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NOTES

A NOTE ON GROWTH EXPECTATION

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Recently, several researchers have succeeded in producing expectation–driven cycles by balancing the tension between the wealth effect and the substitution effect stemming from the higher expected future productivity. Especially, seminal research by Christiano et al. ("Monetary Policy and Stock Market Boom–Bust Cycles," mimeo, Northwestern University, 2007), explains "stock market boom–bust cycles," characterized by increases in consumption, labor inputs, investment, and stock prices relating to high expected future technology levels. We, however, show that such expectation–driven cycles are difficult to generate based on "growth expectation," which reflects expectations of higher productivity growth rates.

Keywords: Expectations, Equilibrium Business Cycle, Technological Progress

1. INTRODUCTION

For a long time, changes in expectations about the future have been thought to be significant sources of economic fluctuations. For example, Pigou (1926) states that "while recognizing that the varying expectations of business men may themselves be in part a psychological reflex of good and bad harvests—while not, indeed, for the present inquiring how these varying expectations themselves come about—we conclude definitely that they, and not anything else, constitute the immediate cause and direct causes or antecedents of industrial fluctuations." It has, however, been considered a difficult challenge to create such an expectation–driven cycle, namely the "Pigou cycle"[1] in equilibrium business cycle models. Barro and King (1984) point out that "With a simple one-capital-good technology, no combination of income effects and shifts to the perceived profitability of investment will yield positive comovements of output, employment, investment and consumption." Only recently have several researchers succeeded in generating the Pigou cycle by balancing the tension between the wealth effect and the substitution effect stemming from higher expected future productivity. The pioneering work of Beaudry and Portier (2004) was the first to generate a Pigou cycle in an equilibrium business cycle model. By introducing the multisectoral adjustment costs, the complementarity

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between consumption and investment is intensified so that consumption, labor, and investment exhibit comovements reflecting forecast errors. Jaimovich and Rebelo (2006) reduce the wealth effect from the news shock by employing Greenwood et al. (1988)–type preferences.[2] They also increase the substitution effect by introducing investment growth adjustment costs, which were first introduced by Christiano et al. (2005). They do so in order to generate expectation–driven business cycle. Denhaan and Kaltenbrunner (2007) use the labor search and matching framework to show that matching frictions offset reduced labor supply reflecting the wealth effect. Because high expected productivity induces firms to post more vacancies, both consumption and investment increase in response to positive news about future productivity. Kobayashi et al. (2007) demonstrate that the Pigou cycle can emerge in a model that incorporates collateral constraints. Good news raises the current price of land, which relaxes the collateral constraint and reduces the inefficiency in the labor market. If this effect is sufficiently strong, equilibrium labor supply increases, as do output, investment, and consumption. Beaudry et al. (2006) focus on the extensive margin of efficiency, namely technological progress in the form of the number of newly introduced goods. Anticipation of the arrival of new goods does not have any wealth effect but does induce investment, which is needed for the production of such new goods. This creates what authors term "gold rush fever."

Christiano et al. (2007; henceforth CIMR) present findings of particular interest. First, their work is based on the *de facto* standard macroeconomic model used by policy-making institutions such as central banks. Currently, many central banks construct their core macroeconomic models by following the influential work of Christiano et al (2005). These models have sufficiently rich dynamics to explain the trend apparent in data by incorporating investment growth adjustment costs, habit formation in consumption, sticky prices and wages, and an inflation–targeting central bank. We know the empirically plausible range of parameter values for this type of model. Second, the CIMR can explain not only comovements in consumption, employment, and investment, but also stock market boom–bust cycles characterized by increases in stock prices relating to high expected levels of future technology. This is a useful contribution because it implies that strict inflation targeting, which is the benchmark principle in the implementation of modern monetary policy, risks generating bubbles.

The research cited has deepened our understanding of the effects of expectations about future events on current variables. The associated models, however, incorporate rather unrealistic expectations about the future. That is, they make assumptions about expectations of the future technology level, not the growth rate.[3] In the above studies, if a positive technology shock is anticipated for the subsequent year, then the technology growth rate is expected to decrease from that year onward. The anticipation of a negative growth rate following a positive level technology shock seems unrealistic.[4] For example, professional forecasters usually predict a higher growth rate, rather than a higher level, following news about future technological progress.[5] Therefore, in this paper, we also examine the effect of people who temporarily anticipate the higher technology growth rate by using the model employed by CIMR; for this model, empirically reasonable ranges of parameter values are readily available. Indeed, in their seminal research, Beaudry and Portier (2006), who use a structural VAR with long–run restrictions to identify a news shock as one that affects the stock price but has no permanent effects on labor productivity, assume an expectation shock relating to a higher future growth rate of technology. It is shown that such an expectation-driven cycle is difficult to generate under the assumption of "growth expectation," under which there is an expectation of a higher productivity growth rate. Thus, the Barro and King (1984), conjecture still applies.

This paper is structured as follows. In Section 2, we briefly describe the model and state the assumption made about technological process. Then, in Section 3, we present simulation results for growth expectation. We summarize our findings in Section 4.

2. THE MODEL

The model in this paper is very standard and almost identical to the one used in CIMR.[6] There exist continua of households and firms each within the unit mass, a central bank, and a fiscal authority. Households determine optimally the demand for goods, the supply of capital, and the supply of labor in a monopolistically competitive labor market by choosing the desired wage subject to a Rotemberg (1982)-type adjustment cost.[7] Firms choose the amount of goods to supply by setting the desired price in a monopolistically competitive market subject to the Rotemberg-type adjustment cost. Firms also optimally choose labor demand and the capital stock. The central bank sets nominal interest rates by following a Taylor (1993)–type rule. The fiscal authority receives from households the lump–sum tax, which funds the subsidies that enable households to avoid undersupplies of labor and goods in the steady state.

In the rest of this section, we describe the log-linearized version of our DSGE model. The aggregate resource is given by

$$\left(\frac{\frac{1}{\beta}-1+\delta}{\alpha}\right)^{\alpha}\left[(1-\alpha)\, z_t+(1-\alpha)\, h_t+\alpha k_t-\alpha u_t\right]$$
$$-\frac{\frac{1}{\beta}-1+(1-\alpha)\,\delta}{\alpha} c_t-\delta i_t=0,$$

where output determined by the technology level (z_t), hours worked (h_t), the capital stock (k_t), and the shock to the growth rate of technology (u_t) is absorbed by consumption (c_t) and investment (i_t). β is the subjective discount factor, δ is the depreciation rate, and α is the capital share. The dynamics of consumption, which follows the Euler equation, consists of

$$\mathrm{E}_t\widehat{\pi}_{t+1}-r_t^n-\mathrm{E}_t\lambda_{t+1}+\lambda_t+\mathrm{E}_t u_{t+1}=0$$

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and

$$bc_{t-1} - (1+b^2\beta)c_t - bu_t - (1-\alpha)^2(1-b)(1-b\beta)\lambda_t$$
$$+ b\beta(\mathrm{E}_t c_{t+1} + \mathrm{E}_t u_{t+1}) = 0.$$

In the former, the marginal utility out of consumption (λ_t) is determined by its expected future value, the shock to the growth rate of technology, and the *ex ante* real interest rate defined by the nominal interest rate (r_t^n) minus expected inflation (π_t). The latter equation is simply the definition of the marginal utility. b stands for the consumption habit parameter. The accumulation of capital is a function of flow investment:

$$-k_{t+1} + (1-\delta)(k_t - u_t) + \delta i_t = 0.$$

The cost of capital (r_t^K) is determined by the marginal product of capital,

$$-r_t^K + \phi_t + (1-\alpha) z_t + (1-\alpha) h_t + (\alpha-1) k_t + (1-\alpha) u_t = 0,$$

where the real marginal cost (ϕ_t) denotes the inverse of the markup. The dynamics of investment comes from the investment Euler equation,

$$P_{K',t} - (1+\beta) S'' i_t + S'' i_{t-1} + \beta S'' \mathrm{E}_t i_{t+1} = 0,$$

where the current investment is determined by the weighted average of past and expected investment and the value of capital ($P_{K'}$), whose arbitrage condition is given by

$$-P_{K',t} + \mathrm{E}_t\lambda_{t+1} - \mathrm{E}_t u_{t+1} - \lambda_t + (1-\beta+\beta\delta)\mathrm{E}_t r_{t+1}^K + \beta(1-\delta)\mathrm{E}_t P_{K',t+1} = 0,$$

where S'' is the investment adjustment cost parameter. Inflation rate is determined by the New Keynesian Phillips curve,

$$-\pi_t + \beta \mathrm{E}_t \pi_{t+1} + \frac{\theta_p}{\zeta_p}\phi_t = 0,$$

with the equation for the real marginal cost,

$$-w_t + \phi_t + (1-\alpha) z_t - \alpha h_t + \alpha k_t - \alpha u_t = 0,$$

where θ_p is the elasticity of substitution among goods and ζ_p is the parameter for the Rotemberg-type price adjustment cost. Similarly, the wage inflation rate (π_t^W) defined by the growth rate of the real wage (w_t),

$$-\pi_t^W + w_t - w_{t-1} = 0,$$

is determined by the New Keynesian Phillips curve for wages,

$$-\pi_t - \pi_t^W + \beta \mathrm{E}_t \pi_{t+1} + \beta \mathrm{E}_t \pi_{t+1}^W + \frac{\theta_h - 1}{\zeta_w}\varphi_t = 0,$$

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TABLE 1. Parameters

Parameter	Value	Description and definitions
θ_p	6	$\theta_p/(\theta_p - 1)$ is the markup in the goods market
θ_w	21	$\theta_w/(\theta_w - 1)$ is the markup in the labor market
ζ_p	27.454	The Rotemberg adjustment cost in goods
ζ_w	199.0819	The Rotemberg adjustment cost in labor
α	0.4	Labor share
b	0.63	Habit formation parameter
β	$1.01358^{-0.25}$	Subjective discount factor
μ	1	The average growth rate
ψ_L	109.82	The level of labor disutility
S''	2.48	The level of investment adjustment costs
ρ	0.81	Coefficient on the lagged interest rate
η	1.95	Coefficient on the inflation rate
η_y	0.18	Coefficient on the output gap
ρ_u	0.83	AR (1) parameter on the growth shock
ρ_z	0.83	AR (1) parameter on the level shock
p	4	A shock is expected to occur at p

where θ_h is the elasticity of substitution among differentiated labor supply and ζ_w is the parameter for the Rotemberg-type wage adjustment cost. The wage gap (φ_t) is determined by the ratio of the marginal rate of substitution between consumption and leisure over the real wage,

$$-\varphi_t + \sigma_L h_t - \widetilde{\lambda}_t - w_t = 0,$$

where σ_L denotes the size of labor disutility. Finally, the nominal interest rate is determined by the simple Taylor-type instrument rule,

$$\begin{aligned} -r_t^n + \rho r_{t-1}^n + (1-\rho)\,\beta\eta \mathrm{E}_t \pi_{t+1} + (1-\rho)\,\beta\eta_y[(1-\alpha)\,z_t \\ + (1-\alpha)\,h_t + \alpha k_t] = 0, \end{aligned}$$

where ρ stands for policy persistence, η is the coefficient of the expected inflation, and η_y is that on the output. Both the technology-level and growth-rate shocks are assumed to follow an AR (1) process with ρ_z and ρ_u:

$$z_t = \rho_z z_{t-1} + \chi_{z,t-p} + \varepsilon_{z,t}$$

and

$$u_t = \rho_u u_{t-1} + \chi_{u,t-p} + \varepsilon_{u,t}.$$

$\varepsilon_{z,t}$ and $\varepsilon_{u,t}$ are standard contemporaneous shocks, whereas $\chi_{z,t-p}$ and $\chi_{u,t-p}$ denote expectation shocks that, at period t, are anticipated to occur at period $t + p$.[8]

Parameters are set following CIMR as in Table 1.

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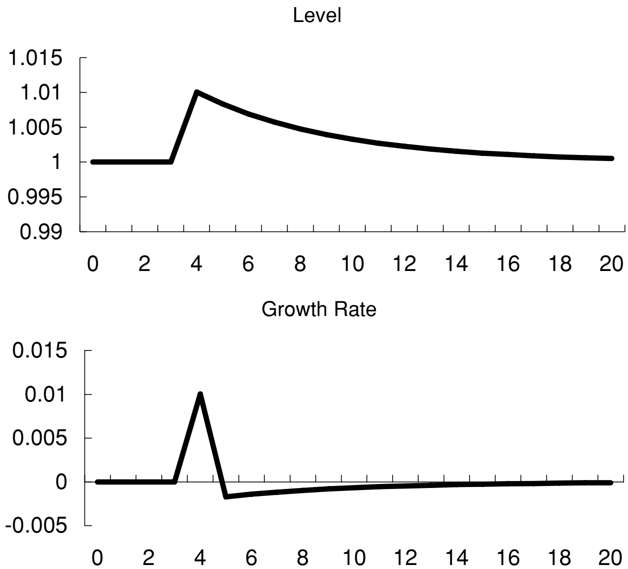

FIGURE 1. Level shock process.

3. SIMULATION RESULTS

We examine both cases in which there is no nominal rigidity and cases in which there are price and wage rigidities.

3.1. Flexible Price Model

First, we show that the Pigou cycle materializes for the technology-level shock, as CIMR demonstrate. Then we indicate that such a cycle is very difficult to generate based on the growth expectation.

Level shock. We first reproduce CIMR's investigation. The shock process anticipated by economic agents is illustrated in Figure 1. A positive 1% technology-level shock is expected to occur in period 4. Because this level shock is assumed to follow an AR(1) process, the expected growth rate has a spike at period 4, but it is expected to be negative thereafter as the level shock decays.

The impulse responses for the shock described above are illustrated in Figure 2. As CIMR found, hours worked, consumption, and investment increase for an expected positive technology-level shock.

Growth shock. Here, it is assumed that agents anticipate a growth-rate shock process, as illustrated in Figure 3. In this case, although it is assumed that growth will eventually cease, it is anticipated that technology will not return to its previous level. Hence, the wealth effect is more prevalent in this shock scenario than before.

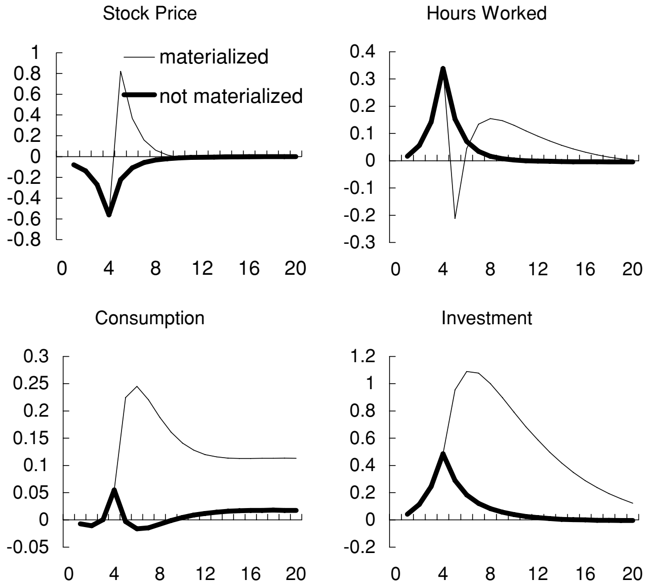

FIGURE 2. Level shock: real model.

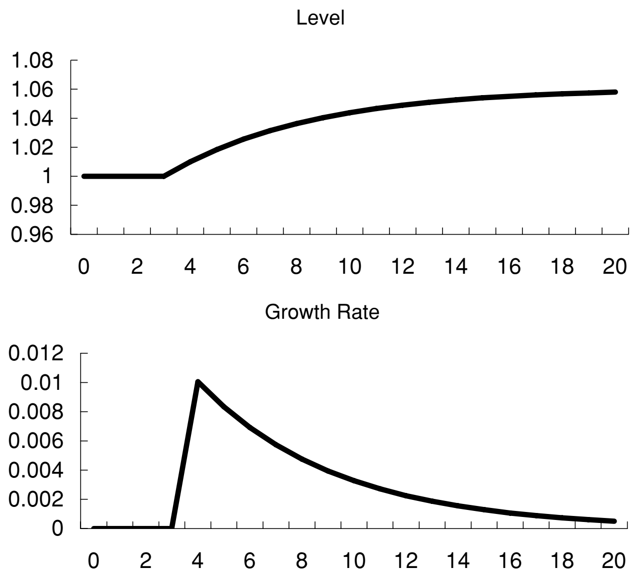

FIGURE 3. Growth shock process.

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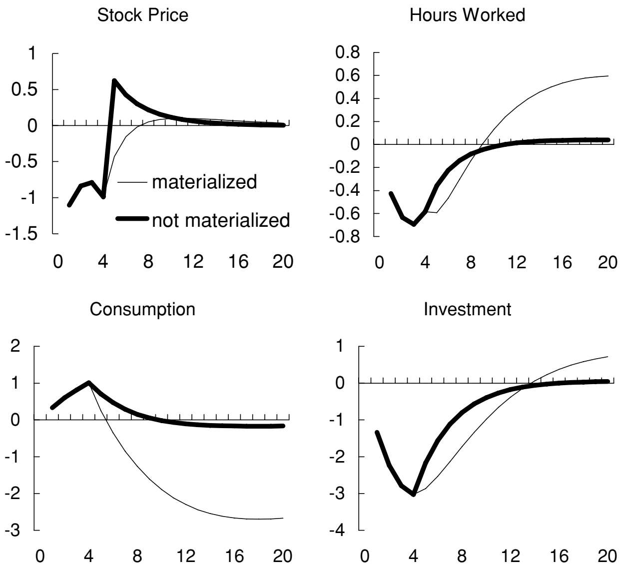

FIGURE 4. Growth shock: real model.

Figure 4 shows the impulse responses for such a growth-rate shock. Because this figure shows the responses of the detrended variables, variables such as consumption and investment should be multiplied by the trend technology when the anticipated shock occurs. Yet, because we are interested in the case in which the anticipated shock fails to materialize, we can ignore the trending problem, as there is no change in the trend growth rate. Analyzing the case in which the shock actually occurs makes possible our understanding of the rational expectations formed by agents when they receive the signal. As expected from the strong wealth effect implied by the shock process illustrated in Figure 3, consumption and leisure increase.[9] Consequently, labor input and investment are reduced.

To generate increased substitution effects, which operate through increased rates of return, we examine the case in which there are extremely high investment adjustment costs (greater than those in the baseline case by a factor of 1,000). Impulse responses in this model are shown in Figure 5. Even with such extremely high adjustment costs, we cannot produce an increase in investment.

To reduce the strength of the wealth effect, rather than using the persistent growth rate shock assumed in previous exercises, we further examine the case in which there is a one-off anticipated permanent increase in the level of technology, as shown in Figure 6, where there are extremely high investment adjustment costs (larger than those in the baseline case by a factor of 1,000). Impulse responses for this case are illustrated in Figure 7. The decreased wealth effect and the increased substitution effect from higher adjustment costs generate comovements in hours worked, consumption, and investment. The most significant finding of the

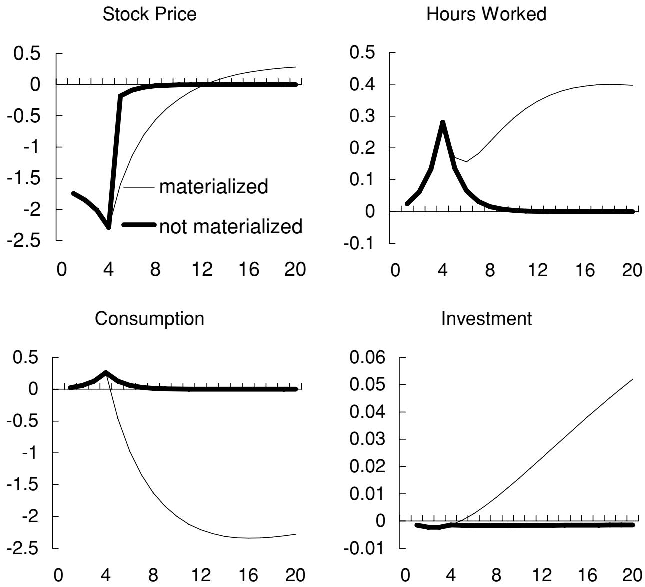

FIGURE 5. Growth shock: real model with very high S''.

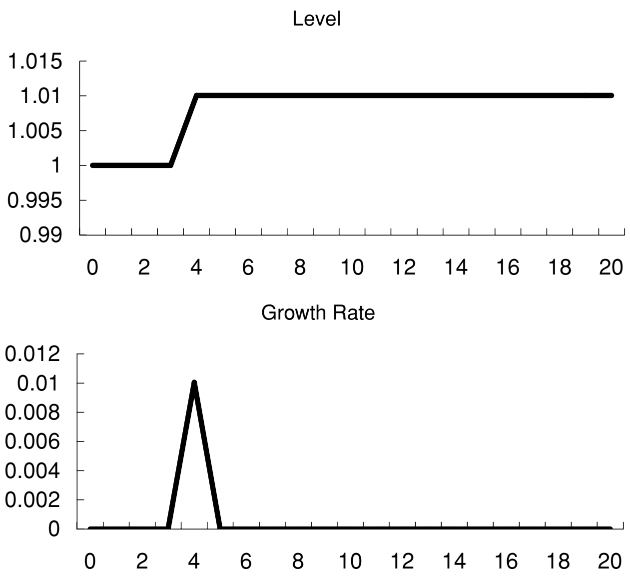

FIGURE 6. Growth shock process (no persistence).

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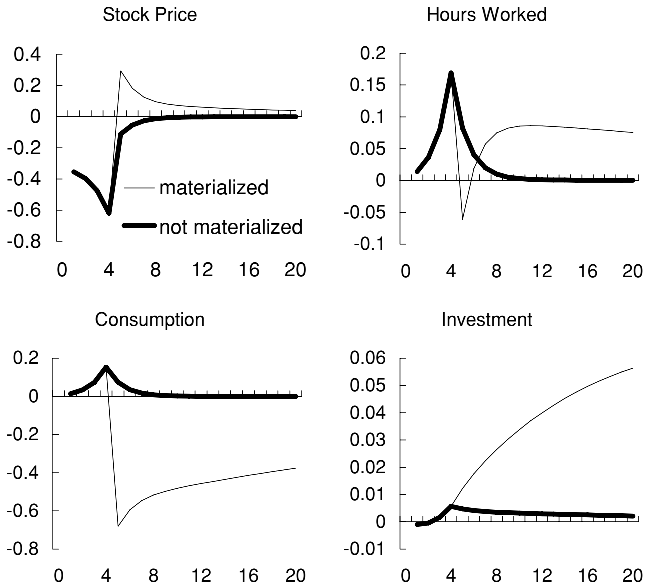

FIGURE 7. Growth shock: real model with very high S'' and $\rho_u = 0$.

exercises so far is, however, that comovements only occur for parameter values that are unrealistic given the estimates obtained from the so–called canonical dynamic general equilibrium models based on Christiano et al. (2005).

3.2. Sticky Price Model

Although we generated positive comovements in consumption, investment, and working hours for a positive news shock to new technology, the theoretical stock price decreased.[10] To explain a stock-price bubble in this setting, CIMR incorporate both sticky prices and sticky wages.[11] CIMR also adopt the Taylor (1993)-type instrument rule.[12] A positive news shock to future productivity implies that future marginal costs will be lower. If price setting is mainly forward-looking (that is, incorporates little indexation and imposes few barriers to the acquisition of new information), then the current inflation rate becomes lower. Hence, according to the Taylor-type instrument rule, under which there are aggressive reactions to inflation developments, nominal as well as real interest rates are lowered. This shifts the capital demand curve outward. As a result, a stock price boom can occur after an expectation shock hits the economy.

We show, however, that such a stock market boom–bust cycle is very hard to generate under growth expectation.

Level shock. For the model with nominal rigidities, Figure 8 shows the responses for the technology level shock, as did Figure 1 for the baseline model.

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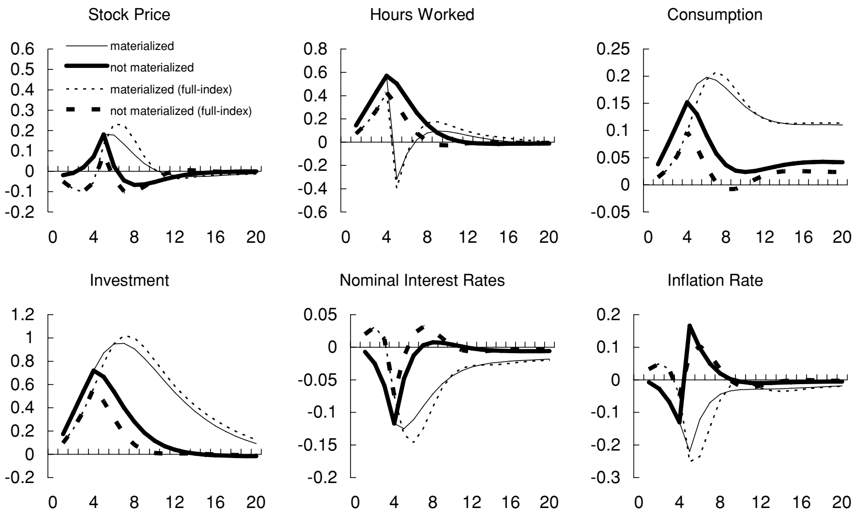

FIGURE 8. Level shock: New Keynesian model.

As stated above, the introduction of nominal rigidities and an inflation-targeting central bank leads lower nominal interest rates, reflecting better future technology, through a lower inflation rate, to contribute to increasing the stock price. Furthermore, reduced interest rates and the wage changes, which reflect an increase in the future marginal product of labor through the sticky wage mechanism, make comovements in hours worked, consumption and investment more evident. The sticky wage mechanism alters the trade-off between consumption and leisure. Because the response of current inflation to expected events is crucial in generating the stock market boom–bust cycle, when prices as well as wages are not indexed, the boom–bust cycle is more evident.

The response of the stock price is as conjectured but minimal. The size of the response seems to be magnified by having more persistent expectations of future technology growth. Next, we show that this simply generates outcomes that are less realistic.

Growth shock. Similarly to Figure 3, Figure 9 illustrates impulse responses for the expected growth rate shock. Similarly to the case of the real model, in this model, we cannot produce comovements in stock prices, hours worked, consumption, and investment. This is because of the strong wealth effect in this economy. Unlike the case with the real model illustrated in Figure 4, however, in this model, hours worked increase. This is consistent with the finding of Barro and King (1984) that "Thus, the two goods can move in opposite directions only if there is a shift in the (schedule for the) current relative price, which is the real wage rate." Because of the sticky wage mechanism, the real wage rate changes to reflect the increase in the future marginal product of labor. This raises current real

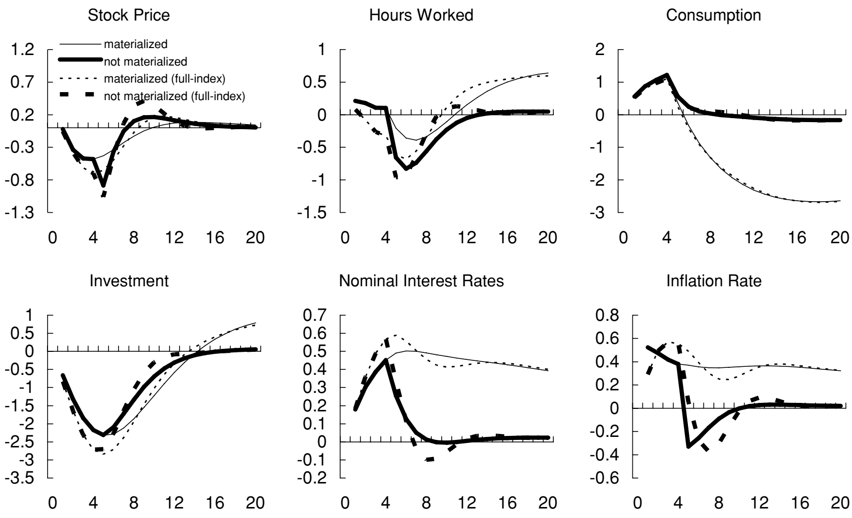

FIGURE 9. Growth shock: New Keynesian model.

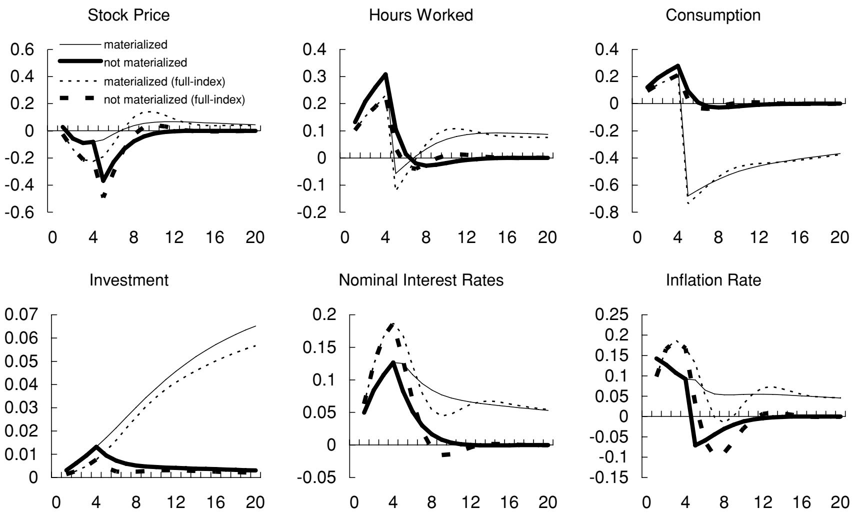

FIGURE 10. Growth shock: New Keynesian model with very high S'' and $\rho_u = 0$.

wages and makes leisure more expensive. The divergence of labor and investment is exacerbated by monetary tightening, which reflects the increase in the inflation rate following the receipt of positive news about the future productivity growth rate. We revisit this issue in the next exercise.

Similarly to Figure 6, Figure 10 shows the responses following a permanent increase in the technology level shock, when investment intertemporal adjustment

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costs are extremely high (100 times larger than those in the baseline model). Because of the high costs of investment growth adjustment and the reduced wealth effect, comovements in hours worked, consumption, and investment are possible. Detrended consumption declines substantially following the confirmation that the news is true, because investment must increase substantially.

Nevertheless, even if investment growth adjustment costs increase and the wealth effect is reduced, there will be no stock market boom in this case. As explained above, this is because inflation rates are higher under growth expectation than when a technology level shock is expected. It is clear from thin lines in Figures 9 and 10 that investment must eventually increase following the permanent positive change in productivity. When investment growth adjustment costs are high, agents try to increase investment as soon as they receive the signal. Yet, because agents know that they will be rich in the future, they would like to consume more and have more leisure through the wealth effect. To mitigate these two motives, that is, by increasing both consumption and investment, agents need to work more hours although they prefer leisure to work. These developments raise the current marginal cost and therefore inflation rates. Thus, both nominal interest rates and eventually real interest rates are raised by the central bank following its Taylor–type instrument rule.[13] By contrast, CIMR predict deflation, low interest rates, and an asset price boom, which is more consistent with the data during an asset price boom.[14]

4. CONCLUSIONS

In this paper, we showed that it is difficult to produce the Pigou cycle, which is characterized by comovements in hours worked, consumption, and investment, in equilibrium business cycle models that incorporate growth expectation. We found that empirically implausible values for some parameters are necessary to generate the Pigou cycle under growth expectation. Furthermore, we found that generating a stock market boom–bust cycle, which is a Pigou cycle augmented by a positive reaction of the stock price, is even more difficult. Even if one uses empirically implausible parameters, it is virtually impossible to get the stock price to react positively to news of higher future productivity growth. Labor inputs must be increased in the face of a substantial wealth effect to meet the demand for investment subject to the adjustment costs. This results in higher inflation and, thereby, through the operations of the inflation-targeting central bank, higher real interest rates. The key mechanism used by CIMR to generate a stock market boom–bust cycle is an outward shift of the capital demand curve following a fall in real interest rates. Under growth expectation, because of strong wealth effects, it seems inconceivable that, in the standard model, one could have both deflation and output growth without an expansion of the production frontier. Therefore, we conclude that Barro and King's (1984) predictions continues to apply.[15]

NOTES

1. We follow the terminology used by Beaudry and Portier (2004).
2. They further assume time–nonseparable preferences.
3. The assumption about technological process made by Denhaan and Kaltenbrunner (2007) can be considered a combined assumption about the growth rate and the level of technology.
4. With a positive deterministic trend for technology growth, the growth rate will not become negative.
5. This is connected to the argument in time-series analyses about whether the time trend is stochastic or deterministic with stationary shocks around it causing variables to fluctuate.
6. For the detailed derivation of the model, see the appendix of Fujiwara (2008).
7. We use the Rotemberg–type cost instead of a Calvo (1983)–type staggered price setting because of its analytical tractability, and also because, when using Calvo pricing, one must assume indexation with possible trend growth. For the latter, see CIMR and Schmitt-Grohé and Uribe (2006).
8. For the details of the shock process examined in this paper, see Fujiwara (2008).
9. Consumption and leisure increase even under a very high parameter for habit formation. Further increase in the parameter for habit formation does not change the results qualitatively.
10. For the details of this mechanism, see CIMR and Fujiwara (2008).
11. In particular, the sticky wage mechanism has direct effects on the Pigou cycle. The sticky wage mechanism can alter the real wage rate to reflect future technological improvements. For details see Barro and King (1984).
12. CIMR assume a forward-looking Taylor-type rule. This also helps to generate stock market boom–bust cycles.
13. This is similar to the predictions of the canonical New Keynesian model. The output gap, measured as the deviation from the output at the flexible price equilibrium, increases according to the Euler equation when there is a shock to the technology growth rate but decreases when there is a shock is to the level of technology.
14. If we alter the forecast horizon of the news shock, the very short-lived expectation-driven business cycle can materialize with small persistence in the growth rate shock. This is because by shortening the forecast horizon, the substitution effect to increase the current capital to prepare for the future increase in the technology becomes stronger; that is, the news shock becomes closer to the contemporaneous shock. Yet inflation rates becomes higher initially, which is not very consistent with the data. For the analysis on the forecast horizon of the news shocks, see Fujiwara et al. (2008).
15. The rational inattention theoretically formalized by Sims (2003) can be useful in generating expectation–driven cycles under growth expectation.

REFERENCES

Barro, Robert J. and Robert G. King (1984) Time-separable preferences and intertemporal-substitution models of business cycles. *Quarterly Journal of Economics* 99(4), 817–839.

Beaudry, Paul and Franck Portier (2004) An exploration into Pigou’s theory of cycles. *Journal of Monetary Economics* 51(6), 1183–1216.

Beaudry, Paul and Franck Portier (2006) Stock prices, news, and economic fluctuations. *American Economic Review* 96(4), 1293–1307.

Beaudry, Paul, Fabrice Collard, and Franck Portier (2006) Gold Rush Fever in Business Cycles. NBER Working Paper 12710.

Calvo, Guillermo A. (1983) Staggered prices in a utility-maximizing framework. *Journal of Monetary Economics* 12(3), 383–398.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans (2005) Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of Political Economy* 113(1), 1–45.

Christiano, Lawrence J., Cosmin Ilut, Roberto Motto, and Massimo Rostagno (2007) Monetary Policy and Stock Market Boom-Bust Cycles. Mimeo, Northwestern University.

Denhaan, Wouter and Georg Kaltenbrunner (2007) Anticipated Growth and Business Cycles in Matching Models. Mimeo, London Business School.

Fujiwara, Ippei (2008) Growth Expectation. IMES Discussion Paper Series 08-E-21, Institute for Monetary and Economic Studies, Bank of Japan.

Fujiwara, Ippei, Yasuo Hirose, and Mototsugu Shintani (2008) Can News Be a Major Source of Aggregate Fluctuations? A Bayesian DSGE Approach. IMES Discussion Paper Series 08-E-16, Institute for Monetary and Economic Studies, Bank of Japan.

Greenwood, Jeremy, Zvi Hercowitz, and Gregory W. Huffman (1988) Investment, capacity utilization, and the real business cycle. *American Economic Review* 78(3), 402–417.

Jaimovich, Nir and Sergio Rebelo (2006) Can News about the Future Drive the Business Cycle? NBER Working Paper 12537.

Kobayashi, Keiichiro, Tomoyuki Nakajima, and Masaru Inaba (2007) Collateral Constraint and News-Driven Cycles. Discussion Paper 07013, Research Institute of Economy, Trade and Industry (RIETI).

Pigou, Arthur C. (1926) *Industrial Fluctuations*. London: MacMillan and Co.

Rotemberg, Julio J. (1982) Sticky prices in the United States. *Journal of Political Economy* 90(6), 1187–1211.

Schmitt-Grohé, Stephanie and Martín Uribe (2006) Optimal Inflation Stabilization in a Medium-Scale Macroeconomic Model. Mimeo, Duke University.

Sims, Christopher A. (2003) Implications of rational inattention. *Journal of Monetary Economics* 50(3), 665–690.

Taylor, John B. (1993) Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy* 39, 195–214.