Labor Income Targeting

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In this paper, we examine a new monetary policy rule: Labor Income Targeting (LIT). First, we evaluate the performance of this rule in a small New Keynesian model by comparing it with the Taylor Rule (TR), Inflation Targeting (IT), Nominal GDP Targeting (NGDPT), and Output Gap Targeting (GT). We find that LIT is the second best rule after output gap targeting. In contrast to gap targeting however, LIT does not suffer from determinacy issues and does not rely upon unobservable variables, thus making it a desirable policy rule. These results are robust to changes in parameter values. Next, we estimate a medium scale model using Bayesian techniques for the US economy and compare the performance of labor income targeting with the estimated Taylor rule. We find that LIT works better in the full sample as well in all the sub samples by generating lower variance for output gap, price inflation and wage inflation. Our findings suggest that labor income targeting possesses desirable properties and could be a viable monetary policy alternative.

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1. Introduction

Do monetary policy rules work? If so, which rule should a central bank follow? Milton Friedman asked the first question four decades ago (Friedman, 1982). He framed the question as a choice between "rules vs authorities", and concluded that it would be preferable to adopt a rules-based approach to policy making. John Taylor later examined the issue as a debate between "rules vs discretion" and came up with the same result (Taylor, 1993). More recent works such as Taylor (2012) and Nikolsko-Rzhevskyy et al. (2014) also confirm that monetary policy rules are vastly superior to discretion.

It is the second question that has remained unresolved despite extensive research. The most widely accepted rule so far has been the Taylor rule (Taylor, 1993). In this rule, the interest rate reacts to movements in inflation and output gap. In the original formulation, the federal funds rate equaled 1 plus 1.5 times inflation plus 0.5 times the output gap. In later iterations, the coefficients for inflation and output gap were changed.

There have been numerous modifications and extensions of the Taylor rule. Many researchers believe that these rules should be "simple" in the sense that they should not depend on unobservable variables such as output gap. As a result, modern variations of the Taylor rule often utilize output growth instead. Some have called for the rule to include other variables such as employment (Faia, 2008), money (Keating & Smith, 2013), credit spreads (Cúrdia & Woodford, 2016), price of capital (Heer et al., 2017), and inequality (Hansen et al., 2020) among others. All of these could be categorized as "instrument rules", where the instrument (interest rate) reacts to a set of variables.

There are also "targeting rules", where the central bank targets a specific condition to be fulfilled. Some examples of these rules include inflation targeting, wage targeting, money growth targeting (Friedman's k percent rule), and output gap targeting. Svensson (2003) argues that simple targeting rules *"have the important advantage that they allow the use of judgment and extra-model information. They are also more robust and easier to verify than optimal instrument rules*". Erceg et al. (2000) compares optimal Taylor rules with other simple targeting rules such as strict inflation targeting and output gap targeting in a New Keynesian model with price and wage stickiness. The study finds that while inflation targeting produces large losses, output gap targeting performs nearly as well as the optimal monetary policy rule. Garín et al. (2016) take this analysis forward by incorporating nominal GDP targeting to the analysis. They find that NGDP targeting produces lower welfare losses than the Taylor rule and inflation targeting. Output gap is better than NGDP targeting but it suffers from measurement and indeterminacy issues.

We extend the previous literature by introducing a new labor income targeting rule. Here, the central bank keeps the growth rate of nominal labor income constant. We first examined this rule in an economy with Non-Ricardian households in Bhatnagar (2022) and found that labor income targeting outperformed other poliy rules for most parameter values. In this paper, we switch to a standard representative agent model (Garín et al., 2016) to compare the Taylor rule, inflation targeting, NGDP targeting, output gap targeting and labor income targeting. We find that LIT dominates the Taylor rule, inflation targeting and NGDP targeting and is second only to gap targeting. In other words, it is the best rule in the class of simple and implementable rules. We also discuss how changing certain parameters of the economy could affect the results. Next, we compare LIT with an estimated Taylor rule for the US economy in a medium scall model. We find that LIT produces much lower volatility for key variables as compared to the Taylor rule. This is true for the complete sample as well as all the sub samples.

The rest of the paper is organized as follows: Section 2 provides details of the small-scale New Keynesian DSGE model along with the results and in section 3, we look at the medium-scale New Keynesian DSGE model. Section 4 presents the conclusion.

2. Small Scale New Keynesian Model

In the section, we briefly describe the New Keynesian model developed by Garín et al. (2016).

2.1 Households

The economy is populated by a continuum of households indexed by $h \in [0,1]$. The utility function of the household is given by:

$$U_t = E_t\{\sum_{i=0}^{\infty} \beta^i \nu_{t+i} \, [\ln(C_{t+i}(h)) - \psi \frac{N_{t+i}(h)^{1+\eta}}{1+\eta}]\} \quad (1)$$

Here, β is the discount factor. The exogenous preference shock, ν_t, follows an AR (1) process and is common to all households. $C_t(h)$ and $N_t(h)$ are the consumption and labor effort of household h. The scaling parameter on the disutility from labor is denoted by ψ, while η represents the inverse of the Frisch elasticity of labor supply.

The budget constraint is given as:

$$C_t + \frac{B_t}{P_t} = w_t(h)N_t(h) + \frac{B_{t-1}(1+i_{t-1})}{P_t} + \Pi_t \tag{2}$$

Here, i_t is the interest rate on bonds, Π_t is the dividend received from the firm and $w_t(h)$ is the real wage received by household h.

Wage setting

Wage setting is subject to nominal rigidities. In every period, each household faces a probability $1-\theta_w$ of being able to re-optimize their wage. Hence, θ_w is a measure of wage rigidity. Households adjust their wage as follows:

$$\begin{array}{ll} w_t(h) = w^{\#}(h) & \text{if } w_t(h) \text{ is chosen optimally} \\ (1+\pi_t)^{-1} w_{t-1}(h) & \text{otherwise} \end{array} \tag{3}$$

Here, $w^{\#}(h)$ is the optimal "reset" real wage chosen by household h and π_t is the inflation rate in period t.

The households supply their labor to a labor-aggregating firm which bundles the labor input as follows:

$$N_t = \left(\int_0^1 N_t(h)^{\frac{\epsilon_{w-1}}{\epsilon_w}} \, dj \right)^{\frac{\epsilon_w}{\epsilon_w - 1}} \tag{4}$$

The optimizing problem of the labor-aggregating firm gives the demand for labor as:

$$N_t(h) = \left(\frac{w_t(h)}{w_t} \right)^{-\epsilon_w} N_t \tag{5}$$

2.2 Goods market

The goods market consists of intermediate goods firms and final goods firms. The final goods market is perfectly competitive. The final goods firm uses $Y_t(j)$ units of each intermediate good $j \in [0,1]$ to manufacture Y_t units of final output according to the following technology:

$$Y_t = \left(\int_0^1 Y_t(j)^{\frac{\epsilon_p - 1}{\epsilon_p}} \, di \right)^{\frac{\epsilon_p}{\epsilon_p - 1}} \tag{6}$$

The competitive final goods firm maximizes profit, which gives rise to the following demand function:

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\epsilon_p} Y_t \tag{7}$$

The intermediate producers operate in a monopolistic setup and can set their own prices. The production function is given as:

$$Y_t(j) = A_t N_t(j) \tag{8}$$

$\mathrm{A_t}$ is the aggregate productivity shock that follows a random walk with positive drift:

$$Log(A_t) = \rho_A Log(A_{t-1}) + \epsilon_{At} \tag{9}$$

Price setting by the intermediate firm

Each intermediate firm can set its own price. Price setting follows the Calvo (1983) mechanism. In every period, each firm faces a $1-\theta_p$ probability of adjusting its prices. The firms which do not receive the signal will update their prices based on an indexation rule Garín et al. (2016) given as:

$$\begin{aligned} &P_t(j) = P^{\#}(j) && \text{if } P_t(j) \text{ is chosen optimally} \\ &P_{t-1}(j) && \text{otherwise} \end{aligned} \tag{10}$$

Here, $P^{\#}(j)$ is the optimal "reset" price chosen by the j^{th} intermediate firm.

2.3 Monetary policy

We adopt a Taylor rule (Taylor, 1993) in the baseline model as follows:

$$\begin{aligned} \log(1+i_t) = (1-\rho_i)\log(1+i^*) + \rho_i \log\big(1+i_{(t-1)}\big) + \phi_\pi \log\left(\frac{1+\pi_t}{1+\pi^*}\right) \\ + \phi_y \log\left(\frac{Y_t/Y_{t-1}}{1+gy}\right) \end{aligned} \tag{11}$$

where i^*, π^* and gy are the steady state interest rate, inflation and growth rate respectively.

Inflation targeting is defined as follows:

$$\pi_t = 0 \tag{12}$$

Nominal GDP targeting is defined as follows:

$$(1+\pi_t)\frac{Y_t}{Y_{t-1}} = 0 \tag{13}$$

Output gap targeting is defined as follows:

$$\mathrm{X_t} = 0 \tag{14}$$

Labor income targeting is defined as follows:

$$(1 + \pi_t)\frac{w_t}{w_{t-1}}\frac{N_t}{N_{t-1}} = 0 \tag{15}$$

The specifications of the inflation targeting rule and the NGDP rule are similar to Garín et al. (2016). The inflation target rule implies that the central bank wants to achieve the inflation target (which is zero in this case) in every period, while the NGDP rule implies that the central bank wants to achieve the nominal income growth target in every period. The labor income rule keeps the growth of nominal labor income constant.

Calibration

All parameter values are obtained from Garín et al. (2016) and are provided in Table 1.

Table 1: Calibrated parameter values

Parameter	Description	Value
β	Discount factor	0.997
ψ	Scaling parameter on the disutility from labor	7
η	Inverse of the Frisch elasticity of labor supply	1
θ_p	Price stickiness parameter	0.75
θ_w	Wage stickiness parameter	0.75
ϵ_p	Elasticity of substitution for price	10
ϵ_w	Elasticity of substitution for wage	10
ρ_i	Interest rate smoothing (Taylor rule)	0.7
ϕ_π	Response to inflation (Taylor rule)	0.45
ϕ_y	Response to output (Taylor rule)	0.0375
ρ_A	Persistence of productivity shock	0.97
ρ_v	Persistence of preference shock	0.70
σ_A	Standard deviation of productivity shock	0.006
σ_v	Standard deviation of preference shock	0.020

2.4 Results

Comparing the rules in the baseline economy

We evaluate the performance of five monetary policy rules: A standard Taylor rule (TR), Inflation Targeting (IT), Nominal GDP Targeting (NGDPT), output gap targeting (GT), and Labor Income Targeting (LIT). In order to compare the five policy rules, we define welfare recursively in our model as follows:

$$V_t = U(C_t, N_t) + \beta E_t(V_{t+1})$$

We then solve the model using a second order approximation around the model's steady state and obtain the unconditional mean of welfare for each policy rule. This is then compared to the unconditional mean of welfare in the flexible price economy where there is no price or wage stickiness ($\theta_p = 0\ and\ \theta_w = 0$).

Based on these unconditional means, we then calculate consumption equivalent welfare losses as follows:

$$CE = \exp\Big((1-\beta) * (E\big(V_{flex}\big) - E(V_1))\Big) - 1$$

Here $E\big(V_{flex}\big)$ is the unconditional mean of welfare in the flexible price economy and $E(V_1)$ is welfare under the alternate monetary policy rules (TR, IT, NGDPT, GT, or LIT). Consumption equivalent welfare loss can be interpreted as the amount of consumption households would be willing to give up in each period to live in the flexible price economy as opposed to living in the economy with nominal rigidities. Hence, these CE values are essentially welfare losses that arise due to frictions.

Table 2 provides the consumption equivalent welfare losses. The values for TR, IT, NGDPT and GT are the same as those obtained by Garín et al. (2016). Inflation targeting performs very poorly. Taylor rule also generates significant welfare losses. Garín et al. (2016) conclude that output gap targeting is the best policy rule followed closely by NGDPT. Here, we show that LIT is a better policy choice than NGDPT.

Table 2: Welfare loss under various monetary policy rules. Note: Values are in percentage terms.

Policy Rule	Welfare loss
Taylor Rule	0.2889
Inflation Targeting	20.3694
Nominal GDP Targeting	0.0314
Labor Income Targeting	0.0236
Gap Targeting	0.0190

Demand vs supply shocks

In this section, we compare the performance of monetary policy rules based on which shocks hit the economy. Our model consists of a demand shock (preference shock ν_t) and a supply shock (productivity shock A_t).

Table 3 reports the welfare gains under each shock. We notice that when the model includes only a demand shock, the performance of the Taylor rule worsens. On the other hand, the four other rules generate no welfare losses. In other words, the choice of monetary policy rule is not as relevant. This is very much in line with the findings of Garín et al. (2016) and Bhatnagar (2022).

Table 3: Consumption equivalent welfare gains relative to using the Taylor rule. Note: Values are in percentage terms.

Policy Rule	Only Demand Shocks	Only Supply Shocks
Taylor Rule	0.3094	0.2740
Inflation Targeting	0.0000	45.0747
Nominal GDP Targeting	0.0000	0.0630
Labor Income Targeting	0.0000	0.0474
Gap Targeting	0.0000	0.0382

When a supply shock hits the economy, the welfare differentials are much larger. Taylor rule continues to generates significant welfare loss. Inflation targeting is the worst rule in this scenario. This is due to the fact that under our supply shock, inflation and output move in opposite directions (Sumner (2014)). As Garín et al. (2016) point out, NGDP targeting does very well under supply shocks and could be the best alternative amongst the simple policy rules. We show that labor income targeting in fact is a better solution as it produces lower welfare losses.

Why does labor income targeting work?

To understand why LIT works better than NGDPT, TR and IT, we need to understand the central bankers loss function, given in equation 16[2].

$$L = (1+\eta)\ var(\tilde{y}_t) + \frac{\theta_p \epsilon_p}{(1-\theta_p)(1-\beta\theta_p)}\ var\left(\pi_t^p\right) + \frac{\theta_w \epsilon_w}{(1-\theta_w)(1-\beta\theta_w)}\ var(\pi_t^w) \tag{16}$$

As we can see, the loss function depends upon the variances of output gap, price inflation, and wage inflation. The standard deviations of these variables is provided in Table 4.

Inflation targeting, by definition, produces zero variance in inflation. However, under IT, output gap and wage inflation are extremely volatile, thus making it an undesirable policy choice. All the other rules produce very similar variances for price and wage inflation. The

[2] The complete derivation of this loss function is provided in appendix 6.1 of Galí (2015)

difference is in terms of the volatility of the output gap. In this respect, LIT is the second best choice after gap targeting. Output gap is seven times more volatile under NGDPT as opposed to LIT. This is the reason that LIT produces relatively low welfare losses.

Table 4: Standard Deviations under different monetary policy rules

Policy Rule	Standard Deviation		
	Output gap	Price inflation	Wage inflation
Taylor Rule	0.026	0.002	0.002
Inflation Targeting	0.402	0.000	0.006
Nominal GDP Targeting	0.007	0.002	0.002
Labor Income Targeting	0.001	0.002	0.002
Gap Targeting	0.000	0.002	0.002

The problem with output gap targeting

The previous results suggest that GT is the optimal monetary policy rule in this small New Keynesian model. However, as Garín et al. (2016) point out, gap targeting has two problems. The first is that it relies on an unobservable variable. Garín et al. (2016) show in great detail that if output gap is observed with noise then gap targeting may not be as effective.

The second issue relates to equilibrium determinacy. Garín et al. (2016) show that when trend inflation is positive, gap targeting may result in equilibrium indeterminacy. We test for this by creating an alternate economy with a steady state inflation of 2%. As expected, gap targeting results in indeterminacy. Labor income targeting turns out to be the best rule in this scenario. This is followed by inflation targeting, Taylor rule and then NGDPT.

Table 5: Welfare loss under various monetary policy rules. Note: Values are in percentage terms.

Policy Rule	Welfare loss
Taylor Rule	0.2575
Inflation Targeting	0.2350
Nominal GDP Targeting	0.2620
Labor Income Targeting	0.2303
Gap Targeting	Indeterminate

Labor income targeting as the next best alternative

Given that gap targeting suffers from indeterminacy and measurement issues, we can look at labor income targeting as the next best policy alternative. It produces the lowest welfare losses of the remaining policy options. Furthermore, LIT responds to shocks in much the same manner as gap targeting.

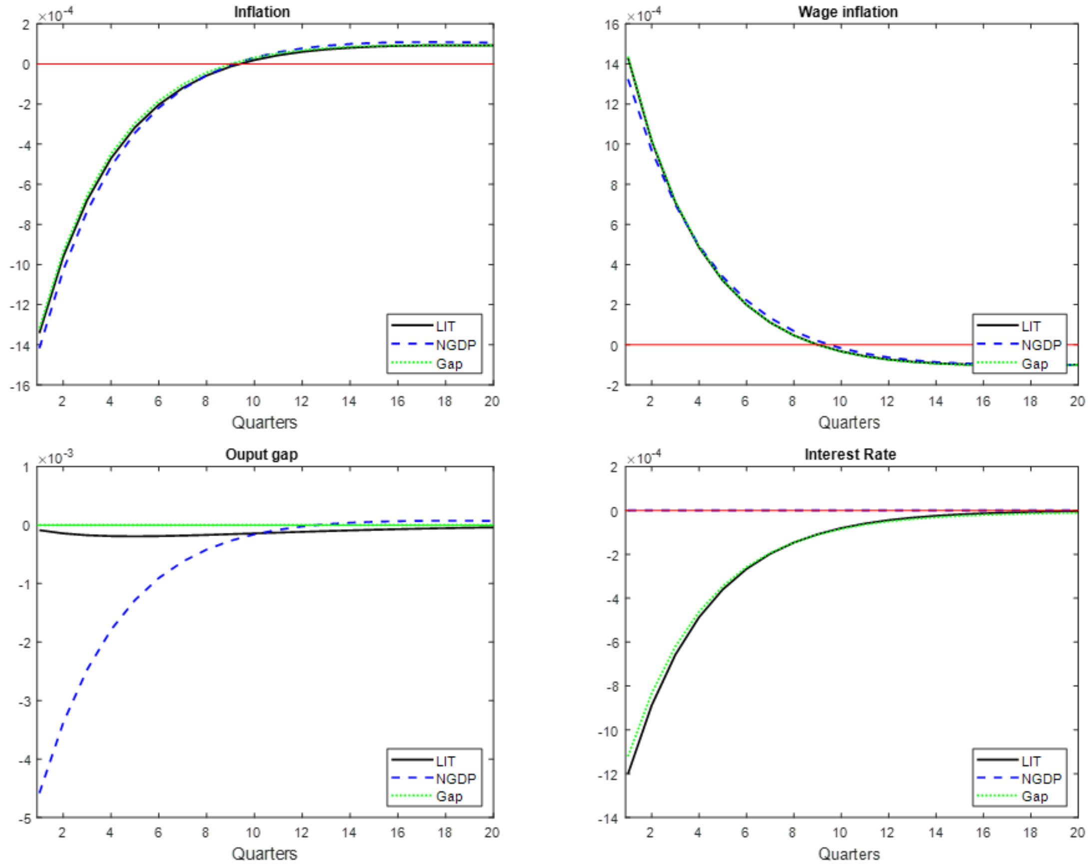

Figure 1: Impulse response to a productivity shock

Figure 1 captures the impulse responses of key variables to a productivity shock. We can see that the response of wage and price inflation is the same for LIT, GT and NGDPT. The difference is in the policy response (i.e. the interest rate) and the impact on output gap. Under nominal GDP targeting, inflation and output growth move in opposite directions. As a result, nominal interest rate remains fixed. However, under LIT and GT, interest rate falls. Labor income targeting mimics the policy response of gap targeting.

The role of price and wage rigidity

Nominal frictions play an important role in the choice of monetary policy. When there is no price stickiness ($\theta_p = 0$), welfare gains under LIT and NGDPT are identical (Table 6). The proof for this is provided in Appendix B.

Table 6: Welfare loss under various monetary policy rules. Note: Values are in percentage terms.

Policy Rule	Baseline	$\boldsymbol{\theta_p = 0}$	$\boldsymbol{\theta_w = 0}$	$\boldsymbol{\theta_w = 0.1}$
Taylor Rule	0.2880	0.2907	0.1603	0.2576
Inflation Targeting	20.3694	20.3694	0.0000	0.0265
Nominal GDP Targeting	0.0314	0.0001	0.0398	0.0407
Gap Targeting	0.0190	0.0000	0.0000	0.0070
Labor Income Targeting	0.0236	0.0001	0.0192	0.0204

The intuition is that under no price stickiness, marginal costs are equal to the inverse of the fixed markup. As a result, movements in wage are entirely driven by movements in aggregate productivity A_t. When this happens, NGDP targeting and labor income targeting are essentially the same. As price stickiness increases, the welfare gap between the two rules expands as shown in Figure 2.

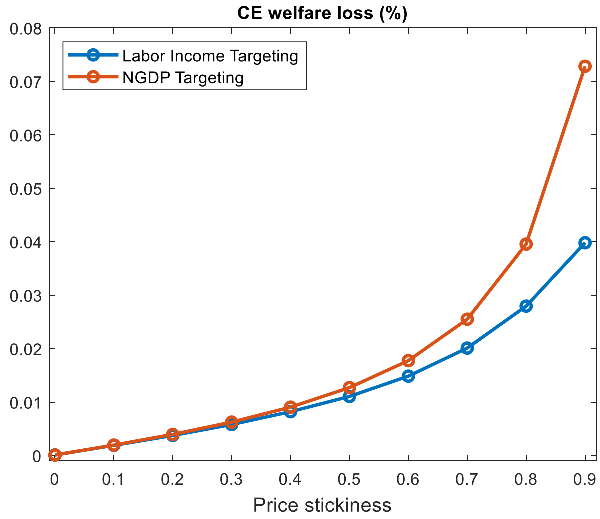

Figure 2: CE welfare gain of using LIT and NGDPT relative to the Taylor rule. Impact of share of non-Ricardian households.

When there is no wage stickiness ($\theta_w = 0$) welfare outcomes change significantly. Under this specification, inflation targeting becomes the best policy rule along with gap targeting. This is because when there is no wage stickiness, the weight on wage inflation in the loss function collapses to zero. As a result, the wage inflation stabilizing properties of NGDPT and LIT are no longer relevant and inflation targeting becomes a better option. These findings are in line with Garín et al. (2016) who also report that inflation targeting performs outperforms other rules when there is no wage stickiness. We find that LIT is the next best rule. This is followed by the Taylor rule and then Nominal GDP targeting. It must be noted that even a small value of $\theta_w = 0.1$ is sufficient to make LIT better than inflation targeting.

Impact of other parameters

Next, we look at the impact of household parameters on the performance of the monetary policy rules. Table 7 provides the welfare loss values. First, we decrease β to 0.99. This would increase the steady state interest rate from 2% to 4%. The welfare losses for each of the rules decreases, but the rankings remain the same. Next, we decrease the labor disutility parameter (ψ) from 7 to 2, which increases the steady state value of labor hours from 1/3 to 2/3. This has no impact on welfare gains. This follows from the loss function in equation 16. We can see that ψ does not appear in the loss function. Hence, changing ψ does not change welfare outcomes.

We then increase the inverse Frisch elasticity parameter (η) from 1 to 1.5. This would imply a Frisch labor supply elasticity of two-third. Increasing the value of η increases the welfare losses (once again we can look at equation 16 to understand why this happens).

Finally, we decrease the elasticities of substitution, ϵ_p and ϵ_w from 10 to 6. This would imply a steady state price and wage markup of 20%. In both these cases, welfare losses decrease. However, the welfare rankings are preserved.

Table 7: Welfare loss under various monetary policy rules. Note: Values are in percentage terms.

Policy Rule	**Baseline**	$\boldsymbol{\beta = 0.99}$	$\boldsymbol{\psi = 2}$	$\boldsymbol{\eta = 5}$	$\boldsymbol{\epsilon_p = 6}$	$\boldsymbol{\epsilon_w = 6}$
TR	0.2880	0. 1424	0.3693	0. 9359	0.2744	0.1972
IT	20.3694	9.4459	36.0830	255.3246	20.3631	7.7349
NGDPT	0.0314	0.0157	0.0333	0.0464	0.0211	0.0316
LIT	0.0236	0.0118	0.0238	0.0241	0.0146	0.0230
GT	0.0190	0.0096	0.0192	0.0195	0.0146	0.0165

3. Medium Scale New Keynesian Model

In the previous section, we used a standard DSGE model to compare labor income targeting with other commonly used monetary policy rules. In this section, our goal is to understand whether labor income targeting could have historically produced better results for the US economy. To do so, we must move away from the stylized DSGE model and deploy a more detailed and realistic one. For this purpose, we use the Smets & Wouters (2007) model, given that it has been widely accepted by economists[3].

We use an updated quarterly dataset that spans from the third quarter of 1954 to the second quarter of 2022. All the variables and their transformations are along the lines of Smets & Wouters (2007). We estimate the model using Bayesian methods. Table 8 lists down the prior distributions of the 35 parameters that we estimate. These values have been sourced from Smets & Wouters (2007).

Table 8: Prior distribution of model parameters

		Prior		
Parameter	**Description**	**Distribution**	**Mean**	**Std Dev.**
ϕ	Steady state elasticity of the capital adjustment cost function	Beta	4.00	1.50
σ_c	Inverse of the elasticity of intertemporal substitution	Normal	1.50	0.375
h	External habit formation	Beta	0.70	0.10
ξ_w	Degree of wage stickiness	Beta	0.50	0.10
σ_l	Elasticity of labor supply	Normal	2.00	0.75
ξ_p	Degree of price stickiness	Beta	0.50	0.10
ι_w	Wage indexation	Beta	0.50	0.15
ι_p	Price indexation	Beta	0.50	0.15
ψ	Capital utilization adjustment cost	Beta	0.50	0.15
Φ	Share of fixed costs in production	Normal	1.25	0.125
r_π	Weight on inflation	Normal	1.50	0.25
ρ	Interest rate smoothing	Beta	0.75	0.10
$r_{\Delta y}$	Weight on output growth	Normal	0.125	0.05
$\bar{\pi}$	Steady state inflation rate	Gamma	0.625	0.10
$100(\beta^{-1} - 1)$	Transformed discount factor	Gamma	0.25	0.10
$\bar{l}$	Steady state hours worked	Normal	0.00	2.00
$\bar{\gamma}$	Trend growth rate	Normal	0.40	0.10
α	Steady state capital share	Normal	0.30	0.05
σ_a	Std. error: technology shock	Inv. gamma	0.10	2.00
σ_b	Std. error: risk premium shock	Inv. gamma	0.10	2.00
σ_g	Std. error: gov spending shock	Inv. gamma	0.10	2.00

[3] (Benchimol & Fourçans, 2019)

σ_I	Std. error: investment shock	Inv. gamma	0.10	2.00
σ_r	Std. error: monetary policy shock	Inv. gamma	0.10	2.00
σ_p	Std. error: price markup shock	Inv. gamma	0.10	2.00
σ_w	Std. error: wage markup shock	Inv. gamma	0.10	2.00
ρ_a	AR: technology shock	Beta	0.50	0.20
ρ_b	AR: risk premium shock	Beta	0.50	0.20
ρ_g	AR: government spending shock	Beta	0.50	0.20
ρ_I	AR: investment shock	Beta	0.50	0.20
ρ_r	AR: monetary policy shock	Beta	0.50	0.20
ρ_p	AR: price markup shock	Beta	0.50	0.20
ρ_w	AR: wage markup shock	Beta	0.50	0.20
μ_p	MA: price markup shock	Beta	0.50	0.20
μ_w	MA: wage markup shock	Beta	0.50	0.20
ρ_{ga}	Productivity in government shock	Beta	0.50	0.25

Table 9 provides the posterior distributions for all the parameters. We use the Metropolis-Hastings algorithm to estimate the posterior distribution of the parameters. We run 250,000 iterations and discard 20% of the draws as the burn-in period.

We repeat the exercise for three sub samples. The first sub sample is the post war period, which ranges from 1955 to 1985. The second sub sample covers the period ranging from 1985 to 2007. This could be classified as the great moderation era. The third sub sample spans from 2007 to 2022. This includes two major periods of upheaval: the great recession and the covid-19 pandemic.

Table 9: Posterior distribution of model parameters

Parameter	1955-2022	1955-1985	1985-2007	2007-2022
ϕ	8.31	5.37	7.48	5.58
σ_c	1.40	1.06	1.38	1.42
h	0.80	0.83	0.77	0.38
ξ_w	0.87	0.75	0.52	0.73
σ_l	1.87	1.82	1.70	1.48
ξ_p	0.71	0.54	0.70	0.73
ι_w	0.81	0.60	0.50	0.60
ι_p	0.16	0.25	0.40	0.37
ψ	0.72	0.42	0.73	0.74
Φ	1.26	1.51	1.56	1.10
r_π	1.61	1.46	1.81	1.66
ρ	0.79	0.71	0.79	0.91
$r_{\Delta y}$	0.20	0.19	0.16	0.17
$\bar{\pi}$	0.83	0.82	0.59	0.61
$100(\beta^{-1}-1)$	0.15	0.19	0.14	0.21
$\bar{l}$	-1.11	0.36	0.07	0.53
$\bar{\gamma}$	0.31	0.38	0.43	0.23

α	0.41	0.63	0.44	0.17
σ_a	0.21	0.22	0.22	0.18
σ_b	0.63	0.56	0.36	0.72
σ_g	0.47	0.30	0.19	0.18
σ_I	0.49	0.55	0.41	0.44
σ_r	0.32	0.34	0.35	0.38
σ_p	0.23	0.30	0.09	0.12
σ_w	0.15	0.17	0.07	0.18
ρ_a	0.39	0.21	0.35	0.87
ρ_b	0.99	0.99	0.94	0.70
ρ_g	0.12	0.21	0.18	0.89
ρ_I	0.96	0.92	0.97	0.88
ρ_r	0.80	0.84	0.62	0.66
ρ_p	0.42	0.26	0.60	0.60
ρ_w	0.97	0.91	0.88	0.57
μ_p	0.69	0.86	0.90	0.35
μ_w	0.78	0.68	0.61	0.50
ρ_{ga}	0.66	0.70	0.64	0.40

Comparing the Taylor Rule with Labor Income Targeting

Table 10 presents the standard deviations of key variables under the estimated Taylor rule as well as under a labor income targeting regime. Given that the model has both price as well as wage stickiness, the loss function would include variance of output gap, price inflation, and wage inflation (as was the case in the small-scale model). We can see that in the full sample, labor income targeting produces lower variance for each of the three variables. LIT does a much better job particularly for in the case of output gap.

We also evaluate the performance of both rules over three different sub samples. In each of the three sub samples, labor income targeting outperforms the estimated Taylor rule. It produces lower variance for all three variables. The only exception is the great moderation period, where the Taylor rule produces marginally lower variance for inflation.

Table 10: Standard Deviation of Key Variables

Period	Standard Deviation	Estimated TR	LIT
Full Sample	Output Gap	5.45	3.92
	Price Inflation	0.52	0.51
	Wage Inflation	0.79	0.77
1955-1985	Output Gap	3.70	3.51
	Price Inflation	0.62	0.47

	Wage Inflation	0.57	0.53
1985-2007	Output Gap	2.54	2.30
	Price Inflation	0.30	0.31
	Wage Inflation	0.81	0.49
2007-2022	Output Gap	5.23	2.06
	Price Inflation	0.88	0.33
	Wage Inflation	1.40	1.30

Figure 3 presents the ratio of standard deviations obtained under LIT to TR. So, a value greater than unity would imply that labor income targeting generates a higher variance and vice versa. As mentioned before, labor income targeting particularly does a great job by reducing variance of output gap and wage inflation. We can also see that LIT especially does well in the third sub sample, where the economy faced two major recessions.

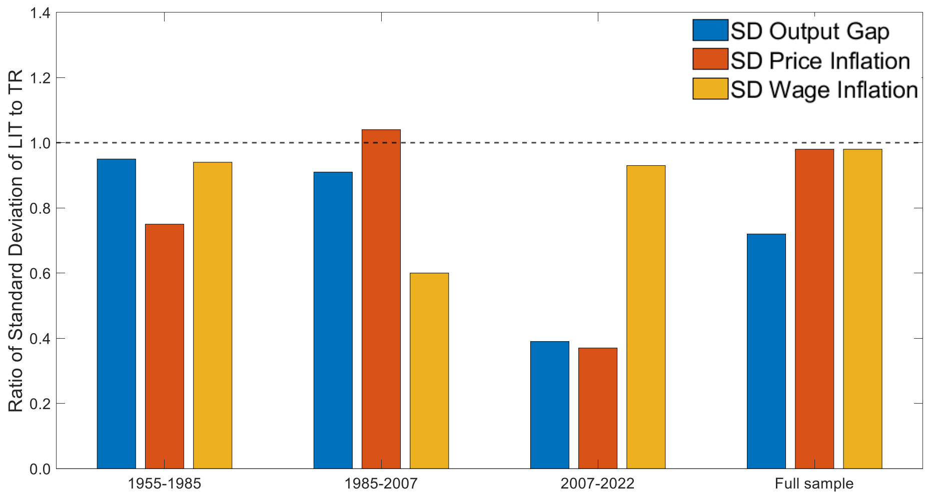

Figure 3: Ratio of standard deviation of key variables under LIT to TR

Finally, we evaluate the performance of both rules under various shocks. The Smets & Wouters (2007) model specifies three categories of shocks. The first category deals with supply shocks, which in this case consists of a technology shock. The second category relates to demand shocks. This category consists of a risk premium shock, a government spending shock, and an investment shock. Smets & Wouters (2007) labelled these shocks as "demand shocks" because when the economy is hit with these shocks, output and inflation move in the same direction. This can be seen in the impulse responses presented in Appendix D. The last category deals with markup shocks. These include price and wage markup shocks.

Figure 4 provides the ratio of standard deviations of key variables under LIT and TR for the three different types of shocks (for the full sample). Once again, a value less than unity would suggest that LIT performs better than TR and vice versa. We can see that under all three shocks the variance of output gap is lower when the central bank chooses labor income targeting as opposed to employing the Taylor rule. Furthermore, we also notice that the performance of LIT is significantly better under demand shocks.

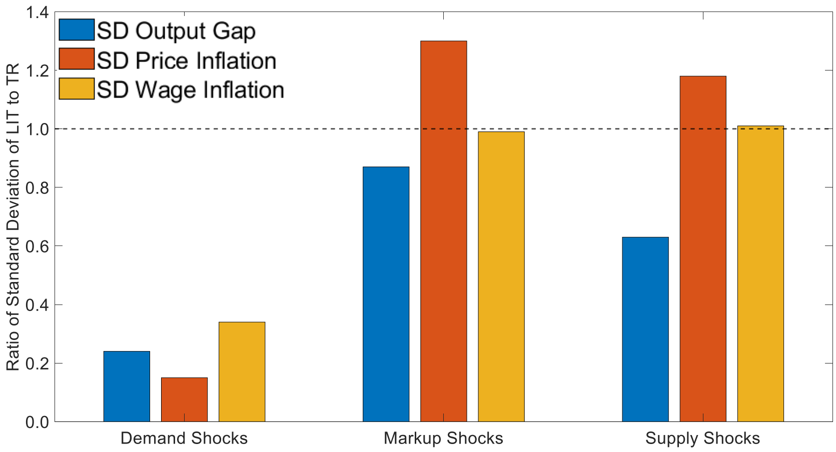

Figure 4: Ratio of standard deviations by shock

Conclusion

In this paper, we examine a new monetary policy rule: Labor Income Targeting (LIT). We evaluate the welfare properties of this rule in a standard New-Keynesian model with nominal rigidities. Our welfare analysis suggests that labor income targeting produces the second lowest welfare loss after output gap targeting. However, unlike output gap targeting LIT is simple in the sense that it does not depend on unobservable variables and is implementable in that it does not suffer from indeterminacy. This makes it a desirable policy choice.

Next, we compare LIT with the conventional Taylor rule in a medium scale model to understand whether LIT could have produced better outcomes for the US economy. We estimate this model using Bayesian techniques. Our simulations suggest that LIT would have produced lower volatility for key variables as compared to Taylor rule. This is not only true for the full sample (consisting of 68 years) but also for all three sub samples.

Overall, our results indicate that labor income targeting appears to be a promising policy rule and that it must be examined in greater detail.

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Appendix A: Small Scale Model

1. Euler equation

$$\frac{\Lambda_t}{\Lambda_{t+1}} = \frac{\beta(1+i_t)}{1+\pi_{t+1}} \tag{A.1}$$

2. Marginal utility of consumption

$$\Lambda_t = \frac{\nu_t}{C_t} \tag{A.2}$$

3. Reset wage

$$w_t^{\#} = \frac{\epsilon_w}{\epsilon_w - 1}\frac{H_{1t}}{H_{2t}} \tag{A.3}$$

4. $H_{1,t}$

$$H_{1,t} = \psi\nu_t\left(\frac{w_t^{\#}}{w_t}\right)^{-\epsilon_w(1+\eta)} N_t^{1+\eta} + \theta_w\beta\left(\frac{w_{t+1}^{\#}}{w_t^{\#}}\right)^{\epsilon_w(1+\eta)} (1+\pi_{t+1})^{\epsilon_w(1+\eta)} H_{1,t+1} \tag{A.4}$$

5. $H_{2,t}$

$$H_{2,t} = \frac{\nu_t}{C_t}\left(\frac{w_t^{\#}}{w_t}\right)^{-\epsilon_w} N_t \;\; + \theta_w\beta\left(\frac{w_{t+1}^{\#}}{w_t^{\#}}\right)^{\epsilon_w} (1+\pi_{t+1})^{(\epsilon_w - 1)} H_{2,t+1} \tag{A.5}$$

6. Evolution of wages

$$w_t^{1-\epsilon_w} = (1-\theta_w) w_t^{\#,(1-\epsilon_w)} + \theta_w(1+\pi_t)^{\epsilon_w - 1} w_{t-1}^{1-\epsilon_w} \tag{A.6}$$

7. Wage dispersion

$$v_t^w = (1-\theta_w)\left(\frac{w_t^{\#}}{w_t}\right)^{-\epsilon_w(1+\eta)} + \theta_w\left(\left(\frac{w_t}{w_{t-1}}\right)(1+\pi_t)\right)^{\epsilon_w(1+\eta)} v_{t-1}^w \tag{A.7}$$

8. Reset price

$$\frac{1+\pi^{\#}}{1+\pi_t} = \frac{\epsilon_p}{\epsilon_p - 1}\frac{X_{1,t}}{X_{2,t}} \tag{A.8}$$

9. $X_{1,t}$

$$X_{1,t} = \Lambda_t mc_t Y_t + \theta_p \beta (1+\pi_{t+1})^{\epsilon_p} X_{1,t+1} \tag{A.9}$$

10. $X_{2,t}$

$$X_{2,t} = \Lambda_t Y_t + \theta_p \beta (1+\pi_{t+1})^{\epsilon_p - 1} X_{2,t+1} \tag{A.10}$$

11. Evolution of prices

$$(1+\pi_t)^{1-\epsilon_p} = (1-\theta_p)(1+\pi_t^{\#})^{1-\epsilon_p} + \theta_p \tag{A.11}$$

12. Price dispersion

$$v_t^p = (1+\pi_t)^{\epsilon_p}\left[\left(1-\theta_p\right)(1+\pi_t^{\#})^{-\epsilon_p} + \theta_p v_{t-1}^p\right] \tag{A.32}$$

13. Production function

$$Y_t = \frac{A_t N_t}{v_t^P} \tag{A.43}$$

14. Goods market first order condition

$$w_t = A_t mc_t \tag{A.54}$$

15. Total output

$$Y_t = C_t \tag{A.65}$$

16. Preference shock

$$\log(\nu_t) = \rho_\nu \log(\nu_{t-1}) + \epsilon_{\nu,t} \tag{A.16}$$

17. Productivity shock

$$Log(A_t) = \rho_A Log(A_{t-1}) + \epsilon_{A,t} \tag{A.17}$$

18. Monetary policy rule

$$\log(1 + i_t) = (1 - \rho_i)\log(1 + i^*) + \rho_i \log(1 + i_{t-1}) + \phi_\pi \log\left(\frac{1 + \pi_t}{1 + \pi^*}\right) + \phi_y \log\left(\frac{Y_t/Y_{t-1}}{1 + gy}\right) \tag{A.18}$$

Appendix B: Proof that when $\theta_p = 0$, NGDPT=LIT

We know from Eq. A.11 that:

$$(1+\pi_t)^{1-\epsilon_p} = (1-\theta_p)(1+\pi_t^{\#})^{1-\epsilon_p} + \theta_p$$

Now, when $\theta_p = 0$, this equation would imply that $\pi_t = \pi_t^{\#}$

Furthermore, equation A.9 would become:

$$X_{1,t} = \Lambda_t mc_t Y_t$$

And equation A.10 would become:

$$X_{2,t} = \Lambda_t Y_t$$

Combining the previous two equations with equation A.8 would imply:

$$mc_t = \frac{\epsilon_p - 1}{\epsilon_p}$$

From equation A.14 we know that

$$w_t = A_t mc_t$$

As a result, when $\theta_p = 0$:

$$\Delta w_t = \Delta A_t$$

Note that nominal income targeting implies that:

$$\Delta P_t + \Delta A_t + \Delta N_t = 0$$

While labor income targeting works as follows:

$$\Delta P_t + \Delta w_t + \Delta N_t = 0$$

But we showed that when $\theta_p = 0,\ \Delta w_t = \Delta A_t$. Hence, in this case, NGDPT would be the same as LIT.

Appendix C: Prior and Posterior Distributions

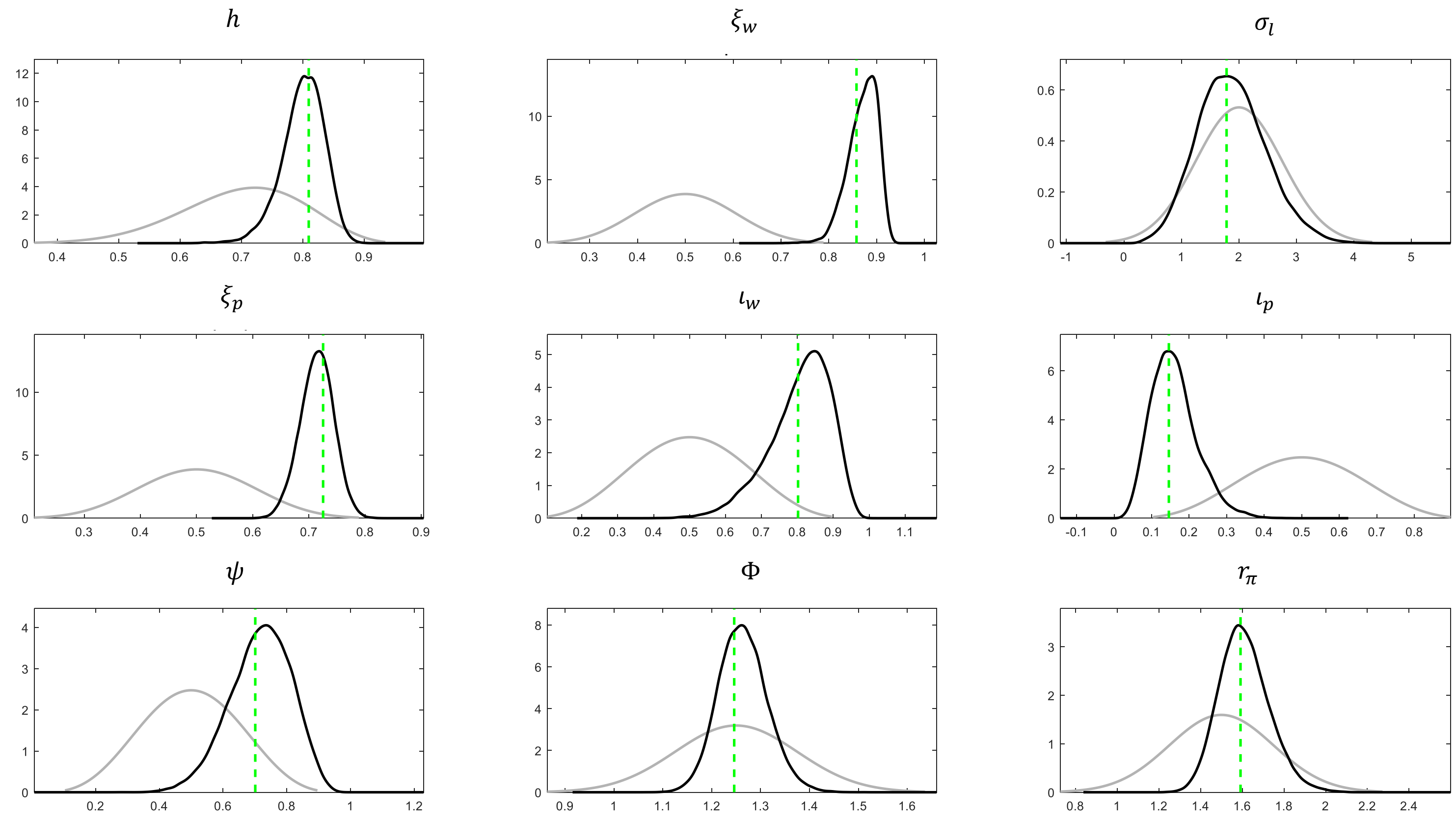

Figure 5: Prior (gray) and posterior (black) distribution of model parameters

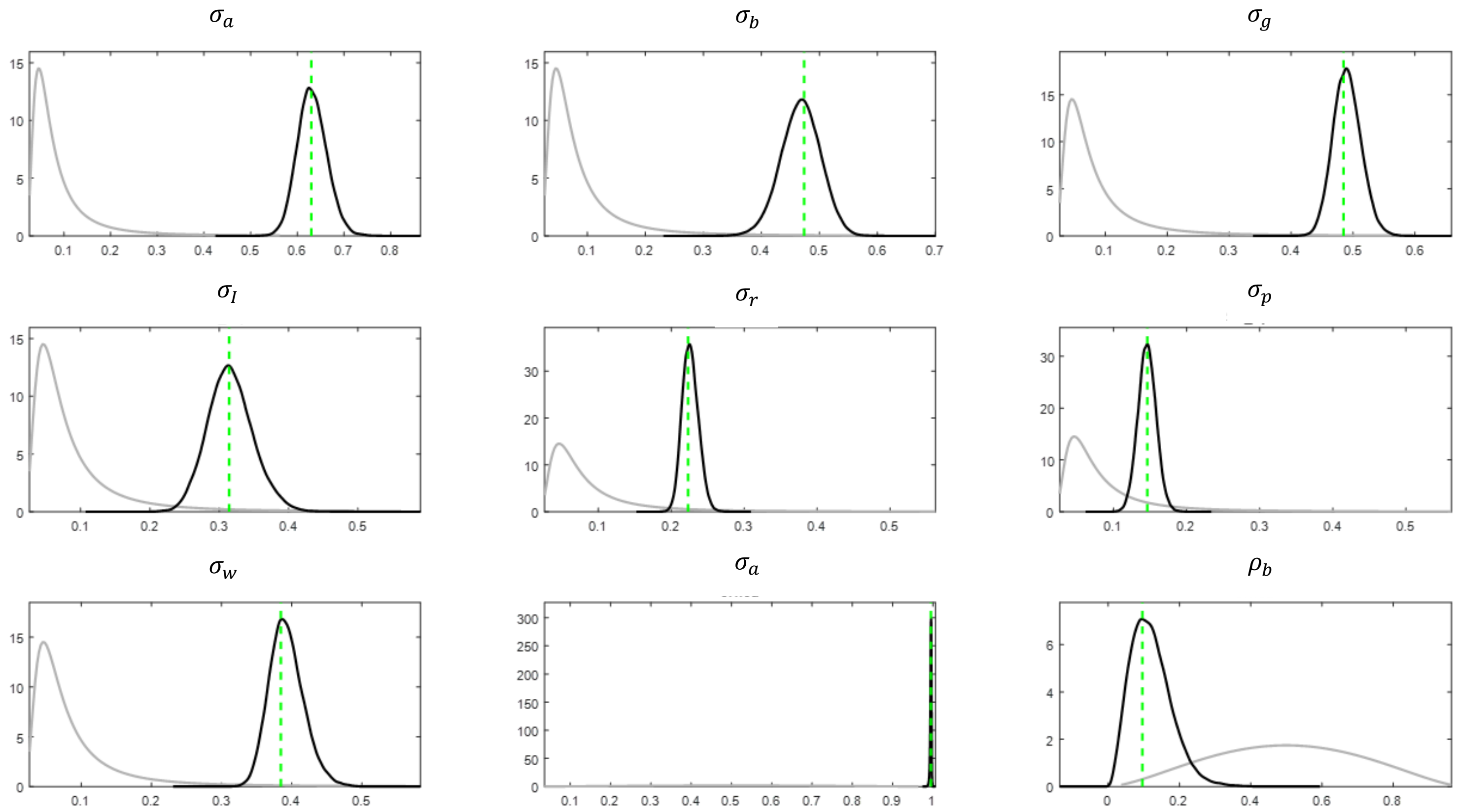

Figure 6: Prior (gray) and posterior (black) distribution of model parameters

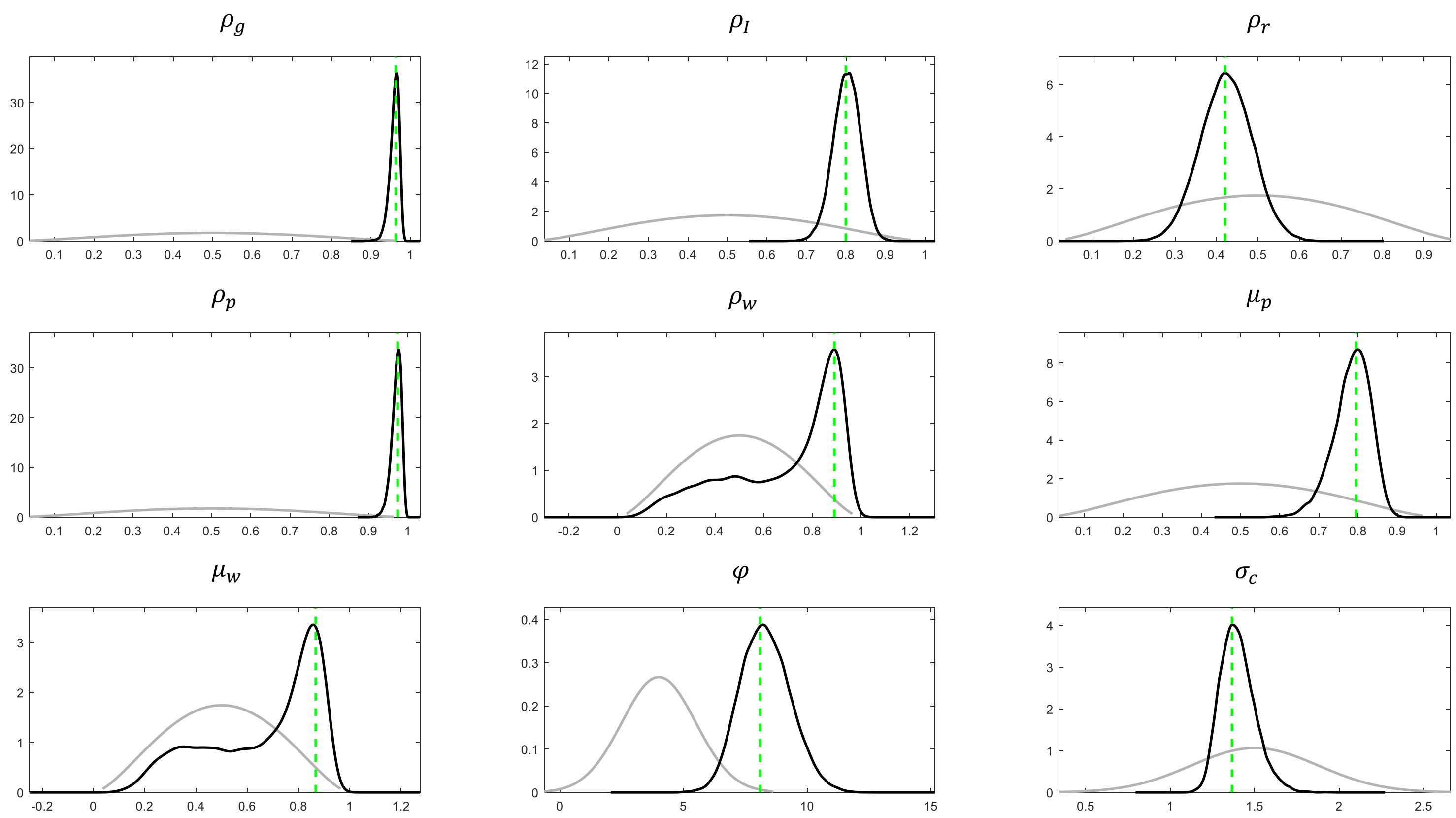

Figure 7: Prior (gray) and posterior (black) distribution of model parameters

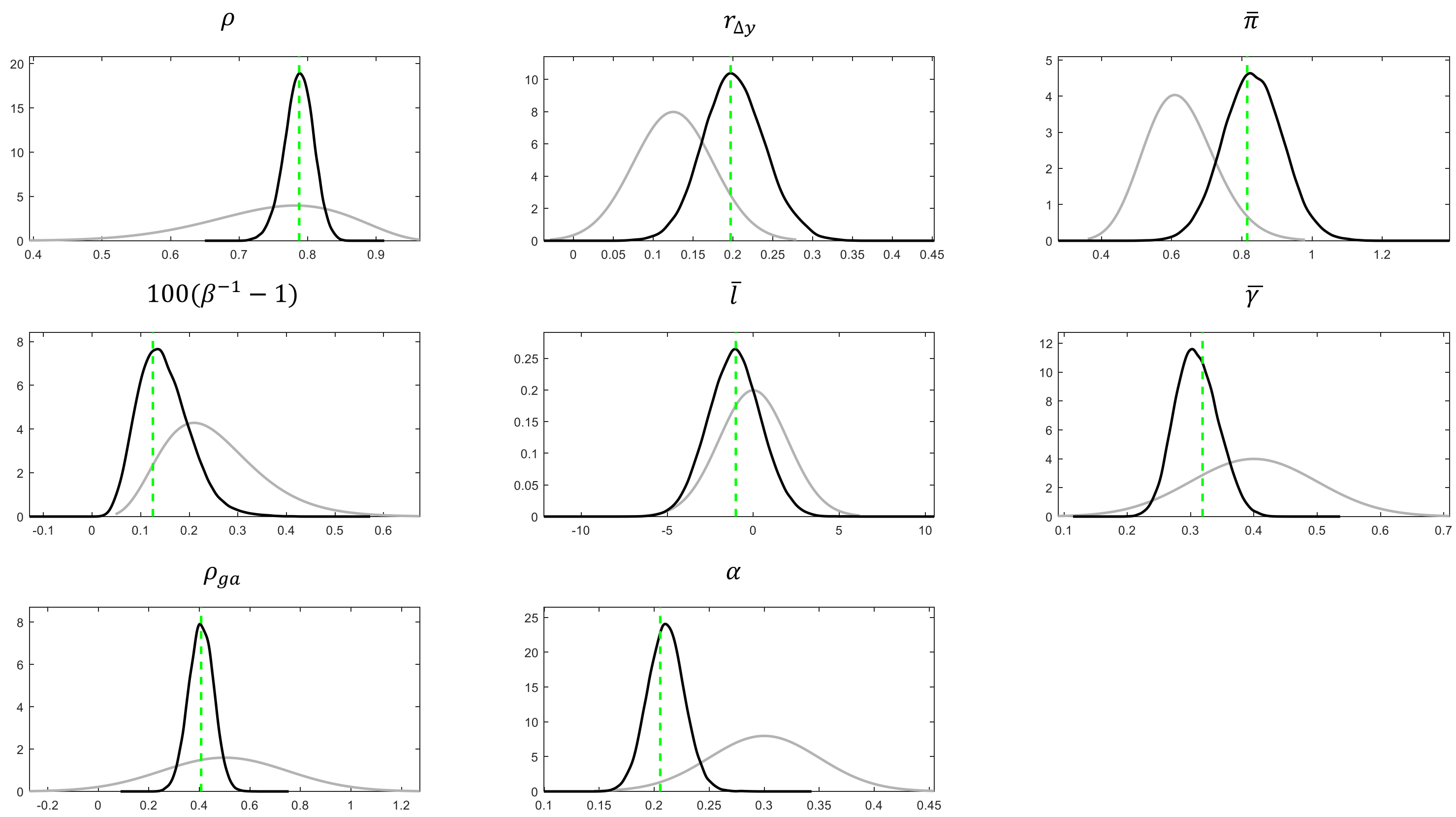

Figure 8: Prior (gray) and posterior (black) distribution of model parameters

Appendix D: Impulse Responses (Medium-Scale Model)

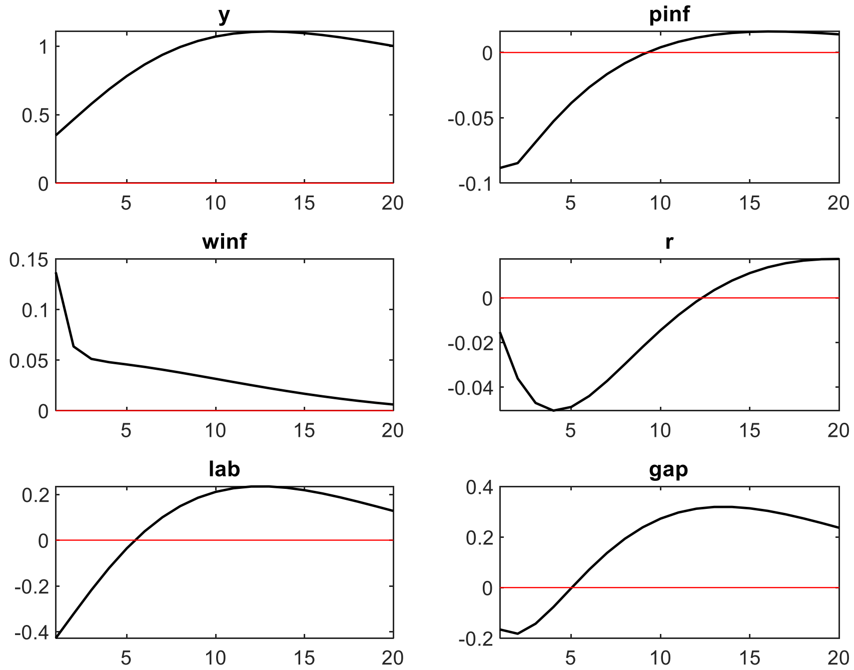

Figure 9: Impulse response of key variables to a technology shock

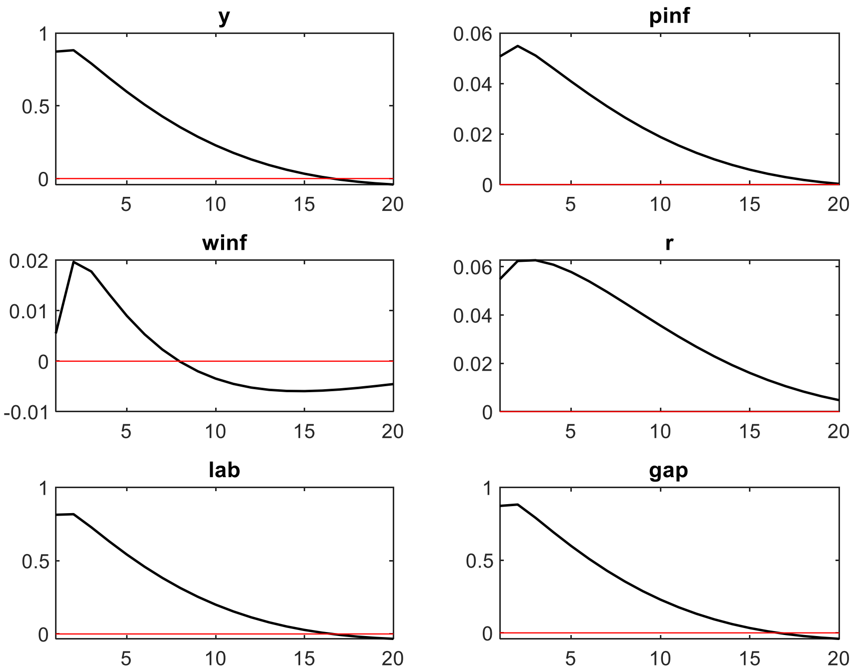

Figure 10: Impulse response of key variables to a risk premium shock

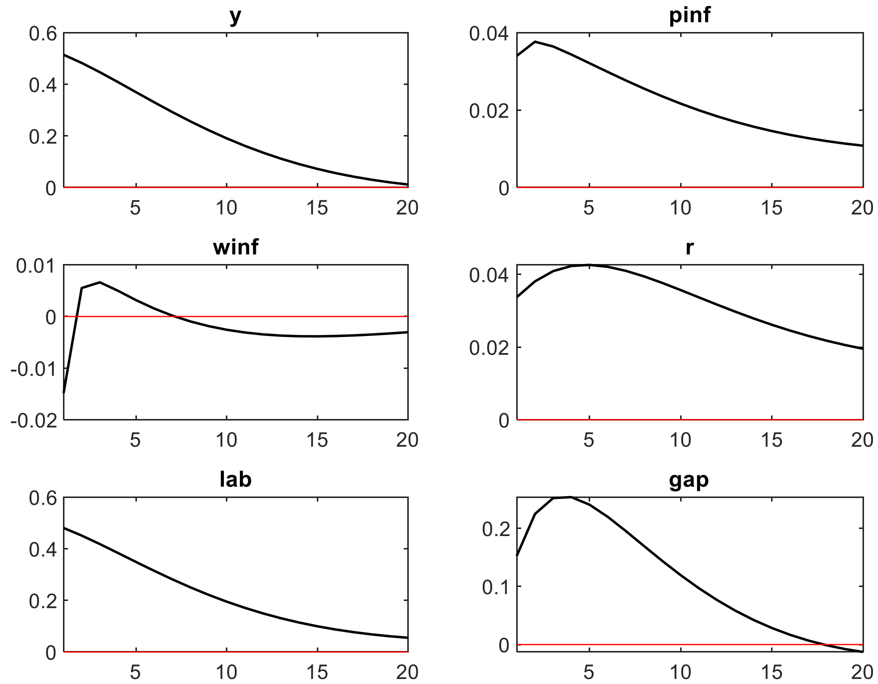

Figure 11: Impulse response of key variables to a government spending shock

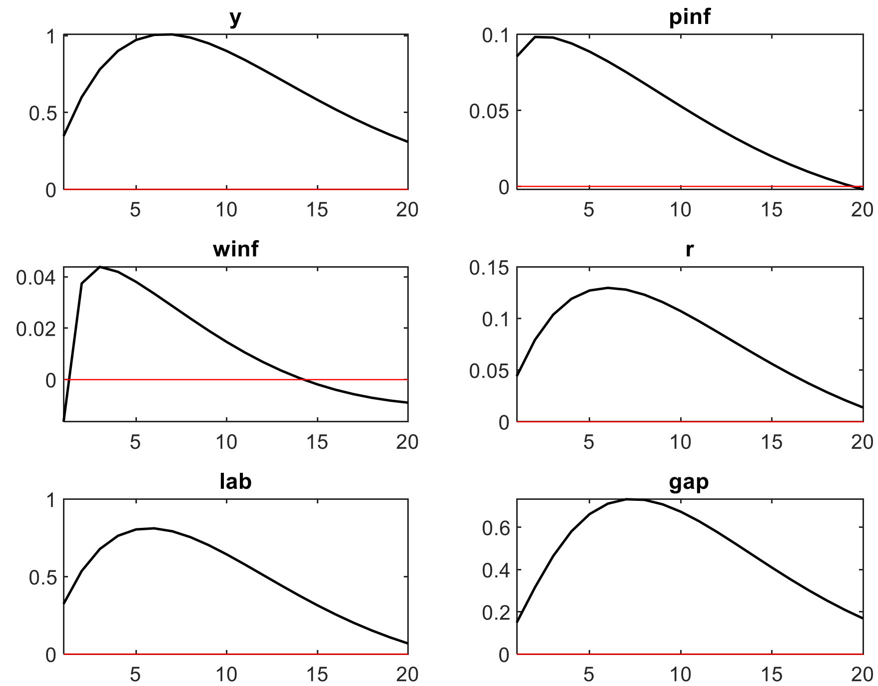

Figure 12: Impulse response of key variables to an investment shock

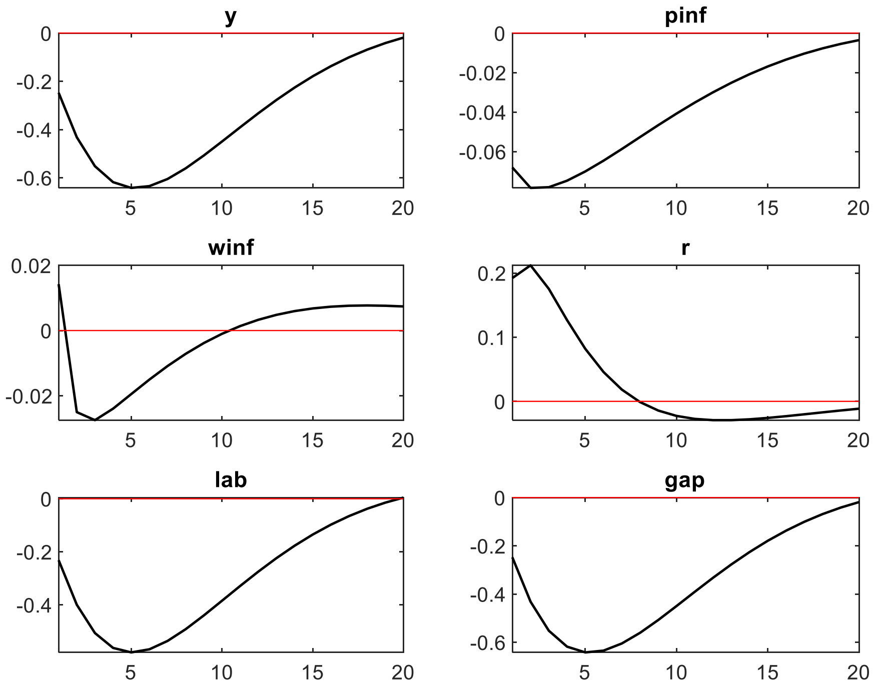

Figure 13: Impulse response of key variables to a monetary policy shock

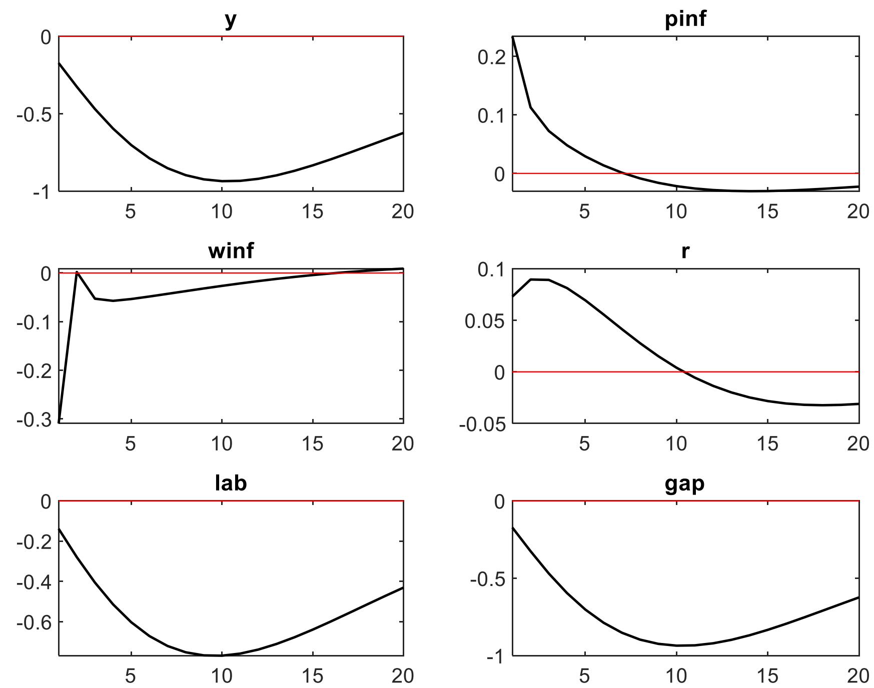

Figure 14: Impulse response of key variables to a price markup shock

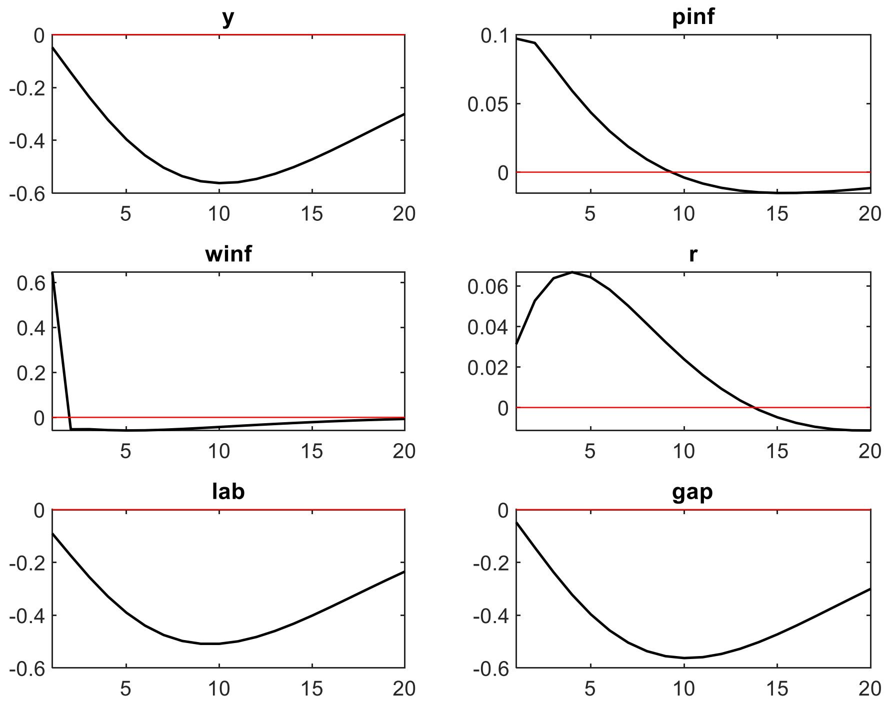

Figure 15: Impulse response of key variables to a wage markup shock