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MONETARY POLICY, INFLATION AND UNEMPLOYMENT: IN DEFENSE OF THE FEDERAL RESERVE

Nicolas Groshenny
Reserve Bank of New Zealand
and
CAMA

To what extent did deviations from the Taylor rule between 2002 and 2006 help to promote price stability and maximum sustainable employment? To address that question, I estimate a New Keynesian model with unemployment and perform a counterfactual experiment where monetary policy strictly follows a Taylor rule over the period 2002:Q1–2006:Q4. I find that such a policy would have generated a sizeable increase in unemployment and resulted in an undesirably low rate of inflation. Around mid-2004, when the counterfactual deviates the most from the actual series, the model indicates that the probability of an unemployment rate greater than 8% would have been as high as 80%, whereas the probability of an inflation rate above 1% would have been close to zero.

Keywords: Business Cycle Models, Inflation, Unemployment, Taylor Rules

1. INTRODUCTION

According to its official mandate, the Federal Reserve sets the federal funds rate to achieve a dual goal of price stability and maximum sustainable employment. Recently, a debate has emerged regarding the justification of the Federal Reserve's conduct of monetary policy after 2001. In particular, Taylor (2007) argues that the Federal Reserve kept the federal funds rate too low for too long in the aftermath of the 2001 recession. In contrast, Bernanke (2010) argues that the stance of monetary policy post-2001 was appropriate to reduce the risks of deflation and high unemployment.[1]

This paper asks whether the deviations from the Taylor rule undertaken by the Federal Reserve over the period 2002–2006 were helpful in promoting "price stability" and "maximum sustainable employment." To answer this question one needs a structural macroeconomic model that describes how monetary policy—in

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particular the federal funds rate—affects inflation and unemployment. I estimate a New Keynesian model with unemployment on U.S. data using Bayesian methods and a sample that finishes in 2001:Q4. The structural estimates are then used to infer the shocks that hit the economy over the period 2002–2009. With these in hand, I perform various counterfactual experiments to understand the role of departures from the Taylor rule that are represented by exogenous monetary policy shocks. The results suggest that the deviations from the estimated rule contributed materially to enhancing macroeconomic stability during the first half of the last decade. In particular, between 2002 and 2006, the non-systematic component of monetary policy significantly reduced the risk of deflation and high unemployment, especially around 2004:Q2. Hence, this paper provides some quantitative evidence that validates Bernanke's (2010) testimony.

The paper proceeds as follows: Section 2 briefly describes the model and the econometric strategy. Section 3 examines the effects on inflation and unemployment of the deviations from the pre-2002 interest-rate rule. Section 4 assesses the robustness of the paper's main result. Section 5 concludes.

2. MODEL AND ECONOMETRIC STRATEGY

2.1. Model

This paper aims at evaluating quantitatively the veracity of Bernanke's claim that the stance of monetary policy in 2002–2006 was appropriate to prevent deflation and high unemployment. The model combines the current workhorse for monetary policy analysis, the New Keynesian model, with the search and matching model of the labor market developed by Diamond, Mortensen, and Pissarides. It incorporates the features introduced by Christiano et al. (2005) and Smets and Wouters (2007) to fit the macro data. This framework enables us to study the joint behavior of inflation, unemployment, and the federal funds rate.[2] The model economy consists of a representative household, a continuum of intermediate goods–producing firms, a representative finished goods–producing firm, and monetary and fiscal authorities.[3]

The representative household. The representative household is a large family that consists of a continuum of individuals of measure one. Family members are either working or searching for a job. Each period, family members self-insure their consumption path against unemployment risk by pooling their income and let the head of the family optimally choose per capita consumption. The household's utility function exhibits internal habit formation in consumption, so consumption responds gradually to shocks.

The household owns capital and chooses the capital utilization rate, which transforms physical capital into effective capital services used for production. Adjusting the utilization rate of capital away from its steady-state value is costly. The household rents the effective capital stock K_t to the intermediate goods–producing firms at rate r_t^K.

Each period, N_t family members are employed by the intermediate goods–producing firms. $N_t \in (0, 1)$ denotes aggregate employment. Each employee works a fixed amount of hours and earns the nominal wage W_t. The remaining $(1 - N_t)$ family members search for jobs and receive unemployment benefits $(1 - N_t)b_t$, financed through lump-sum taxes. $U_t \equiv 1 - N_t$ denotes aggregate unemployment.

During period t, the representative household receives total nominal factor payments $r_t^K K_t + W_t N_t + (1 - N_t)b_t$. In addition, the household also receives profits from the monopolistically competitive intermediate goods–producing firms. Each period the family uses these resources to purchase finished goods for both consumption and investment purposes at price P_t. As in Christiano et al. (2005), the household faces adjustment costs in investment. An investment-specific technology shock affects the efficiency with which consumption goods are transformed into capital.

As in Smets and Wouters (2007), a risk-premium shock drives a wedge between the short-term nominal interest rate r_t controlled by the central bank and the return on assets held by the representative family. This disturbance is meant to capture unmodeled financial frictions that generate fluctuations in the external finance premium.

Intermediate goods–producing firms. Each intermediate goods–producing firm $i \in (0, 1)$ sells its output to the finished goods–producing firm in a monopolistically competitive market. Moreover, firm i faces quadratic costs of adjusting the price of its own product $P_t(i)$. These costs are measured in terms of the finished good and given by

$$\frac{\phi_P}{2}\left[\frac{P_t\,(i)}{\pi_{t-1}^{\varsigma}\pi^{1-\varsigma}P_{t-1}\,(i)} - 1\right]^2 Y_t, \tag{1}$$

where $\pi_t = P_t/P_{t-1}$ denotes the rate of inflation in period t. $\pi > 1$ denotes the steady-state rate of inflation and coincides with the central bank's target. The parameter $0 \leq \varsigma \leq 1$ governs the importance of backward-looking behavior in price setting (Ireland 2007).

Assuming a symmetric equilibrium where all intermediate goods–producing firms behave identically, we can focus on the representative intermediate goods–producing firm. This firm combines labor and capital to produce the intermediate good using Cobb–Douglas technology with constant returns to scale. The growth rate of neutral technological progress follows an AR(1) process.

The firm enters in period t with a stock of N_{t-1} employees. Before production starts, ρN_{t-1} old jobs are destroyed. The rate of job destruction ρ is constant [Hall (2005); Shimer (2005)]. The workers who have lost their jobs start searching immediately and can possibly still be hired in period t. The law of motion of aggregate employment is

$$N_t = (1 - \rho)\,N_{t-1} + m_t, \tag{2}$$

where m_t denotes the flow of new employees. Newly hired workers are immediately productive. The process through which the labor market matches vacant jobs and unemployed workers is described by an aggregate matching function

$$m_t = \zeta S_t^{\sigma} V_t^{1-\sigma}, \tag{3}$$

where ζ is a scale parameter that captures the efficiency of the search and matching process. S_t and V_t denote the pool of job seekers and the aggregate flow of vacancies, respectively. The former is given by $S_t = 1 - (1-\rho)N_{t-1}$.

Each period, the nominal wage W_t is determined through bilateral Nash bargaining between the firm and each worker. The worker's bargaining power follows an exogenous $AR(1)$ process. I refer to this shock as the wage-markup disturbance. Finally, the firm also faces convex costs of adjusting both wages and the hiring rate [Arsenau and Chugh (2008); Gertler et al. (2008)]. These features help the model fit the persistence that we observe in the aggregate labor market data.

The finished goods-producing firm. The finished goods–producing firm uses a Dixit–Stiglitz technology that combines the differentiated intermediate goods to produce Y_t units of the finished good. A shock affects the elasticity of substitution across inputs, generating exogenous fluctuations in the market power of the intermediate goods suppliers. I refer to this shock as the price-markup shock.

Fiscal policy. The government balances its budget every period. Public spending is an exogenous time-varying fraction of GDP and follows an AR(1) process.

Monetary policy. The central bank adjusts the short-term nominal gross interest rate r_t by following a Taylor rule,

$$\ln\left(\frac{r_t}{r}\right) = \rho_r \ln\left(\frac{r_{t-1}}{r}\right) + (1-\rho_r)\left[\rho_\pi \ln\left(\frac{\pi_t}{\pi}\right) + \rho_y \ln\left(\frac{Y_t/Y_{t-1}}{z}\right)\right] + \ln \epsilon_{mpt}. \tag{4}$$

r_t is measured by the effective federal funds rate. π_t denotes inflation and is measured by the quarterly growth rate of the GDP deflator [Taylor (1993)]. Output, denoted by Y_t, is measured by real GDP per capita. z is the steady-state growth rate of output. Variables without a time subscript (r, π, and z) are steady-state values. The degree of interest-rate smoothing ρ_r and the reaction coefficients ρ_π, ρ_y are all positive. The interest-rate rule prescribes raising the federal funds rate whenever inflation is above target or output growth is above steady state. This rule is fully consistent with Taylor's (2007) main recommendation for the conduct of monetary policy.

The residual in the Taylor rule is the monetary policy shock. This random component accounts for the deviations between the actual path of the federal funds rate and the path prescribed by the interest-rate rule. It reflects information ignored by the simple rule but nonetheless used by the central bank to set the interest rate. Consistent with the conventional wisdom that deviations from the

TABLE 1. Calibrated parameters

Capital depreciation rate	δ	0.0250
Capital share	α	0.33
Elasticity of substitution between goods	θ	6.00
Probability of filling a vacancy within a quarter	q	0.7000
Government spending/output ratio	g/y	0.2000
Unemployment rate	U	0.0574
Quarterly growth rate	z	1.0044
Quarterly inflation rate	π	1.0061
Quarterly nominal interest rate	r	1.0144

Taylor rule have sometimes been persistent, especially after 2001 [Taylor (2007)], I assume that the monetary policy shock follows an $AR(1)$ process,

$$\ln \epsilon_{mpt} = \rho_{mp} \ln \epsilon_{mpt-1} + \varepsilon_{mpt}, \tag{5}$$

where $0 \leq \rho_{mp} < 1$ and $\varepsilon_{mpt} \sim$ i.i.d.N$(0, \sigma_{mp}^2)$.

Model solution. Real output, consumption, investment, capital, and wages share the common stochastic trend induced by the unit root process for neutral technological progress. In the absence of shocks, the economy converges to a steady-state growth path in which all stationary variables are constant. I first rewrite the model in terms of stationary variables and then log-linearize the transformed economy around its deterministic steady state. The approximate model can then be solved using standard methods.

2.2. Econometric strategy

Calibrated parameters. Because of identification issues, I calibrate nine parameters prior to estimation. Table 1 reports the calibration. The quarterly depreciation rate δ is set equal to 0.025. The capital share of output α is calibrated at 0.33. The elasticity of substitution between intermediate goods θ is set equal to 6, impliying a steady-state markup of 20% as in Rotemberg and Woodford (1995). The vacancy-filling rate q is set equal to 0.70. This is just a normalization. The steady-state government spending/output ratio G/Y is set equal to 0.20. Finally, the steady-state values of the unemployment rate U, the rate of inflation π, the nominal interest rate r, and the growth rate of output z, are set equal to their respective sample averages over the period 1985:Q1–2001:Q4. Table 2 reports the parameters whose values are derived from the steady-state conditions.[4]

Bayesian estimation. I estimate the remaining 28 parameters using Bayesian techniques. The estimation uses quarterly U.S. data on seven key macro variables: the growth rate of real output per capita, the growth rate of real consumption per capita, the growth rate of real investment per capita, the growth rate of real wages,

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TABLE 2. Parameters derived from steady-state conditions

Employment adjustment cost	$\phi_N = \frac{2\times\left(\frac{\phi_N}{2}x^2\right)}{x^2}$
Discount factor	$\beta = \frac{z\pi}{r^B}$
Job survival rate	$\chi = 1 - \rho$
Employment rate	$N = 1 - U$
Hiring rate	$x = \rho$
Mean of exogenous spending shock	$\epsilon_g = \frac{1}{1-g/y}$
Real marginal cost	$\xi = \frac{\theta-1}{\theta}$
Quarterly net real rental rate of capital	$\widetilde{r}^K = \frac{z}{\beta} - 1 + \delta$
Capital utilization cost first parameter	$\phi_{u1} = \widetilde{r}^K$
Capital/output ratio	$\frac{k}{y} = \frac{\alpha\xi}{\widetilde{r}^K}$
Investment/capital ratio	$\frac{i}{k} = z - 1 + \delta$
Investment/output ratio	$\frac{i}{y} = \frac{i}{k}\frac{k}{y}$
Consumption/output ratio	$\frac{c}{y} = \frac{1}{\epsilon_g} - \frac{\phi_N}{2}x^2 - \frac{i}{y}$
Vacancies	$V = N\frac{x}{q}$
Pool of job seekers	$S = 1 - \chi N$
Matching function efficiency	$\zeta = q\left(\frac{V}{S}\right)^{\sigma}$
Job finding rate	$s = \zeta\left(\frac{V}{S}\right)^{1-\sigma}$
Employees' share of output	$\frac{\widetilde{w}N}{y} = \xi(1-\alpha) - (1 - x - \beta\chi)\phi_N x$
Bargaining power	$\eta = \frac{1-\tau}{\vartheta-\tau}$, where $\vartheta \equiv \frac{[\xi(1-\alpha)+\phi_N x^2+\beta\chi\phi_N x s]}{\frac{\widetilde{w}N}{y}}$
Effective bargaining power	$\eta = \frac{\eta}{1-\eta}$

the inflation rate, the short-term nominal interest rate, and the unemployment rate. The model thus includes as many shocks as observables. The estimation period starts in 1985:Q1, after the Volcker disinflation, and ends in 2001:Q4, excluding the period 2002–2006 over which Taylor (2007) criticizes the conduct of monetary policy. In particular, Taylor (2007) suggests that the reaction of monetary policy to the inflation gap changed around 2002–2003.

Prior distributions are standard [Smets and Wouters (2007); Gertler et al. (2008)]. I use the random-walk Metropolis–Hasting algorithm to generate 500,000 draws from the posterior distribution. The algorithm is tuned to achieve an acceptance ratio between 20 and 30%. Tables 3 and 4 summarize the prior and posterior distributions.

Estimates of the Taylor rule coefficients and monetary policy shocks. Of particular interest for the purpose of this paper are the estimates of the Taylor rule's coefficients. The parameters are identified and consistent with a broad literature. The posterior medians of the degree of interest rate smoothing, the response to

TABLE 3. Priors and posteriors of structural parameters

		Prior distributions	Posterior Median	Std. dev.	5%	95%
Job destruct. rate	ρ	Normal (0.08,0.01)	0.09	0.01	0.07	0.10
Replacement rate	10τ	IGamma (3,0.5)	2.79	0.49	2.22	3.81
Hiring cost/output	$1000\frac{\phi_N}{2}x^2$	Normal (5,0.5)	4.46	0.47	3.70	5.27
Habit in consump.	h	Beta (0.6,0.1)	0.45	0.06	0.35	0.55
Elasticity of match.	σ	Beta (0.5,0.05)	0.49	0.04	0.42	0.57
Invest. adj. cost	ϕ_I	Normal (5,0.5)	4.60	0.51	3.71	5.40
Capital ut. cost	ϕ_{u2}	Normal (0.5,0.1)	0.57	0.08	0.44	0.70
Price adjust. cost	ϕ_P	IGamma (55,10)	48.9	6.96	40.1	62.9
Wage adjust. cost	ϕ_W	IGamma (20,8)	28.6	4.74	22.2	36.3
Price indexation	ς	Beta (0.5,0.2)	0.39	0.12	0.21	0.62
Wage indexation	ϱ	Beta (0.5,0.2)	0.75	0.15	0.43	0.92
Interest smoothing	ρ_r	Beta (0.7,0.15)	0.74	0.03	0.68	0.79
Resp. to inflation	ρ_π	Normal (1.75,0.2)	2.09	0.14	1.86	2.34
Resp. to growth	ρ_y	Normal (0.25,0.1)	0.30	0.08	0.19	0.46

the inflation gap, and the response to output growth are 0.74, 2.09, and 0.30 respectively.

I now use the estimated model and data on the seven observables up to 2009 to back out the time series of the shocks. Figure 1 plots the monetary policy shocks, as well as the actual federal funds rate and the prescriptions from the estimated rule. In

TABLE 4. Priors and posteriors of shock parameters

		Prior distributions	Posterior Median	Std. dev.	5%	95%
Technology growth	ρ_z	Beta (0.35,0.15)	0.20	0.07	0.09	0.32
	$100\sigma_z$	IGamma (0.1,2)	0.84	0.07	0.73	0.95
Monetary policy	ρ_{mp}	Beta (0.5,0.2)	0.32	0.07	0.21	0.44
	$100\sigma_{mp}$	IGamma (0.1,2)	0.12	0.01	0.10	0.14
Investment	ρ_μ	Beta (0.5,0.2)	0.79	0.05	0.70	0.87
	$100\sigma_\mu$	IGamma (0.1,2)	4.66	0.67	3.75	5.92
Risk-premium	ρ_b	Beta (0.5,0.2)	0.92	0.04	0.85	0.97
	$100\sigma_b$	IGamma (0.1,2)	0.14	0.03	0.10	0.21
Price markup	ρ_θ	Beta (0.5,0.2)	0.83	0.07	0.69	0.92
	$100\sigma_\theta$	IGamma (0.1,2)	0.09	0.01	0.07	0.10
Bargaining power	ρ_η	Beta (0.5,0.2)	0.30	0.08	0.17	0.43
	$100\sigma_\eta$	IGamma (0.1,2)	42.6	4.62	38.1	53.3
Government spending	ρ_g	Beta (0.7,0.2)	0.97	0.01	0.94	0.99
	$100\sigma_g$	IGamma (0.1,2)	0.35	0.03	0.31	0.40

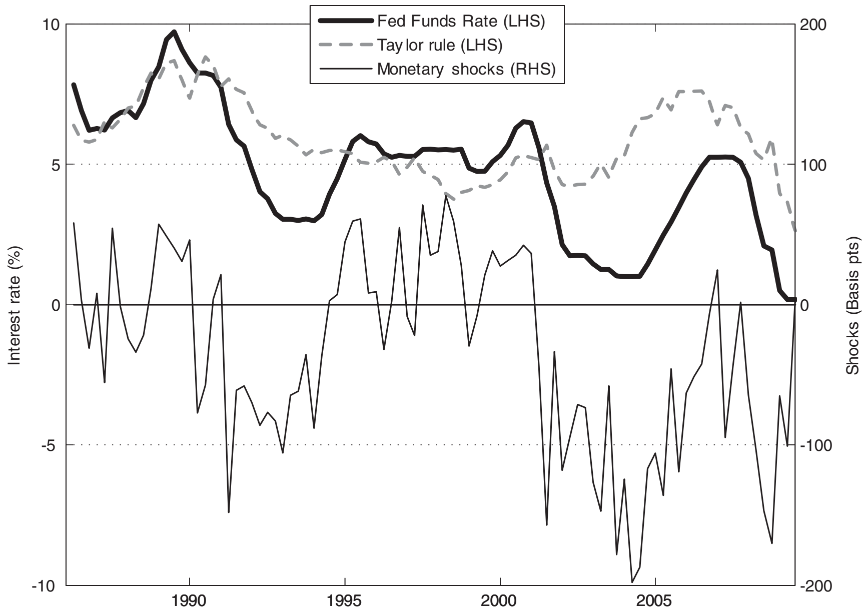

FIGURE 1. (LHS) The actual fed funds rate versus the prescriptions from the estimated Taylor rule. The estimation period is 1985:Q1–2001:Q4. The rule features some interest-rate smoothing. (RHS) Smoothed estimates of the AR(1) monetary policy shocks.

line with Taylor (2007), we see that a string of large expansionary monetary policy shocks occured between 2001 and 2006. The presence of interest-rate smoothing implies that these shocks cumulate over time, resulting in large discrepancies between the actual federal funds rate and the rule's prescriptions.

Figure 2 plots the responses of inflation (quarter-on-quarter, annualized), unemployment, and the policy rate (annualized) to a one–standard deviation monetary policy shock. Impulse responses are expressed in percentage points. We see that such a shock raises the federal funds rate by roughly 25 basis points on impact, pushes unemployment up by nearly 30 basis points, and reduces inflation by approximately 40 basis points. Inflation, unemployment, and the interest rate are back to steady state within two years.

Figure 3 and 4 show the spectral densities of output growth and inflation conditional on each shock. We see that monetary shocks were a minor source of fluctuations over the period 1985–2001.

3. DEVIATIONS FROM THE TAYLOR RULE BETWEEN 2002 AND 2006 AND THE FEDERAL RESERVE'S MANDATE

Taylor (2007) criticizes the Federal Reserve for departing from its usual way of conducting monetary policy after 2001. In particular, Taylor (2007)

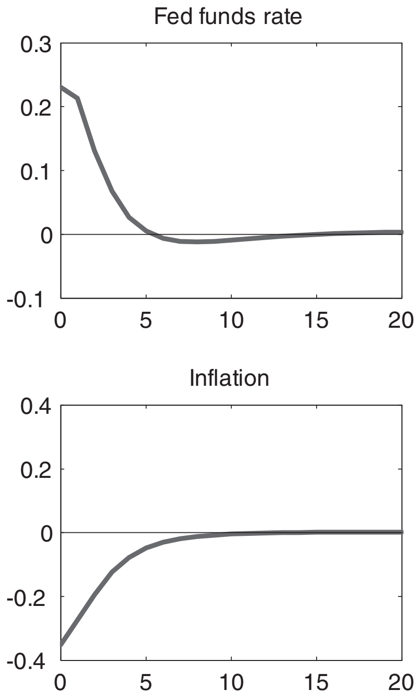

FIGURE 2. Impulse responses to a one–standard deviation monetary policy shock. The responses are expressed in percentage points. Inflation (quarter-on-quarter) and the interest rate are both annualized. Periods are quarters. The responses are computed at the posterior mode.

argues that monetary policy was too loose between 2002 and 2006. On the other hand, Bernanke (2010) defends the monetary policy decisions made by the Federal Reserve during that period on the ground that the risks of deflation and high unemployment were threatening the U.S. economy. In this section, I address the following question: What would have happened to inflation and unemployment if the Federal Reserve had stuck with its simple pre-2002 rule?

3.1. The Effects of Monetary Policy Shocks on Inflation and Unemployment from 2002 to 2006

I can now perform a counterfactual experiment where the estimated deviations from the Taylor rule are set equal to zero over the period 2002:Q1–2006:Q4. Figure 5 shows the 90% posterior intervals around the counterfactual paths of inflation and unemployment. We see that a strict implementation of the simple

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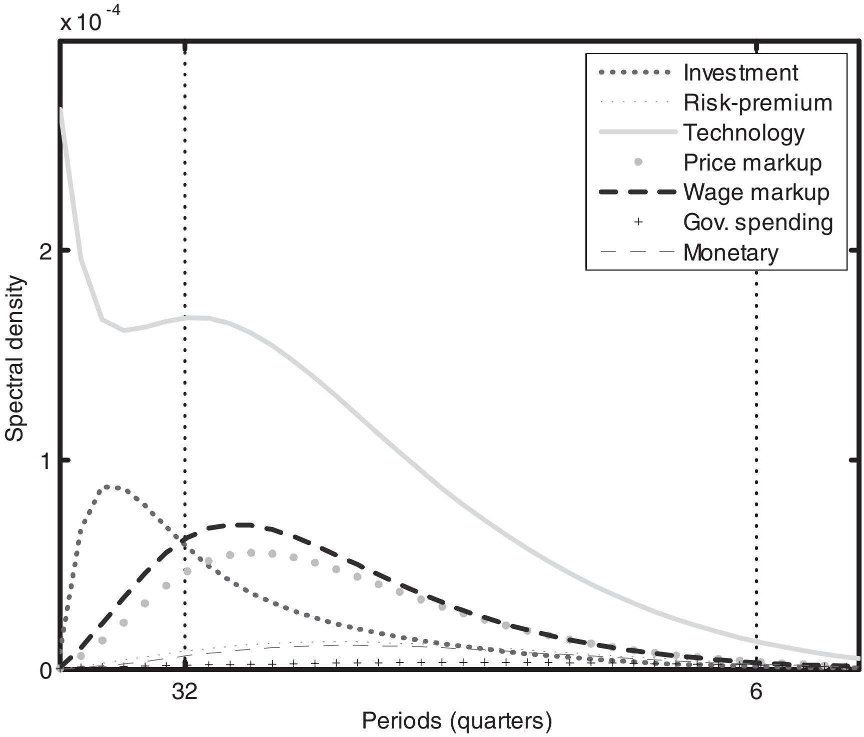

FIGURE 3. Spectral density of output growth conditional on each shock (computed at the posterior mode). Business cycles frequencies correspond to the cycles whose periods range from 6 to 32 quarters.

rule would have caused a large and significant drop in inflation, with a trough in 2004:Q1. From 2004 to 2005, counterfactual inflation would have been on the average 150 basis points lower than historical inflation. The unemployment rate would have increased substantially until 2004:Q2 and would have been rougly 150 basis above its historical path for three years.

In 2003:Q4 and 2004:Q1 inflation would have been below 1% with probability one. Meanwhile, the probability of unemployment greater than 8% in 2004:Q2 would have been 92.6%. These results suggest that the deviations from the Taylor rule between 2002 and 2006 did help reduce the risk of deflation and high unemployment materially. The evidence obtained from this counterfactual experiment is consistent with the justification of the Federal Reserve's conduct of monetary policy between 2002 and 2006 advocated by Bernanke (2010). Deviating from the Taylor rule's prescription enabled policy makers to insure against some of the risks of deflation and high unemployment.

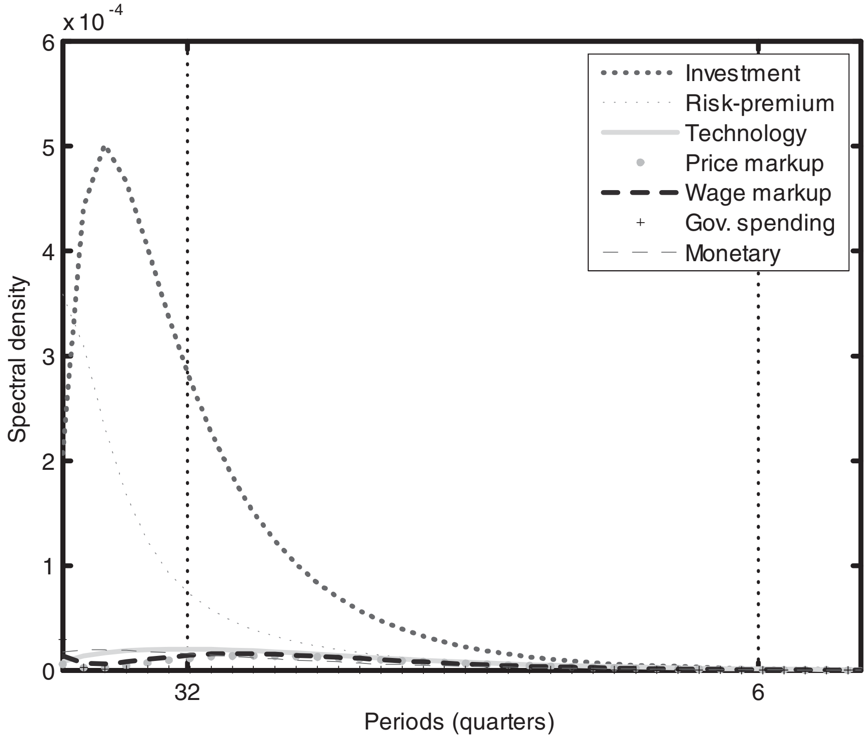

FIGURE 4. Spectral density of inflation conditional on each shock (computed in the posterior mode). Business cycles frequencies correspond to the cycles whose periods range from 6 to 32 quarters.

3.2. Which Shocks Caused the Federal Reserve to Deviate from Its Usual Way of Setting the Policy Rate?

Figures 6 and 7 show the historical decompositions of inflation and unemployment respectively. Adverse risk-premium shocks (i.e., shocks increasing the spread between the effective interest rate faced by households and firms and the policy rate) were the main source of downward pressure on inflation between 2002 and 2005. We also see the expansionary influence of monetary policy shocks from 2002 to 2006, pushing inflation up and unemployment down. The unusually large and persistent deviations from the Taylor rule over that period successfully offset the effects of large, adverse risk-premium shocks.

The correlation between the risk-premium shock and the monetary shock over the period 1985–2001 is equal to 0.08. Instead, over the period 2002–2009, this correlation is equal to −0.27, suggesting that the Federal Reserve had a special concern with risk-premium shocks after 2001. Kohn (2007) emphasizes the importance of adverse risk-premium shocks around 2003. Bernanke (2010) attributes

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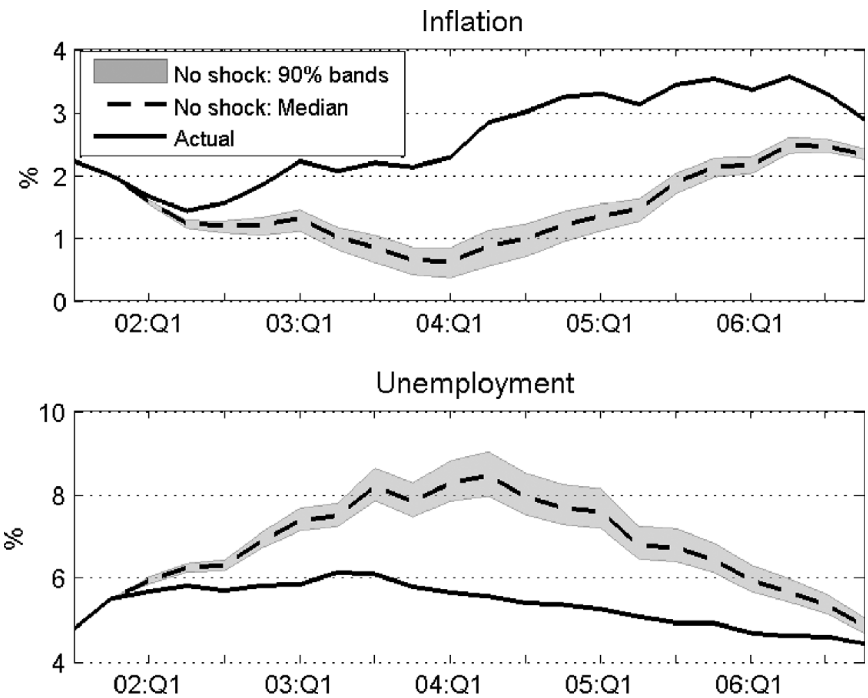

FIGURE 5. Counterfactual paths of inflation and unemployment without monetary shocks over the period 2002:Q1–2006:Q4. In each panel, the solid line represents the actual data, the dashed line represents the posterior median of the counterfactual data, and the shaded area represents the 90% posterior band. Inflation is measured by the year-on-year growth rate of the GDP deflator.

the loose stance of monetary policy during that period to insurance against the risk of deflation.[5]

3.3. Did the Fed Stabilize Unemployment around the Natural Rate?

The mandate of the Federal Reserve emphasizes the aim of promoting maximum sustainable employment. It is therefore crucial to measure the extent to which the deviations from the Taylor rule have contributed to stabilize unemployment around the natural rate. Following Sala et al. (2008), I define the natural rate to be the unemployment rate that would prevail under flexible prices and wages and constant markup and bargaining power.[6] My estimates of the natural rate, shown in Figure 8, are in line with those obtained by Sala et al. (2008). Looking at Figure 9, we see that the model-consistent measure of the output gap and unemployment gap are almost perfectly negatively correlated. Importantly, the output gap decreases in each NBER recession.

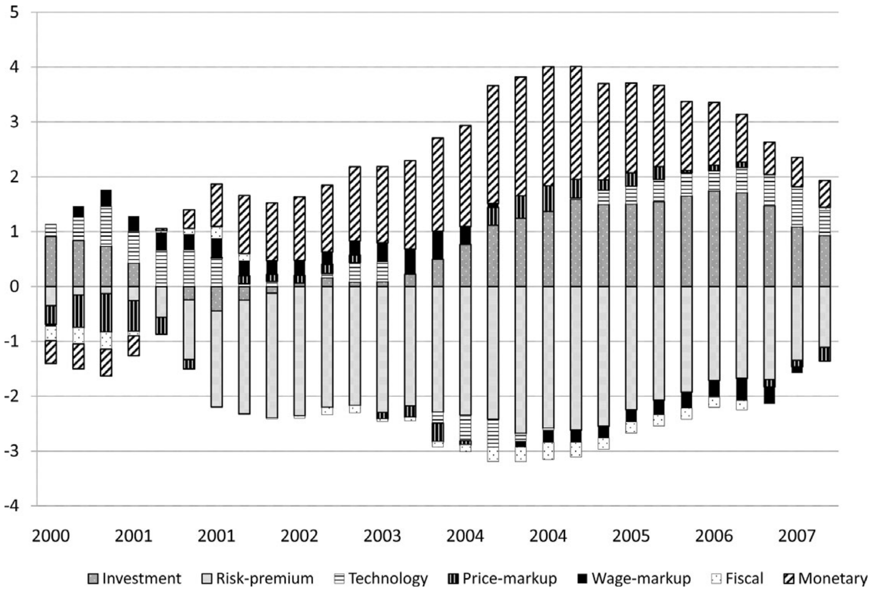

FIGURE 6. Historical decomposition of inflation, expressed in percentage deviation from the sample mean. Inflation is measured by the year-on-year growth rate of the GDP deflator.

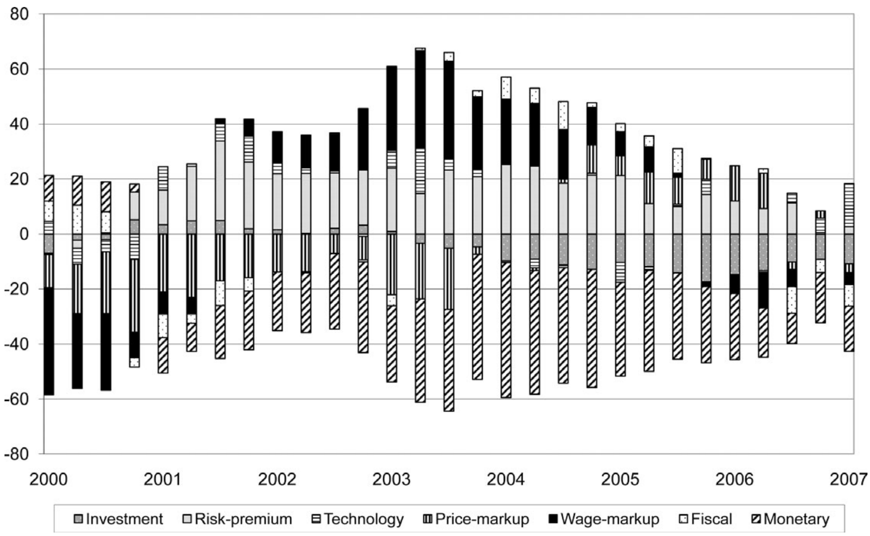

FIGURE 7. Historical decomposition of the unemployment rate, expressed in percentage deviation from the sample mean.

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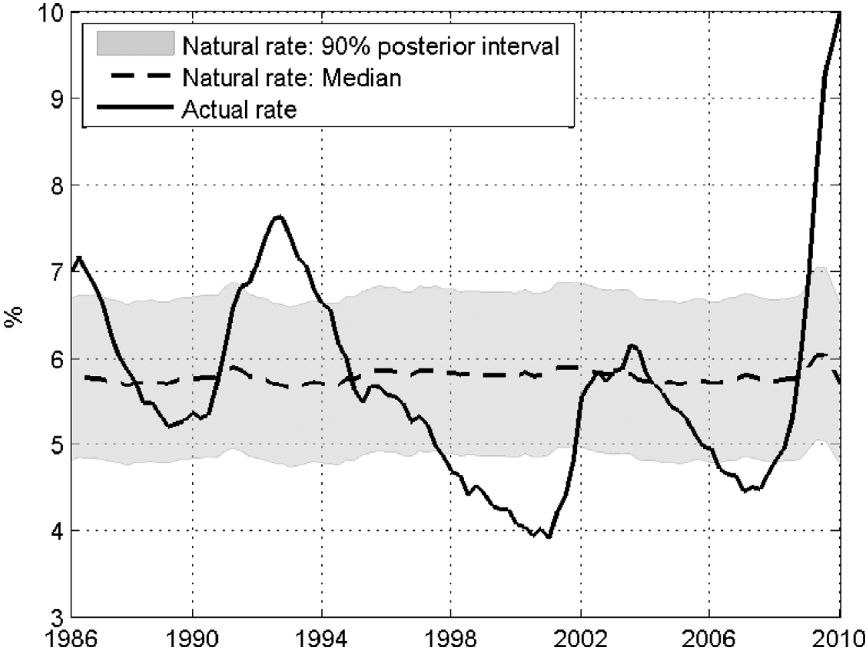

FIGURE 8. The actual and the natural rate of unemployment.

Figure 10 shows the counterfactual path of the unemployment gap when monetary policy shocks are turned off between 2002:Q1 and 2006:Q4. We see that a large positive unemployment gap would have opened up if the Fed had stuck with its pre-2002 rule.

4. SENSITIVITY ANALYSIS

This section checks the robustness of the results to the following changes in the specification of the model: (i) a change in the specification of the interest-rate rule and (ii) a change in the set of shocks hitting the model economy. I estimate the modified models using the same data and priors as for the baseline model and then repeat the same counterfactual experiment.

4.1. Case 1: Taylor Rule Responding to the Output Gap (Instead of Output Growth)

In the baseline model specification, the measure of real activity in the Taylor rule was output growth. Because output growth is observable, such a specification is often encountered in the literature. However, the original rule proposed by Taylor (1993) was responding to a different measure of real activity that is not directly observable, namely the output gap. A systematic response to output growth instead

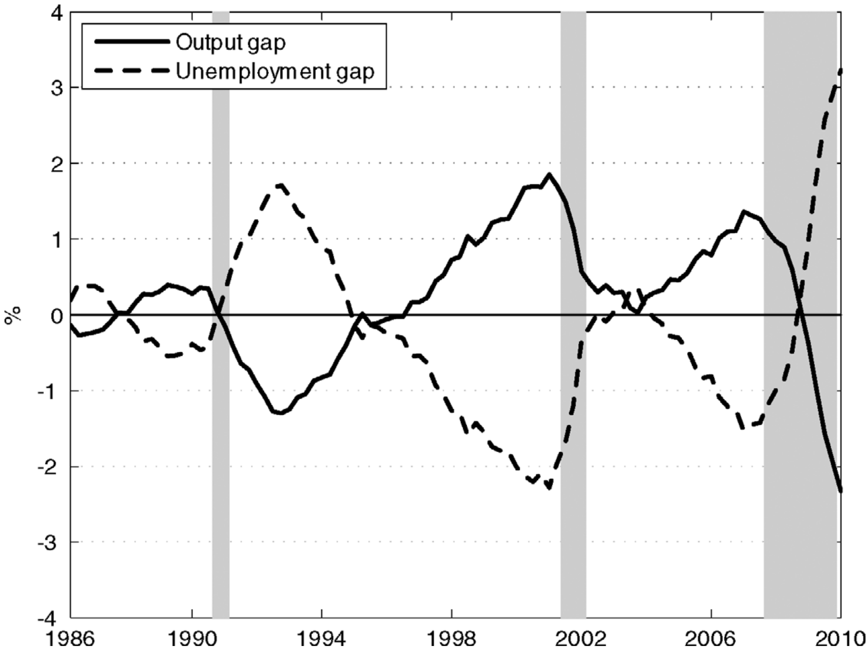

FIGURE 9. The output gap and the unemployment gap.

of the output gap entails different recommendations for the appropriate level of the policy rate, especially during the early stages of a recovery when growth is fast while the output gap is still negative. It is therefore interesting to investigate how the results from the baseline model are affected when the Taylor rule responds to the output gap instead of output growth. Figure 11 shows that the magnitude of the drop in the counterfactual path of inflation is somewhat subdued when the Taylor rule responds to the output gap.

4.2. Case 2: Intertemporal Preference Shocks Instead of Risk-Premium Shocks

I now assess the robustness of the main result to a change in the set of shocks hitting the economy. Chari et al. (2009) argue that risk-premium shocks may not be truly structural disturbances. I therefore reestimate a variant of the baseline model where the risk-premium shocks are replaced with more conventional intertemporal preference shocks, i.e., shocks to the household's discount factor [Primiceri et al. (2006)]. These disturbances induce variations in the patience of the household, and therefore in its willingness to postpone consumption over time to take advantage of temporarily attractive real interest rates. Looking at Figure 11, we see that the main result remains.

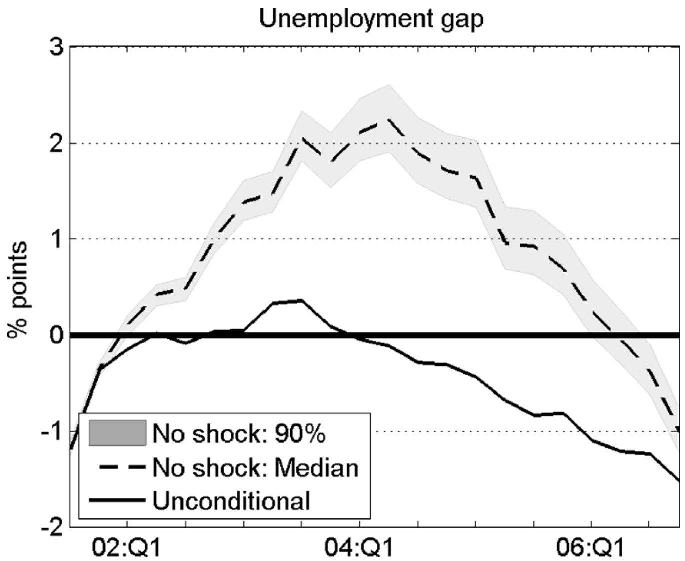

FIGURE 10. Unemployment gap with and without monetary policy shocks. The solid line represents the posterior median of the unconditional gap; the shaded area represents the 90% posterior interval of the gap when monetary policy shocks are turned off over the period 2002:Q1–2006:Q4. The dashed line represents the posterior median.

5. CONCLUDING REMARKS

This paper contributes to the ongoing debate regarding the justification of the Federal Reserve's actions during the last decade. I investigate what would have happened to inflation and unemployment if the Federal Reserve had strictly followed a Taylor rule between 2002 and 2006. I estimate a DSGE model with nominal rigidities and labor market frictions and infer the shocks that have been hitting the U.S. economy. I then simulate the counterfactual path inflation and unemployment where the estimated deviations from the simple interest-rate rule are set equal to zero between 2002 and 2006. I find that such a monetary policy would have generated a sizeable increase in unemployment and resulted in an undesirably low rate of inflation. Around mid-2004, when the counterfactual deviates the most from the actual series, the probability of an unemployment rate greater than 8% would have been as high as 80%, whereas the probability of an inflation rate above 1% would have been close to zero. My results suggest that the expansionary stance of monetary policy in the first half of the decade was appropriate and consistent with the Federal Reserve's dual mandate. This paper thereby validates Bernanke's (2010) testimony.

These findings also remind us that simple rules have limitations. As Kohn (2007) puts it: *"It's not that simple to use simple rules!"* In 2003–2004, monetary policy makers were concerned with the proximity of the zero lower bound and

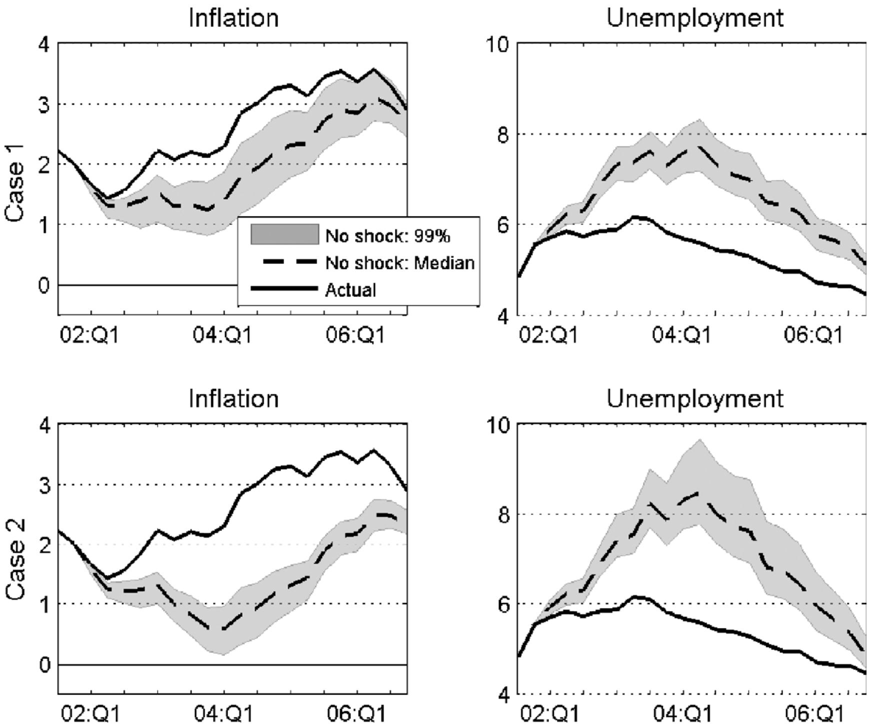

FIGURE 11. Sensitivity analysis. (Top panels) Model where the Taylor rule responds to the output gap (Case 1). (Bottom panels) Model where risk-premium shocks have been replaced with intertemporal preference shocks (Case 2). Shaded areas correspond to the 99% posterior bands of counterfactual inflation and unemployment with no monetary shocks over the period 2002:Q1–2006:Q4.

with the costs associated with the risk of a Japanese-style liquidity trap. A standard Taylor rule simply ignores these issues. In accordance with its official mandate, the Federal Reserve deviated from its usual, relatively systematic, way of conducting monetary policy to reduce the risks of a deflationary spiral and high unemployment.

NOTES

1. Other papers addressing Taylor's (2007) critique are Kohn (2007), Dokko et al. (2009), and Svensson (2010).

2. See Pissarides (2000) for an introduction to the search and matching model. Business cycle models with sticky prices and equilibrium search unemployment were first proposed by Walsh (2005), Krause and Lubik (2007), and Trigari (2009). Gertler et al. (2008) and Groshenny (2009) estimate and evaluate the fit of medium-scale versions of these models.

3. Groshenny (2010) offers a complete description of the model.

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4. Prior to estimation, I normalize the price-markup shock and the wage-markup shock so that they enter with a unit coefficient in the model's equations. Groshenny (2010) contains additional information on the estimation and the data set.

5. Bernanke (2002) and Eggertsson and Woodford (2003) discuss the conduct of monetary policy when the zero lower bound is binding.

6. Price-markup shocks are inefficient because they generate variations in the degree of distortion due to monopolistic competition. Bargaining power shocks are inefficient because they induce deviations from the Hosios condition.

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