News Shocks and the Business Cycle

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Introduction

Expectations play an important rule within the business cycle theory. Households and firms decide whether to consume or to save using the information they receive (Blanchard, L'Huillier, and Lorenzoni (2009)). Pigou was one of the first to name news about future developments as a possible source for business cycle fluctuations. In 1927, he assumed that changes in output result from a change in firms' expectations about the profitability of their investments. Fluctuations happen not only because of real observable changes but also because of new information (Collard (1996)). News shocks are defined as expected future changes that affect business cycles. They contain information that is used by households and firms for their intertemporal consumption or their production decision (Rebelo and Jaimovich (2009), Beaudry and Portier (2004)). This paper will focus on news shocks to technology.

News shocks began to become more interesting partially motivated by the U.S. ”boom-bust” cycle from 1999 to 2001. High expectations about the future productivity led to high growth rates in 1999 and 2000. In 2001, when those ex-

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pectations had to be revised, a recession occurred (Beaudry and Portier (2007)). Today, expectations about future changes are remarked as important sources of economic fluctuations. According to the article on business cycle research of Rebelo (2005) ”news-shocks may be important drivers of business cycles.” Several empirical papers suggest that business cycles are driven by a shock, which can be interpreted as a news shock. Beaudry and Lucke (2010), and Beaudry and Portier (2006) find that news shocks explain more than 50% of business cycle fluctuations. Schmitt-Grohe and Uribe (2010) mention that future changes are mostly anticipated and that more than half the variance of cycles is explained by those expected shocks.

However, it is very difficult to generate an upswing as a reaction to a news shock in a standard business cycle model. Beaudry and Portier (2004), and Cochrane (1994) show that many versions of a simple neoclassical model generate a recession today as a reaction to good news about future developments.

The paper proceeds as follows. First, in the following section I present a simple version of a neoclassical model. The next section will demonstrate the reactions of the model to a news shock by calculating impulse response functions, simulating the model and calculating stylized facts for the generated time series. Furthermore, I will analyze a ”multi-shock” environment, i.e. a model driven by expected and unexpected total factor productivity shocks, and compare the calculated business cycle statistics. Finally, the last section concludes.

The Model

The closed economy is populated by a representative household and a representative firm. There is no government sector. The representative infinitely lived household maximizes the expected value of lifetime utility given by:

$$U = E_t \sum_{t=0}^{\infty} \beta^t (\ln(c_t) - \psi \frac{l_t^{1+\varphi}}{1+\varphi})$$

The function $U(...)$ is concave in consumption (c_t) ($U'_c > 0$, $U''_c < 0$), $\beta \in (0,1)$ is the factor by which future utility is discounted, and l_t are the number of hours the household works ($0 < l \leqslant 1$). The parameter $\varphi \geqslant 0$ represents the wage elasticity of labor supply, $\psi \geqslant 0$ the degree of disutility from work. In each period t the representative firm produces output (y_t) using capital (k_t) and labour (l_t). The technology for producing the homogenous good of this economy is described by a Cobb-Douglas production function with constant returns to scale:

$$y_t = A_t k_t^{\alpha} l_t^{1-\alpha}$$

where A_t represents the level of total factor productivity (TFP) which is specified further below.

The final good can either be consumed or invested (i_t).[1] The capital stock evolves according to the following law of motion:

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

where δ represents the constant rate of capital depreciation.[2] The only exogenous variable in the model is A_t, following a stochastic process driven by two shocks.

$$A_t = \bar{A} e^{z_t}$$

$$z_t = \rho z_{t-1} + \epsilon_t^1 + \epsilon_{t-8}^2$$

[1] $y_t = c_t + i_t$

[2] In addition, there are the nonnegativity constraints $l_t, c_t, k_{t+1} \geqslant 0$ and the transversality condition $\lim_{T->\infty} \beta^T \lambda_T k_{T+1} = 0$.

The shocks are normally distributed with $\epsilon_t^1 \sim N(0, \sigma_{\epsilon_t^1})$ and $\epsilon_{t-8}^2 \sim N(0, \sigma_{\epsilon_{t-8}^2})$. The parameter ρ measures how persistent those shocks are. ϵ_t^1 represents an unexpected shock in period t. The news shock is represented by ϵ_{t-8}^2, it has no contemporaneous effect on TFP. Following Barsky and Sims (2011), the news shock will inform the agents about a change of TFP two years in the future. Hence, one period in this model corresponds to a quarter year. $\bar{A}$ represents the normal level of TFP and is normalized to 1. Agents have perfect information about the shock.

Analysis

The model is calibrated to U.S. data following primarily Cooley and Prescott (1995) and King and Rebelo (1999). Table 1 shows the value assigned to each parameter. Those parameter values are chosen by taking into account average long run observations from empirical data.

The following section will demonstrate that a news shock, saying that a one percent change in TFP will arise eight quarters in the future, leads to a recession today. Consumption will rise while investment, output and hours worked will decrease. After this section I will show, using business cycle statistics of a simulated version of the model, that news shocks do not lead to positive comovement between production and the other main aggregates. Finally, I will present business cycle statistics for a simulation of the model driven by an expected and an unexpected shock to TFP.

Impulse Response Functions

Impulse responses are the time paths of the model to a one time impulse in the technology shock, ϵ_t, ϵ_{t-8}, or both. The economy begins in the steady states, with all shocks to TFP set to zero. Figure 1 demonstrates impulse responses for consumption, capital stock, wage, hours worked, production, investment, and the shock process z. Agents receive a news shock at period zero that TFP will increase by 1 percent at period eight. When receiving the positive news, the households experience a positive wealth effect and, as a reaction to this effect, reduce their hours worked and increase their consumption (Rebelo and Jaimovich (2009)). At period zero the capital stock remains unchanged. This leads, together with the decline in hours worked, to a decrease in output.

Since consumption increases and output decreases, investment, as the residuum of both, has to decline. The capital stock k declines during the first eight quarters, so that the household can consume more.[3]

As the impulse response functions show, changes in expectations about future TFP growth do not lead to positive comovement. Investment and hours worked rise, while consumption is decreasing. Good news about the future lead to a recession today. Only when the shock materializes in period 8 there is a boom.

Business Cycle Statistics

Comparing second moments between simulated and empirical data is another way of evaluating the model's ability to generate realistic business cycle fluctuations. Before calculating the second moments the time series is detrended using the Hodrick and Prescott filter (HP filter). For quarterly data the standard value chosen for the smoothing parameter λ is 1600.

Figure 2 shows the cyclical components of the simulation driven by a news shock, and Figure 3 displays those for the U.S. business cycle. The bright line represents the output, the dark line the respective variable. Table 2 presents a set of stylized facts computed for quarterly U.S. data for the time period from 1948 I to 2010 IV. The standard deviation represents the volatility of the time series, correla-

[3] See also: Beaudry and Portier (2004) p. 1186.

tion represents comovement, and autocorrelation shows how persistent cycles are (Rebelo (2005)). Table 3 displays the stylized facts computed for a simulation of the model driven by a news shock.

Overall the model matches the U.S. second moments. In particular, investment has the highest volatility while consumption has lower volatility than output. For hours worked the data shows higher volatility compared to output, this fact is not replicated. The model also captures the high autocorrelations of all variables.

In addition, since comovement between the major aggregates is an important business cycle fact, and the model can not produce an upswing as an reaction to a news shock, I calculate the correlation of all main variables (Rebelo and Jaimovich (2009) and Barsky and Sims (2011)).

Table 4 demonstrates, that comovement is not generated by the model. The correlation between consumption and investment, and consumption and hours worked is negative. Because of this, news shocks, within a simple neoclassical model, cannot produce realistic business cycles and can be ruled out as an major source for economic fluctuations (Beaudry and Portier (2007)).

”Multi-Shock” Environment

Adding more shocks to the model and using them to generate comovement is another research area beside building models that generate comovement as a reaction to a news shock. Already Cochrane (1994) mentioned this idea: ”The problem we are having is that it is hard to match a single shock model to a multiple shock world.” The empirical papers of Cochrane (1994), Schmitt-Grohe and Uribe (2010), and Barsky and Sims (2011) identify more than one shock as sources of business cycle fluctuations.

Furthermore, Haertel and Lucke (2008) came to a similar result. They identify an unexpected as well as an expected shock to TFP: ”Both types of shocks seem to account for important fractions of the total variance of macroeconomic variables.” Following Barsky and Sims (2011) I will demonstrate that a model driven by both, an expected and an unexpected shock to TFP, can produce business cycles, that are even more realistic. Therefore the model is simulated two more times. Table 5 shows the corresponding correlations of the simulated time series. The first row displays the correlations of the U.S. main aggregates from 1948 I to 2010 IV.

The correlations for a simulation driven by a news shock and an unexpected shock to TFP are shown in row two, and the third row provides those for a simulation driven only by an unexpected TFP shock. Furthermore, Figure 3 shows the simulated time series driven by an expected and an unexpected shock.

As shown in the previous section, a news shock alone does not generate comovement between major aggregates. In contrast to this result, if expected and unexpected shocks to TFP are used as sources for business cycles fluctuations comovement occurs. Furthermore, within a ”multi-shock” environment the correlations between output and the other main aggregates are much closer to U.S. data than those of the simulation driven by only an unexpected shock to TFP.

Conclusion

News shocks may be important sources for business cycle fluctuations. Empirical papers show that large fractions of the volatility of economic fluctuations is explained by anticipated shocks. Furthermore, news shocks can improve the quality of simulated data. They lower, if used together with expected TFP shocks, the correlations between all major aggregates, compared to model driven by a single unexpected TFP shock.

Within a simple neoclassical model news shocks do not lead to comovement between the main aggregates. Consequently developing models to do just that is an important research area. Beaudry and Portier (2004) were the first to present such a model that generates comovement between all major aggregates. Rebelo and Jaimovich (2009) produced an alternative to this model. They expanded a simple neoclassical model by adding non-time-seperable preferences, variable capital utilization and investment adjustment costs.

Especially the model of Rebelo and Jaimovich (2009) can replicate important business cycle facts. The assumption that agents have perfect knowledge about the future developments has to be revised. Rebelo and Jaimovich (2009) as well as Schmitt-Grohe and Uribe (2010) use real predictions of future GDP growth to define their shock processes, or allow baysian updating.

Overall, "searching for a deeper structural explanation for what has been empirically identified and labeled as 'news' is a promising avenue for future work." (Barsky and Sims (2011))

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Appendix

Figures

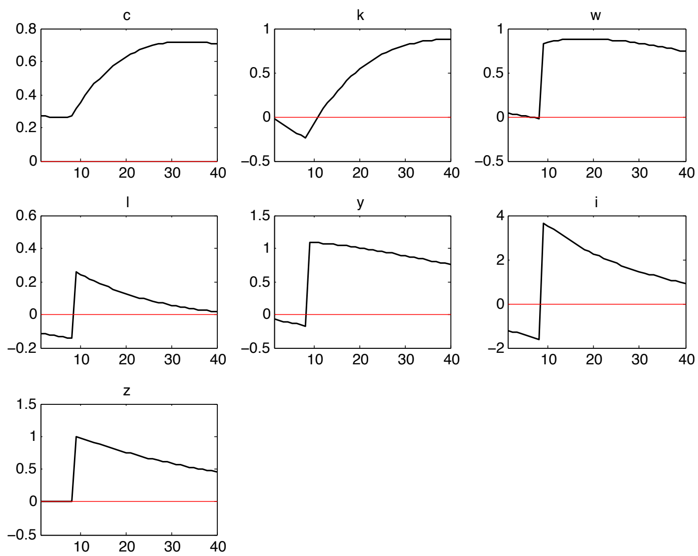

Figure 1: Impuls response functions (News-Shock)

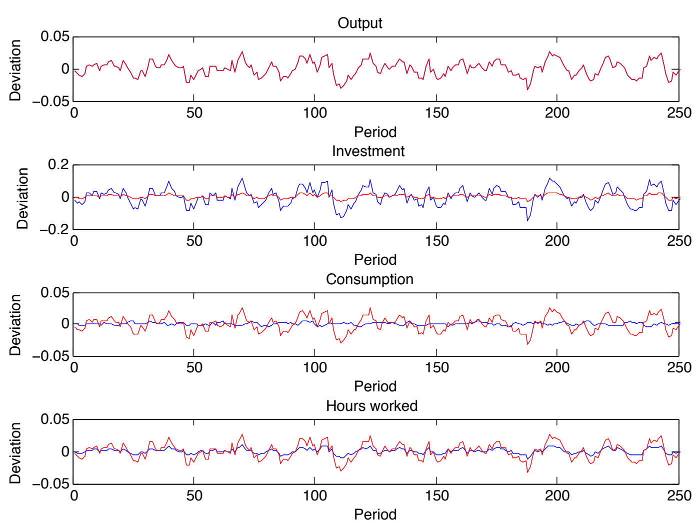

Figure 2: Simulation (News-Shock)

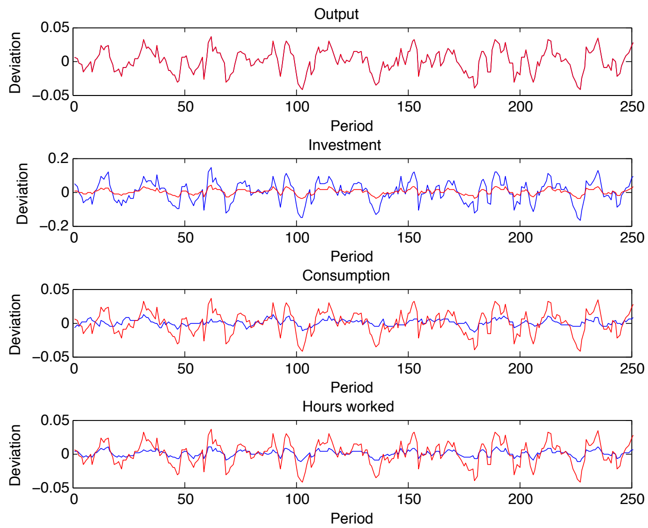

Figure 3: Simulation (unexpected and news shock)

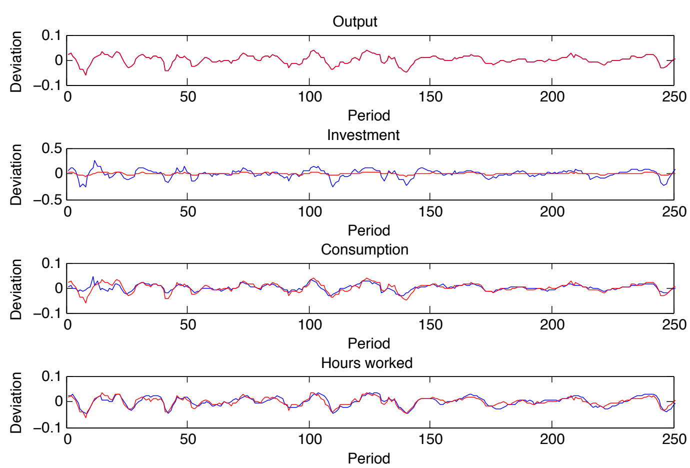

Figure 4: U.S. business cycle

Tables

Variable	Value	Description
β	0.99	Discount factor
δ	0.025	Annual depreciation of 10%
α	0.33	Capital share in output
φ	2	Wage elasticity of labour supply
ψ	24.28	Set labor effort in steady state ($l = 0.33$)
ρ	0.975	TFP shock persistence
σ_ϵ	0.007	TFP shock variance
$\bar{A}$	1	No technological progress

Table 1: Calibration
Source: Cooley and Prescott (1995), and King and Rebelo (1999)

Var	$std(x)(\%)$	$std(x)/std(y)$	$corr(x,y)$	$corr(x_t, x_{t-1})$
Output	1.7221	1.0000	1.0000	0.8483
Investment	8.1562	4.7361	0.8586	0.7974
Consumption	1.2685	0.7366	0.7898	0.8066
Hours worked	1.9277	1.1194	0.8724	0.9006

Table 2: Stylized facts (U.S. data 1948 I - 2010 IV)
HP filtered with smoothing parameter 1600. All time series are expressed in per capita terms, real terms, and in logs. Table 6 shows the corresponding sources.

Var	$std(x)(\%)$	$std(x)/std(y)$	$corr(x,y)$	$corr(x_t, x_{t-1})$
Output	1.1289	1.0000	1.0000	0.7391
Investment	4.9682	4.4008	0.9910	0.7444
Consumption	0.2024	0.1793	-0.0934	0.6257
Hours worked	0.3885	0.3441	0.9849	0.7450

Table 3: Stylized facts (News Shock)
HP filtred with smoothing parameter 1600. We choose $\sigma_{\epsilon_t^1} = 0$; $\sigma_{\epsilon_{t-8}^2} = 0.007$ and $\rho = 0.975$.

Shock	$corr(y,c)$	$corr(y,i)$	$corr(y,n)$	$corr(c,i)$	$corr(c,n)$
U.S. Data	0.82	0.78	0.86	0.61	0.69
News shock	-0.0934	0.9910	0.9849	-0.2260	-0.2641

Table 4: Comovement (News shock and U.S. data)
All time series are HP filtered with smoothing parameter 1600. U.S. time series are expressed in per capita terms, real terms, and in logs.

Shock	$corr(y,c)$	$corr(y,i)$	$corr(y,n)$	$corr(c,i)$	$corr(c,n)$
U.S. data	0.82	0.78	0.86	0.61	0.69
Both shocks	0.63	0.98	0.96	0.47	0.41
unexp. shock	0.99	0.96	0.98	0.92	0.89

Table 5: Comovement (U.S. data and various shocks)
For both shocks we choose $\sigma_{\epsilon_t^1}, \sigma_{\epsilon_{t-8}^2} = 0.007$ and $\rho = 0.975$. For the simulation of the model driven only by an unexpected shock we choose $\sigma_{\epsilon_t^1} = 0.007$; $\sigma_{\epsilon_{t-8}^2} = 0$ and $\rho = 0.975$. All time series are HP filtered with smoothing parameter 1600. U.S. time series are expressed in per capita terms, real terms, and in logs.

Description	Source	Code
real GDP	St. Louis Fed - FRED	GDPC96
real private Investment	St. Louis Fed - FRED	GPDIC96
real private Consumption	St. Louis Fed - FRED	PCECC96
Population aged 16 and older	Bureau of Labor Statistics	LNU00000000Q
Hours worked (seasonal adj.)	Bureau of Labor Statistics	PRS85006033

Table 6: Sources for U.S. data