta_y = \frac{(1-\beta(1-\alpha))}{\alpha(1-\beta(1-\alpha))-\sigma\kappa(1-\alpha)}$ and $\delta_\pi = \frac{\kappa}{1-\beta(1-\alpha)}\delta_y$. Without forward guidance, $\mathbb{E}_t y_\tau = \mathbb{E}_t \pi_\tau = 0$. With forward guidance, we can solve backwards from the terminal condition $\mathbb{E}_t y_{\tau+T} = \mathbb{E}_t \pi_{\tau+T} = 0$ using Equations (1) and (2). Given α, σ, κ, r^n_L, and r^n_S, we can use Equations (1), (2), (15), and (16) to calculate y_t and π_t for any given duration of forward guidance T.

It is well understood in the literature (see for instance Eggertsson and Egiev (ming)) the two-state Markov process for r^n_t implies that output and inflation in the low state are constant and adjust immediately to news about future output and inflation, creating a step-like pattern in response to changes in forward guidance. Adding habit formation in consumption generates more gradual output responses to changes in forward guidance. We add a simple form of habit formation in the appendix to show how the model can then match the more gradual fall and recovery in output.

We to run the following experiment: after calibrating the model to match the bottom of the Great Depression in February 1933, we ask for what T—that is, for what duration of forward guidance—the model matches the movements in output following each of our four episodes. We then compare the changes in forward guidance durations to the changes in 3-year yields in the data to see whether or not they are plausible. The interpretation is straightforward: If the model requires similar or longer durations at the ZLB (T) than suggested by yield curve, then forward guidance is not unreasonably powerful in the model. Our main conclusion is that it is not.

3.1.2 Calibrating the Model Parameters

In this section, we describe how we calibrate the five parameters (α, σ, κ, β, and r^n_S) of our simple model of the Great Depression. We use the yield curve to calibrate β and α, then calibrate σ, κ, and r^n_S to match the decline in aggregate output (approximated by industrial production) and inflation from 1929 to 1933. We approximate GDP with industrial production, as it is available at a monthly frequency, whereas GDP is only available annually for this period. Our numerical experiment relies on the monthly timing of the regime changes.

Since the Federal Reserve was effectively pursuing a zero-inflation policy before the Depression, we calibrate β so that the long-run natural rate of interest, $r_L^n = -\log\beta$, matches the average 20-year yield in 1929: $r_L^n = 3.47\%$ annualized.[9] This implies $\beta = 0.9971$, measured at a monthly frequency. The 20-year yield, shown by the red line in Figure 3, remained stable throughout the Great Depression, so calibrating to match the 20-year yield at a different point in time does not significantly affect our results.

For a given r_L^n, we can infer α from changes in 3-year yields (the green line in Figure 3). The expectations hypothesis of the term structure suggests that the x-month yield in month t, i_t^x, depends on the expected path of the one-month yield, i_t^1, as follows:

$$i_t^x = \sum_{s=0}^{x} E_t\left(i_{t+s}^1\right). \tag{17}$$

The two-state Markov process for the natural rate of interest, together with the policy rule, implies that the one month nominal interest rate can take only two values in our model: $i_t^1 = 0$ while $r_t^n = r_S^n$, and $i_t^1 = r_L^n$ otherwise. Absent any forward guidance, the 3-year yield is therefore

$$i_t^{36} = \sum_{s=0}^{34}(36-(1+s))\alpha(1-\alpha)^s r_L^n \tag{18}$$

The 3-year yield in January 1933—the trough prior to the start of the Roosevelt administration—was 1.97% annualized, implying that agents expected the short-run nominal rate, i_t, to remain at 0 for about 18 months before returning to r_L^n. Assuming $T = 0$ before Roosevelt took office, we conclude that $\alpha = 0.0564$, or $1/\alpha \approx 18$.

With α and r_L^n in hand, we calibrate κ, σ, and r_S^n to match the decline in output and inflation from 1929 to 1933, subject to priors for these three parameters. We use monthly CPI inflation numbers from the NBER's Macro History Database and the Federal Reserve's monthly industrial production series, rescaled to match the 30% decline in

[9] While the Federal Reserve was technically operating under the gold standard until Roosevelt took office, for most of this period gold reserves were not a binding constraint on monetary policy. Even when the U.S. experienced a $750 million gold outflow September 17 to October 30, 1931, the Federal Reserve still had over $1 billion gold reserves more than what they needed to back the money supply. As Meltzer (2003) points out, "between January 1930 and October 1931 [...] the System's reserve ratio never fell below 75 percent, was above the average for the decade of the twenties, and generally was more than twice the required ratio." Furthermore, throughout the downturn, several of the Federal Reserve governors expressed concerns that loose policy would be inflationary, and hoped that recovery could be achieved without inflation. Before the onset of the Depression as well, the U.S. experienced gold inflows, not outflows, and generally policy was not constrained by the gold standard.

output from 1929 to 1933, as our measure of output.

Formally, we assume that deviations between the model and the data are driven by normally distributed error terms.

$$y^{\text{data}}_{\text{Mar,1933}} = y^{\text{model}}_{\text{Mar,1933}} + \varepsilon_y \tag{19}$$

$$\pi^{\text{data}}_{\text{Mar,1933}} = \pi^{\text{model}}_{\text{Mar,1933}} + \varepsilon_\pi \tag{20}$$

Where $\varepsilon_y \sim N\left(0, \sigma_y^2\right)$ and $\varepsilon_\pi \sim N\left(0, \sigma_\pi^2\right)$. To ensure that we hit the target data points as closely as practically possible from a computational perspective, we set $\sigma_y^2 = \sigma_\pi^2 = 10^{-5}$.

Let $\Omega = [\kappa, \sigma, r_S^n]'$ be the vector of parameters. Then the posterior likelihood of Ω given the data is:

$$p\left(\Omega|X\right) = \frac{P(X|\Omega)P(\Omega)}{p(X)}. \tag{21}$$

We solve for the $\widehat{\Omega}$ that maximizes the log-likelihood of the posterior. Ignoring constants that don't depend on the parameters, we solve

$$\widehat{\Omega} = \max_{\Omega} -\frac{\left(y^{\text{model}}_{\text{Mar,1933}} - y^{\text{data}}_{\text{Mar,1933}}\right)^2}{2\sigma_y^2} - \frac{\left(\pi^{\text{model}}_{\text{Mar,1933}} - \pi^{\text{data}}_{\text{Mar,1933}}\right)^2}{2\sigma_\pi^2} + \sum_{\omega\in\Omega} \ln p(\omega) \tag{22}$$

Where $y^{\text{model}}_{\text{Mar,1933}}$ and $\pi^{\text{model}}_{\text{Mar,1933}}$ are obtained from Equations (15) and (16), assuming no forward guidance. We assume truncated normal priors for κ, σ, and r_S^n, all truncated to be positive.[10] Table 2 reports the priors and resulting posterior mode estimates for each of the three parameters. We document the distribution of the entire posterior in the Appendix, as well as how the priors are formed.

Table 2: Priors and posterior mode estimates for κ, σ, and r_S^n.

Parameter	Prior Mean	Prior S.D.	Posterior Mode	Prior Distribution
κ	0.0020	0.0100	0.0017	Truncated Normal
σ	1.0000	0.5000	0.9540	Truncated Normal
r_S^n	0.0100	0.0050	0.0098	Truncated Normal

We run two numerical experiments using the model parametrized as described above. First, we plug estimated durations of forward guidance from the yield curve—we de-

[10] Because κ and r_S^n very close to zero, truncated normal distributions works better for our setting than the more standard gamma distribution often used in the lietarature.

scribe how we get these in the next section—into the model to see how closely the model matches the data given these forward guidance durations.

Second, for each of the four episodes, we find the duration of forward guidance, T, that solves

$$\widehat{T} = \min_{T} \left(y^{\text{data}}(T) - y^{\text{model}}\right)^2, \tag{23}$$

where $y^{\text{data}}(T)$ is the model's prediction for output with T months of forward guidance and y^{data} is the target level of output taken from the data. For the first episode, we target output in November 1934 and find $\widehat{T} = 17$. For the second episode, we target output in April 1937 and find $\widehat{T} = 35$. For the third episode, we target output in June 1938 and find $\widehat{T} = 19$. Finally, for the fourth episode, we target output in April 1939 and find $\widehat{T} = 29$. In each case, these durations for forward guidance are both close to what the yield curve suggests and far beyond anything seen in the estimated effects of monetary policy on the expected duration at the ZLB in the modern era (Bundick and Smith, 2020). It takes a true regime change in monetary policy to generate large recovery in output following the Great Depression.

3.1.3 Estimating the Duration of Forward Guidance From the Yield Curve

We now use the observed data on longer-term yields to determine whether the amount of forward guidance the model needs to match the data is reasonable. We find that it is.

We estimate durations of forward guidance using data for 3-year Treasury yields from Cecchetti (1992) and the expectations hypothesis of the term structure. Due to data constraints, these estimates inevitably carry some uncertainty. Because the FGP posits that forward guidance is unreasonably powerful in the New Keynesian model, it is natural to consider an upper bound on how large forward guidance could plausibly be as measured by changes in the expected duration at the ZLB. If the model does not overstate the responses of output and inflation to these upper bound forward guidance durations then we can comfortably conclude that there was no FGP during the Great Depression.

We therefore attribute the entire peak-to-trough (or trough-to-peak) change in 3-year yields in Figure 3 around each episode to changes in forward guidance. These peak-to-trough periods are represented by the shaded areas. We then use the expectations hypothesis to translate these yield changes into changes in the expected time at the ZLB. We recognize that this may exaggerate the degree of forward guidance, but that should, if anything, lead to a deeper forward guidance puzzle than if we choose a smaller change in the 3-year yield.

We can use a similar procedure to estimate changes in the expected duration at the ZLB to the procedure we use to estimate α. Suppose the central bank changes its commitment to keep interest rates at the ZLB from T_1 periods to T_2 periods. Interest rates now remain at 0 until $\tau + T_2$ instead of until time $\tau + T_1$, and then return to r_L^n.

This change in forward guidance implies the following change in the 3-year yield

$$\Delta i_t^{36} = \sum_{s=0}^{34} \left(\max\{0, 36 - T_2 - (1+s)\} - \max\{0, 36 - T_1 - (1+s)\}\right) \alpha (1-\alpha)^2 r_L^n \quad (24)$$

Inserting observed changes in the 3-year yield gives us a sense of reasonable changes forward guidance durations.

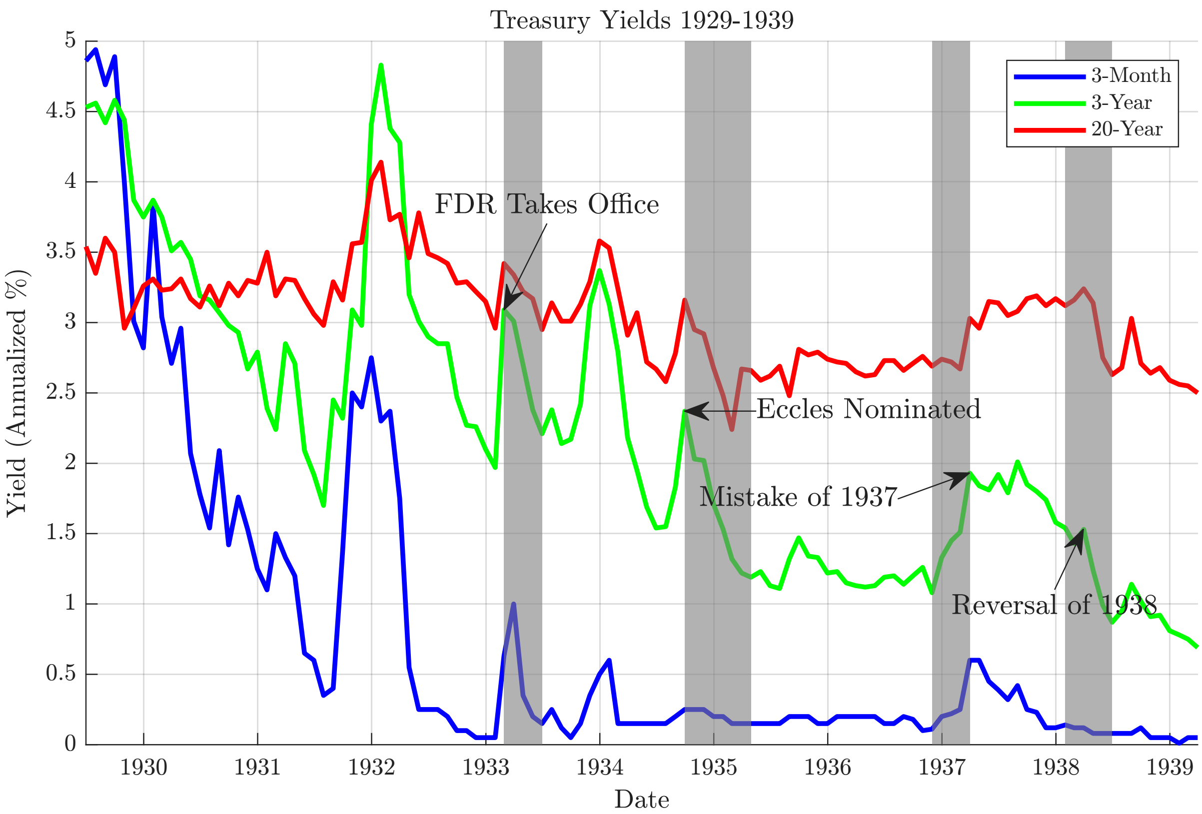


Figure 3: U.S. Treasury yields at various maturities. The shaded regions indicate changes in 3-year yields we use to estimate changes in the expected duration of the ZLB. Source: Cecchetti (1988).

For the first episode, the 3-year yield declined by 88 basis points from 28 February to 30 June 1933, corresponding to about 11 additional months at the ZLB. For the second episode, 3-year yields declined by 118 basis points from 30 September 1934 to 30 April 1935, implying a 24-month increase in the expected ZLB duration, from 11 to 35 months. For the third episode, 3-year yields rose by 85 basis points from 30 November 1936 to 31 March 1937, implying a 20-month decrease in the expected ZLB duration, from 35 to 15 months. Finally, after the fourth episode, 3-year yields fell by 67 basis points from 31 January 1938 to 30 June 1938, implying a 12-month increase in the expected ZLB duration, from 15 to 27 months.

3.2 Results and Historical Narrative

We now connect the basic results in Table 1 to the historical narrative to show that each of the four events we consider were indeed regime changes, and that the models predictions are consistent with the responses of output and inflation to these regime changes.

As described in the previous section, we use the calibrated model to ask the following two questions: First, according to the New Keynesian model, how would output and inflation respond to the amount of forward guidance suggested by the yield curve? Second, how many additional months would the central bank need to keep interest rates at the ZLB after the natural rate reverts to r^n_L to match the output response observed in the data? In each case, the New Keynesian models predictions are reasonable and closely match the data.

Our central result is that the New Keynesian model does not overstate the power of forward guidance during the U.S. Great Depression. The model predicts that a credible commitment to future inflation and extending the duration of the ZLB can have powerful effects on both output and inflation. This is *borne* out in the data: both grew rapidly during the recovery from the Great Depression. In other words, regime changes have large effects in the model and in the data.

Episode 1: Roosevelt takes office. When Roosevelt assumed office in March 1933, marked by the first vertical dashed line in Figure 4, he immediately launched an ambitious policy agenda to combat the Great Depression. On the monetary policy front, Roosevelt abandoned the gold standard, effectively giving the administration unlimited power to print money, and—more importantly—announced the objective of reinflating prices to their 1926 level. On the fiscal policy front, Roosevelt announced a substantial deficit-financed spending program—nearly doubling government consumption and investment in one year—which helped make this policy objective credible.[11] A May 1st statement in the *Wall Street Journal* exemplifies Roosevelt's thinking:[12]

> [O]ur primary need is to insure an increase in the general level of commodity prices. To this end simultaneous actions must be taken in both the economic and the monetary fields.

Roosevelt's policies represented a significant departure from the Hoover administration. President Hoover was a staunch believer in the gold standard, small government, and no deficits. Interestingly, FDR espoused the same principles in the fall presidential campaign, making the regime change as unexpected as it was radical.[13] Nevertheless, perhaps because of dissent from within his own administration, and especially within the Federal Reserve, the commitment was initially not fully credible.[14] Indeed, during Roosevelt's first year in office, several senior government officials resigned in protest.[15] Indeed, Jalil and Rua (2017) find that inflation expectations moderated after July 1933 due to mixed messaging from the Roosevelt administration. From February 28 to June 30, 1933, the 3-year yield decreased by 88 basis points. This decline is equivalent to about 11 months of forward guidance. In response, output initially jumped by 15% before stalling around 9% above the Great Depression trough.

In our calibration, output rises by 6.6% and inflation rises by 2.6% following 11 month of forward guidance. Relative to the data, the model *understates* the response of output and inflation. We can match the 9% increase in output if the central bank commits to 14 additional months at the ZLB after the natural rate reverts to r_L^n. Setting $T = 14$, the model predicts that output jumps by 8.8% and inflation rises by 3.6%, from

[11] See, for instance, the historical account in Kennedy (2003). For a detailed discussion modeling the Roosevelt administration's response to the Great Depression as a credibility problem, see Eggertsson (2008).

[12] Quoted in Eggertsson and Pugsley (2006).

[13] See Jalil and Rua (2016), who find that newspaper reports during the election campaign (and, indeed, between Roosevelt's victory and inauguration) believed that not much would change when he took office.

[14] For instance, on September 29, 1933, the Chicago bank's executive committee voted unanimously to reduce its share in open market purchases encouraged by the Roosevelt administration. Its committee members did not think additional purchases were necessary, and because Chicago was supposed to take the largest share of new purchases, its decision threatened the entire program. The Boston bank followed suit in November, and between November 1933 and March 1934 the Federal Reserve System entirely ceased purchases. Indeed, Federal Reserve credit declined slightly in 1934, despite the stalling recovery, and if not for Roosevelt taking unilateral action by purchasing gold and silver, the monetary base would have decreased in 1934. For a more complete account of Federal Reserve policy during this period, see Meltzer (2003).

[15] The resignations included Director of the Budget Lewis Douglas and Acting Treasury Secretary Dean Acheson. See Davis (1986).

-10.2% to -6.6%.

While the model's predictions for output are reasonable, forward guidance alone is insufficient to account for the large increase in prices from April 1933 to October 1934. This is hardly surprising in light of the existing literature. The Roosevelt administration introduced widespread policy changes that are difficult to capture with monetary policy alone. For instance, the National Industrial Recovery Act (NIRA), passed in June 1933, temporarily suspended antitrust laws to encourage firms to raise prices and facilitated the ability of unions to demand wage increases. Eggertsson (2012) shows that the NIRA can account for some of the rise in inflation during the initial recovery from the Great Depression. Inflation fell when the Supreme Court repealed the NIRA in May 1935—highlighted by the blue circle in Figure 4b. In January of 1934, the Congress passed the Gold Reserve Act, allowing Roosevelt to raise the dollar price of gold by nearly 70 percent, and giving the Treasury broad authority to make purchases on both domestic and international markets to enforce the new price. This effective devaluation of the dollar may explain the additional rapid increase in prices in early 1934.

Episode 2: Eccles's nomination. By the fall of 1933, Roosevelt realized that the Federal Reserve's lack of cooperation and the dissent amount regional branches of the Reserve were undermining the credibility of the price-level objective. He responded by prioritizing the appointment of a supportive Federal Reserve chair—Marriner S. Eccles, whose appointment was rightly interpreted as a precursor to the Banking Act of 1935. This act concentrate power at the Board, and therefore in Eccles' hands.

Eccles, like Roosevelt, favored an active fiscal and monetary response to the Great Depression. In February 1933, Eccles—then President of the Utah-based First Security Corporation—blamed "the vicious cycle of deflation," which lowered wages and increased the real debt burden on borrowers, for the collapse in output and employment. Mirroring ideas later published in John Maynard Keynes's 1936 *General Theory*, Eccles argued that the decline in wages and the rise in debt burdens had led to a shortfall in demand, causing a further drop in prices and employment in a vicious cycle. The problem, he argued, was that "our dollar is too valuable measured in terms of goods and services,"[16] and the only solution was forceful government intervention. He proposed a large, deficit-financed spending program on financial aid for the unemployed, infrastructure investment, debt relief for farmers, deposit insurance, and canceling wartime sovereign debts. Only then, he argued, could the government "bring about and support

[16] Eccles (1933), p. 706, testimony to the Senate Committee on Finance.

a price-level which will reestablish employment and credit.”[17]

Clearly, Eccles agreed with both the Roosevelt administration’s price-level objective and views his role as keeping the interest rates low. He also recognized the importance of credibility, arguing that “the entire public psychology must be changed through propaganda of the press.”[18] After his appointment as Governor in November 1934, he was determined to align the Federal Reserve with the Roosevelt administration. During Congressional testimony supporting the Banking Act of 1935—which reformed both the banking system and the Federal Reserve—Eccles argued that “the present need is to so modify our banking law as to encourage the banking system to give a full measure of cooperation to efforts at economic recovery.”[19] The Banking Act of 1935 was designed to achieve exactly this: It concentrated power in the hands of the Federa; Reserve Board, ensuring that regional disagreements would no longer lead to a crisis of credibility the Federal Reserves’s commitment to the inflation objective, and gave the President additional power over the centralized governance of the Federal Reserve System. Just as importantly, it concentrated power in the hands of Eccles, in whose view the Federal Reserve should fully accommodate the administration’s inflation objective, maintaining low rates and easy access to credit.[20]

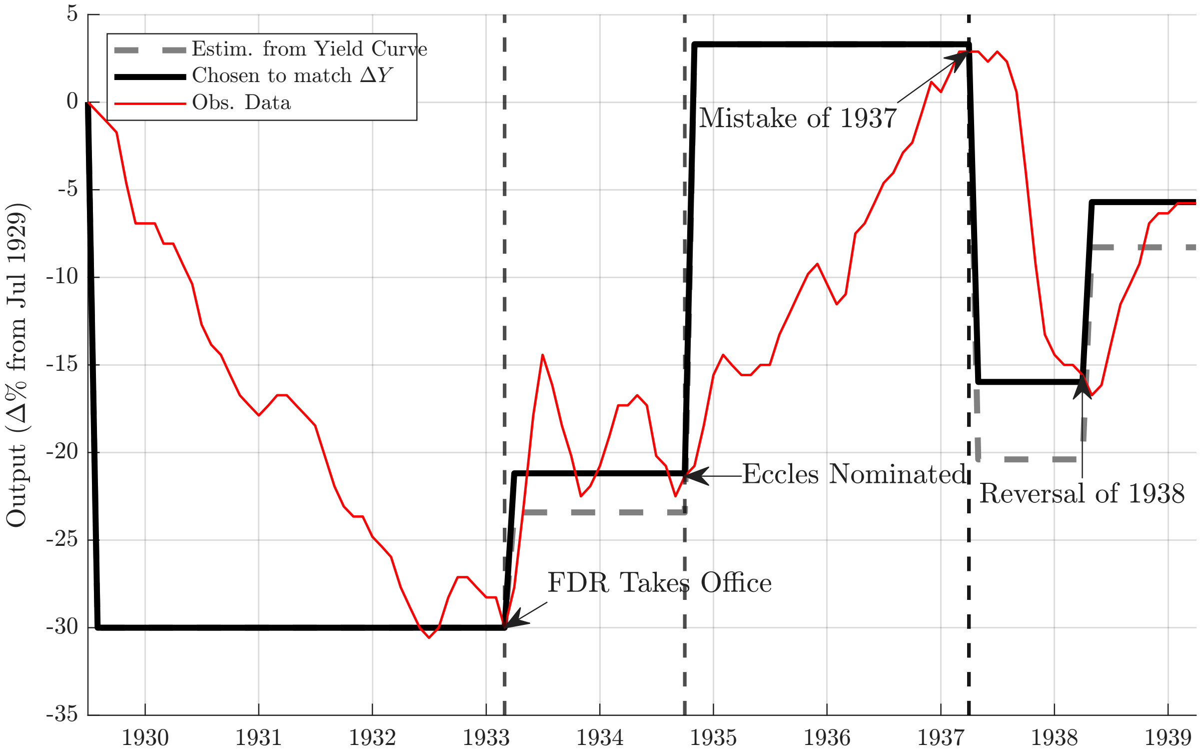
These Eccles’ opinions and the Banking Act of 1935 marked a major departure from the Federal Reserve’s prior stance. In particular, Eccles argued for a departure from the real bills and Riefler-Burgess doctrines in favor of using active monetary policy to promote economic recovery, a regime change that would have been recognized even by the standards of the time. In response, from September 30, 1934, the month preceding Eccles’s nomination, to July 31, 1935, the 3-year yield decreased by 126 basis points—suggesting an additional 24 months of forward guidance, raising T from 11 to 35 months. This shift in expectations ushered in nearly three years of sustained, rapid output growth. By June 1937, output had fully recovered, surpassing its pre-Depression peak by 2.8%.

[17] Eccles (1933), p. 709, testimony to the Senate Committee on Finance.

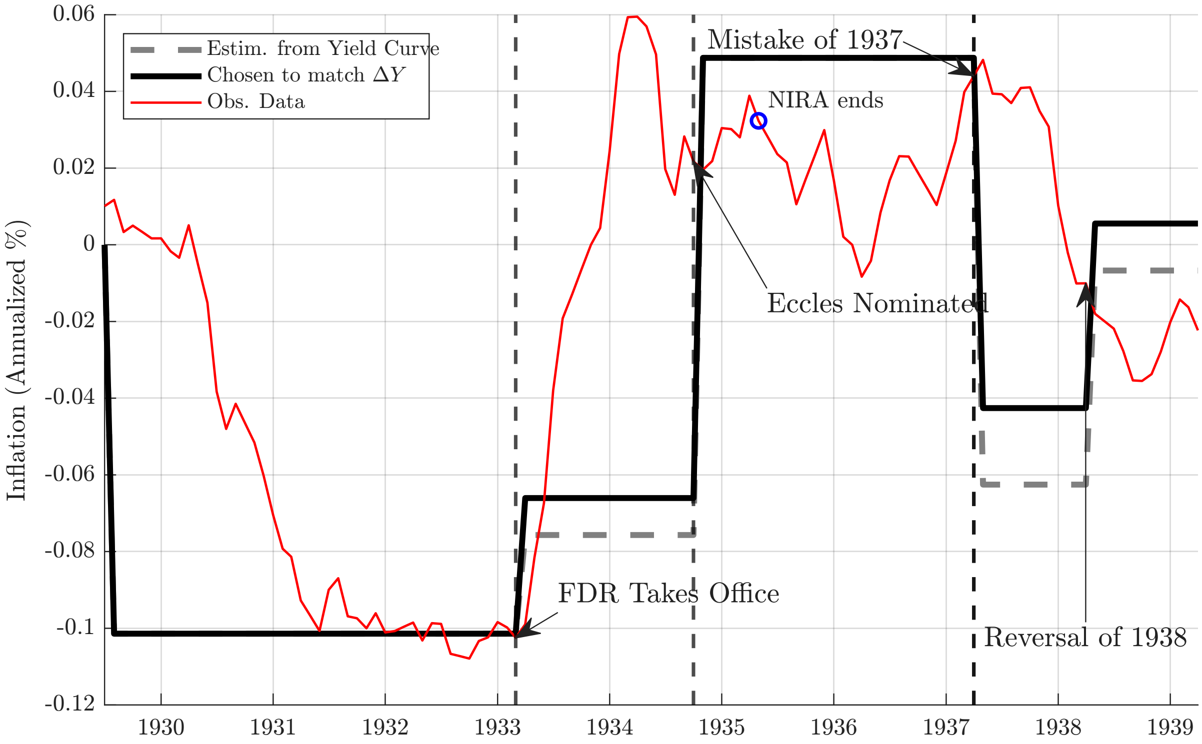
[18] Eccles (1933), p. 720, testimony to the Senate Committee on Finance.

[19] Eccles (1935), p. 180, testimony to the House of Representatives Committee on Banking and Currency.

[20] Indeed, Eccles believed that the position of Governor should be subservient to the President. Ultimately, and against Eccles’s wishes, Congress chose to constrain the President’s power over the Federal Reserve. However, Eccles continued to align himself closely with the Roosevelt administration, even pledging to resign when a new president took office Richardson and Wilcox (2024).



(a)



(b)

Figure 4: **Response of output and inflation.** Solid black lines are response of output (top) and inflation (bottom) to forward guidance picked to match output following regime changes. Dashed gray lines are are response of output (top) and inflation (bottom) to the amount of forward guidance suggested by the yield curve.

In our calibration, output rises to 3.3% above the pre-Depression peak and inflation rises to 4.8% following 35 month of forward guidance, a good match to the data on both output and inflation. In fact, 35 months of forward guidance minimizes the distance between the models predictions and the data. It is exactly what our model would pick to match the recovery in output following Eccles' appointment. Broadly speaking, we our model provides a good match to the output, inflation, and short-term interest rate data, noting that we do not directly target inflation when choosing T, only output.

Episode 3: Mistake of 1937. As the recovery from the Depression gained momentum, the Federal Reserve and the Roosevelt administration became increasingly concerned about potential runaway inflation, even though prices had not yet returned to their 1926 level. The first sign of a looming policy shift came in mid-1936, when the Federal Reserve scheduled a raise in the reserve requirement for August 15 of that year. Initially, the increase in reserve requirement ratios had a limited effect on markets because it was viewed and communicated as primarily a technical change, unrelated to the overall inflation objective, and banks were already holding reserves well in excess of the requirement.[21]

However, circumstances changed by early 1937. On December 23, 1936, the Treasury, led by Henry Morgenthau, began sterilizing the inflow of gold. Instead of allowing gold inflows from abroad to increase reserves, and therefore the money supply, the Treasury started pay for gold by selling debt, effectively keeping total reserves constant in the face of continuing gold inflows. Just over a month later, on January 30, 1937, the Federal Reserve announced two further increases in reserve requirement ratios, scheduled for March and May of that year. This time, the Treasury and the Federal Reserve's actions signaled growing alarm within the administration about the threat of excessive inflation. According to the *Wall Street Journal*, on February 18 Eccles stated that "the short-term rates are excessively low and there may be a tendency for rates near the vanishing point to increase." Although there had been internal discussions at the Federal Reserve for months linking high reserves and gold inflows to inflation, the *Wall Street Journal* went on to report that "This is the first time a member of the board has publicly described the reserve requirement as a device for preventing a further drop in long-term rates."[22]

This statement exemplified forward guidance about the path of interest rates aimed

[21] See the discussion in Orphanides (2004).

[22] *Wall Street Journal*, February 19, 1937, p. 1. See Meltzer (2003) for details on internal discussions.

at preventing inflation. On March 15, in a statement to the *Chicago Daily Tribune*, Eccles said that "The upward spiral of wages and prices into inflationary levels can be as disastrous as the downward spiral of deflation."[23] In a press conference on April 2, Roosevelt made it clear that Eccles was not alone in his concerns: "I am concerned—we are all concerned—over the price rise in certain materials."[24] On the day of this announcement alone, the stock market fell by 6%.

Bond yields responded just as violently, beginning in December 1936. The 3-year yield rose by 85 basis points from November 30, 1936, to March 31, 1937, suggesting about a 20 month reduction in forward guidance—a drop in T from 35 to 15 months. Output, which had stabilized near the pre-Depression peak, plummeted by 18% from July 1937 to May 1938, ushering in the second phase of the Great Depression.

In our calibration, output falls by 23.7% and inflation falls by 11.2% when forward guidance declines from 35 month to 15 months. The model can replicate the output response when we reduce the central bank's forward guidance commitment by 15 months, decreasing T from 35 to 20. With $T = 20$, the model forecasts a 19.2% output decline and a drop in inflation from 4.9% to -4.2%.

Episode 4: The reversal of 1938. The Roosevelt administration reversed course following the rapid decline in output and inflation in late 1937 and early 1938. On February 16, 1938, Roosevelt held a press conference flanked by Treasury Secretary Morgenthau and Federal Reserve Chair Eccles. The *Chicago Daily Tribune* reported: "At his press conference today, the President said that he believes now, as he did in 1933, that achievement of permanent prosperity depends on raising general price-levels to those prevailing in 1926."[25] Two days later, at a press conference on February 18, Roosevelt released a written statement prepared by Morgenthau, Eccles, and economists from various executive departments:

> It is clear that in the present situation a moderate rise in the general price-level is desirable[...]. Our program seeks a balanced system of prices such as will promote a balanced expansion of production.

The Treasury ended its sterilization of gold on February 14, 1938, and the Federal Reserve reduced reserve requirements on April 18, 1938. As an April 14 *New York Times*

[23] *Chicago Daily Tribune*, March 16, 1937, p. 1.
[24] Cited in Eggertsson and Pugsley (2006).
[25] *Chicago Daily Tribune*, February 16, 1938, p. 1.

report exemplifies, the press interpreted these measures as explicitly designed to raise inflation:

> The measures for expanding excess reserves which were announced on Thursday by President Roosevelt will recreate the bases for a great credit inflation.... Monetary management, after having been directed for some time towards guarding against a possible inflationary boom, has turned, under the pressure of the business depression, toward the other extreme.

Just as the retraction of the inflation objective led to a rapid increase in Treasury yields, the re-establishment of the commitment led to a substantial decline in 3-year yields. From January 31, 1938, to June 30, 1938, 3-year yields decreased by 67 basis points, suggesting that forward guidance rose by 12 months—from 15 to 27 months. In response, from May 1938 to April 1939, output rose by 11%, to -5.7%. The turning point in the Recession of 1937 aligns more closely with this renewed regime change than with the later expansion of WWII spending. A common misconception is that WWII ended the Great Depression. This glosses over the incredible recovery in output between 1933 and 1937—the period with the fastest growth in U.S. peacetime history—and the recovery from the second phase of the Depression, which took hold before the start of the World War, thanks to a return to the economic policies of the 1933 to 1937 period.

In our calibration, output rises to -8.3% and inflation rises from -6.3% to -0.7% when forward guidance rises from 15 month to 27 months, again under-predicting the response of output. The model can match the output response if the central bank increases its forward guidance commitment to 29 months. With $T = 29$, output jumps by 10.3%, and inflation rises from -4.2% to 0.6%.

3.3 Mechanism and External Evidence

The model-predicted changes in output and inflation align well with historical data and external narrative and quantitative evidence. This evidence is especially rich for the first episode, Roosevelt taking office in 1933, because this episode is the most widely studied in the prior literature.

The key mechanism behind the rapid recovery in output starting in 1933 is the anticipation of higher inflation and lower interest rates for an extended period of time. By committing to policies that would increase the price-level, the Roosevelt administration effectively promised future inflation. This promise lowered real interest rates at a time when nominal rates were constrained by the ZLB. As firms and households expected prices to rise, they increased spending and investment, leading to an immediate boost in output.

Jalil and Rua (2016) find evidence for this mechanism in newspaper articles from 1933. They find a spike in the number of articles about inflation in April of that year. In a close reading of the *Economist* and *Business Week*, they document that the financial press began to expect inflation after Roosevelt abandoned the gold standard on April 19, 1933. Furthermore, they find that business analysts at the *Magazine of Wall Street*, *Moody's Investment Survey*, *Standard Trade and Securities*, *Business Week*, the *Review of Economics and Statistics*, and the *Trade and Money Index* all forecast inflation by late May 1933. All of these forecasters cited the Roosevelt administration's inflation objective when explaining their predictions, and several noted a rise in "inflationary psychology" among the public.

In addition, Jalil and Rua (2016) find that stock prices rose by an average of 5% in the 24 hours following unanticipated inflationary news. Using a narrative approach, they attribute the powerful effects of inflationary news on stock prices, and ultimately output, to (1) firms raising investment in anticipation of future inflation and (2) a rise in public economic sentiment. This is consistent with the mechanism we describe. This evidence is consistent with measures of inflation expectations in Hamilton (1992), realized changed in commodity prices, and a jump in the S&P 500 around the time Roosevelt came into office (see Figures 5a, 5d, and 5b.)

We are not aware of any similar studies of the period when Eccles was nominated as Fed Chair, and given the large and persistent recovery in output following these two events, we view this as a promising area for future research. However, there is suggestive evidence in Jalil and Rua (2017) that inflation expectations began to falter in late 1933. This perhaps indicates that there was indeed a crisis of confidence around this period, created by inconsistent messaging from the Federal Reserve and the Roosevelt administration. Eccles's nomination and the subsequent concentration of Federal Reserve power in his hands were, we argue, a direct response to this crises of confidence, and it would therefore be interesting to see whether there is evidence in the Newspapers or in the survey expectations of the time, for a turnaround in expectations, solidifying the commitment to reflate the price level.

In addition, Pedemonte (2024) uses regional variation in radio exposure to evaluate the impacts of FDR's 1935 Fireside Chat, finding further evidence that policy communication played an important role in the recovery from the Great Depression. They find that areas with higher radio adoption increased bank debts and automobile spending, and decreased savings in the two weeks following the speech.

In contrast, the policy reversal in 1937—when the administration prematurely retreated from its commitment to reinflation—had the opposite effect. Markets had been expecting continued inflationary pressure, and the sudden shift in expectations prompted a sharp decline in output as firms and households recalibrated to the new reality of lower expected inflation and higher real interest rates. Eggertsson and Pugsley (2006) find similar evidence to Jalil and Rua (2016) for this episode and the subsequent recovery in 1938, using the Proquest Historical Newspaper Database. They find large increases in the number of newspaper articles focused on inflation from February to May 1937 and again from February to May 1938. This suggests that changing inflation expectations played an important role in the mistake of 1937 and the subsequent recovery in 1938.

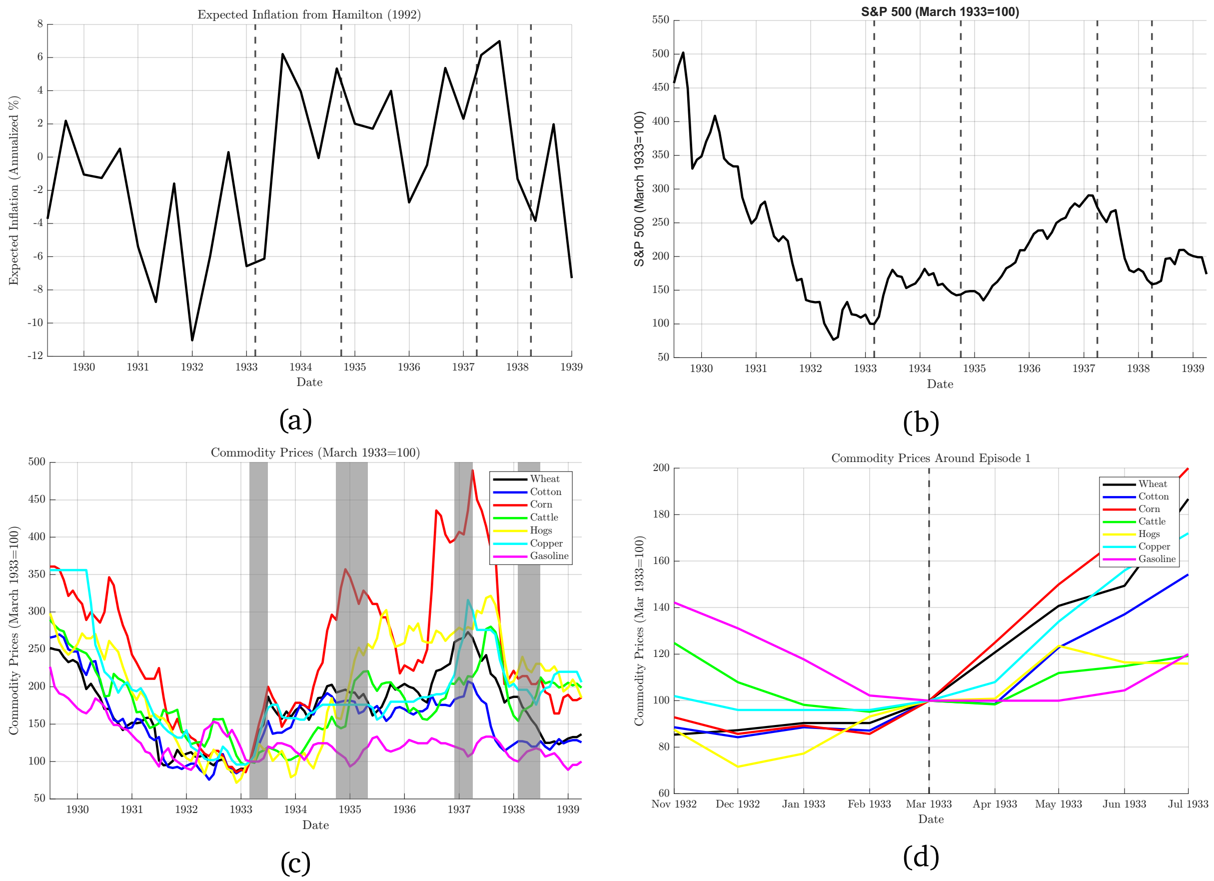


Figure 5: External evidence on the mechanism. Top left panel: Estimated expected inflation rates based on commodity prices, Hamilton (1992). Commodity prices, indexed to March 1933. Top right panel: S&P 500 indexed to March 1933. Bottom left panel: Commodity prices over entire period. Bottom right panel: Commodity prices in Episode 1.

4 Conclusion

We argue that, both theoretically and empirically, the FGP is not a puzzle. Theoretically, the puzzle arises when monetary policy commits to a major regime change. In the typical thought experiment, the central bank commits not only to a future interest rate shock but also to staying on that path regardless of how inflation and output evolve between now and the time of the shock. Generating explosive paths for output and inflation requires an explosive amount of additional accommodation, and there is little reason to expect a central bank not to react in normal circumstances. This implies that major policy regime changes are the appropriate empirical counterpart to the FGP.

We show, using four major regime breaks in the Great Depression, that the large effects of forward guidance predicted by the New Keynesian model are of the same order of magnitude as those observed in the data. The New Keynesian model predicts that regime changes have large effects on output and inflation. The data confirm that output and inflation rose (or fell) dramatically in response to actual regime changes during the Great Depression, mirroring the model's predictions. In this sense, the FGP is a feature of the model that allows it to match large changes in output and inflation in response to economic regime changes, rather than a bug.

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A Impact effect of anticipated future cost-push shocks

In this section we demonstrate that there is nothing particularly special about anticipated future interest rate shocks relative to other anticipated shocks in the New Keynesian model. Anticipated future cost-push shocks induce a similar response to anticipated future interest rate shocks in the New Keynesian model. To show this, we introduce a cost-push shock ε_t to the New Keynesian Phillips curve.

$$\pi_t = \kappa x_t + \beta \mathbb{E}_t \pi_{t+1} + \varepsilon_t$$

When the central bank commits not to respond to the cost-push shock, the impact on output and inflation rises as the shock moves further into the future. Figure 6 demonstrates that, as with a future interest rate shock, it is the central banks commitment not to respond that generates the large effects of the shock. If the central bank instead responds via a Taylor rule, the impact effect of future policy or cost-push shocks are not bigger than the effect of current shocks. Figure 7 confirms this is the case by zooming in on the impact responses when the central bank responds via a Taylor rule. We can now see more clearly that future cost-push and policy rate shocks induce smaller effects on output and inflation today. As the shock moves further and further into the future, the impact effects converge to zero.

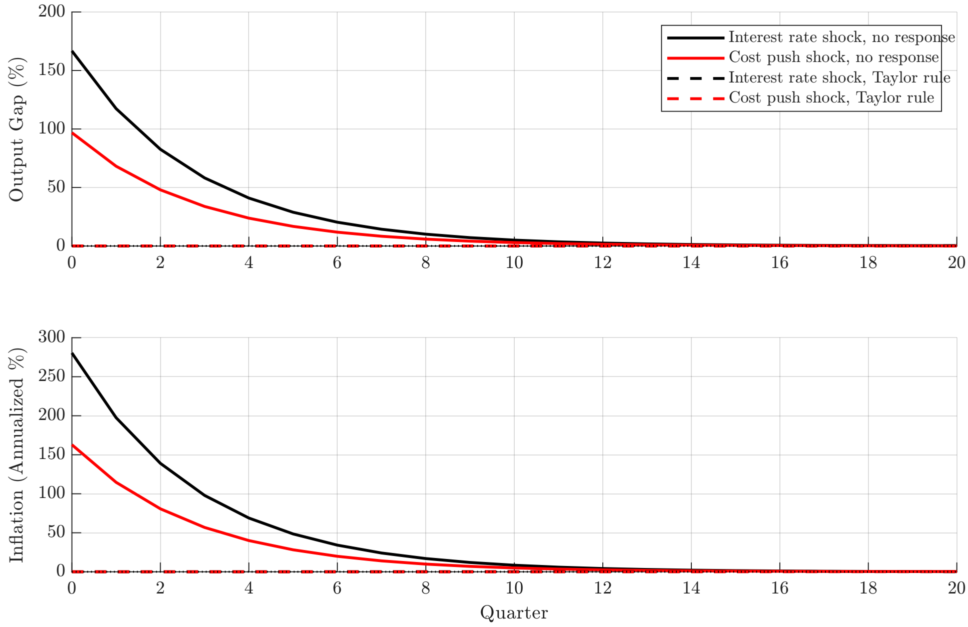


Figure 6: The impulse response of output and inflation to a shock at time T. X-axis is in percentage point deviations from steady state. The red lines are responses to a cost-push shock, the black lines are responses to a monetary policy shock.

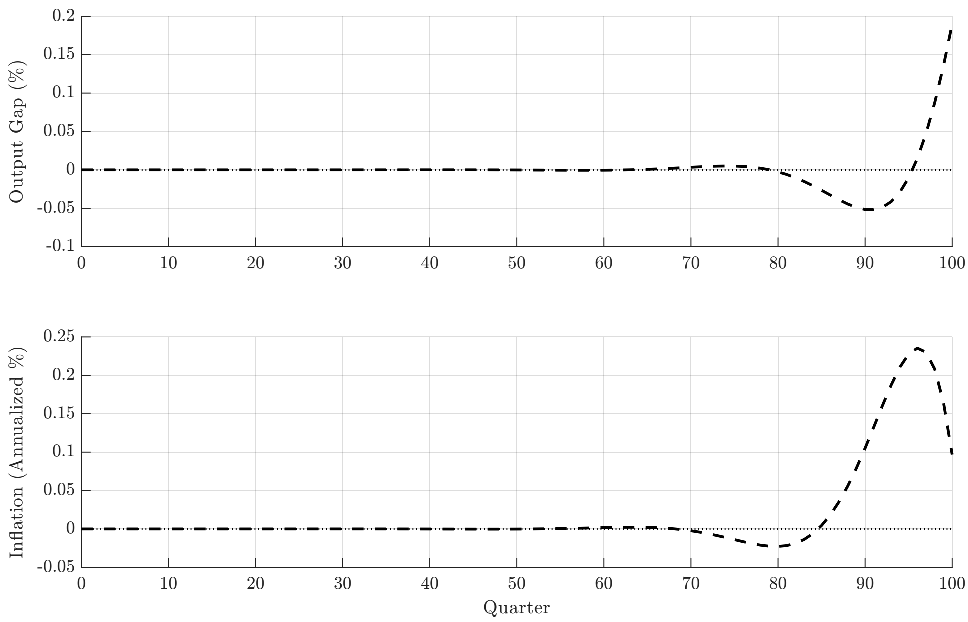


Figure 7: The impulse response of output and inflation to a time T monetary policy shock when the central bank follows a Taylor rule. X-axis is in percentage point deviations from steady state. As this figure demonstrates, the Taylor rule response is not flat, but appears flat in comparison to the large changes in output and inflation that result from deviating from normal policy by keeping the policy rate constant before the shock.

B Robustness

In this section we demonstrate that our results are robust to including habit formation in our model and to parameter uncertainty for κ, σ, and r^n_S.

B.1 Incorporating habit formation

In the basic New Keynesian model, output immediately jumps in response to any changes in monetary policy, whereas output in the data tends to move more gradually. This section demonstrates that allowing for habit formation, which in turn allows us to match the more gradual changes in output observed in the data, does not qualitatively change our conclusions. Realistically sized forward guidance shocks can still lead to large changes in output, but these changes in output are consistent with the changes we observe in the data.

The form of habit formation we choose is simple enough to maintain the structure of the basic New Keynesian model, with a straightforward reinterpretation of variables as quasi-growth rates. With the simple form of habit formation the IS and PC become

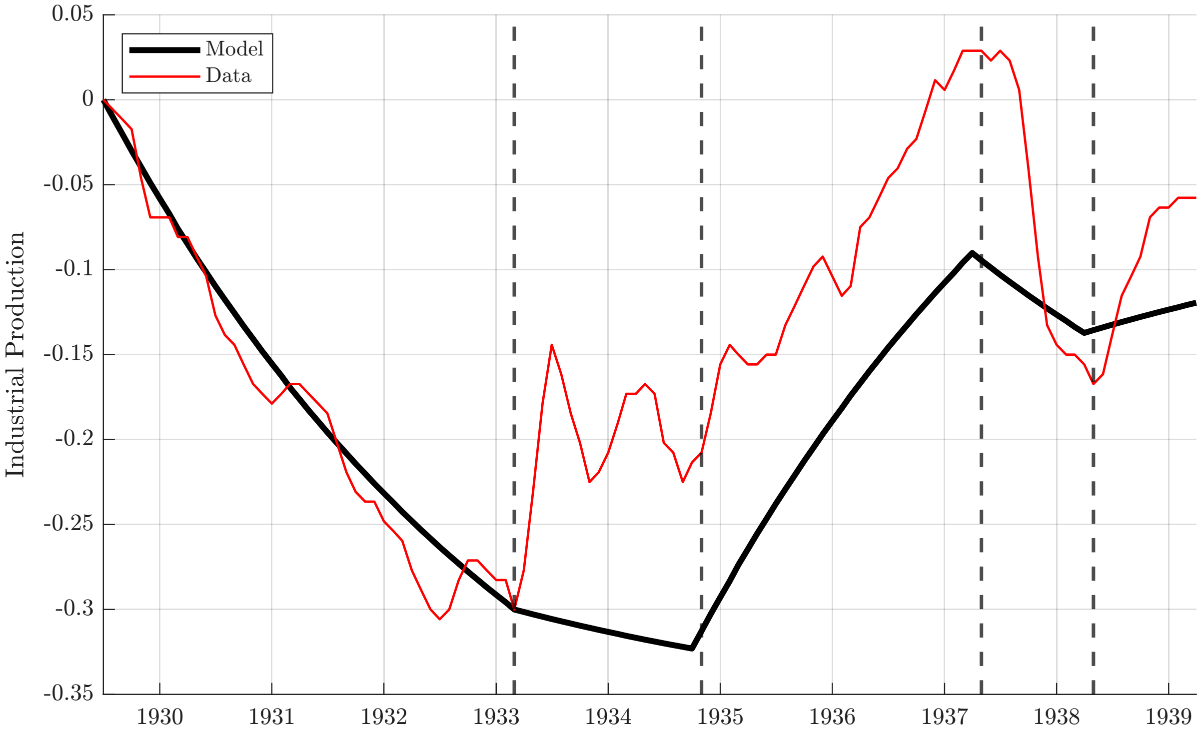
$$\tilde{y}_t = \mathbb{E}_t \tilde{y}_{t+1} - \sigma(i_t - \mathbb{E}_t \pi_{t+1} - r^n_t) \tag{25}$$

$$\pi_t = \kappa \tilde{y}_t + \beta \mathbb{E}_t \pi_{t+1} \tag{26}$$

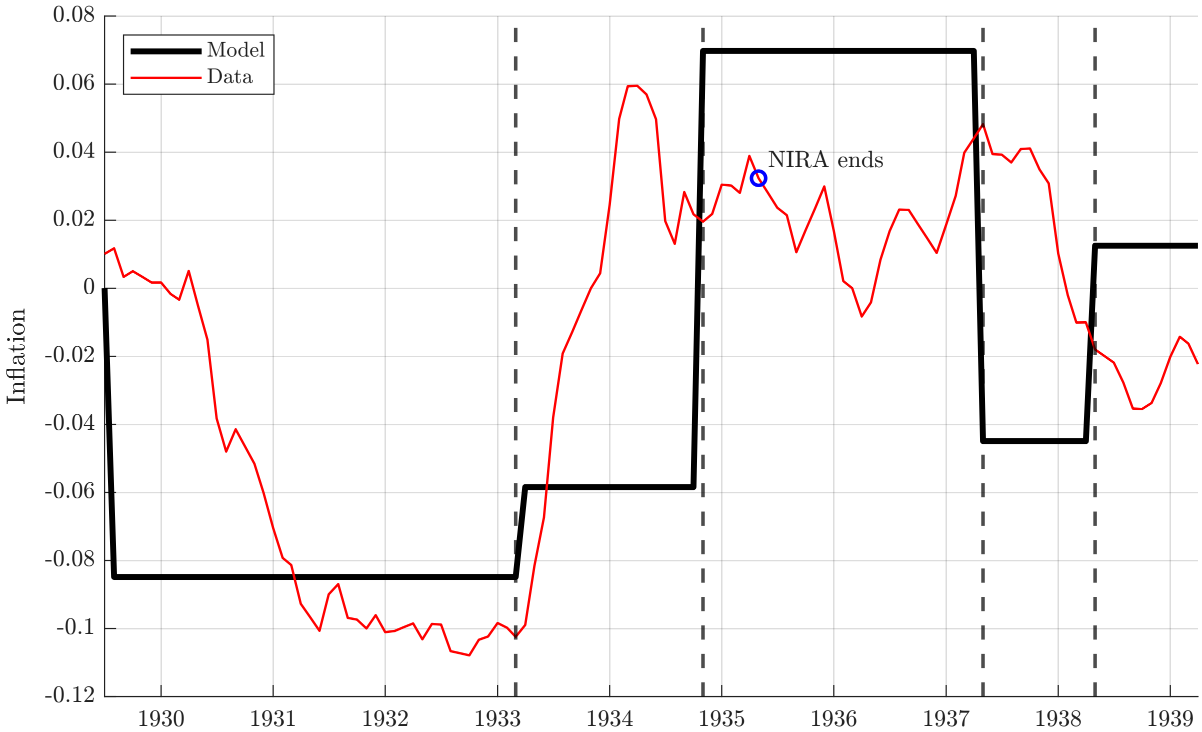
Where $\tilde{y}_t = y_t - \gamma y_{t-1}$ is the quasi-growth rate of output. Eggertsson (2008) provides detailed derivations.

We set the additional parameter γ to 0.98, the monthly equivalent of the value used in Eggertsson (2008). We then recalibrate the model using the same procedures described above. The resulting parameter estimates are $\beta = 0.9971$, $\kappa = 0.0410$, $\sigma = 0.0393$, $r^n_S = 0.0080$, and the durations of forward guidance needed to match the data are $[31, 38, 0, 32]$.

As figure 9 demonstrates, our conclusions still holds when we account for habit formation to match the gradual changes in output.

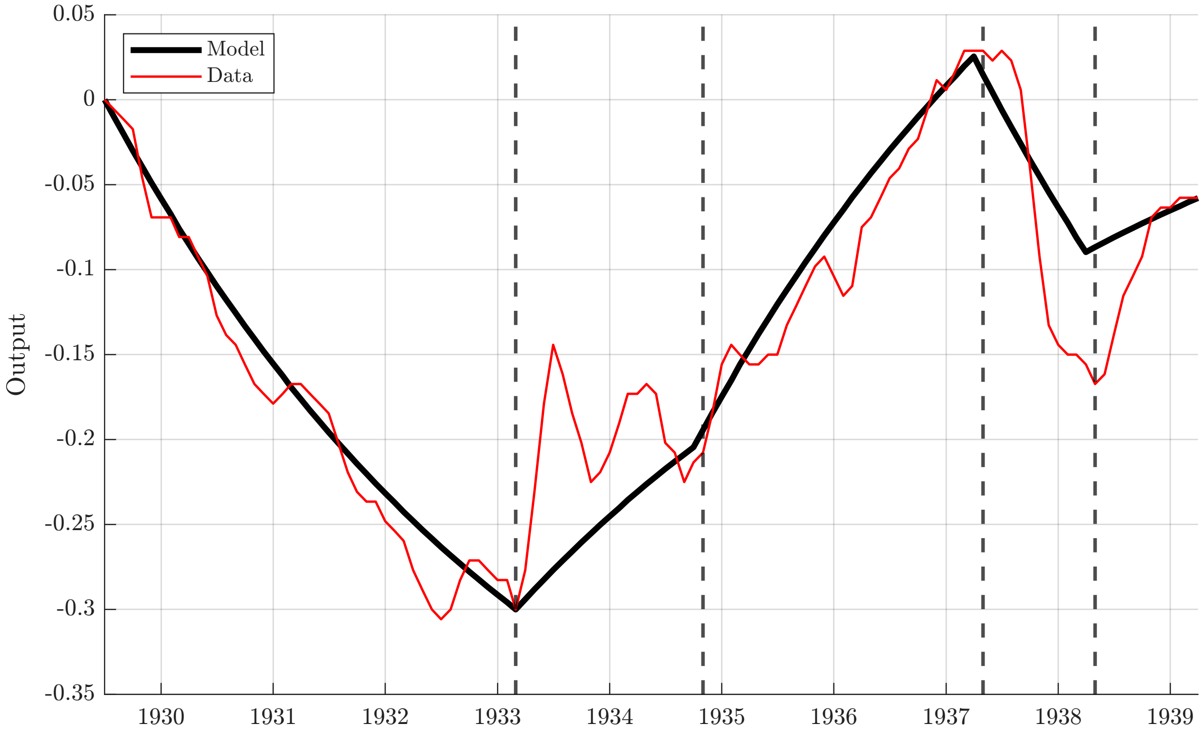


(a)

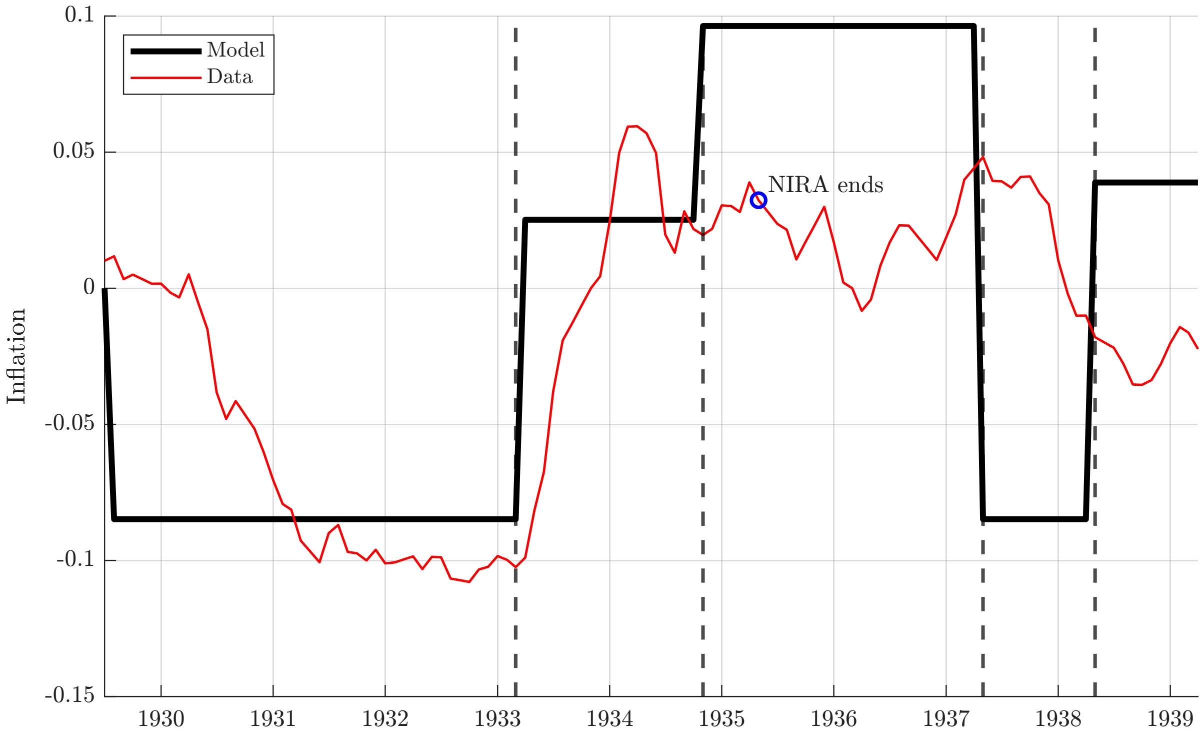


(b)

Figure 8: **Response of output and inflation to the amount of forward guidance suggested by the yield curve.** Model-predicted changes in output (top) and inflation (bottom) following a commitment to keep the interest rate at 0 for 11 additional months in March 1933, 35 additional months in November 1934, a retraction to 15 additional months in April 1937, and 27 additional months in April 1938.



(a)



(b)

Figure 9: **Response of output and inflation when choosing forward guidance to minimize distance between the model and the data.** Model-predicted changes in output (top) and inflation (bottom) following a commitment to keep the interest rate at 0 for 29 additional months in March 1933, 38 additional months in November 1934, a retraction to 0 additional months in April 1937, and 31 additional months in April 1938.

B.2 Accounting for parameter uncertainty

Our main calibration procedure is simple by design. Our intention is to demonstrate that it is possible to match the path of output and inflation during the Great Depression for realistic parameter values and reasonable forward guidance. We do not claim that the exact parameters above are the only parameters for which this is possible nor that these parameters are necessarily exactly the right ones. We were only attempting to find one possible set of parameters that looked reasonable and performed well in matching the data. We therefore do not attempt to account for parameter uncertainty. In this section we account for parameter uncertainty using a Bayesian estimation routine.

In particular, we re-estimate κ, σ, and r^n_S using a procedure that punishes deviations from our priors and between the model and the data at K points in time. We choose these K points in time to try to match the decline in output as well as, to a lesser extent, the response of output after the forward guidance shocks. Assuming that these deviations are independently normally distributed with variances given by $\sigma^2_{x,t}$ and $\sigma^2_{\pi,t}$ allows us to express the log-likelihood of the data given the model in closed form.

$$LL_{data} = -T\log(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\left(\log\sigma^2_{x,t} + \log\sigma^2_{\pi,t}\right) - \frac{1}{2}\sum_{t=0}^{K}\left[\frac{\varepsilon^2_{x,t}}{\sigma^2_{x,t}} + \frac{\varepsilon^2_{\pi,t}}{\sigma^2_{\pi,t}}\right] \qquad (27)$$

We use the same priors as in the main text. These priors are reported in 3 below.

Variable	Distribution	Mean	SD
κ	Tnormal	0.0020	0.0100
σ	Tnormal	1	0.5000
r^n_S	Tnormal	0.0100	0.0050

Table 3: Priors for Bayesian estimation procedure. We assume truncated normal distributions for all parameters. Because two of the three parameters have means close to zero using Gamma distributions would result in large prior probability masses very near zero. Our Bayesian estimation procedure turns out to be much better behaved with truncated normal distributions, which ensure a larger probability mass around the mean and a lower probability mass very near zero.

We then construct 66, 90, and 95 percent credibility sets from 1 million draws from an random-walk Metropolis-Hastings (RWMH) sampler. We report the resulting estimates in table 4.

Variable	Mode	66% c.s.		90% c.s.		95% c.s.	
		l.b.	u.b.	l.b.	u.b.	l.b.	u.b.
κ	0.0016	0.0005	0.0035	0.0002	0.0060	0.0001	0.0074
σ	0.9010	0.5865	1.2705	0.4118	1.5721	0.3519	1.7261
r_S^n	0.0109	0.0072	0.0149	0.0048	0.0180	0.0037	0.0194

Table 4: Parameter estimates from the Bayesian estimation procedure. Results are based on 20 million draws from an RWMH sampler, using the priors specified above and the likelihood function in equation (27).

B.3 Convergence of RWMH Sampler

We generate 20 million draws from an RWMH sampler. Figure 10 reports the cumulative mean of the draws for the three parameters, and the mean of draws in sample partitions of 1,000 draws each for the model without habit formation. The shaded areas are the burn in, which we drop for the other figures reported in the appendix.

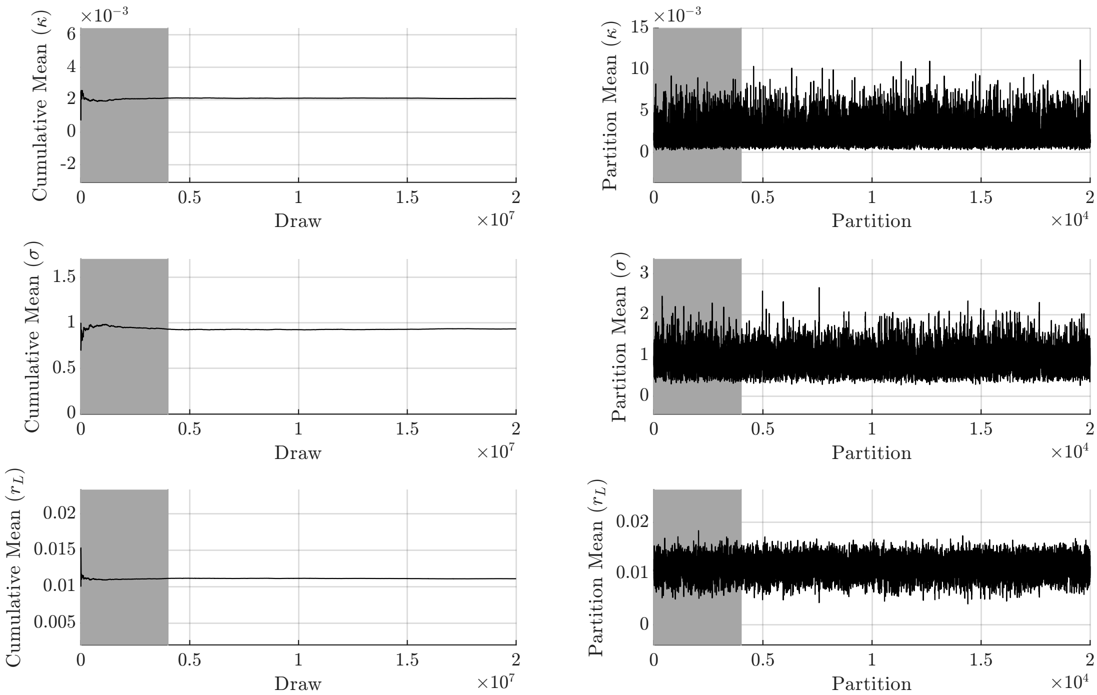


Figure 10: Convergence of RWMH sampler with $\gamma = 0.98$.

Below we report the results of our Bayesian estimation procedure. We use the estimates for T from the yield curve. Even when accounting for parameter uncertainty, the predictions of the New Keynesian model continue to be of the same order of magnitude as the realized responses in the data. Indeed, in many cases the data falls within the 95% credibility set.

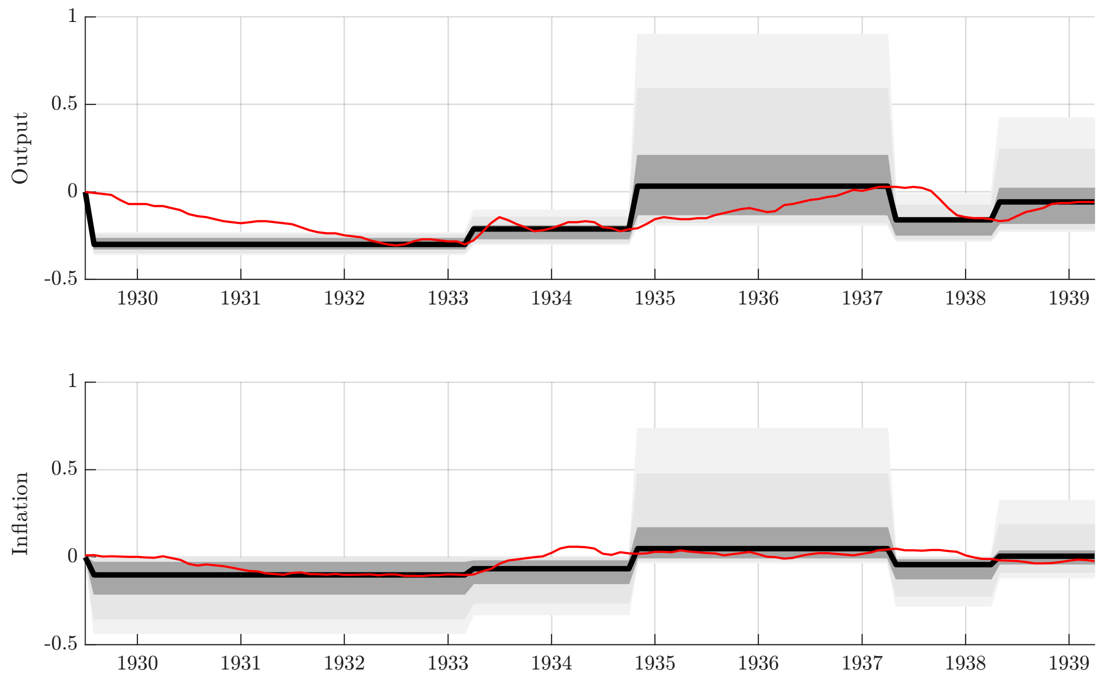


Figure 11: Model predicted changes in output and inflation following 11 months of forward guidance in March 1933, 35 months of forward guidance in November 1934, a retraction to 15 months of forward guidance in April 1937, and 27 months of forward guidance in April 1938. The black solid line denotes the calibrated responses from the main text, the shaded areas are 66, 90, and 95 percent credibility regions from RWMH estimation.