Note on nominal rigidities and news-driven business cycles

Nutahara, Kengo

Department of Economics, Senshu University

19 February 2010

Note on nominal rigidities and news-driven business cycles

Kengo Nutahara[*]

Senshu University

This version: February 19, 2010 (First draft: July 25, 2009)

Abstract

A news-driven business cycle is a positive comovement of consumption, output, labor, and investment from the news about the future. We show that nominal rigidities, especially sticky prices, can cause it in an estimated medium-scale DSGE economy.

Keywords: nominal rigidities ; news-driven business cycles

JEL Classification: E32, E21

---

[*]Postal address: 2-1-1 Higashimita, Tama-ku, Kawasaki, Kanagawa 214-8580 Japan. Tel.: +81-44-911-1230. E-mail: nutti@isc.senshu-u.ac.jp.

1   Introduction

A news-driven business cycle (hereafter, NDBC) is a positive comovement of consumption, labor, investment, and output from a news shock about future productivity. It is well known that the standard real business cycle model cannot generate it. Since the paper by Beaudry and Portier (2004), many models of NDBCs are proposed.[1]

In this paper, we focus on nominal rigidities as sources of NDBCs. We employ the model of Fujiwara, Hirose, and Shintani (2008), which is an estimated medium-scale DSGE economy à la Smets and Wouters (2007) with news shocks. It is shown that NDBCs are generated because of nominal rigidities, especially sticky prices. The news shock causes a boom through the countercyclical movements of price markup. We also find that sticky wages are not sources of NDBCs in our model.

This paper is also closely related to the one by Kobayashi and Nutahara (2008). They show that sticky prices and wages can be sources of NDBCs using a simple model theoretically. However, it is not clear that nominal rigidities work in realistic models with estimated parameter values. Medium-scale DSGE models are widely used for policy analysis and parameter values of our model are estimated. Therefore, we show that sticky prices are important sources of NDBCs in an widely used model with estimated parameter values, but sticky wages are not.

The rest of this paper is organized as follows. Section 2 introduces our model. In Section 3, it is shown that nominal rigidities, especially sticky prices, are sources of NDBCs. Section 4 draws our conclusions.

2   Model

2.1   Baseline model

Our model is the same employed by Fujiwara, Hirose, and Shintani (2008), which is based on a medium-scale DSGE model of Smets and Wouters (2007) with news shocks.

---

[1]For example, see papers by Jaimovich and Rebelo (2008, 2009), Christiano, Ilut, Motto, and Rostagno (2007), Kobayashi, Nakajima, and Inaba (2007), and Kobayashi and Nutahara (2008).

The resource constraint is

$$y_t = \frac{c}{y}c_t + \frac{i}{y}i_t + \frac{r^k k}{y}u_t + \varepsilon_t^g, \tag{1}$$

where ε_t^g is the government expenditure shock.

The consumption Euler equation is

$$c_t = \frac{\lambda}{\gamma\left(1+\frac{\lambda}{\gamma}\right)}c_{t-1} + \left[1 - \frac{\lambda}{\gamma\left(1+\frac{\lambda}{\gamma}\right)}\right]E_t c_{t+1}$$
$$+ \frac{(\sigma_c - 1)\left(\frac{w^h \ell}{c}\right)}{\sigma_c\left(1+\frac{\lambda}{\gamma}\right)}(\ell_t - E_t \ell_{t+1}) - \frac{1-\frac{\lambda}{\gamma}}{\sigma_c\left(1+\frac{\lambda}{\gamma}\right)}(r_t - E_t \pi_{t+1}), \tag{2}$$

where λ denotes the parameter on the external habit; γ, the steady-state growth rate; and σ_c, the inverse of the intertemporal elasticity of substitution.

The investment Euler equation is

$$i_t = \frac{1}{1+\beta\gamma^{1-\sigma_c}}i_{t-1} + \left[1 - \frac{1}{1+\beta\gamma^{1-\sigma_c}}\right]E_t i_{t+1} + \frac{1}{(1+\beta\gamma^{1-\sigma_c})\gamma^2\varphi}q_t + \varepsilon_t^i, \tag{3}$$

where ε_t^i denotes the investment-specific technology shock; β, the discount factor of household; and φ, the steady-state elasticity of the capital adjustment cost function.

The capital Euler equation is

$$q_t = \beta\gamma^{-\sigma_c}(1-\delta)E_t q_{t+1} + \left[1 - \beta\gamma^{-\sigma_c}(1-\delta)\right]E_t r_{t+1}^k - (r_t - E_t \pi_{t+1}), \tag{4}$$

where q_t denotes Tobin's Q and δ denotes the depreciation rate of capital.

The production function is

$$y_t = \phi_p\left[\alpha k_t^s + (1-\alpha)\ell_t + \varepsilon_t^a\right], \tag{5}$$

where k_t^s denotes capital service; ε_t^a, productivity; α, the share of capital in production; and ϕ_p, one plus the share of fixed costs in production.

The capital service, k_t^s, is

$$k_t^s = k_{t-1} + u_t, \tag{6}$$

where k_{t-1} denotes the capital stock at the end of period $t-1$.

The utilization rate, u_t, is determined by

$$u_t = \frac{1-\psi}{\psi} r_t^k, \tag{7}$$

where ψ denotes a positive function of the elasticity of the capital utilization adjustment cost function and normalized to be between zero and one.

The evolution of capital stock, k_t, is

$$k_t = \frac{1-\delta}{\gamma} k_{t-1} + \left[1 - \frac{1-\delta}{\gamma}\right] i_t + \left[1 - \frac{1-\delta}{\gamma}\right] \left[\left(1 + \beta\gamma^{-\sigma_c}\right)\gamma^2\varphi\right]\varepsilon_t^i. \tag{8}$$

The price markup, μ_t^p, is

$$\mu_t^p = \alpha\left[k_t^s - \ell_t\right] + \varepsilon_t^a - w_t. \tag{9}$$

The Phillips curve with partial indexation is

$$\pi_t = \frac{\iota_p}{1 + \beta\gamma^{1-\sigma_c}\iota_p}\pi_{t-1} + \frac{\beta\gamma^{1-\sigma_c}}{1 + \beta\gamma^{1-\sigma_c}\iota_p}E_t\pi_{t+1} - \frac{(1 - \beta\gamma^{1-\sigma_c}\xi_p)(1 - \xi_p)}{(1 + \beta\gamma^{1-\sigma_c}\iota_p)\xi_p[(\phi_p - 1)\varepsilon_p + 1]}\mu_t^p + \varepsilon_t^p, \tag{10}$$

where ι_p denotes the degree of indexation to past inflation; ξ_p, the degree of price stickiness; ε_p, the curvature of the Kimball goods market aggregator; and ε_t^p, the price markup shock.

The rental rate of capital is

$$r_t^k = -(k_t^s - \ell_t) + w_t. \tag{11}$$

The wage markup, μ_t^w, is

$$\mu_t^w = w_t - \left[\sigma_\ell \ell_t + \frac{1}{1 - \frac{\lambda}{\gamma}}\left(c_t - \frac{\lambda}{\gamma}c_{t-1}\right)\right], \tag{12}$$

where σ_ℓ denotes the elasticity of labor supply with respect to the real wage.

The wage Phillips curve with partial indexation is

$$w_t = \frac{1}{1 + \beta\gamma^{1-\sigma_c}}w_{t-1} + \left[1 - \frac{1}{1 + \beta\gamma^{1-\sigma_c}}\right](E_t w_{t+1} + E_t\pi_{t+1}) - \frac{1 + \beta\gamma^{1-\sigma_c}\iota_w}{1 + \beta\gamma^{1-\sigma_c}}\pi_t$$
$$+ \frac{\iota_w}{1 + \beta\gamma^{1-\sigma_c}}\pi_{t-1} - \frac{(1 - \beta\gamma^{1-\sigma_c}\xi_w)(1 - \xi_w)}{(1 + \beta\gamma^{1-\sigma_c})\xi_w[(\phi_w - 1)\varepsilon_w + 1]}\mu_t^w + \varepsilon_t^w, \tag{13}$$

where ι_w denotes the degree of wage indexation; ξ_w, the degree of the wage stickiness; ε_w, the curvature of the Kimball labor market aggregator; and ε_t^w denotes the wage markup shock.

The monetary policy is

$$r_t = \rho r_{t-1} + (1 - \rho)[r_\pi \pi_t + r_y \Delta y_t] + + \varepsilon_t^r, \tag{14}$$

where ε_t^r denotes monetary policy shock.

The evolutions of shocks are AR(1):

$$\varepsilon_t^g = \rho_g \varepsilon_{t-1}^g + \eta_t^g, \tag{15}$$

$$\varepsilon_t^i = \rho_i \varepsilon_{t-1}^i + \eta_t^i, \tag{16}$$

$$\varepsilon_t^a = \rho_a \varepsilon_{t-1}^a + \eta_t^a, \tag{17}$$

$$\varepsilon_t^p = \rho_p \varepsilon_{t-1}^p + \eta_t^p, \tag{18}$$

$$\varepsilon_t^w = \rho_w \varepsilon_{t-1}^w + \eta_t^w, \tag{19}$$

$$\varepsilon_t^r = \rho_r \varepsilon_{t-1}^r + \eta_t^r. \tag{20}$$

Technology shock η_t^a is consist of unanticipated and anticipated components:

$$\eta_t^a = \nu_{0,t} + \nu_{1,t-1} + \nu_{2,t-2} + + \nu_{3,t-3} + + \nu_{4,t-4}, \tag{21}$$

where $\nu_{i,t-i}$ denotes a news shock observed at period $t - i$.

2.2 Flexible price-wage economy

We also consider the role of news shocks in the flexible price-wage economy. In this economy, price and wage markups are constant: $\mu_t^p = \mu_t^w = 0$ and two Phillips curves (10) and (13) are removed from the baseline model.

3 Main result

3.1 Responses to news shocks

Following Christiano, Ilut, Motto, and Rostagno (2008), we consider the following impulse. Up until period $t = 0$, the economy is at the steady state. At period $t = 0$, a

news shock hits the economy: $\nu_{4,0} = .01$. However, at period $t = 4$, the expected rise in productivity does not occur: $\nu_{0,4} + \nu_{4,0} = 0$. This is interpreted as the news turning out to be false.

We employ parameter values estimated by Fujiwara, Hirose, and Shintani (2008) for the Japanese economy. They estimate parameters using the Bayesian technique.[2] Schmitt-Grohé and Uribe (2008) also estimate parameters of a model for NDBCs using the U.S. data. We employ the model of Fujiwara, Hirose, and Shintani (2008) since the model of Schmitt-Grohe and Uribe (2008) is real and there is no nominal rigidities.

Figure 1 shows the responses of the baseline and the flexible price-wage economies.

[Insert Figure 1]

Positive comovements of consumption, labor, investment, and output occur $t = 0, 1, 2,$ and 3, but these variables drop $t = 4$ since the news turns out to be false. Therefore, NDBCs are generated in the baseline model. However, in the flexible price-wage economy, NDBCs are not generated since consumption moves countercyclically.

In order to understand the mechanism, consider our model without capital utilization. By (9) and (12), we obtain

$$(\sigma_\ell + \alpha)\ell_t + \frac{1}{1 - \frac{\lambda}{\gamma}}\left[c_t - \frac{\lambda}{\gamma}c_{t-1}\right] + (\mu_t^p + \mu_t^w) = \alpha k_{t-1} + \varepsilon_t^a. \tag{22}$$

This equation implies that the positive comovements of consumption and labor inputs is possible if the markups, $\mu_t^p + \mu_t^w$, decrease sufficiently. High labor implies increase of output, and the news increases investment since the adjustment costs encourage current investment to prepare for the future. In our model, capital utilization is variable, but its response to the news shock is small and NDBCs are generated through the movements of the markups. On the contrary, in the flexible price-wage economy, markups are constant and NDBCs are not generated.

In the model of Christiano, Ilut, Motto, and Rostagno (2008), NDBCs are generated even without nominal rigidities. What is the reasons of this differet result? The important difference between the present model and their one is habit persistence. In our

---

[2]See Table 1 of Fujiwara, Hirose, and Shintani (2008) for estimated values.

model, habit persistence is external while it is internal in the model of Christiano, Ilut, Motto, and Rostagno (2008). As shown by Nutahara (2009), external habit cannot be a source of NDBCs.

3.2 Price rigidity vs. wage rigidity

NDBCs are not generated in the baseline model if there are no nominal rigidities. Then, which rigidity is important for NDBCs? In order to address this question, we consider the sticky-price economy (wages are flexible) and the sticky-wage economy (prices are flexible). Other settings are the same as in the baseline economy.

Figure 2 shows the responses of the sticky-price and the sticky-wage economies.

[Insert Figure 2]

In the sticky-wage economy, consumption moves countercyclically while NDBCs are generated in the sticky-price economy. Kobayashi and Nutahara (2008) show that the sticky wages can be a source of NDBCs theoretically since it affects labor wedge: the ratio of the marginal rate of substitution between consumption and leisure to the marginal product of labor. However, our results tell that sticky wages are not sources of NDBCs in an estimated medium-scale DSGE economy.

4   Conclusion

In this paper, we focused on nominal rigidities as sources of NDBCs. Our model is a medium-scale DSGE economy à la Smets and Wouters (2007) with news shocks on productivity. Using the estimated parameter values of Fujiwara, Hirose, and Shintani (2008), we showed that, in this economy, NDBCs are generated since there are nominal rigidities, especially the sticky prices. Our results implies that nominal price rigidity not only generate persistent responses to unexpected current shocks, but also drive booms and recessions in response to the news shock.

References

[1] Beaudry, P., and F. Portier, 2004, An exploration into Pigou's theory of cycles, Journal of Monetary Economics 51, 1183–1216.

[2] Christiano, L.J., C. Ilut, R. Motto, and M. Rostagno, 2007, Monetary policy and stock market boom-bust cycles, European Central Bank Working paper Series 955.

[3] Fujiwara, I., Y. Hirose, and M. Shintani, 2008, Can news be a major source of aggregate fluctuations? A Bayesian DSGE approach, IMES Discussion Paper No.2008-E-16, Bank of Japan.

[4] Jaimovich, N., and S. Rebelo, 2008, News and business cycles in open economies, Journal of Money, Credit and Banking 40, 1699–1711.

[5] Jaimovich, N., and S. Rebelo, 2009, Can news about the future drive the business cycle? American Economic Review 99, 1097–1118.

[6] Kobayashi, K., T. Nakajima, and M. Inaba, 2007, Collateral constraint and news-driven cycles, RIETI Discussion Paper 07–E–013.

[7] Kobayashi, K. and K. Nutahara, 2008, Nominal rigidities, news-driven business cycles, and monetary policy, RIETI Discussion Paper 08–E–018.

[8] Nutahara, K. 2009, Internal and external habits and news-driven business cycles, forthcoming in Economics Letters.

[9] Schmitt-Grohé, S. and M. Uribe, 2008, What's news in business cycles?, NBER Working Paper 14215.

[10] Smets, F. and R. Wouters, 2007, Shocks and frictions in US business cycles: A Bayesian DSGE approach, American Economic Review 97, 586–606.

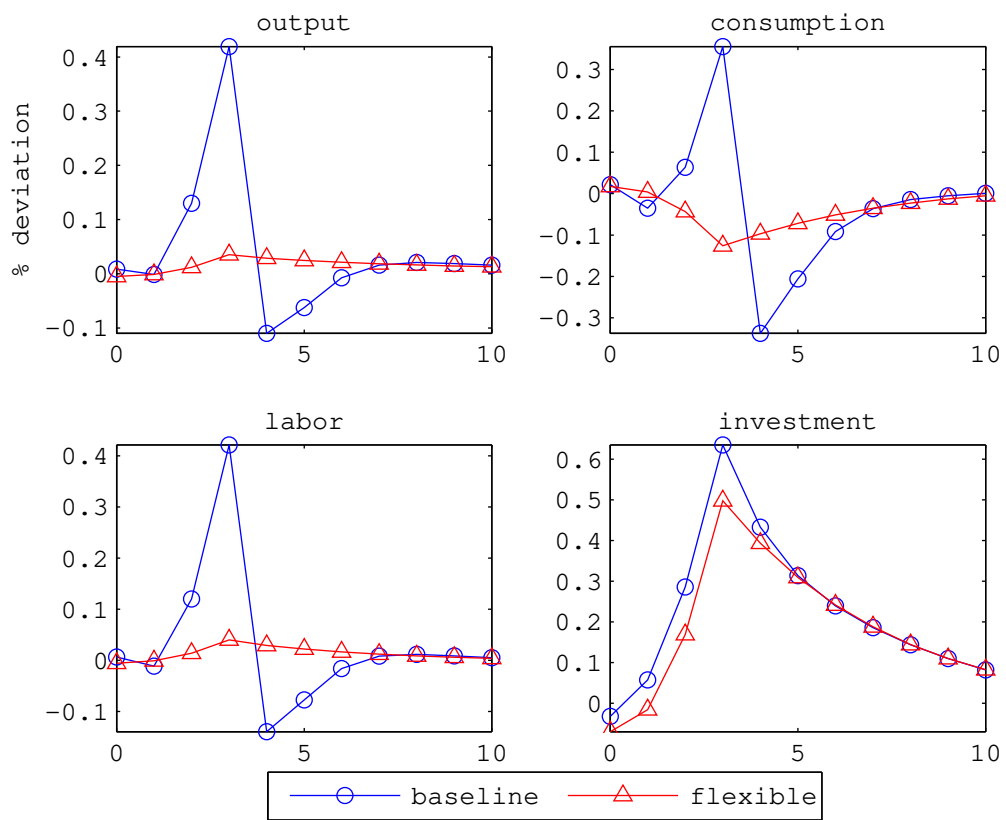Figure 1: Responses to news shock (1): baseline vs. flexible price-wage

Figure 2: Responses to news shock (2): sticky price vs. sticky wage