Note on Nominal Rigidities and News-Driven Business Cycles

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ABSTRACT
A news-driven business cycle is a positive comovement of consumption, output, labor, and investment from a news shock about future productivity. We show that nominal rigidities, especially sticky prices, can cause it in a medium-scale DSGE economy through countercyclical movements of the price-markup. We also find that sticky wages cannot generate it, but they amplify the effects of news shocks.

Keywords: Nominal Rigidities; News-Driven Business Cycles

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 [1], many models of NDBCs are proposed¹.

In this paper, we focus on nominal rigidities as sources of NDBCs. We employ the model of Fujiwara, Hirose, and Shintani [7], which is an estimated medium-scale DSGE economy à la Smets and Wouters [8] 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, but sticky wages are important as frictions that amplify the effect of the news shock.

This paper is also closely related to the one by Kobayashi and Nutahara [6]. 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 we use estimated parameter values. Therefore, we show that sticky prices are important sources of NDBCs in a 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 [7], which is based on a medium-scale DSGE model of Smets and Wouters [8] with news shocks.

In our model, the representative household faces external habit persistence in the consumption and the adjustments costs of investments. The utilization rate of capital is variable. Nominal prices and wages are sticky and they are partially indexed to past inflation. Monetary authority follows a Taylor type nominal interest rate rule. Finally, there are many exogenous shocks that affect the economy.

The resource constraint is
\[ y_t = c_t + i_t + u_t + \varepsilon^e_t, \]
where \( y_t, c_t, i_t,\) and \( \varepsilon^e_t \) denote the output, the consumption, the investment, and the government expenditure shock, respectively. \( c_t, i_t \) and \( u_t \) denote the steady state share in output of consumption, investment and capital utilization cost, respectively.

The consumption Euler equation is
\[ y_t = c_t + \left(1 - c_t\right) E_t c_{t+1} + c_2 \left(\ell_t - E_t \ell_{t+1}\right) + c_3 \left(\ell_t - E_t \pi_{t+1}\right),\]
where
\[c_1 = \left(\lambda/\gamma\right)/(1 + \lambda/\gamma),\]
\[c_2 = (\sigma' - 1)(\nu^\prime e/c)\left[\sigma' (1 + \lambda/\gamma)\right],\]
\[c_2 = (1 - \lambda/\gamma)\left[\sigma' (1 + \lambda/\gamma)\right].\]

\(\lambda\) denotes the parameter on the external habit; \(\gamma\), the steady-state growth rate; and \(\sigma'\), the inverse of the intertemporal elasticity of substitution. \(C_{t-1}\), \(v_{t-1}\), and \(\pi_t\) denote the labor supply, the nominal interest rate, and the inflation rate, respectively.

The investment Euler equation is
\[i_t = i_t^1 + (1 - i_t) E_t i_{t+1} + i_t q_t + e_t^j,\quad (3)\]
where
\[i_t = 1/(1 + \beta\gamma^{\alpha - 1}),\]
\[i_t = 1/(\gamma^2 \varphi (1 + \beta\gamma^{\alpha - 1})),\]
\(\beta\) denotes the discount factor of household; \(\varphi\), the steady-state elasticity of the capital adjustment cost function; and \(e_t^j\), the investment-specific technology shock.

The capital Euler equation is
\[q_t = q_t E_t q_{t+1} + (1 - i_t) E_t k_{t+1} - (r_t - E_t \pi_{t+1}),\quad (4)\]
where
\[q_t = \beta\gamma^{\alpha - 1}(1 - \delta).\]

The price markup, \(\mu_t\), is
\[\mu_t = \alpha\left[k_t^* - \ell_t\right] + e_t^\sigma - w_t,\quad (9)\]
where \(w_t\) denotes the wage rate.

The Phillips curve with partial indexation is
\[\pi_t = \pi_t \pi_{t-1} + \pi_t E_t \pi_{t-1} - (\pi_{t-1} / \pi_t) \mu_{t-1} + e_{t-1},\quad (10)\]
where
\[\pi_t = 1 + \beta\gamma^{\alpha - 1} t_p,\]
\[\pi_t = \beta\gamma^{\alpha - 1} t_p,\]
\[\pi_t = \left(1 - \beta\gamma^{\alpha - 1} \xi_p\right) \left(1 - \xi_p\right),\]
\[\pi_t = \left(1 - \beta\gamma^{\alpha - 1} t_p \xi_p\left(\phi_p - 1\right) e_p + 1\right),\]

\(\xi_p\) denotes the degree of indexation to past inflation; \(\xi_p\), the degree of price stickiness; \(e_p\), the curvature of the Kimball goods market aggregator; and \(e_t^\sigma\), the price markup shock.

The rental rate of capital is
\[r_t^k = -\left(k_t^* - \ell_t\right) + w_t,\quad (11)\]

The wage markup, \(\mu_t^w\), is
\[\mu_t^w = w_t - mrs_t,\quad (12)\]
where
\[mrs_t = \sigma \ell_t + \left[c_t - (\lambda/\gamma) c_{t-1}\right] / (1 - \lambda/\gamma),\quad (13)\]
and \(e_p\) denotes the elasticity of labor supply with respect to the real wage.

The wage Phillips curve with partial indexation is
\[w_t = w_t w_{t-1} + (1 - w_t) (E_t w_{t+1} + E_t \pi_{t+1}) - w_t \pi_t,\]
\[+ w_t \pi_{t-1} + w_t / (w_t w_t) \mu_{t-1} + e_{t-1},\quad (14)\]

where
\[w_t = 1 / (1 + \beta\gamma^{1-\alpha}),\]
\[w_t = (1 + \beta\gamma^{1-\alpha} t_u) / (1 + \beta\gamma^{1-\alpha}),\]
\[w_t = t_u / (1 + \beta\gamma^{1-\alpha}),\]
\[w_t = (1 - \beta\gamma^{1-\alpha} \xi_u) (1 - \xi_u),\]
\[w_t = \xi_u \left[\left(\phi_p - 1\right) e_u + 1\right],\]

\(t_u\) denotes the degree of wage indexation; \(\xi_u\), the degree of the wage stickiness; \(e_u\), the curvature of the Kimball labor market aggregator; and \(e_t^\sigma\) denotes the wage markup shock.

The monetary policy is
\[r_t = \rho r_{t-1} + (1 - \rho) \left[r_t \pi_t + r_t \Delta y_t\right] + e_t',\quad (15)\]
where \(e_t'\) denotes monetary policy shock.
The evolutions of shocks are AR(1):
\[
\begin{align*}
e_i^g &= \rho_p e_{i-1}^g + \eta_i^g, \\
e_i^i &= \rho_p e_{i-1}^i + \eta_i^i, \\
e_i^a &= \rho_p e_{i-1}^a + \eta_i^a, \\
e_i^p &= \rho_p e_{i-1}^p + \eta_i^p, \\
e_i^w &= \rho_p e_{i-1}^w + \eta_i^w, \\
e_i^c &= \rho_p e_{i-1}^c + \eta_i^c.
\end{align*}
\]

(16) (17) (18) (19) (20) (21)

Technology shock \( \eta_i^s \) is consist of unanticipated and anticipated components:
\[
\eta_i^s = \nu_{0,i} + \nu_{1,i-1} + \nu_{2,i-2} + \nu_{3,i-3} + \nu_{4,i-4},
\]
where \( \nu_{i,j-1} \) 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: \( \mu_i^p = \mu_i^w = 0 \) and two Phillips curves (10) and (14) are removed from the baseline model.

3. Main Results
3.1. Responses to News Shocks

Following Christiano, Ilut, Motto, and Rostagno [4], 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: \( \nu_{0,0} = 0.01 \). However, at period \( t = 4 \), the expected rise in productivity does not occur: \( \nu_{0,4} + \nu_{3,0} = 0 \). This is interpreted as the news turning out to be false.


They estimate parameters using the Bayesian technique\(^2\), Schmitt-Grohe and Uribe [9] also estimate parameters of a model for NDBCs using the US data. We employ the model of Fujiwara, Hirose, and Shintani [7] since the model of Schmitt-Grohe and Uribe [9] is real and there is no nominal rigidities.

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

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.

\[^2\text{See Table 1 of Fujiwara, Hirose, and Shintani [7] for estimated values.}\]

In order to understand the mechanism, consider our model without capital utilization. By (9), (12) and (13), we obtain
\[
(\sigma_i + \alpha_i) \ell_i + \left[ c_i - (\lambda_i / \gamma) c_{i-1} \right] /[1 - \lambda_i / \gamma] + \mu_i^p + \mu_i^w = \alpha k_{i-1} + e_i^c.
\]

(23)

This equation implies that the positive comovements of consumption and labor inputs is possible if the markups, \( \mu_i^p + \mu_i^w \), 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 [4], NDBCs are generated even without nominal rigidities. What is the reason of this different result? The important difference between the present model and their one is habit persistence. In our model, habit persistence is external while it is internal in the model of Christiano, Ilut, Motto, and Rostagno [4]. As shown by Nutahara [10], external habit cannot be a source of NDBCs.

3.2. Price Rigidity versus 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 1. Responses to news shock (1): baseline vs flexible price-wage economy.
Figure 2 shows the responses of the sticky-price and the sticky-wage economies. In the sticky-wage economy, consumption moves countercyclically while NDBCs are generated in the sticky-price economy. Kobayashi and Nutahara [6] 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.

While sticky wages are not sources of NDBCs, they are important since the responses of the economy with sticky wages to the news shock are large. Then, sticky wages amplify the effect of news shocks.

4. Conclusions

In this paper, we focused on nominal rigidities as sources of NDBCs. Our model is a medium-scale DSGE economy a la Smets and Wouters [8] with news shocks on productivity. Using the estimated parameter values of Fujiwara, Hirose, and Shintani [7], we showed that, in this economy, NDBCs are generated since there are nominal rigidities, especially the sticky prices.

Our results imply 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.

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REFERENCES


Figure 2. Responses to news shock (2): sticky prices vs sticky wages.